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Indian Point Nuclear Generating Station
Open Session

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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OPEN SESSION

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

Wednesday, November 18, 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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1 P-R-O-C-E-E-D-I-N-G-S

2 (8:34 a.m.)

3 CHAIRMAN MCDADE: Okay. The hearing
4 will come to order. The first order of business,
5 I believe we have some witnesses for 26 who were
6 not witnesses on 25. Do we have anyone here who
7 has not yet been sworn in who is going to be
8 proffered on 26?

9 MR. ROTH: Yes, Your Honor. We do.

10 CHAIRMAN MCDADE: Are you going to
11 move over to the witness tables?

12 MS. BRANCATO: Your Honor, this is
13 Deborah Brancato from Riverkeeper. Would you
14 like Dr. Hopenfeld to go over into the witness
15 table, too?

16 CHAIRMAN MCDADE: Next to Dr. Lahey,
17 Dr. Hopenfeld. Okay. And Dr. Hopenfeld was
18 sworn on Monday, so he doesn't need to be sworn
19 again. He's still under oath. The two new
20 witnesses --

21 MR. HARRIS: Your Honor, Brian Harris,
22 NRC. Do you want to swear the witness for 38 in
23 also at this time?

24 CHAIRMAN MCDADE: I mean we're not
25 going to be getting to 38 today, but we might as

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1 well.

2 MR. SIPOS: Judge McDade?

3 CHAIRMAN MCDADE: Yes.

4 MR. SIPOS: John Sipos for the State
5 of New York. Just to note, Dr. Duquette is not
6 yet present, but we do expect him.

7 CHAIRMAN MCDADE: Right, and before
8 Dr. Duquette begins to testify on 38, we will
9 swear him in. The new witnesses, would you
10 please identify yourself, your name and your
11 short job title and who you represent. Mr. Yee?

12 MR. YEE: On Yee, U.S. NRC, Reactor
13 Systems Engineer with NRC.

14 MR. NG: Ching Ng with the NRC,
15 Reliability and Risk Analyst.

16 MR. KARWOSKI: Ken Karwoski, Senior
17 Level Advisor for Steam Generators Materials
18 Inspection, NRC.

19 CHAIRMAN MCDADE: Okay. Would you
20 please rise? Would you raise your right hand?

21 Will you swear or affirm subject to the
22 penalties for perjury that the testimony you'll give
23 at this hearing will be the truth, the whole truth,
24 and nothing but the truth?

25 (Chorus of I do.)

1 CHAIRMAN MCDADE: Okay. Please be
2 seated. Certain things we told the other
3 witnesses, and we'll repeat for you right now.

4 First of all, it's important that we
5 have a record of the proceedings so that if you
6 are answering a question, before you answer the
7 question, state your name.

8 Now if the question is designed
9 directly towards you, so the judge has said Mr.
10 Yee, and then asks the question, you don't need
11 to repeat your name because the court reporter
12 will have it right there in context.

13 But in many instances, we're going to
14 be asking questions that are directed either to
15 the NRC staff or to Entergy or to the
16 interveners, and in which case then the
17 individual who is speaking should state their
18 name before they begin so that the record will
19 reflect which one of the witnesses was actually
20 speaking.

21 The other thing is we do take periodic
22 breaks. If for any reason you feel that you need
23 a break, don't suffer in silence. Let us know,
24 and we can arrange to take a break. Are there
25 any questions before we get started?

1 MR SIPOS: No questions.

2 CHAIRMAN MCDADE: Okay. There are a
3 few things, administrative matters and some
4 substantive matters that I want to take up before
5 we started.

6 First of all, at the conclusion of
7 yesterday, I asked a question I thought was a
8 simple question that was designed to sort of
9 summarize what had been said over hours of
10 testimony to put it in one place in the record.

11 Perhaps because I was tired, but in
12 any event, I failed miserably and wound up sort
13 of running us down a rabbit warren and wound up
14 confusing things rather than clarifying things.

15 Sort of a quote from the movie Cool
16 Hand Luke, "We had a failure to communicate," and
17 I apologize for that. We were talking about what
18 has been developed and what has still to be
19 developed.

20 And from the testimony, and what I
21 want to do is to sort of summarize a little bit
22 and then make sure from the witnesses, because
23 nothing I say is evidence, that what I'm saying
24 is correct.

25 That we look first of all to MRP-227,

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1 which is NRC Exhibit 114. That sets out various
2 inspection aspects. In Sections 4 and 5 of that
3 document, it talks about examination methods, the
4 qualifications for examination, the frequency of
5 examination, sampling and coverage, the expansion
6 based on observed degradation, evaluation of
7 results and flaw evaluation.

8 Specifically in that, it also
9 addresses Westinghouse manufactured plants
10 specifically. They have tables for Westinghouse
11 plants as well as for plants manufactured by
12 other entities.

13 But as part of those tables, they have
14 listed acceptance criteria. Among those
15 acceptance criteria, they have one for the baffle
16 former bolts.

17 But in that particular document, the
18 MRP-227 and specifically the table 5-3, not all
19 of the details with regard to the acceptance
20 criteria for baffle former bolts are specified,
21 that it indicates that for certain plant-
22 specific, unit-specific details that they will be
23 established as part of the examination technical
24 justification.

25 Now that was then discussed back and

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1 forth between the NRC and Entergy, and it was
2 addressed specifically in Supplement 2 to the
3 SER, which is New York Supplement, excuse me, New
4 York Exhibit 503.

5 And in that, the NRC articulated its
6 position that those specifics, the UT
7 examinations for baffle former bolts have been
8 performed since the 1990s.

9 There's more than 20 years' experience
10 doing that inspections, which provide a
11 reasonable assurance that the examinations can be
12 implemented effectively and that finalizing the
13 TJ closer to the date of the inspection would
14 allow for the latest UT technology and lessons
15 learned for previous inspections to be
16 incorporated.

17 So what remained to be done, which
18 isn't in the original document or in the SER that
19 is in either MPR-227, Exhibit 114 or in the SER,
20 New York Exhibit 507, is the technical
21 justification for the examination.

22 Dr. Hiser, again, nothing I've said is
23 evidence. What I've just gone through, does that
24 accurately reflect the process here?

25 DR. HISER: Yes, I believe it does.

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1 CHAIRMAN MCDADE: Okay. Do you have
2 anything to add to supplement that --

3 DR. HISER: No, I don't.

4 CHAIRMAN MCDADE: -- or to correct it?

5 DR. HISER: No, I do not.

6 CHAIRMAN MCDADE: Okay. And from
7 Entergy, does anybody have anything to supplement
8 or to correct?

9 MR. DOLANSKY: No, Your Honor. This
10 is Bob Dolansky from Entergy. No.

11 CHAIRMAN MCDADE: Okay. So what's
12 left to be done has to do with the technical
13 justification for the inspection, certain plant-
14 specific details.

15 Dr. Hiser, could just very briefly
16 just put on the record what the technical
17 justification for examination is, or if someone
18 is better suited to it?

19 MR. POEHLER: This is Jeffrey Poehler,
20 the staff. I can address that. The technical
21 justification would be a report prepared probably
22 by the vendor that's performing, that will
23 perform the ultrasonic examination.

24 And it would be a detailed report on
25 the qualification of the ultrasonic examination

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1 procedures. It would address things like the
2 detectability of flaws, like what's the minimum
3 size flaw you could detect in a bolt, such as for
4 example, 10 percent of wall thickness or 20
5 percent, something like that.

6 CHAIRMAN MCDADE: Okay. And has that
7 technical justification been received by the NRC?

8 MR. POEHLER: No, it has not. It
9 would not be something we would expect to be
10 submitted or require to be submitted.

11 CHAIRMAN MCDADE: Okay. It is
12 required to be prepared no later than six months
13 before the first inspection, but that is a
14 document that would be maintained at the facility
15 subject to inspection by the resident inspector
16 of the NRC. Correct?

17 MR. POEHLER: Correct.

18 CHAIRMAN MCDADE: Okay. And do you
19 agree with that, from Entergy?

20 MR. DOLANSKY: Yes.

21 CHAIRMAN MCDADE: What is the status
22 of the technical justification for the
23 inspection?

24 MR. DOLANSKY: It has been written.
25 This is Bob Dolansky with Entergy. You're asking

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1 --

2 CHAIRMAN MCDADE: Yes.

3 MR. DOLANSKY: -- has it been written.

4 Yes.

5 CHAIRMAN MCDADE: Okay. And can you
6 elaborate on the kind of details that are in that
7 document that are unit-specific?

8 MR. DOLANSKY: They talk about the
9 parameters of the, that the NDE inspector would
10 use, how he would set up his equipment, when he
11 does his calibration what type of reflectors he
12 would be looking for from the calibration block,
13 that type of thing.

14 CHAIRMAN MCDADE: Okay. And this is
15 intended, based on the words of the SER, to
16 utilize more recent, the most recent UT
17 technology as well as lessons learned from
18 previous inspections?

19 MR. DOLANSKY: Correct. For instance,
20 the vendor, Westinghouse, typically goes to
21 outages in the spring and fall. That's when
22 outages typically occur.

23 So they would go into outages this
24 past fall, now basically, and anything that came
25 out of those outages, if there any lessons

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1 learned or anything like that, they would
2 incorporate that into the procedure before they
3 give it to us.

4 CHAIRMAN MCDADE: Okay. Judge
5 Wardwell, do you have anything further on that?

6 JUDGE WARDWELL: No, I think it's
7 fine. Thank you.

8 JUDGE KENNEDY: No, I do not.

9 CHAIRMAN MCDADE: Okay. I believe
10 that we had, I believe it was referred to
11 yesterday as sort of homework assignments that we
12 had questions that remained up in the air.

13 There was one, I believe, Dr. Lott.
14 There was a question with regard to the lower
15 support column of whether that was cast material,
16 and were you able to identify any other cast RVI
17 components?

18 DR. LOTT: I realize that question was
19 addressed to me, but I think it might better, and
20 I know this, some of my colleagues on the panel
21 here have been doing some research on that. So
22 I would like to turn it over to Mr. Azevedo.

23 CHAIRMAN MCDADE: Okay, Mr. Azevedo.

24 MR. AZEVEDO: Yes, Your Honor. We
25 looked into this. There's a total of six

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1 components that are reactor vessel internals that
2 are made out of cast material.

3 Two of those six are expansion
4 components, which means they were determined to
5 be moderately susceptible to some form of
6 degradation mechanism. Therefore, they're
7 expansion components.

8 The other four components were
9 screened out as not being susceptible to any
10 degradation mechanism per MRP-191.

11 CHAIRMAN MCDADE: Okay. When you're
12 talking about expansion components, you're going
13 back to Section 4 of MPR-227. Correct, where it
14 lists primary then expansion and based on the
15 susceptibility?

16 MR. AZEVEDO: That's correct.

17 CHAIRMAN MCDADE: Okay. Anything
18 further, Mr. Azevedo, on that?

19 MR. AZEVEDO: No, Your Honor.

20 CHAIRMAN MCDADE: Okay. Dr. Lott, I
21 believe there was a question left for you asking
22 whether or not there was, you could point us to
23 a basis for the statement that low ferrite CASS
24 material would not show a meaningful combined
25 effect from thermal aging and irradiation.

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1 Is there anything you could point to
2 us in support of that proposition?

3 DR. LOTT: Yes. I think that was, the
4 particulars of a question was in relation to
5 Question 8 of our supplemental testimony. And
6 that was really addressed to concerns about
7 embrittlement at or below the threshold for
8 radiation embrittlement materials.

9 So I wasn't trying to, and I don't
10 think we were trying to say anything about higher
11 fluence materials. And there's admittedly very
12 sparse data on this topic.

13 I think the statement itself contains
14 a direct reference to VWR-VIP-2015-025, and that
15 document does talk, I think part of the question
16 was why are we talking about these high ferrite
17 materials when you're telling us it's low ferrite
18 material.

19 That document does site actually a
20 Westinghouse study on a low ferrite, a 10 percent
21 cast material that showed that that material was
22 not subject to the same decrease in embrittlement
23 that the higher cast material say inside 184
24 were.

25 And we believe that, those materials

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1 and that's the basis for our document. We'll
2 notice that the NRC has made similar arguments in
3 their justification for their suggestion of 15
4 percent as a standing level for ferrite material,
5 susceptibility in irradiated materials. And
6 that's in NRC Item 201.

7 CHAIRMAN MCDADE: I'm sorry. It is in
8 what?

9 DR. LOTT: NRC Exhibit 201.

10 CHAIRMAN MCDADE: Okay. And the
11 previous document referred to, do you have an
12 exhibit number for that?

13 MR. SIPOS: I think, Your Honor, it's
14 NRC 209, if I recall Mr. Lott's, Dr. Lott's
15 testimony from yesterday.

16 CHAIRMAN MCDADE: Okay. Thank you,
17 Mr. Sipos.

18 MR. KUYLER: I believe that Dr. Lott
19 was referring to Entergy Exhibit 663, Your Honor.

20 CHAIRMAN MCDADE: Well, we will go and
21 look at both of them. Thank you.

22 Okay. Dr. Lahey, I think we had a
23 question yesterday, and it may or may not have
24 been answered regarding NUREG 7184, New York
25 Exhibit 488. And we're talking about, I think at

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1 one point used the word synergistic in another
2 combination.

3 And whether or not there was any
4 evidence that demonstrated that the sum of the
5 thermal embrittlement and irradiation
6 embrittlement is greater than the sum of the
7 parts. Is there any language that you can point
8 us to that would support that proposition?

9 DR. LAHEY: I reviewed, at your
10 request Your Honor, 7184. As I had indicated
11 yesterday, I think, the original language in this
12 report used the work synergistic. And then later
13 on it was changed by the authors to combined.

14 In my view, when I use synergistic I
15 allow for a number of possibilities. I'm not
16 sure what the author allows for. For example,
17 when I use synergistic for a fatigue in
18 radiation, I mean greater than the individual
19 effects.

20 When I use synergistic for thermal and
21 irradiation, I mean combined effects, not
22 necessarily greater than the individual effects.
23 So I can't speak to what the author meant, but
24 they used both at one time.

25 CHAIRMAN MCDADE: Okay. And Dr.

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1 Lahey, I believe there was a question put to you
2 as to whether or not you could identify other RVI
3 components subject to A/LAI 7.

4 DR. LAHEY: Right. Your Honor, I did
5 do a review of a document. It was MRP-191, which
6 carefully went through the various components and
7 the material that they had the radiation fluence
8 that they were subjected to.

9 And as you heard from previous
10 witness, there are a number. The one that
11 appeared to me to be of most concern, other than
12 the one we talked about yesterday, the cap on the
13 lower support plate column is the upper support
14 column base.

15 It has a fluence of around 10 to the
16 21st neutrons per centimeters square. The other
17 ones, at least in my view, didn't seem to be as
18 safety significant as that one might be.

19 CHAIRMAN MCDADE: Okay. Thank you,
20 Dr. Lahey. Judge Wardwell, did that answer your
21 question, or do you wish to follow up?

22 JUDGE WARDWELL: I think I'll follow
23 up with Mr. Azevedo if I might. Was the upper
24 support column base any one of those that you
25 have identified, and was it an expansion or a

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1 screened out component?

2 MR. AZEVEDO: Yes, Your Honor. That's
3 one of the six that I mentioned before, and it
4 was screened out as a Category A, which means not
5 susceptible to any degradation mechanisms.

6 JUDGE WARDWELL: Thank you.

7 CHAIRMAN MCDADE: Can you elaborate at
8 all on why it was screened out, the sort of
9 thought process that went on?

10 MR. AZEVEDO: I don't have the details
11 to how each one was screened out?

12 DR. LOTT: Perhaps I could help here.
13 This is Randy Lott --

14 CHAIRMAN MCDADE: Dr. Lott?

15 DR. LOTT: -- Entergy. In the process
16 of the evaluation, those materials were
17 originally identified as cast materials, but
18 there was a step in the process where we did
19 effectively FMECA analysis.

20 It's described in MRP-191, to look at
21 what the impact of these degradation mechanisms
22 were. There were certain components, including
23 the upper support columns, where it was
24 effectively decided that there was no credible
25 damage in impact or need to do additional

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1 analysis on the upper support columns.

2 And they were put into Category A. So
3 it was recognized there were cast materials, but
4 it was also felt that there were no stressors
5 that would challenge that particular component.

6 It was an engineering evaluation. I
7 can't speak to the details of it here, but I know
8 that that process is described in MRP-191.

9 CHAIRMAN MCDADE: Okay. Dr. Lahey, do
10 you wish to comment on the appropriateness of
11 that screening as explained by Dr. Lott?

12 DR. LAHEY: No, I understand what he
13 said, and it has to do with the criterion that
14 has been established for the onset of significant
15 radiation damage.

16 CHAIRMAN MCDADE: Okay. Yesterday I
17 believe there was a question to you, Dr. Lahey,
18 about addressing the WCAP methodology for
19 determining dynamic load, that you wanted to
20 review some documentation to comment on that.

21 DR. LAHEY: Yes, sir. I spent many
22 happy hours for that last night. And I was, so
23 there were two things that you may recall I was
24 concerned with.

25 It was the methodology that was used

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1 to calculate the forces. Was it truly impact
2 force, or was it smear down? And then the other
3 one is what was analyzed. Was that appropriate?

4 So in this report, which was dated
5 2001, it was, and then it was the one that was
6 reviewed and approved later on by the U.S. NRC.
7 It was a generic study of a 4 loop Westinghouse
8 plant to determine what the minimum number of
9 baffle former bolts could be to withstand certain
10 accident events.

11 The methodology that was used is
12 called by Westinghouse a MULTIFLEX, and it's
13 Version 3. And I view that as sort of the
14 grandson or the son, I'm not sure, either an old
15 son or a young grandson of the WHAM code to show
16 it is, in fact, what I think should be used.

17 It's a sub-cool depressurization code,
18 so it propagates at the speed of sound, the
19 depressurization waves throughout the system. So
20 that was good news for me. I was very happy to
21 see that, and I think it's appropriate.

22 Later on in the transient, they switch
23 over to a version of the track code, which has
24 been married to a version of the Cobra codes. So
25 it's W Cobra slash --

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1 MR. KUYLER: Your Honor, if I may
2 break in for a moment. This is Ray Kuyler from
3 Entergy. I would just note that we are
4 discussing a proprietary Westinghouse report at
5 this moment.

6 DR. LAHEY: I'm sorry.

7 CHAIRMAN MCDADE: Well, let's ask
8 whether or not, it does not appear that we're
9 discussing it in sufficient detail or the
10 proprietary aspects of it are going to be
11 released.

12 MS. SUTTON: Your Honor, let me
13 consult with Westinghouse's counsel. They need
14 to consult with their expert. One second.

15 DR. LAHEY: You're actually going to
16 like what I'm going to say, but go ahead.

17 MS. SUTTON: Okay, Your Honor. As
18 long as he remains at a high level of detail, we
19 can proceed, but if it sinks into greater levels
20 of detail, we'll alert you.

21 CHAIRMAN MCDADE: Okay. And Dr.
22 Lahey, actually we have the report.

23 DR. LAHEY: Right.

24 CHAIRMAN MCDADE: Perhaps can you
25 focus on the conclusions that you have drawn from

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1 the report rather than going into the specific
2 details of the report?

3 DR. LAHEY: Right.

4 CHAIRMAN MCDADE: We're interested in
5 your expert conclusions.

6 DR. LAHEY: I am definitely not going
7 to go into detail. In fact, this report has
8 precious few equations. That's in references
9 that I did not have access to. But anyway, the
10 track code and the Cobra code are widely known,
11 have been published in the open literature.

12 So they are the large control volume
13 codes, but it's only used for the flashing part
14 of the transient, and the loads there are very
15 small.

16 So all the loads that we're concerned
17 with in terms of the integrity of the bolts have
18 to do with the sub-cooled blow down phase. And
19 in that phase, the right technique is apparently
20 being used. So I was happy to see that.

21 Now the other part of my concern has
22 to do with what do you do with these methods,
23 which I've now said I think look appropriate?
24 I'm happy to see that.

25 What was done is a break size, which

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1 was not the large design basis break size. It
2 was a smaller break size. And then use what the
3 NRC likes to call leak before break criteria for
4 opening time.

5 So it wasn't an instantaneous full leg
6 break of the reactor. It was a smaller line
7 break. So that, what that does is it reduces the
8 severity of the load, which propagates through
9 the system.

10 Nevertheless, I mean this was a
11 generic study, and I haven't seen what is being
12 done for the Westinghouse Plants at Indian Point,
13 and I don't think it has been published.

14 So all these things could have been
15 addressed that I'm going to alert you to, but
16 when this was done, it was found that about 50
17 percent of the bolts could withstand the
18 transient.

19 Fluid structure interaction was
20 modeled, all pretty much state of the art in my
21 view for this type of analysis was employed. So
22 that's good news.

23 If you then go to a design basis
24 accident, even though the NRC has said that leak
25 before break is what you do for such things as

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1 pipe width, you don't do it inside the core.

2 You still have to do the regular,
3 local loads. So if these are applied, then it'll
4 be significantly different in terms of the
5 integrity of the bolting.

6 So that remains to be seen, what will
7 be done there. And as I said, I haven't reviewed
8 that. I don't think it's available.

9 CHAIRMAN MCDADE: Okay. Thank you.
10 Judge Wardwell, does that answer your question?

11 JUDGE WARDWELL: Fine. Thank you.

12 CHAIRMAN MCDADE: Do you need any
13 follow up?

14 JUDGE WARDWELL: No.

15 MR. SIPOS: Your Honor, this is John
16 Sipos for the State of New York. I note in that
17 report there is a reference to a code. And that
18 we have checked, and we do not believe that code,
19 we do not have the code that was referenced.

20 And the reference is to WCAP-9735, and
21 it was in the bibliography. Just like to note
22 that for the record.

23 CHAIRMAN MCDADE: Okay. Thank you,
24 Mr. Sipos. Okay. Dr. Lahey, I believe there was
25 a reference that you made yesterday to an Argonne

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1 report, and Judge Wardwell had asked you whether
2 or not you had a cite to an exhibit for that
3 report. Were you able to provide a cite?

4 DR. LAHEY: I believe you're talking
5 about NUREG/CR-7184. Is that the right one?

6 JUDGE WARDWELL: No. It's what you,
7 what are you talking about. It's not what I'm
8 talking about.

9 DR. LAHEY: In my testimony, I look
10 back at my testimony, and I did cite that
11 particular report.

12 JUDGE WARDWELL: Let's make sure we're
13 clear on this.

14 DR. LAHEY: Okay.

15 JUDGE WARDWELL: So your testimony
16 482, page 18, lines 16 through 22 says, "A recent
17 report prepared by Argonne National Lab," and
18 then it goes on for several lines with no cite of
19 what that report is.

20 Two pages later, you cite to two or
21 three different NUREGs.

22 DR. LAHEY: Right.

23 JUDGE WARDWELL: My question is, the
24 482, page 18, lines 16 through 22, Argonne
25 National Laboratory report that you referred to,

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1 what is the cite for that?

2 DR. LAHEY: Yes. I believe that
3 particular one was the Chopra report. The lead
4 author would be Dr. Chopra from ANL.

5 JUDGE WARDWELL: And what's the NUREG
6 number?

7 DR. LAHEY: Okay. Let's see.

8 JUDGE WARDWELL: Would it be 7027?

9 DR. LAHEY: It's possible.

10 JUDGE WARDWELL: The exhibit for that
11 one, at 7027, is New York State 487.

12 DR. LAHEY: Let me look.

13 JUDGE WARDWELL: Not to take the
14 thunder out of Entergy's crack cite locator, but
15 I have to show off sometimes.

16 DR. LAHEY: All right. I don't carry
17 around those numbers in my head, so I'm going to
18 have to look, Your Honor. Let's see.

19 (Pause.)

20 DR. LAHEY: Bear with me please, and
21 I'll search it down.

22 JUDGE WARDWELL: Let's just wait.
23 Could we call up New York State 487 and see if,
24 it would have the author as Chopra.

25 DR. HISER: Your Honor, this is Allen

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1 Hiser of the staff. I think it is New York State
2 488 --

3 JUDGE WARDWELL: Okay.

4 DR. HISER: -- page XV. I believe
5 that top paragraph is executive summary about
6 two-thirds of the way down the paragraph.

7 DR. LAHEY: That one's the Chen report
8 you just put up, but that's not it.

9 JUDGE WARDWELL: You say that's not
10 it?

11 DR. LAHEY: That particular one that's
12 on the screen now, the lead author is Chen.
13 He's, I did reference that report, but you were
14 asking about a different one, I believe.

15 JUDGE WARDWELL: I don't know which
16 one you're asking.

17 DR. LAHEY: I believe it's --

18 JUDGE WARDWELL: I'm asking for your
19 482, page 18, lines 16 through 22, when you say,
20 "A recent report prepared by Argonne National
21 Laboratory for U.S. NRC" --

22 DR. LAHEY: Okay.

23 JUDGE WARDWELL: What is that report?
24 And you say it's the Chopra report. Correct?

25 MR. SIPOS: Your Honor, it's John

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1 Sipos for the State of New York. May I try to
2 resolve this?

3 JUDGE WARDWELL: Sure.

4 MR. SIPOS: Lower down on line 22, I
5 believe, of New York State 482 on page 18, that's
6 where we are.

7 JUDGE WARDWELL: Yes.

8 MR. SIPOS: I believe there's a
9 reference to Chen, et. al. on the very last two
10 lines of that page carrying over.

11 JUDGE WARDWELL: Well, you address
12 that to your witness to have him verify that
13 that's what he's referring to is 488 then.

14 DR. LAHEY: Yes. What is the date of
15 the testimony that you're talking about, or what
16 is the New York State reference?

17 MR. SIPOS: June 2015.

18 DR. LAHEY: Okay.

19 CHAIRMAN MCDADE: Mr. Welkie, can you
20 pull up New York 488? This is 487, isn't it?

21 JUDGE WARDWELL: No, it's 482.

22 CHAIRMAN MCDADE: Never mind. Thank
23 you. All right.

24 DR. LAHEY: So this testimony is June
25 9, 2015, New York State 482. Is that the one,

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1 Your Honor?

2 JUDGE WARDWELL: It's your testimony.

3 DR. LAHEY: That's, I've done a lot of
4 testimony, but that's the one you're concerned
5 with?

6 JUDGE WARDWELL: Yes.

7 DR. LAHEY: All right. Tell me the
8 page number again.

9 JUDGE WARDWELL: 18.

10 DR. LAHEY: Okay.

11 JUDGE WARDWELL: And it's line 16, if
12 you go to line 16, that's where the, it's really
13 on 17, "Moreover, a recent --

14 DR. LAHEY: Right.

15 CHAIRMAN MCDADE: -- laboratory report
16 prepared by Argonne Lab."

17 DR. LAHEY: So that particular quote
18 is for the Chen report.

19 JUDGE WARDWELL: So it is. If we go
20 to the next page, it is 7184 then. Is that
21 correct?

22 DR. LAHEY: Yes, sir.

23 JUDGE WARDWELL: Thank you.

24 DR. LAHEY: Sorry it took so long.

25 JUDGE WARDWELL: No problem. We got

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1 it all straightened out. We have so many numbers
2 of those.

3 CHAIRMAN MCDADE: Those were the only
4 homework assignments that I recall. Is there any
5 witness who right now was asked to look something
6 up that we haven't addressed here this morning so
7 far?

8 MR. GRIESBACH: Yes, Your Honor. This
9 is Tim Griesbach from Entergy.

10 CHAIRMAN MCDADE: Yes.

11 MR. GRIESBACH: I believe Judge
12 Wardwell had asked us to clarify the screening
13 criteria that were used for the cast components,
14 and I'm prepared to do that now.

15 CHAIRMAN MCDADE: Please.

16 MR. GRIESBACH: Let me go through the
17 sequence. The original criteria in MRP-191
18 stated both criteria for thermal embrittlement
19 and irradiation embrittlement. That's in New
20 York State 321, Tables 3-5 and 3-6.

21 They went through and screened the
22 various components, including the lower support
23 columns. There were several criteria, one based
24 on molybdenum content less than or greater than
25 0.5 percent, materials, whether they're

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1 statically or centrifugally cast.

2 And then the ferrite content less than
3 or greater than 20 percent. There's separate
4 criteria for irradiation embrittlement based on
5 1 dpa fluence. So that was the criteria that
6 were used.

7 And in the NRC review of that, they
8 took issue with the criteria. Although those
9 criteria had been published in a letter, called
10 the Grimes Letter, that's NRC document 213, new
11 information particular to the effects of both
12 thermal and irradiation embrittlement came to
13 light.

14 And the NRC staff had offered revised
15 proposed criteria taking into account both. In
16 fact, NRC went back and looked at that, those
17 materials that had screened out per the new
18 criteria, and those can be found in NRC Exhibit
19 201.

20 The same molybdenum content, the same
21 static statically or centrifugally cast material,
22 but there was the combination of thermal and
23 irradiation embrittlement could be screened out
24 if the ferrite content were below 15 percent,
25 which was part of the confusion that we had

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1 yesterday.

2 In fact, those components in Indian
3 Point 2 and 3 did screen out for that very
4 reason. Although the separate criteria to
5 continue to look at them for irradiation
6 embrittlement would be if they exceeded a dpa
7 level of 1.5 dpa.

8 So that was the method, methods to
9 use. I believe Dr. Hiser discussed that
10 yesterday. And that is also very clearly stated
11 in the NRC testimony in their question 163 on NRC
12 Exhibit 197.

13 And that's stated on pages 94 and 95.
14 So I believe that reflects why there may have
15 been two different sets of criteria used and why
16 there was some confusion yesterday.

17 JUDGE WARDWELL: Thank you.

18 DR. HISER: Your Honor --

19 CHAIRMAN MCDADE: Dr. Hiser?

20 DR. HISER: This is Allen Hiser of
21 NRC. You also asked, posed a question yesterday
22 that if Entergy were to implement the
23 Westinghouse methodology on acceptability of
24 their bolt configuration post-inspection what the
25 NRC approval process, what process that would fit

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1 into, whether that would be something would be
2 available for the public to comment on or exactly
3 where that would fall. And I'm prepared to
4 discuss that.

5 CHAIRMAN MCDADE: Please.

6 DR. HISER: If that case were to
7 occur, that the applicant were to do it's
8 inspection and find that there were degraded
9 bolts that it could not justify, would they be
10 able to perform the individual bolt function?

11 And they then move that condition to
12 the corrective action program. If they were to
13 implement this engineering justification that
14 they discussed, then that analysis would be
15 evaluated through 50.59 to determine whether a
16 license amendment would be required by the
17 applicant.

18 If the conclusion was that a license
19 amendment would not be required, then 50.59 would
20 be documented, and it would be available for
21 staff review.

22 If a license amendment were to be
23 necessary, then the applicant would follow the
24 normal 50.90 process for license amendment. At
25 this point, we cannot make, we cannot prejudge

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1 what that 50.59 process, what the result would be
2 from that by the applicant.

3 CHAIRMAN MCDADE: Okay. Thank you,
4 Dr. Hiser. I appreciate that. Okay. I think
5 we're ready to get started then with regard to
6 specific questions regarding exhibit --

7 MR. BESSETTE: Your Honor, this is
8 Paul Bessette. Can we just have a moment to swap
9 witnesses, move one of our witnesses from the
10 back to the right? It might be more convenient
11 for Your Honor.

12 CHAIRMAN MCDADE: Yes, sure.

13 JUDGE WARDWELL: And witnesses that
14 are part of, that are only on 25 should leave the
15 table. But before we do that, I would like to
16 just thank all of the witnesses on 25.

17 I requested certain attributes that I
18 wanted from your answers, and I think it was
19 succeeded very successfully. We got through a
20 lot of stuff in about a day's a little change
21 worth of effort.

22 And it was due mostly because of your
23 succinct answers that you gave, and I want you
24 let you know I appreciate your responses.

25 MR. TURK: Your Honor, this is Sherwin

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1 Turk.

2 CHAIRMAN MCDADE: Mr. Turk?

3 MR. TURK: Can we pause for a moment
4 or two? Some of our witnesses are not in the
5 room currently. They'll be back in a moment, or
6 at least one of them.

7 MS. SUTTON: Your Honor, one of our
8 witnesses needs to also take an emergency break.
9 We'll be very brief.

10 CHAIRMAN MCDADE: We're sort of in a
11 recessing place right now, so do you want to take
12 a short break, Dr. Lahey?

13 DR. LAHEY: If we're on a recess, I
14 will.

15 CHAIRMAN MCDADE: Actually, while we
16 get organized, rather than just sitting here, why
17 don't we take five minutes? And we'll come back
18 in five minutes.

19 MR. TURK: Thank you, Your Honor.

20 (Whereupon, the above-entitled matter
21 went off the record at 9:14 a.m. and resumed at
22 9:22 a.m.)

23 CHAIRMAN MCDADE: Okay. Judge
24 Kennedy?

25 JUDGE KENNEDY: I guess this brings us

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1 to Contention 26. Similar to Contention 25 where
2 Judge Wardwell led the questioning, I'll take the
3 initial cut at questions for the witnesses and
4 New York State 26.

5 So it will proceed as we did for 25.
6 I know there's some new folks here that may not
7 have observed what we did, but I'm the lead
8 questioner, if you will, have the lead on the
9 contention.

10 But my colleagues here will also
11 chime in at various points to ask questions and
12 follow up questions. So I have a series of
13 questions that I'm going to go through and then
14 ask them to chime in as need be.

15 Contention 26, as the Board views it,
16 raises a general challenge to Metal Fatigue Aging
17 Management Program and in specific raises some
18 challenges to the calculations of the cumulative
19 usage factors and the CUFens that are used.

20 It appears to focus extensively on the
21 methodology and approach used to calculate these,
22 and so we'll get into a lot of discussion about
23 those calculations.

24 I know we almost completely avoided
25 any discussion on proprietary information, and

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1 right at the finish line we started to get close.
2 I can assure you the Board's attempted to try to
3 deal with the issues on Contention 26 in a level
4 that we hope is high enough that we won't have to
5 close the meeting.

6 But I do appreciate the efforts of
7 Entergy to keep us on the right path here. As
8 always, we're still technical people, and we get
9 curious. And we raise questions, so I appreciate
10 your efforts and we'll try to deal with it.

11 But I can see this is a very technical
12 contention with a lot of methodology and a lot of
13 proprietary information. We've attempted to try
14 to address our questions at a level about the
15 specifics, if that makes sense at this point.

16 Hopefully it'll make sense as we go
17 through it. We've tried to stay at more of a
18 concept level, not use specific values to try to
19 deal with a lot of these issues from a conceptual
20 level.

21 At the end of the day we may not be
22 able to do that, so there may come times where it
23 has to get down, to really address a specific
24 question, into the details.

25 And again, we'll look to Entergy and

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1 to Westinghouse to help keep us from revealing
2 anything that shouldn't be revealed to the
3 public.

4 MS. SUTTON: Your Honor, this is
5 Kathryn Sutton for Entergy. We have advised our
6 experts that if they believe that they need to
7 wade into details that are proprietary, they
8 should first alert you.

9 But at the same time, we are concerned
10 that we do need to put the contention to bed and
11 make the case. So we will work with you, Your
12 Honor, to make sure that we protect the
13 information. And we'll work with Westinghouse as
14 well.

15 JUDGE KENNEDY: I appreciate that.
16 And as we get through this and get a little
17 experience with the issues at hand here, maybe a
18 path will be clear on how we'll deal with this.

19 I mean it's possible we could move all
20 of those issues to the end of the day or to an
21 appropriate time. Having said that, we're going
22 to try to not get down that road.

23 But I appreciate the difficulty in
24 being able to do this. The Board has spent a lot
25 of time reviewing the pre-filed testimony, and it

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1 contains a lot of proprietary information.

2 With that discussion, this is the
3 issues related to Contention 26. Before I get
4 into the specifics of my questions, it occurred
5 to the Board that it would be useful to have some
6 contextual discussion about CUFs.

7 We'll have to find out how to
8 pronounce some of this so we can communicate, but
9 have some initial discussion about what a CUF is,
10 how it's calculated.

11 And again, my intent is to do this at
12 a level to provide contextual information for the
13 follow up questions. So if you feel the need to
14 get way deep into a methodology detail, let us
15 know.

16 We can maybe park that for a while
17 until we get to more specifics on the details of
18 the calculations. But I wanted to at least have
19 some opening discussion about those parameters.

20 And then we'll use that in the
21 subsequent questions as background material for
22 our follow up questions.

23 My intent, at least to start, is to
24 direct these questions to Entergy. It's their
25 application. It's their CUFs for their plant.

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1 And I guess Westinghouse has a role in this, too.

2 So I'm going start with a series of
3 questions to Westinghouse, to Entergy, and I'll
4 let you folks decide who the appropriate person
5 is.

6 But I had put together, sort of at a
7 high level, a series of questions that try to
8 address this whole CUFs issue, not to solve it,
9 but to provide some context so when we get into
10 the specific issues that have been raised by New
11 York State we have some backdrop information to
12 help make it clear.

13 I'm going to try to do the easy one
14 first. Someone can enlighten us at to what a CUF
15 is, maybe with what it's an acronym for to start
16 with.

17 MR. GRAY: Yes, Mark Gray for Entergy.
18 CUF stands for cumulative usage factor. It's
19 required by the ASME code. The calculation is
20 according to Section 3 of the code, Section NB-
21 3222.4(e) [5].

22 And that section gives a prescribed
23 method for combining stress cycles that occur on
24 a component in a method that allows you to
25 calculate the usage factor, which is for each

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1 pair of stress cycles that form a range.

2 That's called the alternating stress
3 range. It's the amplitude that you use on the
4 fatigue curve. So you calculate the stress
5 range. You get an amplitude, the alternating
6 stress for some stress cycle pair.

7 That stress cycle pair then is
8 assigned an allowable number of cycles from the
9 design fatigue curve. From that allowable number
10 of cycles, you also have the actual or design
11 number of cycles for that stress cycle pair.

12 The ratio of the actual number of
13 cycles in the design divided by the allowable
14 cycles from the curve is the usage factor for
15 that pair. So it's a calculation, to start with.

16 JUDGE KENNEDY: Yes, and sounds like
17 a complex calculation that tries to provide an
18 indication. Does it, the sense I get is it tries
19 to provide an indication based on actual versus
20 a design life of the component.

21 It sounds like it's a ratio. Is it a
22 ratio?

23 MR. GRAY: So it's a ratio of the
24 number of cycles expected for the component
25 divided by the allowable based on the fatigue

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1 curve. So it's the fraction of the allowable
2 life of the component from that stress cycle.

3 The cumulative usage factor is the sum
4 of all those incremental usage factors for all
5 the stress cycles in the design.

6 JUDGE KENNEDY: So all the stress
7 cycles that a particular component or series of
8 components would be exposed to?

9 MR. GRAY: Yes.

10 JUDGE KENNEDY: And so it's a design
11 type calculation. In other words, it's done when
12 the plant is being designed?

13 MR. GRAY: Yes.

14 JUDGE KENNEDY: And it's an indication
15 based on some projected amount of actual cycles
16 that would occur during the operation of the
17 plant of how close you are to ultimate failure of
18 the component, the fatigue life of the component,
19 the design life of the component.

20 MR. GRAY: The design life of the
21 component is represented by that allowable
22 fatigue usage, cumulative fatigue usage factor of
23 1. So basically, it's 100 percent of the stress
24 cycles allowed by the design curve.

25 And you calculate the fraction of that

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1 based on the loadings postulated for the
2 component of all the stress cycles that are
3 postulated for the component.

4 JUDGE KENNEDY: Does that imply that
5 the postulated cycles is less than the design
6 cycles? Is that, would it always be 1? We know
7 it's not, but --

8 MR. GRAY: No, let's clarify
9 terminology a little bit. Section 3 defines that
10 you need, requires a design specification for the
11 component. That design specification tells you
12 all the loads that have to be considered for the
13 component.

14 When it comes to the fatigue loads,
15 those loads are associated with a number of
16 cycles. Those loads translate then into stress
17 cycles on the component.

18 And then those stress cycles are used
19 to calculate the usage factor. So the design
20 cycles, when you say cycles, that's normally used
21 to refer to those number of cycles in the design
22 specification for the loads to be considered.

23 The allowable cycles are the allowable
24 cycles that you get from the design fatigue curve
25 for a given stress level.

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1 JUDGE KENNEDY: So is the allowable
2 some sort of measure from the design perspective
3 of what that component is capable of
4 withstanding?

5 MR. GRAY: Yes, the design allowable
6 number of cycles is from the design fatigue
7 curve, which is based on test data plus margins.

8 JUDGE KENNEDY: And if this is a ratio
9 calculation, is that the denominator of the
10 calculation?

11 MR. GRAY: The denominator, yes.

12 JUDGE KENNEDY: So then the numerator
13 is an expected set of, expected level of --

14 MR. GRAY: Yes, expected number of
15 cycles for that stress cycle.

16 JUDGE KENNEDY: Okay.

17 MR. GRAY: And yes, you're right. The
18 stress cycles are a function of the number of
19 transients.

20 JUDGE KENNEDY: Okay.

21 MR. COX: Judge Kennedy, this is Alan
22 Cox with Entergy. One point of clarification.
23 We say expected cycles. I guess another way to
24 put that will be assumed cycles or cycles that
25 were specified in the design.

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1 Again, these calculations were done 40
2 years ago as part of the design, so what was
3 assumed for some of those cycles, today we may
4 not expect to ever get there.

5 So it's some slight nuance there, but
6 it's something that could come into play because
7 of the operating history of the plant.

8 JUDGE KENNEDY: So the CUF value has
9 expected values in the numerator, and the
10 denominator is based on the design parameters.
11 And these are all done, the entire calculation is
12 done during the design process.

13 So these are, as Mr. Cox said,
14 historical values?

15 MR. GRAY: Well, this is Mark Gray
16 again. The original CUF was calculated during
17 the design process for the component when that
18 component was a Section 3 component.

19 JUDGE KENNEDY: Are you going to go on
20 to tell me that these have been recalculated
21 during the operation of the plant or due to
22 changes? Would you recalculate this design
23 parameter?

24 MR. GRAY: Yes. You can recalculate
25 that at any time. The reason I qualified what I

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1 said is not all of the Indian Point components
2 that have been evaluated for environmental
3 fatigue, had an original Section 3 design CUF
4 requirement.

5 JUDGE KENNEDY: So did those need to
6 be calculated to support the license renewal
7 application then?

8 MR. GRAY: Yes.

9 JUDGE KENNEDY: Okay. Would there be
10 any reason, during the life of the plant, to
11 recalculate other than say a need that you have
12 identified for the license renewal proceeding, to
13 recalculate the CUF?

14 MR. GRAY: Yes. In fact, there have
15 been instances of loadings that have been found
16 in operation at plants that weren't considered in
17 the original design.

18 And in those cases, a new analysis
19 would be performed to demonstrate that the
20 component was still good under the revised
21 loadings.

22 JUDGE KENNEDY: If the operating
23 history of the plant was different than the
24 allowable cycles, maybe I'm using the wrong word.
25 The actual cycles are allowable. I'm not sure.

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1 Whatever's in the numerator, is that allowable?

2 There's head shaking going on over
3 here. Let's stay with Mr. Gray for a minute. Am
4 I getting crossed up again with this design
5 versus allowable?

6 MR. GRAY: Yes. Let me define. When
7 we, for a component that has a CUF calculation,
8 that CUF is based on the design fatigue curve.
9 And the denominator in those usage factor
10 calculations came from the design fatigue curve.

11 The numerator in those calculations
12 came from the design specification, the number of
13 expected loadings for the component. For
14 example, if there's an operational transient
15 that's discovered, that changes the numerator.

16 When the plant is counting their
17 cycles against what's been designed, now that
18 numerator now becomes the allowable for the plant
19 to track to because that's what was used in the
20 CUF calculation.

21 JUDGE KENNEDY: Okay. Yes, that helps
22 if I think in terms of fixed parameters versus
23 non-fixed parameters. From your testimony, I get
24 the sense that the denominator is a fixed
25 parameter and that the numerator could be fluid.

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1 That may be a bad term in this context
2 but could change during the operation of the
3 facility as the operating history of the plant
4 changes. Is that fair?

5 MR. GRAY: That's a fair
6 interpretation, yes.

7 JUDGE KENNEDY: Okay.

8 MR. COX: This is Alan Cox again. I
9 think one clarification to that, or not
10 clarification, but another way to say it is the
11 allowable is the allowable for that analysis to
12 remain valid.

13 If the analysis said you had a low
14 CUF, you could allow additional cycles and revise
15 the analysis to accommodate those additional
16 cycles. But for that calculation, to calculate
17 that particular CUF to remain valid, you have to
18 stay below those number of cycles.

19 JUDGE KENNEDY: And I guess would the
20 limit then be on the allowable cycles up to a
21 value of, a ratio of 1.0? I mean if you
22 recalculate it, is that the limit to where you --

23 MR. COX: Yes. That's correct. You
24 could, that's the limit from the design spec.
25 Those are limits to make, for the calc to remain

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1 valid. If you have a low CUF, you can revise the
2 calc to use a higher allowable.

3 And it would be up to the point of
4 where you exceeded 1.0

5 JUDGE KENNEDY: So starting at some
6 initial point, you had allowable and the design
7 values. Is that then the design basis for the
8 operation of the plant?

9 Is that monitored? Again, this is
10 probably not license renewal. Maybe it is
11 license renewal, but prior to the period of
12 extended operation, this was a design calculation
13 that was in place. I guess --

14 MR. AZEVEDO: This is Nelson Azevedo
15 from Entergy. Yes, Your Honor, just if I may try
16 to clarify, and maybe I won't. But the way I
17 think that they're the actual cycles the plant
18 sees.

19 Then next, they're the design cycles
20 that the plant was designed and then the
21 allowable cycles that the ASME code provides. So
22 that's the way I look at it, those three
23 different numbers.

24 So when the plant was originally
25 designed, or if it was modified, these

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1 calculations would get redone. It was designed
2 for X amount of cycles to make sure there
3 remained within the allowables from the ASME
4 code.

5 And now we track the actual cycles
6 versus the design cycles that were originally
7 used to design the component, if that clarifies
8 it.

9 JUDGE KENNEDY: The allowable, can
10 that, is that specified by the designer, or is it
11 specified by the code?

12 MR. AZEVEDO: The allowable cycles
13 comes from the ASME code. There's a stress range
14 versus number of allowable cycles. There's an SM
15 curve in the ASME code.

16 And for that specific stress, for that
17 specific cycle, you go to that curve, it'll tell
18 you what the allowable number of cycles is for
19 that specific condition.

20 JUDGE KENNEDY: And those constitute
21 the allowables?

22 MR. AZEVEDO: Those are the allowables
23 from the ASME code.

24 JUDGE KENNEDY: And that's in the
25 numerator or the denominator?

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1 MR. AZEVEDO: That's in the
2 denominator.

3 JUDGE KENNEDY: Okay. So the actuals
4 are, whatever you, whatever's specified for the
5 design spec for the operation of a plant would go
6 in the numerator. And then that's tracked. Is
7 that tracked then through time?

8 MR. AZEVEDO: Yes. What we do is we
9 actually track the actual cycles versus the
10 design cycles that we used in the calculation.
11 The analyzed cycles, design cycles, those are
12 interchangeable terms.

13 JUDGE KENNEDY: Okay. Thanks. Mr.
14 Hiser, or Dr. Hiser, sorry. We're getting a
15 little, too. We've asked you too many questions.
16 They're getting a little too friendly here.

17 You seem to be expressing some, that's
18 the face. Are we tracking with how the NRC views
19 this CUF picture?

20 DR. HISER: This is Allen Hiser with
21 the staff. Yes, I think you're on the right
22 track now. It's very confusing between
23 allowable, design, projected and sorting that
24 out, I think, is a very important first step.

25 JUDGE KENNEDY: You can. I'm probably

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1 making the same face back at you because that's
2 where I was when we first started reading this
3 testimony.

4 DR. HISER: And I apologize. It's my
5 thinking of things and not --

6 (Simultaneous speaking.)

7 JUDGE KENNEDY: I believe we all do
8 it, and I apologize for bringing to anybody's
9 attention.

10 CHAIRMAN MCDADE: And we certainly
11 don't want to discourage you from thinking about
12 this.

13 DR. HISER: Thank you.

14 JUDGE KENNEDY: Maybe to the witnesses
15 for the State of New York, any concerns over the
16 discussion that Entergy's provided?

17 DR. LAHEY: This is Richard Lahey.
18 That's my understanding as well of the original
19 CUF.

20 JUDGE KENNEDY: Dr. Hopenfeld?

21 DR. HOPENFELD: This is Joram
22 Hopenfeld, Riverkeeper. There's one important
23 point that I would like to, can you hear me well?
24 Can you hear me okay?

25 JUDGE KENNEDY: Please take both, yes.

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1 Maybe move the mic a little bit.

2 DR. HOPENFELD: It's not a detail, but
3 it's an important point because it relates to
4 your question as to what you do at the beginning
5 during the design stage.

6 After you take your maximum stress to
7 identify the minimal stress during that
8 transient. Take the difference. You have to
9 multiply that difference by a stress
10 concentration factor to allow for the fact that
11 LOCA stress may initiate or may propagate
12 differently than if you had just considered only
13 the average.

14 So the point is, that stress
15 concentration factor is a factor. It depends on
16 geometry. So if a situation in the plant, and
17 it's on the secondary side, due to geometry of
18 the changes or you have radiation effect.

19 JUDGE KENNEDY: Let me, I don't mean
20 to interrupt you, but we're going to get to that.
21 This, to me, is sort of setting the stage so that
22 we're all on the same page.

23 I think you've raised some of those
24 concerns in your testimony, and we'll get into
25 the specifics later of the calculations and I

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1 think try to deal with some of the points you
2 made.

3 I didn't mean to cut you off, but
4 we're going to get way beyond where I think we
5 need to be at this point. Appreciate it though.
6 Thank you.

7 MR. SIPOS: Excuse me, Your Honor,
8 John Sipos for the State of New York. Could I
9 move Dr. Hopenfeld's microphone closer to him?

10 CHAIRMAN MCDADE: Please.

11 MR. SIPOS: Thank you. Mr. Welkie can
12 do a better job of it than I can.

13 DR. HOPENFELD: Thank you.

14 CHAIRMAN MCDADE: All right. We're
15 going to get you a different microphone, Dr.
16 Hopenfeld. So we're going to continue. We've
17 got some questions over here to Entergy.

18 So by the time you're called on again,
19 Mr. Welkie will have a more effective microphone
20 for you.

21 DR. HOPENFELD: Hope it's not a
22 message for me.

23 JUDGE KENNEDY: Hopefully if you have
24 any questions before we get your microphone in
25 please jot them down so we don't lose them.

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1 Let's go back to Entergy and maybe Mr. Gray,
2 we'll start with you.

3 Are there conservatisms built into
4 those calculations, and maybe, I guess I don't
5 want a simple yes or no because we're going to
6 get into conservatisms and margins later. But if
7 you could maybe outline if there are and sort of
8 in general terms, the types of conservatisms that
9 could be at play here.

10 MR. GRAY: Yes, and as you eluded to,
11 in our testimony we do make a distinction between
12 the ASME code margins and ASME code conservatisms
13 and analysis conservatisms.

14 Those are three categories of some
15 amount of conservatism. And the calculations
16 contain all three of those.

17 JUDGE KENNEDY: Right, and I
18 appreciate that, and I do remember that from the
19 testimony. And we'll have some specific
20 discussion about that and give New York State an
21 opportunity to weigh in.

22 But that's what I was looking for is
23 at that level, yes, there are conservatisms built
24 into it as you point out.

25 Does the WESTEMS code play a role in

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1 the CUF calculation, or is that a different
2 aspect of this, to this puzzle?

3 MR. GRAY: This is Mark Gray. The
4 WESTEMS code is the tool that Westinghouse used
5 for the ASME Section 3 evaluations, so yes, it
6 does the CUF calculation.

7 JUDGE KENNEDY: All right. Thank you.
8 Now let's move into, and I don't know how to say
9 these either. There's the CUFens. What's going
10 on there, and I'll start with Mr. Gray. And
11 there are probably others to answer.

12 So we started with just CUF, and now
13 we've added something to those calculations.
14 Maybe if you could address in sort of general
15 terms what that's all about and why it was done.

16 MR. GRAY: The CUF calculation was
17 done according to the ASME code, Section 3. The
18 penalty factor to account for the effects of
19 reactor water environment is termed Fen.

20 That methodology is prescribed by the
21 NUREGs, and there are a number of different ways
22 that that Fen can be applied. But essentially
23 the CUFen is the product of the ASME code CUF and
24 the Fen penalty factor to account for reactor
25 water environment.

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1 And the reason that is done is because
2 the NRC has required that plants doing a license
3 renewal evaluation evaluate certain components
4 for the effects of the reactor water environment
5 on their design fatigue calculations.

6 JUDGE KENNEDY: And did you just
7 mention that those Fens, I'm not sure what, so
8 the environmental adjustment, that's prescribed
9 by the NRC and was used in these CUFen
10 calculations?

11 MR. GRAY: Yes. The Fen factors are
12 defined in different NUREG reports.

13 JUDGE KENNEDY: Okay. Let me go
14 backwards just a little bit because I was using
15 some terms relative to conservatisms. Later on
16 we're going to talk a little bit about safety
17 margin and reductions in safety margin and
18 conservatisms.

19 In your mind, is there a difference
20 between the term margins and conservatisms? Are
21 they different concepts? They trying to do
22 different things, or should the Board view those
23 as similar?

24 MR. GRAY: While they may have a
25 similar effect on the results of an analysis, we

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1 do view those as having a different role. The
2 margin is something that, as an analyst, I can't
3 touch.

4 That's defined in the code methodology
5 and allowables, particularly the design fatigue
6 curve. The conservatism is a function of the way
7 the analysis is performed.

8 And that conservatism can be a
9 function of which section of the code I used to
10 do my analysis. The code allows different types
11 of analysis to be done that have different levels
12 of conservatism in them.

13 The other aspect of conservatism is
14 the assumptions that the analyst makes in the
15 inputs and the modeling. And that has to be
16 determined by the analyst and, of course, go
17 through a verification process.

18 JUDGE KENNEDY: So one distinction
19 that I heard you make is that margins are
20 dictated by the code and cannot be adjusted or
21 changed or reduced. Is that what I heard you
22 say?

23 MR. GRAY: Yes. I'll only qualify
24 that by the ASME code does have sort of a blanket
25 statement that if you can justify something other

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1 than what it says, you could do that.

2 But generally speaking, and what we've
3 done here, that hasn't been performed.

4 JUDGE KENNEDY: All right. Thank you.
5 Dr. Hopenfeld or Dr. Lahey, do you, we're going
6 to get into safety margins and reductions and
7 stuff. But do you have anything you'd like to
8 add to what Mr. Gray has said here about margins
9 and conservatisms?

10 DR. LAHEY: Your Honor, this is
11 Richard Lahey, not about the margins. When we
12 talked about Fen, then I have something to say.

13 JUDGE KENNEDY: Yes, and I think we're
14 going to get into, this is sort of the
15 preliminaries. We're going to get into the
16 details a little later, so just I'm sure we'll
17 get a chance to get into that.

18 Too many stickies here. At some point
19 in the testimony, and I guess New York State has
20 raised some objections or discussions about the
21 revision to the CUFen calculations that were
22 performed.

23 What motivated the, well, is that true
24 first of all? Were the CUFen calculations
25 revised during the license renewal process? And

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1 if so, why was that done? And I'll guess we'll
2 take it from there. Mr. Gray?

3 MR. GRAY: Yes. This is Mark Gray for
4 Entergy. There actually, in the whole process
5 there have been revisions to the calculations for
6 different reasons.

7 But I think the main thing that you're
8 referring to is that in the midst of performing
9 their fatigue management program, the cycles, the
10 actual cycles of different transients attract.

11 So as you know, this has been going on
12 over a number of years, so some of those original
13 CUFen calculations assumed a given number of
14 cycles for analysis based on projected cycles for
15 the plant.

16 As the cycle counts are updated, and
17 those projections are revised, then the
18 calculation may be revised to use a higher number
19 in the analysis so that there is more room for
20 the plant to operate within still an acceptable
21 number of analyzing cycles.

22 JUDGE KENNEDY: So these calculations
23 are revised to bring actual cycle information
24 into the calculation from the operation of the
25 plant. Is that what I heard?

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1 MR. GRAY: Yes, and to allow more
2 because the plant's going to compare what they've
3 tracked against what we've analyzed.

4 So that's the plant's allowable versus
5 the analysts' allowable, which is the assigned
6 current allowable. I don't want to make, confuse
7 that again.

8 JUDGE KENNEDY: Does this include
9 being able to operate the plant beyond the 40
10 year life? I mean is that part of this puzzle
11 piece?

12 MR. GRAY: Yes. Let me qualify that
13 though by saying something, I think, that was
14 mentioned yesterday. The 40 year life is tied an
15 assumed number cycles in that 40 year life.

16 So the 60 year life, if it has been
17 justified that that 40 year design number of
18 cycles is really not even going to be reached in
19 a 60 year life, it's the 40 and the 60, it's
20 still defined by the same number of analyzed
21 cycles.

22 JUDGE KENNEDY: Okay. It seems like,
23 and this is, I don't really have anything here.
24 But it seems like from memory that a lot of these
25 revised CUF calculations were much lower than the

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1 original CUF calculations that were in the
2 application.

3 It would seem to me if you're, and I'm
4 not sure what caused that. Is it, as some would
5 say, a reduction in conservatisms or is it
6 bringing more actual plant data into the
7 calculation?

8 MR. GRAY: Okay. I think now you've
9 defined a context for me that I can better answer
10 your question.

11 JUDGE KENNEDY: Okay.

12 MR. GRAY: When you're referring to
13 the license renewal application, at that time,
14 the penalty factors and the CUF values that
15 Entergy used were simply, probably much more
16 conservative design fatigue usage factors.

17 Maybe at this point I should mention
18 that it's important to understand that when we do
19 a CUF calculation for design, we're not looking
20 to predict an exact or precise number.

21 We're looking to make sure that it's
22 within the allowable of one. When the analyst
23 gets the number under 1, he stops. And those
24 would be the types of numbers that Entergy
25 would've been taking from the design and applying

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1 a screening Fen factor, just to give an idea of
2 what components had to be analyzed further.

3 And when those components were
4 analyzed further within the details of how the
5 NUREGs say to apply the Fens and the current
6 industry practices, that analysis would have
7 removed a lot of conservatism from those original
8 design calculations. And that's why that big
9 difference.

10 JUDGE KENNEDY: Okay. And I think
11 we'll get into some of that discussion later on.
12 I know New York State has some questions that
13 we'll be addressing.

14 So there's now a set. At some point
15 there were CUFs. Now I guess as part of the
16 license renewal process, we have these CUFens.
17 So the values of CUFen that were developed, were
18 those developed as part of the license renewal
19 process? And are those the numbers that are
20 provided in the application?

21 MR. COX: This is Alan Cox with
22 Entergy. I think Mr. Gray eluded to the initial
23 calculations and using the initial CUF values
24 from the original design and then applying the,
25 what we consider bounding Fen factors, to give an

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1 estimate.

2 It was a projection that was put in
3 the LRA, and you saw some of the CUFen values
4 that were greater than one in that projection.
5 So that was, like I said, an initial screening
6 attempt.

7 The things that passed that screening
8 attempt didn't require further consideration.
9 The things that didn't pass that screening
10 attempt were slated for the revision of the
11 calculation, the more refined calculations that
12 Mr. Gray has since worked with Westinghouse to
13 accomplish.

14 JUDGE KENNEDY: All right. Thank you.
15 Yesterday we had some discussion about, maybe it
16 wasn't yesterday. It may have been Monday, the
17 discussion of time limited aging analyses.

18 Are these CUF, CUFen values considered
19 time limited aging analyses for the purpose of
20 license renewal?

21 MR. COX: This is Alan Cox for
22 Entergy. They are treated as time limited aging
23 analyses for the purpose of license renewal.
24 They are discussed in the same section.

25 A TLAA, by definition, is a current

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1 licensing basis analysis. I believe, as Mr. Gray
2 indicated, the CUF, the environmental factor was
3 not a requirement of the initial design.

4 So that was not a, there was not a
5 CUFen calculation that was part of the current
6 licensing basis. So these environmental crushing
7 factors are applied as part of the aging
8 management program going forward for license
9 renewal.

10 JUDGE KENNEDY: Let me make sure I got
11 that clear. So the environmental adjustment is
12 performed on the current licensing basis,
13 cumulative usage factor calculations. Is that
14 what you just said?

15 MR. COX: That's correct. And in some
16 cases, that current licensing basis usage factor
17 calculation was revised along with applying the
18 Fen.

19 MR. STROSNIDER: This is Jack
20 Strosnider. Let me see if I, I'd like to see if
21 I can clarify one thing here that with regard to
22 the TLAA, the original fatigue calculation
23 originally calculated CUF without an
24 environmental factor is the TLAA because it was
25 in the licensing basis, the current licensing

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1 basis.

2 The environmental factor was not in
3 the current licensing basis, but the NRC
4 established guidance that it should be considered
5 as part of getting a renewed license.

6 So it will become part of the current
7 licensing basis when the license would be issued.
8 All right, so I don't know if that distinction
9 helps you.

10 But TLAA is actually the original
11 calculation because that's what was in the
12 licensing basis. And now there's some additional
13 work being done in support of license renewal to
14 adjust it for the environmental factor.

15 JUDGE KENNEDY: Just, Mr. Strosnider,
16 just to make sure I've got this clear. I think
17 Mr. Cox eluded to some revised CUF calculations
18 that were performed.

19 Those would be TLAA's that are part of
20 the current licensing basis once that revision
21 was done?

22 MR. STROSNIDER: Yes, recalculations
23 without the environmental factor would be one way
24 to manage the TLAA.

25 JUDGE KENNEDY: All right. Thank you.

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1 That's what I thought I heard from Mr. Cox. I
2 appreciate it though. I don't know if anyone,
3 I'll go walk down the row here if the staff has
4 anything to offer in this sort of preliminary
5 discussion of CUFs and CUFens.

6 DR. HISER: This is Allen Hiser of the
7 staff. Now we agreed that CUF from the original
8 license, there's your CLB analyses, the RTLAAs,
9 revisions to those.

10 Clearly, it would just be updates to
11 the TLAA. The CUFen values are not TLAAs because
12 they are not in the CLB.

13 MR. STROSNIDER: Your Honor, this is
14 Jack Strosnider. If I could, you're asking, I'd
15 like to go back just for a second to the
16 discussion on margins because I think there's
17 something I should have pointed out that could
18 become important later.

19 That is that the fatigue analyses that
20 were being defined are captured in the
21 regulations in 10 CFR 5055(a). And the NRC has
22 said that you need to meet the fatigue analysis
23 and that the margins associated with ASME code
24 Section 3 analyses provide, essentially that's a
25 conclusion of adequate protection.

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1 So what that translates to from a
2 practical point of view is that you need to meet
3 the cumulative usage factor of one and that
4 provides sufficient margin in accordance with the
5 regulations.

6 All right. So that could be different
7 than a margin less than one or something of that
8 nature. What the regulations require is
9 maintaining that cum and usage factor of 1 and
10 that that provides adequate margin.

11 So that could become part of the
12 discussion later.

13 JUDGE KENNEDY: All right. Thank you.
14 And just to be fair, do the New York State
15 witnesses have anything to offer in this
16 preliminary discussion?

17 DR. HOPENFELD: Joram Hopenfeld. I
18 can just make a comment, just an overall comment.
19 I don't want to get into details. It's important
20 to understand that the damage, the CUF really
21 represents damage to the material, fatigue
22 damage.

23 And that basically is a random
24 phenomenon, but what we are doing here, we are
25 using a deterministic method to calculate it.

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1 And that's where the issue of conservatism would
2 come in.

3 JUDGE KENNEDY: All right. Thanks,
4 and we'll get into more of that as we move on.
5 I'll walk down the table of judges here. Is
6 there anything to ask in terms of the CUFs?

7 So we'll relieve you of this
8 preliminary discussion and move into some
9 specific questions. I have the questions
10 organized or grouped by topical area.

11 The first area I'd like to look at is,
12 as I mentioned in my opening remarks, the state,
13 I believe, has raised an overarching concern
14 issue with the adequacy of the Metal Fatigue
15 Aging Management Program.

16 I guess, for the record, I'd like to
17 ask Entergy to tell the Board what aging
18 management program is used for metal fatigue or
19 to manage?

20 MR. COX: It's the Fatigue Monitoring
21 Program.

22 JUDGE KENNEDY: Back to Entergy. In
23 your statement of position, you indicate that the
24 metal fatigue amp is consistent with GALL Rev 1
25 and the guidance in NUREG/CR-6250 and NUREG/CR-

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1 5999.

2 What's specific GALL AMP is consistent
3 with the fatigue monitoring program?

4 MR. COX: Your Honor, this is Alan Cox
5 for Entergy. That would be the GALL AMP that's
6 in Chapter 10. It's amp with a designation of
7 M1.

8 JUDGE KENNEDY: M1. What is the
9 relevance and --

10 (Simultaneous speaking.)

11 JUDGE WARDWELL: Excuse me. What's
12 the name on that one? Is there a name to that
13 amp?

14 MR. COX: I can get back to you on it.
15 I think it may be Fatigue Monitoring Program.
16 I'll have to check and get the exact --

17 JUDGE WARDWELL: Well, I can probably
18 look it up also myself. I just thought you might
19 know off the top of your head. Sorry.

20 MR. NG: This is Ching Ng from the
21 staff. The name of, the title of the amp is not,
22 M1 is metal fatigue of the pressure boundary.

23 JUDGE WARDWELL: Thank you.

24 JUDGE KENNEDY: Mr. Cox or whoever's
25 appropriate, the significance of the NUREG

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1 citations, NUREG/CR-6250 and NUREG/CR-5999. Is
2 that 6260? I wrote 6250. Do I have it
3 incorrect?

4 MR. COX: I believe that 6260 is the
5 NUREG. And I believe, Mr. Gray can correct me if
6 I'm wrong, this is Alan Cox again. I believe
7 that NUREG 6260 is the NUREG that defines a set
8 of representative components that should be
9 assessed for environmental effects.

10 JUDGE KENNEDY: Any thoughts on CR-
11 5999?

12 MR. GRAY: This is Mark Gray for
13 Entergy. CR-5999 was the initial NUREG to the
14 industry that identified a potential issue with
15 the effects of the reactor water environment.

16 And so NUREG/CR-6260 actually did
17 their evaluation to the curves of the CR-5999.

18 JUDGE KENNEDY: Dr. Lahey, and I guess
19 in fairness Dr. Hopenfeld, other than the issues
20 that New York State has raised with the CUFen
21 calculations and the synergistic effects, do you
22 have any specific concerns in your testimony that
23 you've identified with the Aging Management
24 Program for metal fatigue?

25 DR. LAHEY: Yes, Your Honor. And

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1 later on I hope we can get into it. It has to do
2 with the predictions by WESTEMS and the
3 uncertainty or what they would call the
4 conservatisms that are in there, how to quantify
5 that.

6 JUDGE KENNEDY: Would that be the
7 CUFen, the CUF calculations then? Yes. Okay.

8 DR. LAHEY: In the CUFen calculation.

9 JUDGE KENNEDY: And we will get to
10 that. Dr. Hopenfeld?

11 DR. HOPENFELD: It's the same.

12 JUDGE KENNEDY: Okay. So we'll get to
13 that. I just wanted to make sure there was
14 nothing specific about the Aging Management
15 Program that you had issues with outside of those
16 calculations.

17 The CUF calculations, are they
18 relevant to anything other than metal fatigue or
19 the CUFen calculations? Is that strictly a, I
20 guess I'll start with Entergy. Is that strictly
21 a metal fatigue issue?

22 MR. AZEVEDO: Nelson Azevedo for
23 Entergy. Yes, that's correct, Your Honor.

24 JUDGE KENNEDY: And so how does the
25 fatigue monitoring program manage the metal

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1 fatigue aging effect?

2 MR. AZEVEDO: We have a site-specific
3 procedure for each unit, and we have a table.
4 And that table has the allowable number of cycles
5 that were analyzed by Westinghouse to ensure that
6 the CUF stays below 1.

7 So that is our allowable number of
8 cycles for each transient. And then
9 periodically, we go back. We actually review the
10 operating blocks from the plant and count all the
11 cycles.

12 JUDGE KENNEDY: So this is a
13 monitoring and data analysis to deal with the
14 numerator of the CUF calculation. Is that where
15 this goes?

16 MR. AZEVEDO: That's correct.

17 JUDGE WARDWELL: And by each unit, you
18 mean each plant and not some groupings of system,
19 structure or components. Is that correct?

20 MR. AZEVEDO: Yes. We have one for
21 Unit 2 and one for Unit 3 because they have
22 different cycles.

23 JUDGE KENNEDY: And are those cycles
24 monitored then for each? Are there different
25 cycles that are monitored for each particular

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1 component that's identified as subject to metal
2 fatigue?

3 MR. AZEVEDO: Whatever the number of
4 types of cycles that were analyzed for each
5 component, we monitored those, all those.

6 JUDGE KENNEDY: Okay. Thank you. I'm
7 at the limit of my questions on the adequacy of
8 the amp. Again, I think the real issues, as we
9 pointed out earlier, lie in the CUFen
10 calculations and the CUF calculations and the
11 relative margins.

12 With that, I'm going to move away from
13 the amp discussion unless anyone on the Board
14 has, I'd like to start a little bit of discussion
15 on synergistic effects.

16 I recognize that we spent quite a bit
17 of time yesterday on synergism, but I thought it
18 would be appropriate to at least touch this issue
19 again with Dr. Hopenfeld sitting here today as a
20 witness for 26.

21 I guess I would ask if there's
22 anything that you could point to. Again, this is
23 either Dr. Lahey or Dr. Hopenfeld, if there's
24 anything in your testimony that would enlighten
25 us beyond, that we didn't touch on yesterday in

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1 25.

2 Any specific point in your testimony
3 that you'd like us to be aware of that wasn't
4 covered yesterday?

5 DR. HOPENFELD: Yes.

6 JUDGE KENNEDY: And what would that
7 be, Dr. Hopenfeld?

8 DR. HOPENFELD: That would be related
9 to the proposition that neutron irradiation is
10 not going to affect metal fatigue RVI components
11 because they do not contain flaws.

12 According to my analysis, that is not
13 true. A number of them does contain flaws. So
14 a crack will propagate from those flaws.

15 JUDGE KENNEDY: Can you point us to an
16 exhibit or a place in your testimony for support
17 for that assertion?

18 DR. HOPENFELD: Yes.

19 JUDGE KENNEDY: And if you need some
20 time, we can move on, and we could come back to
21 it. I'll give you a brief amount of time --

22 DR. HOPENFELD: Very brief. If you
23 look at my June 15th report on page 18.

24 CHAIRMAN MCDADE: Okay. Dr.
25 Hopenfeld, if you could, you tend a little bit to

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1 bob and weave when you're testifying --

2 DR. HOPENFELD: I'm sorry.

3 CHAIRMAN MCDADE: -- so you're coming
4 closer and further away from the microphone.

5 DR. HOPENFELD: As you can see, I'm
6 not a public speaker.

7 CHAIRMAN MCDADE: So maybe pull the
8 microphone a little to you so that you won't get
9 so far away from it.

10 DR. HOPENFELD: Yes. Page 18 on my
11 June 15th report.

12 MS. BRANCATO: That's Riverkeeper
13 Exhibit 144.

14 JUDGE KENNEDY: 144, and I guess that
15 reminds me. I've been referring to these as New
16 York State witnesses. I appreciate the fact that
17 Dr. Hopenfeld is here representing Riverkeeper.
18 My mistake. Thank you.

19 Page 18 of Riverkeeper 144. Is that
20 what you said, Dr. Hopenfeld?

21 DR. HOPENFELD: Yes. Do you see I
22 referring to numbers like CUFen of a factor of 3,
23 larger than the numbers that they have presented.
24 When you have factor of 3 on top of a number of,
25 this is not proprietary information.

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1 JUDGE KENNEDY: I guess, Dr.
2 Hopenfled, what support do you have for this
3 factor of 3? I wasn't able in your report to --

4 DR. HOPENFELD: Thank you. Thank you
5 very much. Can we go to Entergy 00683?

6 JUDGE KENNEDY: Are you asking us to
7 call up that --

8 DR. HOPENFELD: Riverkeeper, it's
9 NUREG 6909.

10 MS. BRANCATO: And that's actually --

11 DR. HOPENFELD: 857. Okay, NUREG
12 6909.

13 JUDGE KENNEDY: Dr. Hopenfled?

14 CHAIRMAN MCDADA: Can you repeat the
15 exhibit number, Doctor? What was the exhibit
16 number for that, for NUREG 6909?

17 DR. HOPENFELD: It's New York 357.

18 CHAIRMAN MCDADA: 3-5-7?

19 DR. HOPENFELD: Yes.

20 CHAIRMAN MCDADA: Okay. You said New
21 York. I believe, is that Entergy 357?

22 MS. BRANCATO: No. He misspoke when
23 he referred to an Entergy exhibit. He's
24 referring to NUREG 6909, which is New York State
25 357.

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1 CHAIRMAN MCDADE: Okay. Thank you.

2 DR. HOPENFELD: Can we go, can I
3 continue?

4 JUDGE KENNEDY: And this reference
5 that you've had us put up, this is to support
6 your assertion that there could be a factor of 3?

7 DR. HOPENFELD: That's correct, and
8 when you have a factor of 3, we use that on top
9 of their numbers. And again, I don't want to say
10 the number. And you put the number on their
11 numbers.

12 Then you come with the CUF or Fen
13 larger than 1, which indicates that there is an
14 engineering crack. There is a flaw.
15 Furthermore, even if the CUFen piece below 1, you
16 can also have a flaw.

17 JUDGE KENNEDY: I'm sort of a slow
18 reader here, but is there some specific section,
19 page that you're --

20 DR. HOPENFELD: Yes, page, I'm going
21 to go on. It's page 26 on that NUREG. And page
22 37, 28 and page 47.

23 JUDGE KENNEDY: You're going overload
24 us --

25 DR. HOPENFELD: Okay.

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1 JUDGE KENNEDY: -- here, Dr.
2 Hopenfled. Do you want to start with one
3 particular page?

4 DR. HOPENFELD: Let's start with page
5 26. Would you like me to make comment?

6 JUDGE KENNEDY: Point us to what
7 you're --

8 DR. HOPENFELD: Oh, yes. Would you
9 like me to comment on it?

10 JUDGE KENNEDY: In a perfect world I'm
11 hoping that you can point us to the support for
12 your assertion of the factor of 3.

13 DR. HOPENFELD: Yes, page 26.

14 JUDGE KENNEDY: Okay. Do we need to
15 come down a little bit? This appears to be 26.

16 DR. HOPENFELD: My page 26 is
17 different than this. Oh, here we go. Here we
18 go. It's just on top of 4.2.4, just a trigger,
19 just on top.

20 JUDGE KENNEDY: Are you, you want us
21 to be looking at Figure 15?

22 DR. HOPENFELD: Yes, the other figure.
23 This is for carbon scale. The other figure is of
24 --

25 (Simultaneous speaking.)

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1 MR. HARRIS: I can't hear you, Doctor.

2 DR. HOPENFELD: This is for carbon
3 scale. The other figure is for stainless steel
4 or similar.

5 CHAIRMAN MCDADE: So I see a factor of
6 3 on there.

7 DR. HOPENFELD: Yes.

8 CHAIRMAN MCDADE: Is that the point
9 you're trying to make here?

10 DR. HOPENFELD: Yes.

11 CHAIRMAN MCDADE: And you're looking
12 at Figure 15, the left hand side, the middle of
13 it?

14 DR. HOPENFELD: That's correct.

15 JUDGE WARDWELL: And a factor of 3
16 basically covers the bounding limits, the upper
17 limits of all the scatter of the data rather than
18 the mean. Is that a fair assessment?

19 DR. HOPENFELD: That's correct. It
20 covers the scatter, the data. They took a series
21 of experiments, and obviously you have scatter.
22 So then they tried to correlate the light, which
23 is defined by a crack which is 3 millimeters
24 deep.

25 They tried to correlate it with an

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1 equation so they can deterministically calculate
2 it. And if you see here, to be conservative,
3 really you have to, you must calculate the
4 numbers by a factor of 3.

5 So when they say that the CUFen is,
6 and this is an inherent number in the
7 calculation. There is not new modeling or
8 anything up to this point.

9 The modeling would be the next step.
10 The assumptions and uncertainties in the models
11 have nothing to do with this. This is inherent
12 in the equation that they are using to calculate
13 the CUFen.

14 JUDGE KENNEDY: I guess, Dr.
15 Hopenfeld, I'm not sure I'm tracking how this
16 translates from this data to the need to apply a
17 factor of 3 on the cumulative usage factor.

18 DR. HOPENFELD: Okay. I think the
19 question is why do I apply a factor of 3.

20 JUDGE KENNEDY: Yes.

21 DR. HOPENFELD: If you take the Fen
22 factor, which is a correction factor for the
23 environment, and multiply it by the CLB CUF --

24 CHAIRMAN MCDADE: Okay. Excuse me,
25 Dr. Hopenfeld. Let me interrupt for a second.

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1 There's a popular book out now referred to as
2 Lean In. Could you do that in a different
3 context?

4 You need to lean in to get closer to
5 the microphone. It's important for us to
6 understand what you're saying.

7 DR. HOPENFELD: Absolutely.

8 CHAIRMAN MCDADE: But in order to
9 understand it, we've got to hear it.

10 DR. HOPENFELD: Okay. The Fen, which
11 is a ratio of light and air to life in water, so
12 when you calculate the Fen, the Fen is based on
13 the ability to predict life in water. And that
14 represents, is represented by this data.

15 JUDGE KENNEDY: I guess, here's where
16 I'm struggling.

17 DR. HOPENFELD: Okay.

18 JUDGE KENNEDY: Entergy, admittedly,
19 was our overview discussion about CUFs and
20 CUFens, but what I heard him say is when they
21 apply the environmental adjustment factor, they
22 use a set of parameters or a methodology that has
23 been provided by the NRC and approved.

24 Is this suggesting that the NRC
25 methodology is incorrect? I don't know how to

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1 reconcile this with what Entergy has just
2 testified to how they adjust the CUF for
3 environmental factors.

4 I mean they clearly, well, I don't
5 think they apply a factor of three, yet they have
6 adjusted the CUF values for the plant for
7 environmental conditions.

8 We've got a lot of experts here. I
9 see it. I see a factor of 3 that covers the
10 spread in the data, but yet I recognize that the
11 Agency has provided a set of adjustment equations
12 that Entergy has said they faithfully have
13 applied.

14 We have four NRC staff witnesses. Any
15 thoughts on --

16 MR. STEVENS: Your Honor, Gary Stevens
17 of the staff. We're looking at this figure a
18 little bit out of context, so let me try and put
19 it in context for you.

20 This is an interim figure that
21 evaluating data scatter and material durability,
22 and it's not in any way indicating that the Fen
23 is off by a factor of 3.

24 And if you refer to page 25 at the
25 bottom, the text, and the discussion about Figure

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1 15, it in fact tells you that, the argument is
2 being made is that this modified rate approach
3 works very well and that most of the scatter is
4 due to heat variation, which we call material
5 variability.

6 The important discussion, therefore,
7 is really in Chapter 7 of this document, which
8 begins on page 71, Chapter 7, which discusses all
9 the margins that need to be accounted for in
10 doing these kinds of evaluation.

11 And specifically, material variability
12 and data scatter is discussed in Section 7 that
13 begins on page 90, or sorry, 73. And what you
14 see from all of this discussion in this chapter
15 is there are factors that are applied to the
16 design fatigue curves to account for these kinds
17 of variations that are picked up by the Fen.

18 One of those factors is data scatter
19 and material variability, and that's really where
20 this factor of 3 comes in.

21 DR. HISER: And I think, Your Honor,
22 if you go to the figure or Table 12 --

23 MR. STEVENS: What page is it?

24 DR. HISER: It's on page 76 of New
25 York State 357.

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1 MR. STEVENS: So what you see in this
2 table, and thank you Dr. Hiser for point that
3 out, the very top line is material variability
4 and data scatter.

5 And what you see is in the original
6 Section 3, ASME Fatigue Curves, they considered
7 a factor of 2 originally. And in this study,
8 we've increased that.

9 These are log normal distributions
10 that were considered, but the range is 2.1 to
11 2.8. And that's effectively that factor of 3 you
12 saw in that other figure.

13 Those are built into the design
14 fatigue curve for calculating the CUF itself.
15 So, in fact, the factor 3 is accounted for in the
16 CUF calculation.

17 JUDGE KENNEDY: So Mr. Stevens, it
18 would be your expectation in the calculations
19 that Entergy performed, they would have already
20 considered this factor of 3 in the scatter of the
21 data?

22 MR. STEVENS: Correct.

23 JUDGE WARDWELL: But this Table 12
24 says present report is 2.1 to 2.8. How do we get
25 from that number to showing where the actual

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1 number that was used for the fatigue curves that
2 demonstrate where in that range it was using?

3 Or does it have that range plotted
4 that you use to then estimate somewhere in
5 between it? How does that work?

6 MR. STEVENS: This is Gary Stevens
7 with the staff. The factors that are shown in
8 Table 12 are log normal distributions of how
9 these factors play into, and there's a Monte
10 Carlo statistical analysis that's done to develop
11 a fatigue curve that it bounds 95 percent of the
12 data with 95 percent confidence.

13 The results of that Monte Carlo
14 statistical evaluation results in reduction
15 factors applied to the curve, which if you scroll
16 down to Table 13 on page 77, you'll see the end
17 result is that there's a reduction in life of
18 approximately 12 to 13 applied to the curves for
19 the different materials.

20 So what you may have read in the, I'm
21 sure you did read in the testimony, are factors
22 of 2 and 20 or 2 and 12. This is where they came
23 from. The life, the fatigue, the design curve is
24 reduced by a factor of 2 on stress or 12 on life,
25 whichever is more conservative.

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1 And this is where they come from. So
2 based on the statistical evaluation of those log
3 normal distributions in Table 12, to get a 95
4 percent lower bound and 95 percent confidence
5 curve, you would come up with these factors on
6 life.

7 JUDGE WARDWELL: And again, just to
8 make sure I'm clear, this is all in relationship
9 to the Fen calculation.

10 MR. STEVENS: No. This is in relation
11 to actually the design fatigue curve that would
12 be used for the CUF calculation.

13 JUDGE WARDWELL: So I guess I'd go to
14 Dr. Hopenfeld then. I think you said that this,
15 that first graph that had the factor of 3 arrow
16 applied to the water condition.

17 And doesn't that seem to conflict with
18 where we've sugared this all down to in Table 13,
19 where if it's only involved with the CU
20 calculation, the CUF calculation?

21 DR. HOPENFELD: Yes. Can I answer
22 now? We confusing two things here, I believe.

23 JUDGE WARDWELL: If you can't hear
24 yourself over the speaker, we can't hear you for
25 sure.

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1 DR. HOPENFELD: I think we're
2 confusing two things. Table 3 relates to the
3 ASME code, to the uncertainty in the ASME.

4 JUDGE WARDWELL: You say Table 3 or
5 13?

6 DR. HOPENFELD: Table 13. Excuse me.
7 Table 13 relates to the ASME code, to the margins
8 that we talked. That's what he is talking about
9 here.

10 What I was talking about, the factor
11 of 3, has nothing to do, the ASME code never
12 heard of Fen. They never heard of that. This
13 was done 30 or 40 years --

14 JUDGE WARDWELL: But can you show that
15 that previous figure you referenced, and what was
16 the figure again? Let's go back to that quickly.

17 DR. HOPENFELD: That was --

18 MR. SIPOS: I believe it was Figure
19 15, Your Honor.

20 DR. HOPENFELD: 15.

21 JUDGE WARDWELL: Sorry.

22 MR. SIPOS: Figure 15.

23 JUDGE WARDWELL: Okay. There we go.
24 There it is. It's in front of you now.

25 DR. HOPENFELD: Okay. This you can --

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1 JUDGE WARDWELL: Where does that show
2 that that deals with the water effects, the Fen
3 part of this equation?

4 DR. HOPENFELD: Because this data was
5 obtained in water. There is also --

6 JUDGE WARDWELL: Where is that stated?

7 DR. HOPENFELD: Yes. If you take a
8 look at the equation that you have, you see, I
9 don't know which page it is. The equation that
10 comes from this figure, the mean equation, the
11 average equation for Fen --

12 JUDGE WARDWELL: Well, maybe I can
13 simplify it. Mr. Stevens for staff, do you agree
14 that this Figure 15 relates to in water types of
15 analyses?

16 MR. STEVENS: Yes.

17 JUDGE WARDWELL: Okay. Thank you.
18 Dr. Hopenfeld, is that, do you have anything
19 further to add? I mean it seems --

20 DR. HOPENFELD: Well, I just want to
21 make sure that we understand that the
22 uncertainties in the code have nothing to do with
23 this factor of 3. It's just two different
24 animals.

25 This factor of 3 is simply they took

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1 a large number of tests, and they had to put it
2 in a matter that one could calculate the
3 conversion factor.

4 So they correlate it. You see, and
5 they correlate it. You see that correlation is
6 good within a factor of 3. And it's the same
7 thing for, this is for carbon steel, but they are
8 the same thing for stainless steel that use the
9 other pages I gave you.

10 And there's more data than these, so
11 there's a lot of data that all show that they
12 fall within a factor of 3, the ability of Argonne
13 to correlate their data so the user can put it
14 somewhere in a deterministic way.

15 That's what I prefaced my presentation
16 before. So you can calculate it analytically.
17 But if you looked at this, it is because you are
18 using a deterministic method to calculate the
19 CUFen.

20 You have to use, you have to be
21 conservative. You can look at a minus 3. You
22 cannot look at the lower. You have to take the
23 ends of your distribution.

24 You have to be conservative. That's
25 why you have to multiply this by a factor of 3.

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1 JUDGE KENNEDY: Said another way, Dr.
2 Hopenfeld, are you challenging the final
3 conclusions of this overall report, which seem to
4 lead to a way to deal with the scatter in the
5 data?

6 I mean it seems like these data
7 scatter issues are addressed as Mr. Stevens has
8 pointed out. And going back to the original
9 figure doesn't seem to convince me that it's not
10 included.

11 So I think we're at an impasse here.
12 I appreciate you bringing to our attention, and
13 I appreciate members of the staff taking us
14 through the report.

15 This seems to me to be an indication
16 that what you have identified is included in the
17 ultimate calculation. I'm not suggesting you
18 agree with that, but I haven't seen anything here
19 that would lead me to believe it's not being
20 accounted for.

21 And we're going to come back. I'm
22 sure this is going to come up again. I know
23 you've got issues all through here on the
24 conservatisms and the margins embedded in the
25 calculations.

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1 But at least for now, I'd like to move
2 off of this figure and off of this topic.

3 MR. SIPOS: Excuse me, Judge Kennedy,
4 John Sipos over here for the State of New York.
5 I understand Your Honor's desire to move forward.
6 I'd just note for the record the Dr. Hopenfeld,
7 I believe, also referred to page, to charts on
8 page 37 and possibly 47.

9 And page 37 is PDF frame 57 of this
10 document should we wish to ever return to it.

11 JUDGE KENNEDY: Is there something,
12 let's at least put one of those pages up and see
13 if it enlightens us differently, 37.

14 MR. SIPOS: So page 37 is PDF frame
15 57.

16 JUDGE KENNEDY: Is this not just the
17 same data for different conditions and has a
18 displayed scatter? It may lack the factor of 3,
19 but it seems more of the same to me.

20 CHAIRMAN MCDADE: That's a question to
21 you, Dr. Hopenfeld.

22 JUDGE KENNEDY: Oh, I'm sorry. Does
23 this lead us to a different conclusion that we
24 would have with Figure 15?

25 DR. HOPENFELD: Can I answer that?

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1 JUDGE KENNEDY: Oh, I'm sorry, Doctor.
2 Yes, I guess I'm not being clear.

3 DR. HOPENFELD: No. It's the same,
4 just gives you more data. But the point is, it's
5 more useful. And I should have probably started
6 with this page because you can see when you
7 derive the Fen, you see that Equation 21.

8 That equation that you see here is the
9 best fit line, you see. So that is the best fit.
10 It doesn't have a factor of 3 in here. It's for
11 you to, when you calculate the CUFen, you should
12 use the factor of 3.

13 JUDGE KENNEDY: I guess instead of me
14 testifying, Mr. Stevens, would you care to
15 address this yet again? It seems to me to be the
16 same issue.

17 MR. STEVENS: You're correct. It's
18 the same issue, just with more data. The
19 previous graph on page 26 I think it was, was
20 limited because it was doing an estimate using a
21 modified rate approach.

22 So it was just done on a subset of the
23 data, and here you're seeing all the data. So
24 it's essentially the same thing.

25 The other thing that we should correct

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1 in Equation 21 is not the best fit curve
2 regarding the fatigue. Equation 21 has to do
3 with the Fen factor, so I just wanted to correct
4 that.

5 JUDGE KENNEDY: All right. Thank you.
6 Just I guess as a curiosity, and we keep using
7 the words margin and conservatism. Maybe I keep
8 using them.

9 These factors to try to deal with data
10 scatter, would you view those as, and I guess
11 I'll direct it to Mr. Stevens first. Is that a
12 margin, a conservatism, or are we talking about
13 the same thing?

14 MR. STEVENS: It's a difficult
15 question. Let me see if I can clarify. And I'm
16 going to, if you'll allow me to back up just a
17 little bit on the discussion on margins and
18 conservatisms, I'm going to give you my spin on
19 this.

20 So what I would call this is a part of
21 a design factor that's built into the design
22 curve. A design factor is, in fact, contributes
23 to a margin.

24 The way I look at margins is it's a
25 difference between where you are and where you're

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1 allowed to go. And I break it into two pieces.
2 Some might think of margin as the difference
3 between where you are and what might constitute
4 a failure or a crack to initiate.

5 And another one is a margin between
6 where you are and where you're allowed to go. In
7 this case, we have an allowed CUFen of 1.0.
8 There are two different margins. And one we can
9 play with, and one we can't.

10 In the first case, the code itself
11 applies to the design factors to come in and the
12 methodology and the limit of 1.0 for CUF values.
13 And we're not allowed to play with the margins
14 that go into that value.

15 So these design factors we're talking
16 about that go into the design curve, they
17 contribute to that margin. And that's something
18 that we must meet. We can't change that.

19 And there's not even an argument to be
20 made where we can change those values and justify
21 them. It's a requirement of the code to maintain
22 those. That's one margin.

23 Another margin is if I calculate a
24 CUF, say of 0.5, I have margin between that and
25 the allowed value of 1. And that's something

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1 that I can deal with and address.

2 That allows me to, for example, apply
3 more loading to the component and still maintain
4 its original design because I'm allowed, the
5 criteria that I'm allowed to go to is a CUF
6 allowed of 1.0.

7 So I look at margin as those two
8 parts. One is I can't touch, and the other I
9 can. And these design factors that we showed
10 here that went into the building of the design
11 curve that's in the ASME code, we're not allowed
12 to touch those.

13 Then we can talk about conservatisms
14 because as an analyst, if I'm doing a
15 calculation, the objective I have is to show
16 acceptability, not margin.

17 So once I achieve a CUF of less than
18 or equal to 1, my job is complete. I can stop
19 work. Any additional margins to drive that
20 calculated value lower, I'm not required to do.

21 JUDGE KENNEDY: But in the analysis to
22 try to get to that acceptable value, did I
23 understand you to say that there's a piece of
24 margin there that you can't touch, and that's the
25 stuff that's embedded in the code?

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1 MR. STEVENS: The stuff that's
2 embedded into the code with respect to the limit
3 on the usage factor of 1.0 and the design fatigue
4 curves and the margins they contain and the
5 stress allowables and the design factors that
6 might be applied to those, I'm not allowed to
7 touch those.

8 Now another we can talk about is
9 conservatism, and what I kind of view
10 conservatism as are simplifications I might do as
11 an analyst to get the job done quicker.

12 For example, if I have to evaluate 100
13 different loads, I may choose to pick the worst
14 one and just assume all the other 99 are of that
15 severity to make my job to complete it quicker.

16 And that's a conservatism that I as an
17 analyst choose to put into the analysis, and I'm
18 allowed to do so much as, so long as I continue
19 to meet those required margins.

20 In this case, my CUF I calculate must
21 be equal to or less than 1.0. If I don't achieve
22 that, then obviously that simplification was a
23 little too gross, and I might have to refine that
24 simplification to still meet those margins that
25 I cannot change.

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1 So I look at, we have margins. Again,
2 I'll repeat. We have a margin that I'm not
3 allowed to touch. And these design factors we're
4 talking about that are built into fatigue curves
5 fall into that category.

6 Stress limits in the code and other
7 design factors fall into that category. There's
8 a margin I might obtain in my analysis with
9 respect to what I calculate versus what I'm
10 allowed.

11 And there's conservatisms that I might
12 apply, which I look at as simplifications that I
13 might use in my calculation process to get me to
14 the end. And those are what I would call
15 conservatisms.

16 Another form of conservatism, if there
17 is some embedded in the methodology, specified by
18 ASME code and by how they calculate, how they
19 combine stresses and what limits they use.

20 And again, those are, I put that into
21 the margin category as opposed to a conservatism.
22 It is a conservative thing to do, but it's a
23 margin that I'm not allowed to touch. I hope
24 that clarifies.

25 JUDGE KENNEDY: Thank you, Mr.

1 Stevens.

2 CHAIRMAN MCDADE: If you could,
3 regrettably, I need to ask you to clarify it a
4 little bit more. We're talking about certain
5 things that you can play with.

6 And to me, that's sort of engineering
7 speak for what you can legitimately adjust. Can
8 you give me a sort of summary of those kinds of
9 factors that you can legitimately adjust and
10 those that you can't, just sort of a quick
11 summary of that? Give some examples.

12 MR. STEVENS: Some examples, I gave
13 one, which would be in the number of different
14 loads I might evaluate. I can adjust. I still
15 must look at all the different loads, but how
16 exactly I consider those loads is within the
17 purview of what I can alter.

18 Things I can't change, I can't change
19 the stress limit I'm designing to. I cannot
20 change the usage factor limit that I have to
21 design to. I cannot change the fatigue curve I
22 use to calculate that usage factor in any way.

23 Other things I might change, heat
24 transfer coefficient, things of that nature that
25 go into the analysis. I can use different

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1 assumptions, apply different conservatisms in
2 that.

3 So there's many aspects of the code
4 methodology that are not explicitly defined that
5 are left up to analyst judgment. And those
6 things that are explicitly defined in words in
7 the code are the things that I can't change.

8 CHAIRMAN MCDADE: Okay. Thank you,
9 Mr. Stevens.

10 JUDGE KENNEDY: Not to keep this
11 whole, Mr. Gray, earlier in the opening remarks
12 you talked about different types of conservatisms
13 and what was allowed to be changed by the analyst
14 and where there was flexibility.

15 Could you maybe put the Entergy
16 approach in the same context that Mr. Stevens
17 just did, if it's possible?

18 MR. GRAY: Yes. This is Mark Gray for
19 Entergy. I think what Mr. Stevens just said is
20 just a different semantical way of saying what I
21 said earlier.

22 The margins that are in the code
23 methodology and design curve, we did not touch.
24 We used the code design curve. We also used the
25 Fen expressions that were defined by the NUREGs.

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1 The conservatisms that were, for
2 example, in that original, the original Section
3 3 design analyses were conservatism that we did
4 touch. And so we performed a more detailed
5 analysis of a component.

6 Find an element analysis versus an
7 interaction analysis, for example, and used more
8 specific loadings, using less enveloping or
9 grouping, as Mr. Stevens referred to, to remove
10 any gross conservatisms in the methodology,
11 particularly with the loadings.

12 JUDGE KENNEDY: So later on when we,
13 and I think we're going to get to a discussion
14 with Dr. Lahey and Dr. Hopenfeld about margins
15 and margin reductions.

16 I'm going to use that framework
17 hopefully when we pose questions coming up. So
18 Dr. Lahey, you have your hand up. I'll --

19 DR. LAHEY: Thank you. Can you hear
20 me all right?

21 JUDGE KENNEDY: I can. Just recognize
22 we're going to give you an opportunity to get
23 into safety margins and conservatism.

24 DR. LAHEY: Yes. And I'm only going
25 to talk about Fen right now because that's what

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1 you've been talking about, how to handle any
2 uncertainty by that factor.

3 JUDGE KENNEDY: To be honest, this
4 started as a discussion on synergism, and Figure
5 15 was used as an example of a synergistic issue
6 that needed to be dealt with in the CUF
7 calculation.

8 That's what I thought I had asked, and
9 maybe I've taken us down a long road. But that's
10 what I, my intent was to deal with synergism and
11 to offer up an opportunity to put anything in the
12 current testimony in front of us on Contention 26
13 that we didn't address yesterday.

14 And I know Dr. Hopenfeld didn't
15 participate yesterday even though he was here.
16 He wasn't a witness on 25. So I wanted to give
17 him that opportunity to bring that up. And
18 that's what he offered.

19 DR. LAHEY: So you don't want to talk
20 about any other uncertainty in Fen that's not
21 reflected here?

22 JUDGE KENNEDY: I believe we're going
23 to get to that.

24 DR. LAHEY: Okay.

25 JUDGE KENNEDY: Okay. And I'm going

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1 to give you an opportunity. We'll have an
2 opportunity to go through that. I guess what I
3 was trying to do is close out some issues on
4 synergism.

5 And I've got a couple more questions
6 here and then possibly we can take a break.

7 CHAIRMAN MCDADE: Before you do, Judge
8 Kennedy, just to Dr. Hopenfeld, you had referred
9 not only to page 37 but also to page 47. And on
10 page 47, there's a Figure 36.

11 And that figure is basically the same
12 sort of data that was on page 37, except here is
13 relates to austenitic stainless steel and air as
14 opposed to carbon steels and low alloy steels in
15 the LWR environment. Is that correct?

16 DR. HOPENFELD: Probably, yes.

17 CHAIRMAN MCDADE: Okay.

18 JUDGE KENNEDY: Thinking back again to
19 the synergistic effects, and again here we're
20 dealing with the effect of potential irradiation
21 on metal fatigue.

22 Dr. Lahey, you provided a number of
23 references to support your synergism argument in
24 your pre-file testimony.

25 If I put aside for the time being, the

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1 expanded materials degradation assessment report
2 or reference, what, I had a difficult time going
3 through.

4 I went through all your references.
5 I had a difficult time finding any examples that
6 would support your synergistic argument.

7 So I'm going to give you the
8 opportunity to point me to something in your
9 references, your exhibits and pre-file testimony
10 that would support your synergistic argument on
11 the potential that I missed them when I reviewed
12 your documents.

13 DR. LAHEY: All right, and thank you,
14 Your Honor. There was a report, the technical
15 paper by Korth, et. al. And I can get you a copy
16 of that if you don't have it.

17 JUDGE KENNEDY: If you could just give
18 me the exhibit number, that would be, and in a
19 perfect world if you could point me, unless it's
20 a short document. I'm pretty sure I've looked
21 through these, but --

22 DR. LAHEY: Well, we talked about it.
23 I would think you have. But anyway, in there is
24 a discussion of experiments. Now this was done
25 for fast breeder reactor conditions --

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1 JUDGE KENNEDY: Right.

2 DR. LAHEY: -- higher temperature.

3 But in there they stated that when they ran low
4 cycle, I mean low amplitude, high frequency
5 fatigue experiments, because of the hardening due
6 to radiation-induced embrittlement, things were
7 better in terms of the fatigue.

8 The failure cycles were increased.
9 When they ran large amplitude, low frequency
10 fatigue experiments, it was the opposite. In
11 fact, in decreased by a factor of 2.

12 So there was a significant decrease.
13 When we talked about the experiments that Mr.
14 Lott was a coauthor of, that particular paper,
15 they also made similar statement.

16 Although they, their particular
17 experiments for light water reactor conditions,
18 which are our concern, were only done for low
19 amplitude, higher frequency fatigue.

20 But nevertheless, they cited the same
21 issue. So there's no perfect data set that I
22 know of exactly for our conditions, which would
23 allow us to quantify the degradation due to
24 embrittlement for fatigue for light water reactor
25 conditions.

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1 But there's indication that there is
2 an effect, and this is being worked on for sure
3 by the light water reactor sustainability folks
4 in Chicago. So this is the basis of that
5 assertion that I made.

6 MR. SIPOS: And Judge Kennedy, just
7 for record identification, you were asking for
8 exhibit numbers.

9 JUDGE KENNEDY: Please.

10 MR. SIPOS: Korth, K-O-R-T-H,
11 Riverkeeper Exhibit 152, Arai, New York Exhibit
12 564 and Kanasaki, NRC Exhibit 177.

13 JUDGE KENNEDY: All right. Thank you,
14 Mr. Sipos. This question, I don't remember if it
15 came up yesterday, but this discussion about --

16 CHAIRMAN MCDADE: Excuse me. Just one
17 second if I could, and the Kanasaki exhibit,
18 that's the one that you were a coauthor on.
19 Correct, Dr. Lott?

20 DR. LOTT: That's correct.

21 CHAIRMAN MCDADE: And that's the one
22 you were referring to?

23 DR. LAHEY: Yes, Your Honor.

24 DR. LOTT: It's actually Kanasaki,
25 Hiroshi Kanasaki.

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1 CHAIRMAN MCDADE: Okay. Thank you.

2 JUDGE WARDWELL: And what's the
3 exhibit number again?

4 MR. SIPOS: NRC 177.

5 JUDGE WARDWELL: Thank you.

6 JUDGE KENNEDY: I direct this question
7 to Entergy. This fast breeder reactor data with
8 the large amplitude, low frequency, is that data
9 at all relevant for metal fatigue in light water
10 reactors?

11 Is the type of fatigue that's being
12 dealt with in Indian Point 2 or 3 subject to
13 large, I guess, large amplitude, low frequency
14 fatigue.

15 DR. LOTT: No, I do not believe that
16 data is directly related to any PWR reactor
17 internals application. And we actually have done
18 some looking at the strain ranges that are in the
19 irradiated internals.

20 It's a small, very small number of
21 irradiated internals in the cumulative usage
22 factor calculations. And those tend to be on the
23 low side of the strain range within the limits
24 that were in the Kanasaki paper.

25 JUDGE KENNEDY: Dr. Lahey, any

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1 rebuttal to the assertion that large amplitude,
2 low frequency isn't a concern for metal fatigue
3 in Indian Point 2 or 3?

4 DR. LAHEY: No, I disagree with his
5 conclusion. I think that remains to be seen. We
6 do need a database sufficient to quantify, but
7 there's no doubt in my mind there will be an
8 effect, a detrimental effect.

9 JUDGE KENNEDY: All right. Make sure
10 I understood what you just said. Are you
11 disagreeing that large amplitude, low frequency
12 cycles are not, now we've got too many notes here.

13 Dr. Lott seemed to testify that,
14 appeared to testify that large amplitude, low
15 frequency cycling is not of a concern at Indian
16 Point 2 or 3. Is that what you're disagreeing
17 with, or are you disagreeing with something else?

18 DR. LAHEY: Yes, Your Honor. I would
19 disagree with that. The high frequency fatigue
20 is associated with things like flow induced
21 vibration, which have small amplitude but a lot
22 of cycles.

23 And I can clearly understand how the
24 hardening associated with irradiation can improve
25 the fatigue life. But when you go to the type of

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1 cycles that we look at here, which are associated
2 with thermal transients, with operation of the
3 pressurizer, scram, so in many different cycles
4 that they go through in a plant.

5 I think it's clearly a lower
6 frequency, larger amplitude type of application.

7 JUDGE KENNEDY: Are you saying that
8 you would characterize those types of transients
9 to be large amplitude, low frequency?

10 DR. LAHEY: Some of them definitely
11 will be.

12 JUDGE KENNEDY: Entergy?

13 MR. GRIESBACH: Your Honor, this is
14 Tim Griesbach from Entergy. I've looked at that
15 Korth and Harper paper also. That was done under
16 the liquid metal fast breeder reactor program at
17 very high temperatures, between 900 and 1100
18 degrees Fahrenheit and at very high strain
19 levels.

20 That would be considered more of a
21 creep fatigue rupture. And that describes
22 mechanisms that clearly we don't see in the PWR
23 operating environment under the stress levels and
24 strain levels that we would expect.

25 JUDGE KENNEDY: Thank you. Maybe does

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1 the staff have any view towards this large
2 amplitude, low frequency? Should we be concerned
3 about it for light water reactors?

4 MR. STEVENS: This is Gary Stevens of
5 the staff. Those types of cycles are, which I
6 think we're really going to, the discussion in
7 the last few days has centered on accident loads,
8 are not something that would be considered in a
9 CUF calculation.

10 ASME code, it's not important to the
11 evaluation of those events, and ASME code doesn't
12 include the evaluation of those types of cycles
13 in the calculation of CUF.

14 JUDGE KENNEDY: Would those types of
15 events be more applicable to the shock loading
16 type discussion that Dr. Lahey has brought up?

17 MR. STEVENS: That's correct. This is
18 Gary Stevens of the staff. They're low
19 frequency, low probably events. And crack
20 initiation, fatigue crack initiation is not the
21 important thing that you evaluate for for those
22 events.

23 And that's not to say they're not
24 evaluated by ASME code. In fact, they are. It's
25 just that they're not included in a fatigue

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1 calculation.

2 JUDGE KENNEDY: All right. Thank you
3 very much. Unless one of my board mates has a
4 follow up question, I would like to offer this up
5 as a time for a break --

6 CHAIRMAN MCDADE: Okay, it's just a --

7 JUDGE KENNEDY: -- if I may be so
8 bold.

9 CHAIRMAN MCDADE: -- few minutes
10 between 11:00 and 11:05. Should we come back at
11 11:15? Does anybody need any additional time?

12 MS. SUTTON: That works, Your Honor.

13 CHAIRMAN MCDADE: And we are in
14 recess.

15 (Whereupon, the above-entitled matter
16 went off the record at 11:01 a.m. and resumed at
17 11:15 a.m.)

18 CHAIRMAN MCDADE: Please be seated.
19 The hearing will come to order.

20 JUDGE KENNEDY: I have a few
21 additional questions on the general topic of
22 synergism and its relationship to metal fatigue.
23 Dr. Lahey, in my previous question I excluded the
24 expanded materials degradation assessment.

25 And I guess I'd like to open that, let

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1 that come back in. It seemed to me that that was
2 a series of studies that focused on extension of
3 operating licenses beyond the 60 years.

4 And I think you used the term
5 sustainability a couple of times in the hearing.
6 I guess what I'm really wanting to discuss, and
7 conceding that there's work to be done to extend
8 the licenses from 60 to 80 years, how should the
9 Board view those particular references in this
10 particular licensing proceeding here today?

11 What's the relevance of that material?
12 Is there something in there that you can point to
13 that we need to pay attention to even though it's
14 for a 60 to 80 year license extension, if you
15 could address that?

16 DR. LAHEY: Thank you, Your Honor. As
17 I had indicated yesterday, this study is, in
18 fact, funded to go out to as far as 80 years.
19 However, no one believes, including those
20 researchers, that there's a sharp demarcation in
21 time.

22 So a lot of the issues that they're
23 concerned with extend down to 50 years, 60 years,
24 70 years, whatever. All right.

25 So they're working on what happens in

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1 terms of degradation, what we can count on as
2 going longer, what we have to fix or replace in
3 some way or what we can't do period.

4 And so that was the source of that.
5 Some of the things we're talking about here are
6 underway. The particular one we just got through
7 talking about, irradiation and the synergism or
8 possible synergism of embrittled material due to
9 radiation with fatigue is an experiment that
10 really there's only one place in the country it
11 can be done.

12 And that's in Idaho in their hot cells
13 and using their facility. And that's not an
14 experiment that's underway to my knowledge right
15 now because it's a big ticket, long duration item
16 if you think about how you have to do their
17 parametric experiments.

18 But it's definitely one that they have
19 in mind doing. It's just a question when it'll
20 be done. So my concern is not that we have data
21 that we can use right now to quantify the effect.

22 I know we do not. However, there's
23 indication that there is an effect. People say
24 there's uncertainty. We ought to take data.
25 Even the NRC said it's inclusive.

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1 My concern is what do you do in the
2 meantime. Do you just say okay, we'll press on
3 and use our inspection program and that's good
4 enough? Or do you say there's a possibility and
5 try to put a factor in there so it's F
6 embrittlement.

7 So it's not only CUF times Fen. It's
8 times F embrittlement. And that's a number
9 greater than 1. How big it is depends on what
10 kind of margin you allow.

11 So that's really the crux of where we
12 stand. I would never say that we have the data
13 from the fast breeder program was sufficient to
14 work up the effect. I know it's not.

15 JUDGE KENNEDY: Okay.

16 DR. LAHEY: But it's not irrelevant
17 either. I do not believe it's irrelevant.

18 JUDGE KENNEDY: Let me turn it around
19 just slightly since you seem to indicate that
20 there's relevance in those documents.

21 Is there something that you could
22 point to in those references that would call into
23 question any particular decisions we would be
24 inclined to make here in this proceeding relative
25 to metal fatigue?

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1 And maybe you've already done it, but
2 I'm not sure. I've got it fixed in my mind.

3 DR. LAHEY: Well, I think we've talked
4 about that issue. Yesterday, we talked about the
5 fact that you have researchers, like Dr. Chopra,
6 saying that we need, we don't have sufficient
7 data to understand any synergism that may occur.

8 We need to take data. All right. And
9 you have all these things that we've been talking
10 about today and yesterday were reviewed by the
11 NRC when they made a decision as to what to do.

12 And you had people make input as to
13 what they should consider, what they should do.
14 So it's not new. I'm not bringing up anything
15 that hasn't been discussed before.

16 What I'm suggesting is it just seems
17 to me to be questionable engineering to not take
18 into account some uncertainty when there is
19 uncertainty as to what's going to happen.

20 And it's going to happen. If it
21 happens, it's going to happen in a bad direction,
22 not a good direction.

23 JUDGE KENNEDY: Let me be more
24 specific, be even more specific. Is there
25 something in those reports that draws into

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1 question what has been going on over the last 20
2 years, which is extending licenses from 40 to 60
3 years?

4 Is there something specific that you
5 would point to in there that would lead us to
6 take note of what we're trying to do in this
7 proceeding, which is grant a license for another
8 20 years of operation for Indian Point?

9 I think we all recognize on the Board
10 that's there's a need to continue to grow the
11 data set and to look at issues that have, that
12 would resurrect themselves in the 60 to 80 time
13 frame.

14 But I think what we're trying to point
15 to is could we find something in those documents
16 that would draw into question what we're trying
17 to do here, which is extend a license from 20 to
18 60 years.

19 DR. LAHEY: In my view, not anything
20 different than the opinions, the suggestions and
21 the conclusions that we've already talked about
22 in the various documents, both Argonne Lab
23 documents, both informal discussions by people,
24 researchers and the technical papers, which you
25 had asked about earlier.

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1 JUDGE KENNEDY: And in a nutshell,
2 what are those conclusions that those researchers
3 would offer to us?

4 DR. LAHEY: That there's the potential
5 for degradation in the fatigue life due to
6 embrittlement, and more work is needed to work up
7 a database so that we can find what that
8 degradation is, level of degradation.

9 JUDGE KENNEDY: And you view those
10 researchers as being concerned in extending the
11 life of a, extending a license from 40 to 60
12 years as well as looking forward beyond that?

13 DR. LAHEY: Absolutely, and you may
14 recall, my overarching concern is not only the
15 degradation of the fatigue life but at any time
16 during the extended operation, if you have an
17 impulsive load withstanding that in terms of core
18 coolability and damage to those components.

19 JUDGE KENNEDY: All right. Thank you.
20 Maybe I could turn to the NRC staff. Do you
21 share Dr. Lahey's concern that there may be some
22 issues that need to be addressed in this 40 to 60
23 year time period?

24 MR. STEVENS: This is Gary Stevens of
25 the NRC staff. No, we don't. Specifically, I

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1 guess I'll point to a few things. We earlier
2 were discussing NUREG 6909, which was New York
3 State Exhibit 357.

4 And that document itself really
5 doesn't have much in the way of discussion of
6 radiation effects. However, New York State
7 Exhibit 490A, which is the draft revision 1 of
8 that document, we have a section, 1.3.2, that
9 discusses this.

10 So staff is cognizant of the issue,
11 and we're not ignoring it. And, in fact, the
12 three citations that Dr. Lahey has offered in his
13 testimony are discussed in that section of
14 NUREG/CR-6909, one of the implicitly.

15 The Arai paper, which is New York
16 State 564 is actually referenced in the Kanasaki
17 paper, which is NRC 177.

18 You've already heard testimony from a
19 lot of the experts regarding the impact of the
20 radiation on strengthened materials and what all
21 the experts say about the impact on fatigue crack
22 life initiation, fatigue initiation crack life,
23 sorry.

24 That tends to improve that. You've
25 also heard testimony regarding the Korth and

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1 Harper paper, which is Riverkeeper 152, that in
2 fact that testing was done at very high
3 temperatures, 900 to 1100 degrees Fahrenheit.

4 And the concerns we have with that is,
5 as was mentioned by Mr. Griesbach, fatigue creep
6 and other effects that aren't applicable to light
7 water reactors.

8 From our perspective, if I could point
9 you to one thing that probably does the best job
10 to summarize where we are with this, it would be
11 Figure 12 of the Kanasaki paper, which is NRC
12 177.

13 JUDGE KENNEDY: Should we call that
14 up?

15 MR. STEVENS: That would be helpful.
16 Yes, thanks.

17 JUDGE KENNEDY: Mr. Welkie?

18 MR. STEVENS: Okay. Figure 12 here is
19 a comparison of the test data that was irradiated
20 with respect to the ASME design fatigue curve,
21 which is what is used to calculate CUF factors.

22 And as you can see, even though
23 there's a lack of data, the data we see tells us
24 that the ASME design sufficiently covers
25 irradiation effects.

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1 We've had a lot of discussion on low
2 amplitude, high cycle, high amplitude, low cycle.
3 And generally speaking, the differentiation
4 between those two comes between 10 to the 4th, 10
5 to the 5th cycle.

6 So what you see here is the data
7 stands low and high cycle regimes. In fact, this
8 plot I would say covers the general level of
9 strain amplitudes that are seen in light water
10 reactor conditions under normal and upset
11 conditions.

12 And so we have no evidence, and we're
13 reasonably assured that radiation effects are
14 adequately covered by what we know right now.

15 We agree that more data would be
16 helpful and to quantify, but all the evidence we
17 have to date supports that what we're doing is
18 adequate.

19 JUDGE KENNEDY: All right. Thank you,
20 Mr. Stevens. Dr. Lahey, would you like to
21 respond to Figure 12?

22 DR. LAHEY: Yes. I'm certainly
23 familiar with that and this paper, and I have no
24 doubt that because of the hardening that occurs
25 with irradiation embrittlement that when you

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1 have smaller amplitudes, like was run here, that
2 things get better.

3 My concern is for larger amplitudes,
4 and I really want to get into that when we
5 discuss the WESTEMS code and what it calculates
6 right now and some problems with those
7 calculations. But I think it's not the right
8 time at this point.

9 JUDGE KENNEDY: When you say large
10 amplitude, small amplitude, how do I view that on
11 this Figure 12? What would constitute, I guess,
12 large amplitude? What would constitute low
13 amplitude?

14 DR. LAHEY: To understand that, you
15 really need to draw the stress-strain curve or a
16 hardened material. And it steepens, the stress
17 versus strain on the ordinate and abscissa.

18 And it steepens so you get a higher
19 yield strength, a higher ultimate strength, but
20 it drops off at a much lower strain. All right.
21 So to know exactly what the strain is, you'd have
22 to know exactly what the fluence is and the
23 damage is.

24 JUDGE KENNEDY: Maybe I could go back
25 to Mr. Stevens. This strain amplitude versus

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1 fatigue life, what's being represented on the Y-
2 axis? And does it bear any, provide any input or
3 insight to the large amplitude, low amplitude
4 discussion?

5 MR. STEVENS: You heard testimony,
6 this is Gary Stevens of the NRC staff. You heard
7 testimony earlier of an S-N curve, and this is an
8 example of one of those.

9 And what you see on the left, the
10 vertical axis, is a measure of the stress-strain
11 that would a complement where material would be
12 exposed to. What I would call high amplitude,
13 low cycle would be the left side of the figure.

14 JUDGE KENNEDY: Okay.

15 MR. STEVENS: Left, upper left.

16 JUDGE KENNEDY: Upper left. And Dr.
17 Lahey, that would not be your characterization of
18 large amplitude, low cycle?

19 DR. LAHEY: I mean you got to
20 understand the strain is elongation over the
21 initial length, right?

22 JUDGE KENNEDY: Yes, sir.

23 DR. LAHEY: I think it depends
24 entirely on the forcing function that you put on
25 a component, which strain it goes to. And I do

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1 not necessarily view this as large amplitude
2 strain.

3 CHAIRMAN MCDADE: Can you quantify for
4 me what you would consider high amplitude strain?

5 DR. LAHEY: Certainly strains that get
6 you up into the plastic region. What I mean,
7 beyond the yield strength, when you're up into
8 the plastic region and beyond. Those are high
9 strains.

10 So if you plot it, you have, you want
11 me to try to draw it?

12 CHAIRMAN MCDADE: Well, just describe
13 it for here.

14 DR. LAHEY: Okay. So it comes up.
15 Then you have yield and then ultimate, and then
16 you're gone. All right. And this is strain. So
17 when you're up into the plastic region, when
18 you're out of the elastic region, that's high
19 amplitude. And then beyond it's higher.

20 JUDGE KENNEDY: What sort of events
21 would we, would lead to those types of
22 conditions?

23 DR. LAHEY: Significant bloating of
24 structures, impulsive bloating of structures with
25 thermal events.

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1 JUDGE KENNEDY: Caused by?

2 DR. LAHEY: Caused by your normal
3 operational transients. We'll talk about that in
4 detail, how it's being done now and what I view
5 as the deficiencies in the code.

6 My guess is we'll need to clear the
7 courtroom when we do that.

8 JUDGE KENNEDY: I guess. I mean
9 Entergy testified earlier that in terms of metal
10 fatigue, they don't view these large amplitude,
11 low cycle events to be of concern for metal
12 fatigue.

13 Are you, again, suggesting otherwise?
14 Are we back to that disagreement?

15 DR. LAHEY: Yes, sir. I think they
16 get results, which depend entirely on the models
17 they use and the transients that are assumed.
18 And if you did things in a different way, you get
19 a significantly higher amplitude.

20 JUDGE KENNEDY: So you're suggesting
21 for the same forcing function or same event, you
22 could get different results, depending on the
23 methodology?

24 DR. LAHEY: Yes. And I'll show you
25 some reasons why they get the results they get.

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1 JUDGE KENNEDY: All right.

2 CHAIRMAN MCDADE: And the clarify in
3 my own mind that it's the position of Entergy
4 that these high amplitude events are not of
5 concern is because they're not going to happen in
6 the Indian Point environment. Is that correct?

7 DR. LOTT: This is Randy Lott for
8 Entergy. That is essentially correct. Yes.
9 We're not, we believe that the particular cases
10 we have with irradiated internals will fit into
11 the scheme that's described by this Figure 12.

12 CHAIRMAN MCDADE: Okay. And your
13 disagreement is that you believe in the
14 environment present at Indian Point, these will
15 occur or may occur.

16 DR. LAHEY: Your Honor, I believe
17 they're under-predicting it right now, and I'll
18 show you why when we get into that.

19 CHAIRMAN MCDADE: Okay. And are you,
20 to differentiate, are you saying they will occur,
21 or are you saying they may occur?

22 DR. LAHEY: They may occur.

23 CHAIRMAN MCDADE: Okay.

24 JUDGE KENNEDY: All right. Thank you.

25 MR. STEVENS: Your Honor, if I could

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1 make a clarification. This is Gary Stevens, NRC
2 staff.

3 JUDGE KENNEDY: Okay.

4 MR. STEVENS: You have to recognize
5 that if there's a load in the design basis, even
6 one cycle of a load, it could not fall above the
7 dotted line with respect to strain amplitude, or
8 you would calculate a CUF greater than 1 and you
9 would not have an acceptable design.

10 So I just wanted to make sure that
11 we're not discussing strain amplitude loads that
12 are off the chart here because you would not be
13 able to qualify such a load for an adequate
14 design.

15 JUDGE KENNEDY: Maybe I'm mishearing
16 Dr. Lahey, but I believe he's suggesting for the
17 same events that Entergy's analyzing, he's
18 contending that he would get a different result
19 or someone else would get a different result for
20 the same event.

21 I don't know if that, where that falls
22 in this fatigue curve discussion. But I think
23 it, seems to have a general disagreement of what
24 the amplitude would be for the same event.

25 CHAIRMAN MCDADE: Is that correct, Dr.

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1 Lahey?

2 DR. LAHEY: Yes, sir.

3 JUDGE KENNEDY: I needed a couple
4 minutes. There's a whole bunch of questions here
5 that were already asked yesterday on 26, so I
6 need to make sure I don't miss one nor ask you
7 that you guys have already answered.

8 At this point, I'd like to start some
9 discussion related to Dr. Lahey's supplemental
10 reply testimony. In particular, so this is New
11 York State 567.

12 And in there, there's a Figure 1,
13 which I believe Dr. Lahey has offered to try to
14 explain his position. And I think the Board has,
15 at least a number of questions to try to
16 understand what's being presented in Figure 1.

17 So Mr. Welkie, could you, if I've got
18 the right citation, it's New York State 567. And
19 there's a Figure 1 back about five or six pages.

20 DR. LAHEY: All right, Your Honor. As
21 I discuss this, you'll need to tell me what is
22 proprietary and what is not.

23 JUDGE KENNEDY: Are you suggesting
24 there's real data in there?

25 DR. LAHEY: No, but I'm going to

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1 discuss the way WESTEMS works and the way, what's
2 missing and things like that. So I don't know
3 how nervous that makes Westinghouse.

4 JUDGE KENNEDY: This is a great
5 example where I thought I had a bunch of
6 conceptual questions on a depiction that had no,
7 I mean it has the concepts displayed but no basis
8 in Indian Point data or WESTEMS methodology.

9 But is it, can we start first with
10 just the figure itself? I know you don't know
11 what questions we're going to ask. But is there
12 any problem with that figure? I'm sorry?

13 MR. KUYLER: Yes, Your Honor. There's
14 no problem discussing this figure.

15 JUDGE KENNEDY: So we'll ask our
16 questions slowly, give you a chance to react.

17 MS. SUTTON: Yes, Your Honor. If we
18 start getting into the WESTEMS methodology, in
19 particular, we'll slow you down.

20 JUDGE KENNEDY: And I guess from my
21 perspective, I would, I'm a little shocked to
22 find out we're going to get into WESTEMS
23 methodology.

24 But maybe I, maybe it's a good
25 indication I don't understand this figure. So

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1 start to walk us through it, at least with an
2 overview of what is being displayed here.

3 And we'll stop before you go into
4 WESTEMS methodology unless you can't describe
5 this figure without going into the WESTEMS
6 methodology, and we'll go a different way.

7 Could you at least, from an overview
8 perspective, describe what's being displayed
9 here?

10 DR. LAHEY: Certainly. I will do my
11 best to keep away from any sensitive information.
12 On the vertical axis, the ordinate, is CUFen.
13 And you've now defined that carefully.

14 And on the abscissa, the horizontal
15 axis, is a time scale. So there's actually two
16 scales there. One is fluence, which is the
17 integrated, high energy neutron flux times time,
18 the time you're at that level and the other
19 scale, which is time itself.

20 So both of them are proportional to
21 time. So you can think about it, the horizontal
22 axis is a time axis. The only reason it's not
23 perfect is because you don't operate all the
24 time.

25 There would be periods in which you

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1 wouldn't be operating. But it's convenient to
2 just think about it as a time axis.

3 JUDGE WARDWELL: I've got to ask this
4 question right off the bat, I guess, Dr. Lahey.
5 This is Judge Wardwell. There's only one value
6 shown on each of the two axes.

7 That gives us no relation, no idea of
8 how long any of the axes are. There's no way to,
9 there's no scale, if you will, in regards to the
10 two axes such that this is only a schematic. Is
11 that a fair assessment? There's no --

12 DR. LAHEY: You should think about it
13 as a cartoon, a schematic, yes.

14 JUDGE WARDWELL: Thank you.

15 DR. LAHEY: The 10 to the 17th there,
16 when you think about fluence because it's
17 normally quoted in decades, 10 to the 21, 10 to
18 the 22, that sort of thing, you should think
19 about it as a log scale.

20 And so, 10 to the 17th was put there
21 just as a benchmark for the onset of irradiation
22 damage to carbon steel.

23 JUDGE WARDWELL: Right, but it doesn't
24 get us into any indication of where is 10 to the
25 22nd.

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1 DR. LAHEY: No, but --

2 JUDGE WARDWELL: And same with the
3 CUFen on the vertical axis, we've got one.
4 That's fine, but I have no idea where 0.5 is.

5 DR. LAHEY: Well zero is on the
6 bottom.

7 JUDGE WARDWELL: Well, there's not a
8 zero there.

9 DR. LAHEY: No, but I'm telling you.

10 JUDGE WARDWELL: So that is a zero.

11 DR. LAHEY: It should be there, and so
12 halfway in between would be the 0.5.

13 JUDGE WARDWELL: Is zero on the
14 horizontal axis, or is that horizontal axis log
15 rhythmic for both values?

16 DR. LAHEY: it's a log scale.

17 JUDGE WARDWELL: Thank you.

18 DR. LAHEY: But down to the left on
19 that axis is a low fluence. So it's not of any
20 concern in terms of radiation damage. So what
21 I'm trying to show on this figure is at least
22 three things.

23 I'm sorry if I put so much data on one
24 figure, but hopefully I can talk you through it.
25 So the first thing is just let's look at what I

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1 call the limit line, the LL.

2 The limit line is the predictions that
3 are being done by WESTEMS now. And why do I call
4 it a limit line? Because that's what you
5 normally call a prediction or a correlation that
6 is conservative.

7 And the way WESTEMS is used and the
8 way it's been formulated is you try to make
9 assumptions such that the results have
10 conservatism in that.

11 And so it's always below. It's always
12 better, or excuse me, not below. It's always
13 closer to CUFen of 1 than what you really think
14 it should be. Is that clear to everybody?

15 All right. So as time goes on, this
16 dotted line goes up until you get to the end of
17 light for the period of extended operations. And
18 in this case, at that point, there's a margin, a
19 small margin.

20 So it would be some number slightly
21 less than 1. I don't want to quote a number, but
22 less than 1. All right.

23 Now the question is, the fundamental
24 question is because the way WESTEMS is used,
25 you're allowed to systematically, if you're above

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1 1, if you make assumptions which are too
2 conservative and it gives you a result that's
3 above 1, you're allowed to go back and
4 recalculate, make different assumptions as long
5 as you can justify them, until you get below 1.

6 So in the end, as that goes on and on
7 and you get closer and closer to unity, which is
8 your failure criteria, and you start really
9 pushing it, then the question of how conservative
10 is WESTEMS? What's the margin? What really is
11 the margin that's there?

12 And everyone says it's conservative.
13 Don't worry about it because we got a lot of
14 conservatism in there. But then the question is
15 we're willing to trust, but you need to verify.

16 So how do you verify the margin? So
17 a good way to do that, the normal way to do that,
18 is you make the run. It doesn't have to be for
19 every component. You just pick one that's
20 sensitive, and you make a best estimate
21 prediction.

22 So instead of saying I'm using what I
23 think is a large heat transfer coefficient, you
24 use your best estimate for the heat transfer
25 coefficient.

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1 Instead of doing all kinds of
2 assumptions that are built into the model, with
3 some conservatism, use your best estimate. And
4 then do what's known is a propagation of error
5 analysis.

6 I know the NRC likes to think about it
7 as a propagation of uncertainty. But I didn't
8 make up the words. That's what people call it.
9 And work out the intervals in plus or minus
10 uncertainty.

11 And these are, if you read any
12 technical paper, a journal paper and you see
13 experimental data with an error band on it, plus
14 or minus, that's what we're talking about.

15 It's the best fit to the data plus or
16 minus the uncertainty due to measurement errors
17 and whatever. Okay. So this is the uncertainty
18 due to prediction errors, modeling errors, et
19 cetera.

20 And that's what I've called delta. So
21 I drew three cases here. Case 1, which is all
22 the way to the right, is my best estimate line
23 assuming no degradation in the prediction due to
24 irradiation.

25 So this is no embrittlement. So BE

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1 means best estimate. Sub NE means no
2 embrittlement. All right. So that's what right
3 now the licensing process would propose.

4 And so if we go out here at this
5 point, then you look at plus or minus
6 uncertainty. And how do I do that? I'm
7 suggesting, and I've put in my testimony, you can
8 use a number of ways to do it.

9 One way is the Kline & McClintock
10 propagation of error analysis. And so I won't
11 write it down, but I'll tell you how it goes.
12 You just take the partial, so if you, partial
13 derivative.

14 So if you're an engineer, you just
15 love this method because you say the uncertainty
16 squared is equal to partial of a function of
17 different variables that contribute to error.

18 Partial of F, respect to X1 squared
19 and then the error in X1 squared plus the partial
20 of F at function, respect to X2 squared times the
21 error of that variable squared. So --

22 JUDGE KENNEDY: So --

23 DR. LAHEY: -- let me just give you a
24 specific example --

25 JUDGE KENNEDY: Okay.

1 DR. LAHEY: -- so it'll make it
2 concrete.

3 JUDGE KENNEDY: That's what I was
4 going to ask you for.

5 DR. LAHEY: Okay. So power is equal
6 to I square R. Right? Everybody okay with that?
7 Power is equal to I square R, electric power. R
8 is --

9 JUDGE KENNEDY: I don't know what it
10 does to fatigue, but I'll let you keep going.

11 JUDGE WARDWELL: You're just
12 illustrating the propagation of error.

13 DR. LAHEY: I'm illustrating the
14 method with something that's easy to do. So now
15 the error in power is the partial of I square R
16 with respect to I. So it'd be 2I times R times
17 the error in our current measurement.

18 So if you run an experiment, you have
19 plus or minus 2 percent error in reading the
20 amps. Okay. Plus, and so you square that. Plus
21 the partial of power respect to R.

22 So that's just I square times the
23 error in R. So you go to the manufacturer of
24 your resistor, and it says this has so many ohms
25 plus or minus 2 percent. Put that in.

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1 You then take the square root of both
2 sides. You have the error in your power
3 measurement. So that's just a simple way. You
4 can do it with any function.

5 And so it's not, I had the question or
6 not the question, the criticism come back, you're
7 talking about random sort of stuff. And this is
8 deterministic. This is highly deterministic.

9 You're just talking about the
10 uncertainty in these particular models. All
11 right, or these particular evaluations. So
12 that's how you get plus or minus delta.

13 Is that clear because I mean it's
14 nothing magic? It's pretty straightforward.
15 Engineers love it because it's easy to do. It
16 gets them to use their calculus, and they crank
17 their way to victory.

18 Okay. So now I've assumed, just for
19 argument's sake, that my plus error band or my
20 error bar plus delta is as shown there so that
21 the upper part of it is above CUF of 1. Okay.

22 So what does that mean? That means
23 that even my best estimate prediction has some
24 chance of exceeding 1. The best estimate is
25 significantly below, but there is an error or an

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1 uncertainty, which allows it to be above 1.

2 So even though, when I, now I compared
3 the limit line with the best estimate, and I
4 would say in that case, the limit line is not
5 really conservative. It's not. They think it
6 is. It's not. On the other hand --

7 JUDGE WARDWELL: But as I look at
8 this, just to make sure I understand what you're
9 saying, the error you have in that, your
10 propagation of error results ended up to be about
11 0.25 worth of CUF.

12 DR. LAHEY: Yes. They're large.

13 JUDGE WARDWELL: Order of the CUF.

14 DR. LAHEY: It would be the error --

15 JUDGE WARDWELL: That's just your
16 schematic assumption. It has, that was no
17 calculation that you derived based on CUF
18 analyses, right? That's just schematically
19 showing if you did have --

20 DR. LAHEY: If I did have this 0.25
21 arranging CUF --

22 JUDGE WARDWELL: Right.

23 DR. LAHEY: -- that's what it would
24 be. And it could be the other way. It could be
25 the top of those error bars is below, in which

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1 case the conclusion is the limit line is
2 adequately conservative.

3 JUDGE WARDWELL: Or another way to say
4 it, if in fact the propagation of error was only
5 0.1 in the CUF, it would be well below it.

6 DR. LAHEY: Yes.

7 JUDGE WARDWELL: Okay.

8 DR. LAHEY: If, in fact, the best
9 estimate is that far below, as shown here,
10 exactly that.

11 JUDGE WARDWELL: Or on top of it. If
12 the propagation of error resulted in 0.01 instead
13 of 0.25 as you have schematically represented --

14 DR. LAHEY: Right.

15 JUDGE WARDWELL: -- then schematically
16 representing this, it would show a very tiny, a
17 bit above the best estimate line and be well
18 below the limit line. Correct?

19 DR. LAHEY: Exactly.

20 JUDGE WARDWELL: Okay.

21 DR. LAHEY: Then I would be very
22 happy. I'd say I'm happy.

23 JUDGE WARDWELL: And you don't have
24 any data to show what that bar should be.

25 DR. LAHEY: I don't have anything, and

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1 when they get really, really tight, and they
2 start working out in the plasticity region,
3 you're really pushing the envelope.

4 And I need to know what the margins,
5 I think it's very imprudent not to know what the
6 margin is. I mean if we're really working our
7 way out in the bathtub curve towards the upper
8 part.

9 JUDGE WARDWELL: This schematic,
10 again, is just illustrating what it might look
11 like, if in fact, you hit it up with --

12 DR. LAHEY: -- a large bar --

13 JUDGE WARDWELL: -- error bar like a
14 quarter of a total distance.

15 DR. LAHEY: Where would that bar come
16 from? For example, can I deviate, Your Honor,
17 from this plot for a little bit?

18 JUDGE KENNEDY: Let's stay right here
19 for a second.

20 DR. LAHEY: Because I can tell you why
21 that error bar may be large. And we'll come back
22 to it. All right. So the next part of this is,
23 now let's say that the concerns not only that I
24 have but others have about the possible
25 degradation of the fatigue life due to

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1 embrittlement, due to radiation-induced
2 embrittlement or thermally-induced embrittlement,
3 but here, radiation because of fluence.

4 So now I have a curve, which goes up.
5 And until it gets to about, I don't know, 10 to
6 the 21 or six point, they have a criterion, 6.7
7 times 10 to the something or other, it'll stay
8 essentially the same.

9 And then it starts getting worse
10 because the denominator gets worse. Remember,
11 it's the number of cycles over the number of
12 cycles to failure times F_{en} .

13 So the number of cycles to failure.
14 If embrittlement reduces that, the denominator
15 gets smaller. Therefore, the CUF_{en} prediction
16 gets bigger. So now --

17 JUDGE KENNEDY: Just for argument's
18 sake, we've been at this for a couple of days.
19 I'm still not sure we've seen the support for the
20 premise that that synergistic effect occurs.

21 I mean it's an interesting hypothesis,
22 and this certainly demonstrates the hypothesis
23 that's been in front of us through all this
24 testimony. But I'm still looking for that
25 citation that points us to where this hypothesis

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1 has been supported.

2 DR. LAHEY: I would love to bring you
3 the data, Your Honor, but it won't be here for a
4 few years. That's the problem.

5 JUDGE KENNEDY: So you're --

6 DR. LAHEY: But people aren't spending
7 millions and millions of dollars of taxpayer
8 money just for the fun of it. I mean they're
9 worried about it as well.

10 CHAIRMAN MCDADE: Excuse me. Dr.
11 Lahey, let me make sure I understand. What
12 you're saying is because of an absence of data,
13 that in your view, this error bar should be
14 large?

15 DR. LAHEY: No. And Your Honor, I'm
16 not trying to tie that to our uncertainty as to
17 whether this embrittlement impacts it or not.
18 I'm going to assume here it does for this
19 particular curve.

20 JUDGE WARDWELL: The comment I would
21 like to make would be to get this on even footing
22 would be that you've got the lines labeled wrong.
23 It's not BE with no embrittlement.

24 It's really BE assuming embrittlement
25 doesn't affect the strength, and then your BE

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1 with the E isn't BE with embrittlement.

2 DR. LAHEY: Exactly.

3 JUDGE WARDWELL: It's BE with the
4 assumption that embrittlement does affect fatigue
5 life.

6 DR. LAHEY: I agree. That's a very
7 good way to think about it. Or it could be
8 something without embrittlement. I mean just no
9 irradiation, but that's a very good way to think
10 about it.

11 JUDGE WARDWELL: Right.

12 DR. LAHEY: So anyway, if you'll buy
13 this just to see what happens, what happens as
14 time goes on, this fluence goes on. It's gets
15 worse and worse.

16 And at some point, it hits 1.0 well
17 before the end of a period of extended operation.
18 In fact, so that's 0.2. But in fact, at 0.3, if
19 you tie on the uncertainty --

20 JUDGE WARDWELL: There's no facts in
21 this figure. Is that correct?

22 DR. LAHEY: Well, in fact, that's the
23 only fact. Yes. I mean this is my cartoon, man.
24 I'm the cartoonist, so I can do as I wish. So
25 anyway, when you get to 0.3, you now have that

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1 uncertainty bar.

2 And you see that well before the end
3 of the period of extended operation, if it
4 happens that there is synergism with irradiation
5 and fatigue, you will have a good chance of
6 fatigue failure.

7 So that's how this all fits together.
8 Now, the reason I put this in my testimony was
9 because we kept saying for years you're giving us
10 this limit line prediction.

11 You're giving us these CUFen results,
12 and you keep cranking it up, cranking it up.
13 You're going to make sure what they call
14 conservatism, you keep eliminating them.

15 And I'm worried about at some point,
16 it's not longer conservatisms. It's necessary
17 margins that you're cutting into, design margins.
18 And so I need, to feel comfortable, I need to
19 know what's the margin.

20 Is it really that conservative, to
21 don't worry about anything? You can just keep
22 iterating. Or at some point, are you non-
23 conservative?

24 And the only way I know to get that,
25 and we've been suggesting it for years is do an

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1 error analysis. And this is how you do an error
2 analysis. I sent references to a textbook all
3 sophomores at RPI used to learn how to do this.
4 And it bounced.

5 It didn't work. They thought, it
6 doesn't matter what they thought. But anyway,
7 now I figure if I draw a cartoon and write down
8 the equation for a propagation of errors, you
9 can't miss it.

10 That's what I'm talking about. So
11 this is a plea to do this because I don't know
12 any other way to know what the margin is.

13 It's not good enough to say there's
14 conservatism, and I've done this and that because
15 later on I'm going to show you other pictures,
16 which show you things that they believe are
17 conservative assumptions, which are not.

18 They're doing them in the wrong way.
19 I mean they're not conservative. They're missing
20 the boat on some of these things.

21 JUDGE KENNEDY: I've got millions of
22 questions. One thought that comes to mind, we
23 had a lot of discussion earlier about margins,
24 the margins that are in the ASME code calculation
25 plus the margin to CUF of 1, and then on top of

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1 that, the concept of conservatisms.

2 I'm assuming you tracked that
3 conversation before.

4 DR. LAHEY: Yes.

5 JUDGE KENNEDY: How does that bear
6 into this cartoon here? Does the best estimate
7 have margins in it?

8 DR. LAHEY: I would suggest to compare
9 apples and apples, that all the ASME code
10 conservatism, which is similar to what we talked
11 about earlier, all right, should remain in the
12 best estimate. I have no trouble with that.

13 JUDGE KENNEDY: Right. And I believe
14 I heard Entergy testify that they don't and will
15 not reduce those margins, that those are off the
16 table.

17 DR. LAHEY: I think they're off the
18 table.

19 MR. GRAY: Yes, that's correct.

20 DR. LAHEY: They're off the table.

21 JUDGE KENNEDY: So we've got margins

22 --

23 DR. LAHEY: Yes.

24 JUDGE KENNEDY: -- that nobody's
25 disputing.

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1 DR. LAHEY: So you might quarrel with
2 it being called best estimate, but anyway, those
3 margins are in there because fatigue, the onset
4 of a crack is a random process.

5 I used to do this at GE, and you run
6 these samples. And they all look the same, but
7 they all don't have the same number of cycles to
8 failure. But if you then plot it up, they're
9 within a band.

10 And then the uncertainty that the ASME
11 puts on bounds that plus a little more surface
12 finish and et cetera, et cetera. So I think
13 that, you don't touch.

14 That's not part of the best estimate.
15 Otherwise, it's really not apples and apples
16 comparison with your limit line.

17 JUDGE KENNEDY: I mean I think the
18 other question you've already, you already
19 testified that the limit line, again, potential
20 WESTEMS calculation has conservatisms built in
21 it.

22 And it's difficult to me. I can sort
23 of, I sort of understand your best estimate and
24 then doing an error analysis and getting an
25 uncertainty and laying that on top of there.

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1 I don't know how to translate that to
2 the load limit line and put an uncertainty on
3 that in the same manner because it already has
4 conservatisms built into it.

5 DR. LAHEY: I'm sorry I'm mislead you.
6 I'm not recommending you put a plus or minus
7 uncertainty on the limit line.

8 JUDGE KENNEDY: Well, I --

9 DR. LAHEY: The limit line, by
10 definition, is supposed to be conservative.

11 JUDGE KENNEDY: But I thought I heard
12 you say that because of the uncertainty, even
13 though the limit line shows a CUF less than 1 at
14 end of life, it could actually be greater than 1
15 because of the uncertainty.

16 And I guess all I'm suggesting, do you
17 really intend to apply the same uncertainty to
18 the best estimate line and the limit line?

19 DR. LAHEY: So let's go back to Case
20 1 again. And so we can say here's the best
21 estimate, which I would agree with Judge
22 Wardwell, we could think about as a best estimate
23 calculation where no effective embrittlement is
24 taken into account.

25 And then you have an uncertainty bar,

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1 and we can talk about what goes into that, why I
2 think it might be large. It exceeds unity at the
3 top. The plus delta exceeds unity.

4 So that says if you really do the best
5 you can do and do the error analysis or the
6 uncertainty analysis, there's a pretty good
7 chance you're going to have a failure at that
8 point or actually a little before that point.

9 So your prediction in your limit line,
10 which says it's below 1 is wrong. It really --

11 JUDGE KENNEDY: I'm sorry.

12 DR. LAHEY: -- is not taking into
13 account what the true situation is. It can fail
14 earlier. It's not conservative.

15 JUDGE KENNEDY: I guess I don't know
16 how you, well, again, recognizing this is a
17 cartoon, but we're trying to bring it into the
18 real world here because it is demonstrative of
19 the issues we're trying to deal with.

20 DR. LAHEY: Exactly.

21 JUDGE KENNEDY: And we're going to get
22 to margins and conservatisms probably as we move
23 through the day.

24 I have a difficult time trying to
25 think in the same terms of a best estimate line

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1 with uncertainties and a limit line that has
2 uncertainties or conservatisms already embedded
3 in it with the same uncertainty band around it.

4 So, I mean I could argue on the other
5 side, and maybe Entergy would and maybe we should
6 give them a chance, that that limit line is so
7 conservative there's no uncertainties to be
8 placed on that limit line. And it's good to go.

9 DR. LAHEY: That's exactly what they
10 do, Your Honor. And now the question is, is it
11 that conservative? And here's how you determine.
12 Let me tell you where, I'll give you another
13 example.

14 I don't know exactly your background,
15 so I don't know if this is helpful. But in the
16 world that I have lived in, we worry about the
17 thermal limits on the fuel, so-called critical
18 heat flux.

19 So if you plot the flux versus
20 quality, you take the experimental data. And one
21 way to run your plant is draw a line underneath
22 all that data. That's the limit line.

23 And as long as you don't go in heat
24 flux greater than that, you're okay. The other
25 way is to make a best fit of that data plus or

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1 minus uncertainty and then evaluate it.

2 Both ways have been used in the past.
3 I've used both ways.

4 JUDGE KENNEDY: Are those the two ways
5 that are evidenced on this chart?

6 DR. LAHEY: That's our two ways. But
7 the question is, because we don't have any way to
8 know has this been drawn under all the data. I
9 mean is it, are they living in a fool's paradise,
10 I mean is one way to think about it.

11 Do they think they're all that
12 conservative, and they're not really?

13 JUDGE KENNEDY: I guess said another
14 way, if that limit line isn't right, we should be
15 seeing failures in real plant data with CUFs less
16 than 1. So we have a CUF prediction based on the
17 limit line that's 0.9. That component fails due
18 to metal fatigue.

19 DR. LAHEY: Well, there have been some
20 failures, which have been attributed to
21 manufacturing flaws and things like that when
22 they're below 1.

23 But in fact, we haven't run this out
24 far enough to take into account the effect of
25 embrittlement, for example, and what that might

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1 do to it.

2 JUDGE KENNEDY: And again, that's the
3 inconclusive data that you constantly point to.

4 DR. LAHEY: That's one way to do it.

5 JUDGE KENNEDY: Maybe just in case I
6 didn't hear it right, you don't, you're not aware
7 of any metal fatigue failures where a predictive
8 technique would have predicted that the metal
9 shouldn't have fatigued and failed.

10 Is there any evidence of that that
11 you've seen?

12 DR. LAHEY: Yes. There has been that
13 data. I don't know I can give you the reference
14 off the --

15 JUDGE KENNEDY: Is that different than
16 the manufacturing defects that you just --

17 DR. LAHEY: That's what they attribute
18 it to.

19 JUDGE KENNEDY: Maybe --

20 DR. LAHEY: I think it was a 0.7,
21 Havana 0.7.

22 JUDGE KENNEDY: What would that be
23 indicative of in this whole discussion here about
24 trying to manage aging for metal fatigue? Is
25 that an issue that's not included, not

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1 considered?

2 DR. LAHEY: The reason I'm doing this
3 and I'm concerned with it is because we have been
4 asked to trust the results are conservative.
5 Trust us. They're conservative.

6 And then we can go back and keep
7 reducing what we view as conservatisms that are
8 unnecessary because we have so much margin we
9 don't need them.

10 And it just gets tighter and tighter
11 and tighter. And at some point, you worry about
12 how do you know what the conservatism is. How
13 much conservatism do you really have? And this
14 is the only way I know how to actually get at
15 that.

16 JUDGE KENNEDY: If Entergy reduced the
17 conservatisms, took all the conservatisms out and
18 left only the margin, design margins or whatever
19 the right word is in the ASME code, is that still
20 a conservative calculation?

21 DR. LAHEY: I think they could use,
22 the WESTEMS code is really an encoding of a
23 procedure that we used to do by hand. In 1961,
24 when I did my first job, I was doing exactly
25 this, thermal stress analysis, but we did it all

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1 by hand.

2 Now it's much more encoded, and I
3 think that's great. It helps out as long as you
4 get it right. I can show you later on what they
5 would need to do to that code to do a best
6 estimate calculation.

7 They do it with that code. And then
8 do the error analysis and sit the problem, answer
9 the concern. Is it conservative or not?

10 JUDGE KENNEDY: And again, I guess
11 what we'd be most interested in is can you
12 identify a problem with using the margins that
13 are in the ASME code plus some conservatisms or
14 no conservatisms to generate a load limit line.
15 What is fundamentally wrong with that?

16 DR. LAHEY: At the end of the day,
17 that may cover all the concerns. But it's not
18 for sure. And when you're playing with the
19 health and safety of people in this area of the
20 country, I think it's not the right thing to do.

21 JUDGE KENNEDY: Are you suggesting
22 that there's insufficient margin in the ASME
23 calculation to cover the uncertainties in, I
24 guess, the overall calculation?

25 DR. LAHEY: Yes. For example, the

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1 ASME code, the 20 cycles and the factor, or
2 excuse me, the two cycles and the factor of 20,
3 20 cycles and a factor of 2 on stress, that is
4 for the air data.

5 If you look at the Fen prediction, and
6 you think about how did they take that data. So
7 how did they take that data? They did it in
8 autoclave. So they put the little machine that
9 runs the fatigue experiments, and you could
10 control the chemistry, the temperature.

11 You could do a precise job. And then
12 that's what they fit and got the Fen correlation.
13 The problem is, when you go to the plant, then
14 you look at a flow situation where you have
15 turbulence and you start thinking about what the
16 chemical engineers called surface renewal theory,
17 sub-shielding of the oxygen.

18 You get a lot of sub-shielding in an
19 autoclave that you would not get in the real
20 application. So is the Fen really accurate, and
21 how do you put that uncertainty into the thing?

22 Well, this is one way to do that.
23 It's part of the delta.

24 JUDGE KENNEDY: So your concern isn't
25 with the original CUF calculation and

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1 uncertainties in that. Your concern is with the
2 environmental adjustment factor and covering the
3 uncertainties in that.

4 DR. LAHEY: It's only one part.
5 There's also part of the modelings that we can
6 get into, which are not, which are really not
7 conservative at all. They're non-conservative.

8 JUDGE KENNEDY: I think, let's stay on
9 the cartoon for a while.

10 JUDGE WARDWELL: I got a question
11 before we leave this cartoon.

12 (Simultaneous speaking.)

13 JUDGE WARDWELL: -- one clarifying
14 thing that may --

15 JUDGE KENNEDY: Thank you, Dr. Lahey.

16 JUDGE WARDWELL: Give you some time,
17 give you time to think of something else. But I
18 do want to clarify one statement you made early
19 on. You stated that that limit line is
20 associated with the WESTEMS calculation.
21 Correct? That's what you said.

22 DR. LAHEY: I'm calling the results of
23 the WESTEMS calculation a limit line, yes.

24 JUDGE WARDWELL: Okay. But isn't the
25 WESTEMS just a computer code that is one

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1 mechanism to calculate out the CUFs. The limit
2 line is just a calculation of the CUFs. Could it
3 not have been done by hand?

4 DR. LAHEY: Absolutely.

5 JUDGE WARDWELL: Okay. So that limit
6 line is not necessarily indicate of WESTEMS or
7 not. It's the calculation of the CUF line.

8 DR. LAHEY: Right. If you made the
9 same assumptions that they make in the code --

10 JUDGE WARDWELL: Right.

11 DR. LAHEY: -- and did it by hand,
12 well they may, you may have a WESTEMS limit line.

13 JUDGE WARDWELL: Right. You may have
14 whatever, but a limit line is not unique, I'm
15 saying, in regard, your cartoon is not unique to
16 WESTEMS.

17 It could be a cartoon for any limit
18 line that happened to be calculated to, happened
19 to be done, calculating out the CUF relationship
20 with either the time for a period event at
21 operation or the fluence.

22 DR. LAHEY: Yes, sir. When I say
23 limit line, what I mean is instead of a best
24 estimate, it's a supposedly conservative
25 calculation.

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1 JUDGE WARDWELL: Right.

2 (Simultaneous speaking.)

3 DR. LAHEY: Right now the question is

4 --

5 JUDGE WARDWELL: However it was done.

6 DR. LAHEY: -- is it really, and
7 what's the margin.

8 JUDGE WARDWELL: Fine. I just wanted
9 to clarify that point --

10 DR. LAHEY: Right.

11 JUDGE WARDWELL: -- that it's not just
12 a WESTEMS calc.

13 JUDGE KENNEDY: All right. Dr. Lahey,
14 is there anything additional that you'd like to
15 discuss? This is Judge Kennedy, on this figure.

16 DR. LAHEY: Unless there's any
17 questions, I've tried to explain it. If I didn't
18 do it, please have somebody ask me.

19 JUDGE KENNEDY: I think we'll have
20 additional questions when we get to the
21 conservativisms discussion later.

22 DR. LAHEY: All right.

23 JUDGE KENNEDY: I guess I'll turn to
24 Entergy. Do you have any rebuttal to this
25 figure, this cartoon, other than what's been --

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1 MR. GRAY: This is Mark Gray for
2 Entergy. The concept is pretty straightforward,
3 and if we were trying to do a precise
4 calculation, we probably could use such a
5 technique.

6 But what we would propose, in fact, is
7 you can do this on the front end or on the back
8 end. If you do it on the front end, you select
9 your inputs in such a way that the only error
10 that you're going to get is going to go below the
11 limit line.

12 And so when we are maximizing stresses
13 so that we can get a conservative usage factor,
14 we select the inputs to the stress calculation,
15 and we model the calculation that we do for the
16 stresses, such that we're already calculating a
17 larger than expected load and stress range that
18 we use for the fatigue calculation.

19 So I would say that the calculation
20 that we've done is sufficient because any
21 uncertainty on our assumptions would go in the,
22 would make the answer less.

23 JUDGE KENNEDY: So you don't, do you
24 not feel the need to add any uncertainty upon
25 your calculation, as Dr. Lahey has indicated, a

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1 delta above your calculation to account for
2 uncertainties?

3 MR. GRAY: No, we do not.

4 JUDGE KENNEDY: Do you believe they're
5 included in the original calculation, analysis
6 method?

7 MR. GRAY: Yes.

8 JUDGE KENNEDY: This discussion of the
9 ASME margins that I may have miscommunicated,
10 going back to some conservatisms can be removed,
11 margins cannot be removed.

12 So one thought I had in trying to
13 address Dr. Lahey's concern about the reduction
14 in conservatism is to suggest that there's still
15 margins in the code evaluations.

16 Is that a true statement? Is their
17 margin still, are those untouchable margins in
18 the code something that can be relied on to give
19 confidence in the final result?

20 MR. GRAY: Yes. As we said
21 previously, we're not touching those margins in
22 our selection of inputs and conservatisms in the
23 analysis.

24 JUDGE KENNEDY: Are those margins
25 sufficient to cover potential uncertainties in

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1 the analysis, or is that the wrong way to be
2 thinking about this?

3 MR. GRAY: The ASME code doesn't
4 dictate the method that you use to get your
5 stresses, for example.

6 It has some very high level guidelines
7 of the ways that you treat the stresses that you
8 calculate and how you conform them to the
9 equations that are stipulated that you meet in
10 the code on your way to calculation of the usage
11 factor.

12 After that, the analyst must justify
13 that his stress calculation is a conservative.

14 JUDGE KENNEDY: Go ahead.

15 DR. LAHEY: Your Honor, could I say
16 one thing on that his?

17 JUDGE KENNEDY: On the ASME margins?

18 DR. LAHEY: On the statement and your
19 suggestion. By definition, a limit line
20 shouldn't have any plus or minus delta on it. I
21 mean it's very consistent to use ASME code
22 assumptions of conservatism in a limit line.

23 It's very consistent to make
24 assumptions to make it conservative. But by
25 definition, it doesn't need any uncertainty

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1 because it's a bounding calculation.

2 It has enough conservatism built in.
3 The only thing of concern is what is it. I mean
4 --

5 (Simultaneous speaking.)

6 JUDGE WARDWELL: Yes. I think that
7 will get into my questions I have for Mr. Gray.
8 So as I heard you said that you know what those,
9 as you're assuming conservative parameters for
10 your input that you're allowed to do, you're
11 aware of those that you are doing.

12 And you're usually motivated, as I
13 heard Mr. Stevens say, usually probably because
14 it's a less expensive analysis because you can
15 simplify some of the runs or whatever else.

16 But you are aware of what those are.
17 Correct?

18 MR. GRAY: That's correct.

19 JUDGE WARDWELL: Right. And so you
20 are developing a limit line. And what you're
21 saying is that with that limit line, as long as
22 we're below 1, we know we're conservative.

23 MR. GRAY: That's correct.

24 JUDGE WARDWELL: But likewise, you
25 could also take out all those conservatisms out

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1 of that for every one of the parameters. Could
2 you not right off the bat?

3 MR. GRAY: Theoretically you could.

4 JUDGE WARDWELL: And so you could
5 create a best estimate line because that's where
6 you would be at that point. Would it not be the
7 closest to your guess of what truth would be in
8 that particular sets of materials and the
9 resulting CUFs that you're calculating with the
10 cycles that are applied to it?

11 MR. GRAY: While your suggestion might
12 be a responsibility --

13 JUDGE WARDWELL: I'm not suggesting
14 anything. I'm just saying you could come up with
15 that best estimate line, if in fact, you
16 eliminated all the, you took your best estimate
17 of all the parameters that you're putting in, not
18 incorporating any of the conservatisms, the
19 margins.

20 MR. GRAY: If you had a way to do
21 that, that might be possible, but I don't believe
22 that that's possible. So we do always make some
23 conservative assumptions, yes.

24 JUDGE WARDWELL: Well, I thought you
25 knew how much conservatism, conservative nature

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1 of your inputs that developed your limit line.

2 MR. GRAY: You know what maximum loads
3 are. You know what maximum inputs are, for
4 example. That doesn't mean you know precisely
5 what the actual value might be.

6 JUDGE WARDWELL: Or another way to say
7 it, you really don't know what you would want to
8 say is your minimum loads necessarily.

9 MR. GRAY: Or best estimate.

10 JUDGE WARDWELL: Best estimate load.
11 Okay. Thank you. Let me just finish up. But if
12 you could, if you were able, I understand what
13 you just said.

14 But if you were able to, that would
15 just create a best estimate line. Correct, in
16 regards to just trying to correlate what you're
17 saying with this cartoon?

18 MR. GRAY: That could be possible.

19 JUDGE WARDWELL: Okay.

20 MR. STEVENS: Your Honor, Gary Stevens
21 as NRC staff. Would you mind if I said a few
22 words here?

23 JUDGE WARDWELL: Not at all.

24 MR. STEVENS: I guess I would
25 interpret it that he would not be allowed to do

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1 a best estimate line because, let's go back to
2 the margin discussion that I had earlier.

3 Part of the margin is things he can't
4 touch. In order to do an appropriate uncertainty
5 analysis, if you could, which by the way you
6 can't because the code would not allow that.

7 And the reason it would not allow that
8 is because part of your best estimate analysis
9 would be to use a best estimate fatigue curve,
10 which you're not allowed to do.

11 JUDGE WARDWELL: Of the what curve?

12 MR. STEVENS: Fatigue curve or the S-N
13 curve, to calculate your CUF. You're not allowed
14 to do that with the code. You have to use the
15 design curve --

16 JUDGE WARDWELL: But haven't we taken
17 out, we all agree that we're not going to touch
18 those code things. And those are as if there are
19 no margin. We were taking those at those values,
20 and we're not touching them.

21 MR. STEVENS: Well to me, that's not
22 a best estimate analysis.

23 JUDGE WARDWELL: I'm only using that
24 phrase in regards to this cartoon. I'm not
25 giving it any other credence in regards to the

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1 bestness of it or the estimate of it. It's just
2 nomenclature to relate to this cartoon. That's
3 all.

4 You would create a line below your
5 limit line that would have the conservative
6 assumptions that you've made and are allowed to
7 make out of it is all I'm saying.

8 You could derive a line for that is
9 what I was asking. Okay.

10 MR. STEVENS: Okay.

11 JUDGE WARDWELL: Any other comments on
12 that? So I understand that there are those
13 margins from the code and actions required by the
14 code that limit the degree that you can touch.

15 And I think we all agree those are
16 untouchable and will always be in there.

17 MR. COX: Yes. Your Honor, one
18 comment on that. I think if I understand Mr.
19 Stevens correctly, you could do that, but you
20 wouldn't have a best estimate line. You would
21 have a lower limit line.

22 JUDGE WARDWELL: Well, call it
23 anything you want to. I'm only using, again, I
24 only use that nomenclature in reference to
25 picturing this on this cartoon.

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1 Call it an Ernie line if you want. I
2 don't care what you call the line. I'm not
3 giving it any credence that it is the best
4 estimate. I'm just giving it a, being consistent
5 with what's on the cartoon. That's all. Thank
6 you.

7 DR. LAHEY: Your Honor, I certainly
8 agree. And I think I said earlier, to do this
9 "best estimate" --

10 JUDGE WARDWELL: You don't like my
11 suggestion of Ernie?

12 DR. LAHEY: But I would recommend you
13 retain the ASME code. And so it's not exactly a
14 best estimate, but then it's apples and apples
15 comparison.

16 So some things that, just so you
17 understand, one of the things that we're talking
18 about here is right now you make an assumption of
19 so many scrams during the light.

20 Let's say your best estimate of number
21 of scrams is 100, and so, but you really don't
22 use the same thing. I mean you can use 200 in
23 your limit line.

24 And you say I got conservatism here,
25 which you do if you really believe you only have

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1 100. So you'd use 200 in the limit line and 100
2 in the best estimate and go through each one like
3 that.

4 And in the end, you have some way to
5 define what sort of margin. We have some ability
6 to understand what's the cushion, if any. Right
7 now we don't know, particularly as you get closer
8 and closer and closer.

9 I come from a background where if I'm
10 sitting there in my office, and I ask somebody to
11 design a piece of equipment to last for 60 years
12 and fatigue is one of the issues, and they come
13 in with a design where they're rapidly
14 approaching 1 and they got all kinds of, it's
15 really at the bitter edge, I'd throw them out of
16 the office.

17 I'd say, listen guy. You're not going
18 to design a piece of equipment like that. But
19 now because we can't redesign the reactor, we're
20 asking to get out there, the stuff that any
21 rational engineer would never accept.

22 So what you need is enough confidence
23 you got enough margin in there to take into
24 account anything that may happen. That's where
25 we're at.

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1 JUDGE KENNEDY: I can't let the
2 rapidly approaching 1 go by the wayside without
3 asking a question. Do you perceive the CUF
4 values that are calculated for Indian Point 1 and
5 2, 2 and 3?

6 I don't know what the values of 1
7 would be, for 2 and 3 are rapidly approaching 1
8 over the next 20 years?

9 DR. LAHEY: Well, they're --

10 JUDGE KENNEDY: And I'm not sure what
11 --

12 DR. LAHEY: Yes, they're --

13 JUDGE KENNEDY: -- graphically
14 approaching means in this context.

15 DR. LAHEY: I can give you a numerical
16 value, but I was asked not to do it.

17 JUDGE KENNEDY: Well, let's --

18 DR. LAHEY: There are several
19 components are --

20 JUDGE KENNEDY: Let's say for
21 argument's sake they're all going to get to 1, 20
22 years from now. Is that your concept of rapidly
23 approaching?

24 DR. LAHEY: Yes.

25 JUDGE KENNEDY: And why is that a

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1 concern?

2 DR. LAHEY: If you get to 1 or beyond,
3 you got a problem. Well, even in the licensing
4 basis, they would have to take action at that
5 point, yes.

6 JUDGE KENNEDY: Right.

7 DR. LAHEY: If I'm, if you calculate
8 at the end of 60 years, end of period of extended
9 operation, you have a CUFen of 0.2, I'm not
10 really concerned about that.

11 But if it's decimal point, you know
12 what I'm saying?

13 JUDGE KENNEDY: So your concern, as it
14 gets to 1, what do you perceive happens when the
15 CUF value gets to 1? Do we lose the intended
16 function? Do we crack? Do we fail?

17 DR. LAHEY: The assumption, of course,
18 is you get a crack of 3 millimeters. My, as you
19 may remember from the last couple days, my
20 problem is as this, and this is a new discussion
21 I'm going to create.

22 JUDGE KENNEDY: It is.

23 DR. LAHEY: As this thing fatigues --

24 JUDGE KENNEDY: I started it.

25 DR. LAHEY: We hear and we hear, and

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1 you get a number of microcracks. And all of a
2 sudden you have an impulsive load. Then you've
3 got a big problem. So I don't want a design
4 where things get very degraded.

5 JUDGE KENNEDY: I guess I'm getting
6 confused again because I thought we put to bed
7 this question of did they analyze these shock
8 loads. And I'm assuming that this covers all the
9 way up to the maximum CUF values that they have
10 in their analysis to date.

11 Are you suggesting they did not do
12 that? I thought we just settled that question.

13 DR. LAHEY: What we talked about this
14 morning was for the baffle bolt, baffle former
15 bolts. An analytical method has been set up,
16 which I believe will create the right kind of
17 shock loads.

18 And they could be applied to other
19 components as well. I haven't seen that, but
20 this type of sub-cool decompression model could
21 be applied throughout the system.

22 But as you may recall, right now I
23 haven't seen them do the type of design basis
24 LOCA breaks with a type of opening times that
25 would create the larger ones.

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1 In principle, they can get the loads.
2 They can get the loads right, but it makes a huge
3 difference if it's a snap load or a gradual load.

4 JUDGE KENNEDY: But didn't they do
5 that for the original design, and why is it
6 different?

7 DR. LAHEY: Using a different code,
8 they have done that. And to assure if you have
9 ductile structures, you will maintain an intact
10 geometry.

11 And as I said yesterday, we spent a
12 lot of taxpayer money verifying that in the LOCA
13 program to show that indeed you could maintain
14 the coolable geometry and cool the core.

15 Now that we're winding up with a
16 highly degraded geometry, both due to fatigue and
17 irradiation, that hasn't been done.

18 JUDGE KENNEDY: We have no CUF values
19 at the end of life greater than 1 according to
20 the testimony of Entergy. Why are we in a highly
21 degraded condition?

22 DR. LAHEY: Okay. The CUF value is a
23 moving target. I mean there was a really nice
24 Westinghouse paper, and I think the author of it
25 is in the room, which described the process for

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1 a RHR accumulator nozzle.

2 It's an iterative process. You make
3 certain assumptions, and they're supposedly very
4 conservative. And if you get a CUF of less than
5 1, CUFen less than 1, you stop. It's good
6 enough.

7 Maybe that's fine, but if it becomes
8 19, which happened, then you go back and start
9 looking at what did you do that you might want to
10 relax. And some of them are obviously
11 conservative.

12 If you assume too many cycles of a
13 certain transient, so back it up. You did this
14 or that. Back it up. But as you keep doing this
15 and you keep going over and over, there's no
16 limit to what you can cut in order to get below
17 1.

18 And that's where we become very
19 concerned. At some point, you're cutting into
20 design margins. It's not just conservatism.

21 JUDGE KENNEDY: This is where I keep
22 getting confused. I thought there was a point
23 beyond which these reductions are off the table.

24 And I guess maybe I keep getting
25 myself confused between conservatisms and

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1 margins, which we tried to earlier have a lot of
2 discussion about.

3 But I keep hearing from Entergy that
4 there's a limit to this refinement of
5 calculation, that there's areas that they do not
6 go. Are you suggesting that's not true?

7 DR. LAHEY: Well, I think maybe the
8 NRC should comment on it, but what I've read says
9 that if they have that situation, they can either
10 fix it or they can recalculate it.

11 They're allowed to recalculate it, and
12 then if they can justify that that's a
13 conservative calculation, fine. The problem is
14 they just say it's conservative.

15 I mean there's no, there's nothing
16 that has been defined as what conservatism really
17 is in the code. That's the concern.

18 JUDGE KENNEDY: Are you saying in the
19 code or in the analysis method, in the input, I
20 mean are you opening it up to the whole --

21 DR. LAHEY: Into the results of
22 WESTEMS, which includes all of those things.

23 JUDGE KENNEDY: I think we'll get back
24 to this in the afternoon. But I appreciate your
25 input.

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1 DR. LAHEY: I mean, I want to say that
2 I understand the approach. And even though if
3 you don't really understand what they're doing,
4 it looks pretty startling when you see numbers go
5 from 20 down to 0.8.

6 And you say oh my God. What's going
7 on? And then you realize it's a process that
8 they do. And I don't even mind the process. I
9 understand it.

10 It's just at some point as you keep
11 doing it, you're cutting into the bone. All
12 right. And we need to know --

13 JUDGE KENNEDY: How would you know
14 when we're at that point? Do you have a sense of
15 where that point is?

16 DR. LAHEY: The only way I know is to
17 determine what sort of margin you have and to
18 compare it, something like this.

19 JUDGE KENNEDY: To do a best estimates
20 calculation.

21 DR. LAHEY: Best estimate with
22 uncertainty. And then you say okay, compared to
23 that, my error bar is below the limit line and --

24 (Simultaneous speaking.)

25 JUDGE KENNEDY: So you're not buying

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1 Entergy's argument that in doing the calculations
2 or in essence doing a load limit type
3 calculation.

4 DR. LAHEY: I believe President Reagan
5 was right. You trust but verify.

6 CHAIRMAN MCDADE: Okay. And I don't
7 want to get into a big discussion here right
8 before lunch.

9 But just to satisfy me, from your
10 standpoint, if you were looking at it during the
11 period of extended operation and the
12 environmental adjusted CUF was 0.1, you wouldn't
13 have very many concerns because you would believe
14 that there would be sufficient margin there so
15 that there would not be a potential for problem.

16 At the other end of the spectrum, if
17 within the period of extended operation, the
18 environmentally adjusted CUF was 0.99, you would
19 be very concerned because of the possibility of
20 insufficient margin.

21 (Simultaneous speaking.)

22 CHAIRMAN MCDADE: So that, in fact, it
23 might be above 1, although their calculation is
24 below 1. Is that correct?

25 DR. LAHEY: Yes, Your Honor. That's

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1 exactly right.

2 CHAIRMAN MCDADE: Okay. And that in
3 factoring, in preparing their environmental
4 adjustment for the CUF, in your view, there are
5 factors that are not adequately considered, such
6 as the effect of neutron embrittlement and such
7 as the fact that in your view, there are the
8 potential for high amplitude events within the
9 design basis that have not factored in.

10 DR. LAHEY: And we'll get into that
11 after lunch, I guess, on some of the modeling
12 assumptions that are made, some of the models
13 that are used and how if you do those correctly,
14 you dramatically increase the amplitude.

15 CHAIRMAN MCDADE: Okay. But at least
16 the way I described it is consistent with the
17 testimony you were hoping that we would
18 understand this morning. Nothing that I said was
19 --

20 (Simultaneous speaking.)

21 DR. LAHEY: I agree with what you
22 said, except there's also modeling things that
23 are influencing the result --

24 CHAIRMAN MCDADE: Right, in addition
25 to --

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1 DR. LAHEY: -- that were non-
2 conservative in my view.

3 CHAIRMAN MCDADE: In addition to that
4 we're going to get into later.

5 DR. LAHEY: Yes.

6 CHAIRMAN MCDADE: Okay. Thank you.
7 Judge Kennedy, your suggestion?

8 JUDGE KENNEDY: I suggest we take a
9 break at this time.

10 CHAIRMAN MCDADE: Okay. One quick
11 thing before we do break for lunch, and let me
12 just note for administrative. There was an
13 Entergy document, Entergy R-00186. It was filed
14 in connection with Track 1.

15 It was an R document. There was a new
16 one that was filed in connection with the Track
17 2, and we are going to sua sponte make that
18 Entergy R-20186. So when you do your revised
19 exhibit list, if you could have that correspond.

20 It is now 12:40. Would it be
21 appropriate to break until 1:40? Okay. And the
22 next question is, and I'm thinking this may well
23 be that when we come back at 1:40, it might be
24 appropriate for us to go into a closed session
25 initially so that Dr. Lahey might comment on some

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1 proprietary information.

2 So for the individuals who are
3 spectators and all of the participants here have
4 signed the non-disclosure agreements. But we
5 will at least at 1:40 have a closed session.

6 And for anybody who is present
7 probably we're hopeful that by 2 o'clock then we
8 would be able to open up the session again to the
9 public session.

10 So we will stand at recess until 1:40,
11 have a closed session with anticipation we'll
12 open it approximately 2 o'clock.

13 MR. SIPOS: Excuse me, Your Honor?
14 John Sipos for the State of New York. I just
15 wanted to clarify one question for the Board, and
16 it follows up on a question from Judge Kennedy.

17 There was some discussion of the
18 phrase "rapidly approaching 1 or 1.0 or unity,"
19 and that was a phrase that we picked up during
20 the November 5 pre-hearing conference.

21 And it was our understand that that
22 was a safe harbor phrase that would be
23 acceptable.

24 MS. SUTTON: Your Honor, this is
25 Kathryn Sutton. This is the third time counsel

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1 from New York has testified on behalf of his
2 witnesses. And we object.

3 MR. SIPOS: I'm not.

4 CHAIRMAN MCDADE: Okay. I don't
5 believe that Mr. Sipos was testifying. I believe
6 that he was clarifying.

7 And I think that he correctly
8 commented on what was said during the status
9 conference, that we did not want the witnesses
10 and asked parties to instruct the witnesses not
11 to use specifics but that, again, the term that
12 as I understood it, what Dr. Lahey was saying by
13 rapidly approaching meaning in his view, the
14 environmental adjusted CUF was close to.

15 It had nothing to do with speed. It
16 had to do with its nearness to the 0.1 or 1.0,
17 which then raised concerns in his mind. Is that
18 how you were using the term, Dr. Lahey?

19 DR. LAHEY: Yes, sir. Yes, Your
20 Honor.

21 CHAIRMAN MCDADE: And that is what you
22 were referring to, Mr. Sipos?

23 MR. SIPOS: Yes, Your Honor. And I
24 was not trying to testify. I was trying to
25 provide --

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1 CHAIRMAN MCDADE: I didn't anticipate
2 that you were testifying. I thought you were
3 trying to clarify something for the Board so that
4 we would properly understand Mr. Lahey, Dr.
5 Lahey's testimony.

6 MR. SIPOS: And it was a phrase that
7 originated from the Board.

8 CHAIRMAN MCDADE: I believe, actually
9 from me.

10 MR. SIPOS: I believe so, Your Honor.
11 That's all I was trying to clarify.

12 MS. SUTTON: It's good to know, Your
13 Honor, that we can make similar clarifications as
14 necessary. So thank you very much.

15 CHAIRMAN MCDADE: If you believe that
16 it is necessary to clarify something, I am
17 confident that you will not be shot.

18 MS. SUTTON: Thank you, Your Honor.

19 CHAIRMAN MCDADE: We are in recess.

20 (Whereupon, the above-entitled matter
21 went off the record at 12:41 p.m. and resumed at
22 1:44 p.m. in Closed Session.)

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12 redacted.)

13 CHAIRMAN MCDADE: Okay. Are we ready
14 to go? We're on the record and we're in an open
15 session. And the public has been seated. I've
16 got two final questions back on the old synergism
17 topic that we had this morning. Entergy, on Page
18 152 of your pre-filed testimony which I believe
19 is Entergy 679, you state that fatigue in a
20 radiation embrittlement contribute to potential
21 aging effects in very different ways.

22 And then you go on to say, no basis to
23 apply additional fatigue correction factor to
24 address, there is no basis to apply an additional
25 fatigue correction factor to address potential

NEAL R. GROSS

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WASHINGTON, D.C. 20005-3701

1 embrittlement. And it cites to ENT631 at D3. I
2 can't find that statement at D3. Either my
3 reading is failing or the cite may be inaccurate.

4 So it starts on Page 152 of the pre-
5 filed testimony and it's discussing fatigue in a
6 radiation embrittlement and how they contribute
7 in very different ways. I mean, I think this is
8 an attempt to address Dr. Lahey's thoughts of
9 adding another additional factor to deal with
10 embrittlement and its combined effect on fatigue.

11 MR. KUYLER: Your Honor, would it be
12 possible to have Entergy Exhibit 631, Page D3 put
13 up on the screen?

14 CHAIRMAN MCDADE: That would be fine.
15 Mr. Welkie? It's not proprietary, it's just
16 copyrighted, correct?

17 MR. KUYLER: Your Honor, I believe
18 that exhibit is full text copyrighted but not
19 proprietary.

20 CHAIRMAN MCDADE: Okay. Thank you.

21 JUDGE KENNEDY: It's quite a ways into
22 the document. And if it leaps off the page at
23 us, I'll stand corrected. So that's D3. I
24 believe the discussion is related to fatigue and
25 radiation embrittlement contributions, aging

NEAL R. GROSS

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1 effects.

2 DR. LOTT: Can we go back up?

3 JUDGE KENNEDY: If it's going to be
4 anywhere, it's probably going to be in that.

5 DR. LOTT: Yes. I think we were
6 referring to the statement at the end of, I guess
7 it's the top paragraph on this view at least.
8 That the work of several researches suggest that
9 neutron radiation does not result in further
10 reduction of fatigue properties. And some cases
11 suggest an improvement which is effectively a
12 description of the discussion we've had in 6909.

13 However, minimal data on the combined
14 effects of water chemistry and neutron influence
15 currently exist in literature.

16 JUDGE KENNEDY: Okay. I mean I guess
17 --

18 MR. LOTT: Did we present that as a
19 direct cite? Or was it --

20 JUDGE KENNEDY: Well I was thinking it
21 was a direct quote from your, in your pre-filed
22 testimony from D3. So if that's the statement,
23 the indication is that there's no data to
24 support.

25 DR. LOTT: Well I think it suggests

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1 that work of several researchers that neutron
2 embrittlement does not result in further
3 reduction. So I think that's a positive
4 statement rather than a fairly negative statement
5 as you suggested.

6 JUDGE KENNEDY: Oh I see. I got you.
7 All right. I think I see the logic better -- I
8 had a question about walk us through the logic
9 but given the way the statement's worded here
10 which is different than I had written down -- and
11 I'll have to go back and check this out.

12 If your testimony is that this is the
13 support for the statement of why no additional
14 fatigue correction factor is warranted to address
15 potential embrittlement --

16 DR. LOTT: Yes.

17 JUDGE KENNEDY: And I'll think about
18 that in relation to the way it's, fold it back
19 into the original testimony.

20 DR. LOTT: Okay.

21 JUDGE KENNEDY: So D3, the last
22 sentence in the paragraph. I guess the first
23 paragraph. All right, I'm going to have to think
24 about it. I really just wanted to find the
25 support and where I looked, I wasn't finding the

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1 words that were in the original testimony. That
2 helps.

3 DR. LOTT: Okay.

4 JUDGE KENNEDY: Well it may help but
5 I'll take it for now. It's the best we can do.
6 I have a number of questions related to a safety
7 margins discussion that Dr. Lahey has started.
8 I'll start first with Dr. Lahey.

9 You've introduced a set of concerns
10 related to the reduction in conservatisms in the
11 CUFen calculations. And your concern appears to
12 be that they could be reducing the safety
13 margins. And I first want to start by having you
14 clarify what you mean by safety margins.

15 I mean, we recognize we're reducing
16 conservatisms. But I think your concern goes to
17 a reduction in safety margins.

18 DR. LAHEY: That's correct. In the,
19 what I call the limit line approach or the
20 WESTEMS approach, what's assumed is that there's
21 a lot of conservatism and from various sources,
22 modeling or number of cycles or various ways that
23 they proceed with this calculation.

24 As a consequence, when they make a
25 calculation and they find that it's too high,

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1 it's above CUFen of one then they're free to go
2 back and redo that if they can identify something
3 that's a conservatism that's pretty obvious. And
4 they can relax it and justify it. So they do.

5 And there's nothing wrong with that
6 approach except at some point, you start cutting
7 into -- you go from conservatisms to margins,
8 engineering margins that allow for uncertainties.
9 And if you keep cutting too much, you're really
10 cutting into things that are important.

11 Normally, there's a demarcation for
12 that but we see no demarcation at all. There
13 seems to be no rules, no guidance as to what you
14 can do or what you can't. To the point you have
15 some components that -- I'm going to use, you
16 know, my normal language. They're playing every
17 trick in the book. All right?

18 They're doing all the things you're
19 allowed. And they're all the way up to working
20 in the plasticity range. And once you get there,
21 you're pushing that thing pretty hard. You're
22 way up there towards fatigue failure.

23 So to us, we believe it's very
24 important to know what margins there are. I
25 mean, I'm sure that the people who do that feel

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1 comfortable that there's enough residual
2 conservatism so that that's not such a scary
3 thing. But unless you know what that is, it's
4 potentially pretty scary.

5 So that was the whole thing that I
6 discussed earlier about how to quantify the
7 margin.

8 JUDGE KENNEDY: So if I understand you
9 correctly, you don't have necessarily a concern
10 about reduction in conservatisms. It's
11 constantly reducing the conservatisms and not
12 knowing that you haven't eroded the safety
13 margins.

14 DR. LAHEY: That's correct Your Honor.

15 JUDGE KENNEDY: And this concern arose
16 as you reviewed the revised calculations that
17 were presented in the testimony. And the
18 potential to redo those calculations, I guess at
19 any time.

20 DR. LAHEY: That's correct. I mean,
21 I've been looking at all this for eight years
22 now. And you get a result that's high and then
23 next time you see it, it's really low and then
24 the next time you see it, it's halfway between.
25 I mean it just floats all over the place.

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1 And once it gets up, essentially to
2 unity, then I'm very concerned. Because I don't
3 know what's left. Is it enough?

4 JUDGE KENNEDY: Fair enough. Let's
5 turn to Entergy. I think we talked a little bit
6 about this this morning but I'm not sure we got
7 all the way through the problem. So I thought
8 I'd bring the safety margins discussion back up.
9 We talked about margins and we talked about
10 conservatism this morning.

11 I guess I would like to see if you
12 could address how the analyst knows that he can't
13 continue to reduce conservatism and erode safety
14 margins. Where is the guidance for the analyst
15 to know that they're not taking away margins that
16 are needed to cover for uncertainties or other
17 issues? And I'll look to Mr. Gray first.

18 MR. GRAY: Mark Gray for Entergy. I
19 think the primary guidance that every analyst has
20 in this industry is the ASME code. We must
21 follow the code and the conservative methods that
22 are explicitly given within the code.

23 As we said earlier, the code designed
24 fatigue curve includes margin. The code methods
25 for stress allowables -- for example, the design

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1 stress intensity allowable in Section 3 is an
2 allowable stress with built in margin that
3 affects factors in your evaluation.

4 And so, these are given margins that
5 we must live with. We can't change. After that,
6 as far as conservatism goes, I also have
7 different methods that I can use within the
8 boundaries of the code. And let me use the
9 example.

10 These analyses that have been
11 performed are still elastic analyses. They are
12 linear elastic analyses. Now NB-3228 of the code
13 allows you to do a plastic analysis. We have not
14 done that yet. So at this point, we have not
15 even gone to that. And that would be, within
16 Section 3, that would be your next major step in
17 reducing conservatism in your analysis.

18 So we haven't used that approach.
19 We've used the linear elastic approach given in
20 NB-3200 along with the other conservatisms that
21 are there. There is such a thing called, in NB-
22 3228.5 --

23 CHAIRMAN MCDADE: Sorry, could you
24 repeat that?

25 MR. GRAY: NB-3228.5. There's a

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1 penalty factor called K sub E which is known
2 throughout the industry to give a very
3 conservative correction when your primary plus
4 secondary stress intensity exceeds an allowable
5 value. You're allowed to that then check another
6 equation and penalize your usage factor
7 calculation with KE.

8 All of these are still in the analysis
9 that we've been done. So at this point, even
10 these calculations haven't used the least
11 conservative method that the code allows.

12 CHAIRMAN MCDADE: And perhaps, is
13 there any way that you can, you know, sort of
14 briefly summarize that when the environmentally
15 adjusted CUF is recalculated, how the analyst
16 determines and quantifies the impact on the
17 safety margin.

18 MR. GRAY: Once again, the safety
19 margin is defined by the code. And so, the
20 inherent margins that we're not allowed to touch,
21 the analyst meets by meeting the 1.0 allowable in
22 the code. And making sure that the corresponding
23 stresses are within the design stress intensity
24 allowables. And so, that's a place that we don't
25 touch. And that's the margin in the analysis.

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1 CHAIRMAN MCDADE: But what Dr. Lahey
2 was talking about is that you look at the
3 analysis, it is at a particular level, just it's
4 X. That it's then recalculated and it's X minus
5 .2. And then you look at it again and it's X
6 minus .3.

7 When it's recalculated, how does the
8 analyst determine whether that recalculation has
9 an impact on the conservatism? And if so, what
10 that impact is. Is there any way of quantifying
11 that?

12 MR. GRAY: Your first question was how
13 does the analyst deal with margin? Now you've
14 asked me how the analyst deals with conservatism.

15 CHAIRMAN MCDADE: Well you seem to be
16 saying that the margin is in the code itself. So
17 that's I changed it from margin to conservatism.

18 MR. GRAY: Okay. So for conservatism,
19 there are different levels of conservatism that
20 are generally used in these analyses. For
21 example, you group your transients. When you
22 know that that's too conservative, when the
23 answer is too high, you can ungroup those
24 transients.

25 CHAIRMAN MCDADE: But why are those

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1 two terms synonymous? That it's too high and
2 therefore, it's --

3 MR. GRAY: Okay. I'll fix my words.
4 When it does not meet the allowable. That's the
5 only thing that makes it too high, when it
6 doesn't meet the allowable. This is binary.

7 JUDGE KENNEDY: And by bundling them,
8 that's an assumption the analyst has made to
9 simplify the calculation?

10 MR. GRAY: Correct.

11 JUDGE KENNEDY: And so, they don't
12 meet the allowable so now they're going to
13 unbundle -- as if I know what these terms mean.
14 Unbundle the transients and do individual
15 calculations. And that's perceived as a
16 reduction in conservatism?

17 MR. GRAY: Yes because all the
18 transients are not of the same severity. So if
19 I'm going to be conservative, if I have 500
20 cycles of different transients, I take the worst
21 transient with the worst severity will give me
22 the worst stress range. And I assume all 500
23 cycles are of that severity, that's conservative.

24 I can then -- if those 500 cycles are
25 really distributed over ten different transients

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1 of different severities, I can unbundle, to use
2 your word, those transients into ten different
3 cases with their respective cycles.

4 JUDGE KENNEDY: In some ways, a more
5 accurate calculation, maybe more reflective of
6 the actual conditions. I don't know about
7 accuracy but more reflective of the actual
8 conditions. As opposed to bundling them and
9 using a maximum --

10 MR. GRAY: Yes.

11 JUDGE KENNEDY: -- a parameter that
12 would maximally impact the cumulative usage
13 factor.

14 MR. GRAY: Yes.

15 CHAIRMAN MCDADE: That's your view Mr.
16 Gray and the view of Entergy?

17 MR. GRAY: Yes.

18 CHAIRMAN MCDADE: Okay.

19 MR. STROSNIDER: This is Jack
20 Strosnider for Entergy. I'd like to give a
21 little perspective on this concept of margin in
22 terms of what it takes to meet the regulations.
23 I want to start off with the fact that the
24 tendency of 55A endorses the ASME code which
25 establishes a very clear demarcation in terms of

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1 what margin needs to be maintained.

2 You need to meet a usage factor,
3 cumulative usage factor of one with those margins
4 that are in the ASME code. And that's why you've
5 heard numerous witnesses already testify that
6 they don't touch that. That's what you have to
7 maintain, the margin you have to maintain in
8 order to meet the regulations and in order to
9 satisfy Part 54 in terms of maintaining your
10 current licensing basis.

11 The people also talk about a margin
12 between what they're calculated cumulative usage
13 factor is and that demarcation point of one. The
14 example was given earlier today of what if it's
15 .5? Then I've got a margin of .5 to one. That's
16 not the margin that's required by the
17 regulations. And you can go and you can
18 recalculate and you can use up some of that
19 margin if you want to characterize it that way.

20 But as long as you're meeting the
21 usage factor of one as calculated with the
22 margins that are in the ASME code, you're
23 satisfying the regulations. And that is adjusted
24 now for the environmental effects as consistent
25 with the guidance to meet Part 54.

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1 So I just wanted to make sure that
2 it's very clear, the margin we're talking about
3 that's necessary to satisfy the license renewal
4 rule, if you will.

5 JUDGE KENNEDY: That's the, I guess to
6 put it back to the original question, would that
7 be perceived to be the safety margin at the
8 untouchable part of the calculation?

9 MR. STROSNIDER: Yes, that's correct.
10 And that is, you know, by endorsing that in the
11 regulations, the NRC has concluded that that's
12 what's necessary for reasonable assurance. All
13 right, it's a regulation and that margin is
14 there. And that's why people don't touch it and
15 that's what you need to meet.

16 The rest of the margin and the
17 conservatisms are things that people can work
18 with. But they need to meet what's in the code
19 as endorsed in the regulations.

20 JUDGE KENNEDY: Thank you. Dr. Lahey?

21 CHAIRMAN MCDADE: I was just going to
22 say, our concern in understanding this is that
23 when you take the first glance at this, you say
24 that the environmental adjusted CUF can't exceed
25 one. But when it approaches one, it's

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1 recalculated. And you know that it needs to be
2 recalculated because it's approaching one.

3 And then if it approaches one again,
4 you recalculate it again. So almost by
5 definition then, it can never exceed one because
6 before it reaches one, it's going to be
7 recalculated. So what we need to have clear in
8 our minds and on the record is the justification
9 for the recalculation. And the assurance that
10 the recalculation provides the accurate
11 description of reality of what's actually there.

12 And that's, I think, what Dr.
13 Kennedy's questions are and I think that was Dr.
14 Lahey's concern. And we're just trying to see --
15 I want to make sure I understand how Entergy and
16 the NRC staff is addressing the concern of that
17 perception. Am I correct in what your concern
18 was Dr. Leahy?

19 DR. LAHEY: Yes, sir. My concern is
20 in this process of iterating, getting below one,
21 that you don't throw out necessary design margin.

22 CHAIRMAN MCDADE: And necessary
23 conservativisms.

24 DR. LAHEY: That's correct.

25 MR. STROSNIDER: This is Jack

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1 Strosnider for Entergy. I'd like to address that
2 again if I can. I think the problem is that
3 people are dismissing those margins that are
4 required by the ASME code. The margins are
5 there. All right? That's what's required.

6 And when you recalculate because
7 you're using a less conservative analysis method,
8 you can do that. You haven't touched the margins
9 that are required by the ASME code. And those
10 margins, I mean those design rules provide
11 margin.

12 The other thing I want to comment on
13 is this notion that people keep saying that you
14 can just redo this cumulative usage factor
15 forever and never reach one. And that's not the
16 case. There are examples and I know some of the
17 people from Entergy can speak to examples where
18 they've actually had to go in and do other
19 actions because they couldn't.

20 You know, they have to change the
21 loading or they have to change components. So
22 it's not a given that you can always recalculate
23 and get it less than one. All right? So I hope
24 that's helpful.

25 MR. AZEVEDO: Your Honor, this is

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1 Nelson Azevedo. If I may add some --

2 CHAIRMAN MCDADE: Yes, sir. Go ahead.

3 MR. AZEVEDO: Yes. In fact, Mr. Gray
4 a few moments ago mentioned plastic analysis. We
5 haven't gotten to that point yet. Some of the
6 analysis, especially once again to the elastic
7 plastic analysis become very expensive.

8 And there have been cases that I've
9 been involved with, in fact some at Indian Point,
10 where it's cheaper for us to either modify the
11 way we run the plant or just replace the end
12 component.

13 One case I was involved with was to
14 pressurize a spray piping at another plant. We
15 just chose to replace the piping. It was just
16 more cost effective than getting to these elastic
17 plastic analyses were very expensive.

18 Specific at Indian Point, back in the
19 '90s on the charging nozzle, we use what we call
20 the normal charging nozzle. And we were coming
21 up to a CUF of one. And we just decided to use
22 a different nozzle. So we changed the way we run
23 the plant just to address, you know, these
24 issues.

25 So the idea that we can just keep

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1 going forever and ever and keep redoing these
2 analyses, it's not practical and it's not even
3 cost effective. If I may just say another
4 comment, I heard statements like we play every
5 trick in the book and manipulate these analyses.

6 I am the owner of these issues at
7 Indian Point. And we absolutely make sure that
8 we meet all our safety margins. And we do not
9 manipulate any of these calculations.

10 JUDGE KENNEDY: Thank you Mr. Azevedo.

11 CHAIRMAN MCDADE: Dr. Leahy, do you
12 now understand where the safety margins are?

13 DR. LAHEY: I like a couple of the
14 comments and I agree with them. I like in
15 particular, the last one. We wholeheartedly
16 endorse that approach. My understanding is that
17 for one of the Indian Point reactors, and I can
18 identify if you wish, the CUF end is for the
19 pressurizer spray nozzle rapidly approaching
20 unity. And they have done what I call every
21 trick in the book but they're allowed. I mean,
22 they've done the averaging of the stresses, peak
23 averaging, et cetera, including elastic plastic
24 analysis. We had two -- that's the documentation
25 that we were sent. So we've had two people say

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1 they don't do any elastic plastic analysis.

2 But that's very different from what we
3 read. But the approach of, once you get to that
4 point which is sort of pushing the envelope, then
5 it should be a decision based on cost. And we
6 wholeheartedly embrace the thought of replacement
7 and make the problem go away versus keep
8 iterating the calculation.

9 CHAIRMAN MCDADE: Okay. And if I
10 could interject here, Dr. Lahey a couple of
11 things. One, you know, when you use the term
12 every trick in the book, we did not interpret
13 that as a pejorative term in any way. I
14 interpreted as, that there were certain
15 mechanisms that are available to them and that
16 they were utilizing the mechanisms that are
17 identified.

18 The second is, you again used the
19 term, you know, rapidly approaching unity. And
20 as we had a discussion with Mr. Sipos before
21 lunch, that that phrase originated with me. And
22 perhaps it's, since it's not necessarily
23 temporally related, getting darn close might be
24 a better, more descriptive way of doing that.

25 So rather than just simply adopting

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1 the inarticulate phrase that I used, you know,
2 would getting darn close be a, perhaps, more
3 accurate substitute?

4 DR. LAHEY: Extremely close, yes. I
5 agree, darn close.

6 JUDGE KENNEDY: And again, that is
7 darn close at end of life or today?

8 DR. LAHEY: Yes, calculated for the
9 end of life or the extended operation.

10 JUDGE KENNEDY: Thank you. In the
11 discussion that you heard from Entergy, did you
12 understand there to be any reduction in safety
13 margins or margins that you're concerned about in
14 the approach that they've taken?

15 DR. LAHEY: I mean I understand the
16 position that there's inherent margin in the ASME
17 code. All right? We do appreciate that. That's
18 from the error data. But now, they have other
19 things going on. I've described some of them.
20 The Fen factor has uncertainty. And I talked
21 about, you know, what the real situation is in
22 the plant versus the autoclave data.

23 There's a lot of things that, in the
24 end, we would like to have some understanding of
25 what the real margin is. If the only thing it is

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1 is this 20 cycles, factor 20 on cycles or two on
2 stress, okay, that's where it's known. If
3 there's other things, better yet. But we don't
4 know what it is.

5 CHAIRMAN MCDADE: Dr. Hopenfeld, did
6 you have something to add to that?

7 DR. HOPENFELD: Yes. Just as a note,
8 I took a course from the father of all the ASME
9 code, Dr. Cooper many, many years. One thing I
10 do remember, what he said was that these things
11 are not for modeling the margins that you have in
12 the code off a scanner for materials variability.
13 Some statistical as to how the stresses were
14 counted.

15 They are not for stress concentration
16 factors. They are not for the effect of the
17 environment. They are not to affect for modeling
18 or assumptions or input. This is up to the user.

19 Now according to Entergy, and I can
20 quote it, according to them, because there is a
21 margin there, a factor of two and a factor of 20
22 -- and I think they change it now. But because
23 of those factors, they can go back and the
24 analyst can come up with any model he feels or is
25 in his judgment to use and he will satisfy the

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1 code. And that is just not true.

2 There's one example because I was
3 concerned about the effect of it, was the effect
4 of oxygen on the Fen. The Argonne recommended to
5 use a certain value for a reason to which we will
6 later go into tomorrow. They said well, we use
7 this number, the result is too high. So it's too
8 conservative.

9 In other words, the word too
10 conservative is immediate tells you that what are
11 they are doing, they're really shaving the
12 margin. They are trying to get a number that
13 they want to get.

14 So what you want to do to do it in an
15 honest way, you put in your best estimate of what
16 the input is. And in this case, you're supposed
17 to use the conservative value of the input
18 because it's a deterministic method. So you use
19 a conservative value but if the result isn't, you
20 use the result whatever it is.

21 But when they see the result is too
22 high, they just say well, we changed the model.
23 That's what they do. And that's what's wrong
24 about it.

25 CHAIRMAN MCDADE: They're not just

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1 changing it. They have to --

2 DR. HOPENFELD: So you can keep on
3 going with it as long as you go back and devise
4 another model. Now stress concentration, for
5 example, there is a definite technical reason why
6 there is a synergy. And what I mean a synergy,
7 that one and one together more than one
8 separately.

9 There is a symmetry between stress
10 energy, stress corrosion cracking and metal
11 fatigue. Both for the initiation part of it and
12 for the propagation part of it. That additional
13 static stress that you have due to stress
14 corrosion cracking reduces the time of destroying
15 the oxide layer. So it needs fixing. But they
16 don't account for that.

17 This is just one example. That can go
18 to the heat transfer too. We started discussing
19 it. We'll get more into it tomorrow about
20 thermal static. Most of the previous that
21 occurred due to thermal fatigue were due to
22 stratification. And they made a lot, all of it
23 is based on models. They had lost but they don't
24 have data for 20 years which is half of a
25 lifetime of the plant.

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1 For the thermal stratification on the
2 pressurized, surge line on the pressurizer.
3 There must be uncertainties. When you have data,
4 you must have some kind of a model to come up
5 with data. You don't have thermal data so you
6 generate something. It's impossible to conceive
7 that there are no uncertainties in this.

8 CHAIRMAN MCDADE: Okay. Thank you Dr.
9 Hopenfeld.

10 JUDGE KENNEDY: One last question
11 maybe for Mr. Gray and I'm trying to this from
12 memory from the discussion this morning. I think
13 we get the point about the code driven margins.
14 And you know, I've been using the term safety
15 margins because those seem to be areas that just
16 aren't touched.

17 There are some modeling assumptions
18 and user inputs that are adjustable. Are there
19 likewise some user inputs, techniques that are
20 applied to calculate the thermal stresses that
21 are also off the table for the user?

22 In other words, the example I'm
23 thinking of that comes to mind when I hear this
24 discussion is the delta T that was applied for
25 the stratification and the way that was done.

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1 Could a user go in and change that? Could they
2 do it differently?

3 I mean, I'm sure they can. But is
4 that sort of thing that's not allowed within the
5 process that you have built at Entergy for Indian
6 Point?

7 CHAIRMAN MCDADE: And if I could add,
8 and if so, what would be necessary to justify it?

9 MR. GRAY: The delta T is an input to
10 the problem. In fact, my earlier example I think
11 might be what you're talking about. Where I
12 could look at the worst temperature difference
13 that could ever occur across the component and
14 use that for all the cycles that could ever
15 occur.

16 But when we know better and we have
17 information that tells us that it's not always
18 that high, then what would be required of the
19 analyst is to justify lower delta Ts for some
20 number of cycles.

21 And for example, that's what I
22 referred to earlier in WCAP 17199. You'll see
23 that, for example, for the charging nozzle.
24 That's what was done. The nature of the design
25 transient, its shape was not changed but those

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1 values were. And those were based on a
2 calculation and just a whole development of a
3 methodology that had to be justified and verified
4 by an independent verifier.

5 JUDGE KENNEDY: So the only rock solid
6 margins that we can point to, the untouchables,
7 would be the code based margins? I mean, other
8 than the justification of changing techniques
9 that would have to meet someone's review and
10 approval. I mean, those are all on a case by
11 case basis.

12 MR. GRAY: They are case by case.

13 MR. COX: This is Alan Cox for
14 Entergy. Let me add just a little bit to that.
15 I mean, we're talking about removing
16 conservatisms. We're not removing all of the
17 conservatisms. The analyst that's working for
18 Mark doing these calculations, when he makes
19 these changes to remove excess conservatism, he
20 still has to justify that the result that he has
21 or the input that he ends up with is still
22 conservative.

23 The one exception I can think of to
24 that might be the number of transients. Now you
25 could say we're going to use a best estimate

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1 number for transients instead of using the design
2 value. And you might say, well that's a problem.

3 Well it would be a problem except we
4 have a program that's set up to monitor the
5 number of actual transients to make sure that we
6 don't ever go over that number without taking
7 actions to address the situation.

8 So I think, you know, you never get to
9 a point where you've taken all the conservatism
10 out of these estimates. You always end up with
11 a conservative input even though it may not be as
12 conservative as where you started in the initial
13 revision of the calculation.

14 JUDGE KENNEDY: So a check and balance
15 on the reduction in conservatisms is the review
16 of the calculation? And the need for the analyst
17 to prove that the calculation is conservative
18 with the new set of inputs?

19 MR. COX: That's correct. It's
20 incumbent upon the analyst and his reviewer to
21 make sure that those assumptions are justifiable.

22 JUDGE KENNEDY: Are these calculations
23 all done under the Appendix B program for the
24 station?

25 MR. AZEVEDO: Yes, Your Honor. This

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1 is Nelson Azevedo. They're done under -- I can't
2 speak for, I'm sure the Westinghouse methodology
3 is similar to what we have at the site. So all
4 calculations are done under our 10 CFR 50
5 Appendix B program.

6 Mr. Cox stated, they're independently
7 reviewed and they're approved by a supervisor.
8 In addition to that, we have an independent
9 oversight organization. From time to time, they
10 pull these documents and they go through and they
11 verify that everything was done appropriately.

12 And on top of that, the NRC comes on
13 site and audits as well. So it's not just the
14 independent reviewer. It's the approver and the
15 on-site organization and the NRC as well.

16 JUDGE KENNEDY: Thank you. And that
17 brings up an interesting question. Maybe Mr.
18 Stevens, you've heard the back and forth on the
19 reduction of conservatisms and the redoing of
20 calculations or refinement of calculations or
21 whatever word that you want to use. From the
22 staff's perspective, is there any level of
23 discomfort in what you've heard here?

24 MR. STEVENS: No, sir.

25 JUDGE KENNEDY: So maybe to get you to

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1 expand a little bit, what raises your comfort
2 level in this discussion?

3 MR. STEVENS: This is Gary Stevens
4 with the staff. So I guess I'll reflect first
5 back to my discussion when I talked about two
6 margins and conservatism. And I said, I'll call
7 it margin one is something that's implicit or
8 explicit in the code and we can't touch it.

9 And margin two is a result of our
10 calculation and that we might be less than the
11 allowable and there's some margin left. And then
12 conservatism is simplifications we may have put
13 into the analysis.

14 And I think the testimony has been
15 pretty clear that nobody can touch margin one.
16 I guess one observation I wanted to make, you
17 know, because I think a lot of the discussion
18 I've heard is we're trying to quantify margins.
19 And in some cases we can do that.

20 I showed you factors of two and twelve
21 on fatigue curves and two and 20. So we can
22 quantify that. Section 3 tends to use a factor
23 of three against ultimate failure. We can
24 quantify that.

25 But there are other things that lead

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1 to the margin one term that can't be touched.
2 And one example that I'll give is, when you have
3 several transients you're analyzing, how you
4 combine those into paired loads for use in a
5 fatigue calculation.

6 The code is explicit on how you do
7 that and there's conservatism in that process.
8 Because from a designer point of view, you don't
9 know the order of occurrence that these loads may
10 occur in. And the code, the way, the process
11 they use is to take the worst case scenario of
12 how those loads might occur to make a
13 conservative evaluation.

14 So there's other things that go into
15 that margin one term that really can't be
16 quantified but they're explicit in the code
17 methodology. And I tried to allude to that
18 earlier when I talked about margin one and that
19 there are certain design factors as well as
20 explicit instructions in the code that lead to
21 that margin.

22 So I bring that up because what the
23 analysts can change or alter is those things that
24 contribute to margin two and the conservatism.
25 And where I can appreciate the observation that

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1 it seems like the analyst has an unlimited
2 opportunity to go back and revisit those, the
3 reality is there's not an infinite opportunity.

4 There were a finite amount of
5 assumptions that the analyst would have built in.
6 An experienced person like myself or some of the
7 other expert witnesses, it would be a function of
8 each analysis.

9 You know, they would look at an
10 analysis and, from their own experience and
11 industry experience and what they know about code
12 analysis, they would come up with a list of those
13 things that contributed to margin two and
14 conservatism such that if they were going to
15 revisit that analysis, they would pick off from
16 that list those things they could do to come up
17 with an acceptable result.

18 The staff doesn't have any discomfort
19 with that process because in the final analysis,
20 we have reasonable assurance, with our knowledge
21 of the code, the processes used, the industry
22 practices that have been adopted, that in the
23 final analysis a CUF or a CUFen of less than one
24 provides reasonable assurance that there's low
25 likelihood of crack initiation.

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1 JUDGE KENNEDY: All right, thank you.
2 I hazard to look to Dr. Lahey. One final closure
3 statement you care to make on safety margins and
4 reduction in conservatisms?

5 DR. LAHEY: Well I think that it's
6 been a good discussion. I find there's great
7 inconsistency in the discussions we had
8 associated with some of the issues I brought up
9 with nodalization, heat transfer coefficient
10 locally, that sort of thing and some other input
11 that we had.

12 They can't both be true. So that's
13 why I want to look at the record a little bit and
14 try to understand what's happening. I mean, if
15 in fact it doesn't matter what the heat transfer
16 coefficient is, there's a lot of people talking
17 about stuff that they don't have to. And a lot
18 of write up on things they don't have to.

19 And why worry about the code going
20 unstable at 8,00 BTU per hour foot square if it
21 doesn't matter? So you know, there's things like
22 that. But by and large, I think it was a
23 reasonable discussion.

24 I want to say again -- I know for the
25 people who have been here all the time, it seems

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1 like a long time now, three days. My overarching
2 concern is not that you just cycle this baby
3 until you get a crack. I mean, that's something
4 we have to worry about.

5 But I'm really concerned about the
6 weakening of the material as you cycle it. And
7 at some point in time, you get a significant
8 shock load which causes failure. And if that
9 leads to a uncoolable geometry, we're in big
10 trouble.

11 So I've merged all my silos with
12 embrittlement, fatigue, and safety analysis. And
13 hopefully, future meetings like this will involve
14 it all. I noticed from day one, our discussion
15 sort of covered everything. And that's a big
16 change from when we started. Where we were told,
17 look that has nothing to do with fatigue. You
18 know, you're talking about embrittlement.

19 So I think we've made some progress.
20 And I think in the right direction. And I
21 appreciate the opportunity to participate.

22 JUDGE KENNEDY: All right, thank you.
23 Dr. Hopenfeld, last words?

24 DR. HOPENFELD: I'd like to make a
25 couple of words regarding conservatism. We can't

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1 just talk about conservatism. There must be some
2 kind of a test to see what that really means. I
3 can tell you what it doesn't mean.

4 It definitely doesn't mean that
5 counting the number of that you repeat in your
6 report, that you are conservative almost every
7 second setting, that that is the proof that you
8 are conservative. That is not proof that you are
9 conservative.

10 So I would like to know when they keep
11 on saying that they are conservative, that all
12 their models, all their assumptions, even the
13 over simplified model are all conservative, the
14 inputs they used are conservative and Entergy, I
15 mean NRC agrees with that. I'd like to know
16 where is the test? Where is the verification of
17 that? What's the philosophy behind it that you
18 can show me yes, this is conservative.

19 And the reason it's important, because
20 going back to what I said at the beginning, the
21 CUFen are calculated, that's a deterministic
22 calculation. The ASME requires you, that the
23 burden of proof is on them, not on us. They have
24 to defend it, not just say well, I'm
25 conservative, the analyst thinks that this is

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1 fine. That is not enough.

2 And as regulations say, you have to
3 verify it. And I don't believe that NRC, from
4 what they have testified here, that they verify.
5 They do not verify it.

6 JUDGE KENNEDY: All right. Thank you
7 Dr. Hopenfeld. Maybe a question for, certainly
8 related to the revision of the CUFen calculation.
9 On Page 66, Dr. Lahey, of your pre-filed
10 testimony which is New York State 530, you raised
11 some concerns with these revised calculations.

12 Two things caught my eye. One is you
13 had concerns related to the use of modified
14 design transients and 60 year projected cycles.
15 I guess first of all, what do you mean by
16 modified design transients? And what's the
17 problem with their usage?

18 DR. LAHEY: I don't actually recall
19 the quote. But I think we did talk about the
20 number of transients and that we have a track
21 record. It seems right to me, if you know what
22 the various transients are, to take advantage of
23 it.

24 But you have to also remember that you
25 have to extrapolate that out for 20 more years.

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1 And so, you can't always tell when you're going
2 to get a scram or some other event like that. So
3 there has to be some margin built in.

4 And I take it from what I've seen,
5 they've tried to preserve that. They've tried to
6 do it.

7 JUDGE KENNEDY: Does it provide you
8 any comfort that they're also monitoring these
9 transients continuously?

10 DR. LAHEY: Yes, that's what I said.
11 I think it's good to take advantage of what's
12 happened historically, monitor it, you know, do
13 a guesstimation of what it's going to be in the
14 future, monitor it and then take whatever action
15 you have.

16 And let me say why. Because we have
17 a couple of components that I'm seriously
18 concerned about. One we talked about that has
19 already gone into the elastic plastic analysis so
20 you're beyond the yield curve.

21 And the other one is your RHR
22 accumulator, low pressure injection, intermediate
23 pressure injection nozzle. So this particular
24 nozzle is, I won't say rapidly approaching one,
25 but darn high in CUF. And if it fails, you not

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1 only create a loss of coolant accident, but you
2 knock our your accumulator, you knock our several
3 of your engineering ECC system, emergency core
4 coolant system.

5 If you want to fail something, that's
6 probably the worst thing to fail. And so I think
7 it's very incumbent upon us to make sure we don't
8 push that margin too hard because there's some
9 consequences for those kind of failures.

10 JUDGE KENNEDY: I understand your
11 concern but is not, at least as I understand it,
12 all the current cumulative usage fatigue values
13 at Indian point less than one, project to the end
14 of life today?

15 DR. LAHEY: They are. Some of them
16 are hard to get to. All right? I don't want to
17 say pulling all the tricks out but you've had to
18 do a lot of things to get there.

19 JUDGE KENNEDY: All right, thank you.
20 Another question for you, Dr. Lahey and I think
21 it, well it comes out of your testimony. And I
22 guess we may have to go to Entergy to get the
23 answer. But you raised a question about the FEN
24 values used for two similar reactor coolant
25 system pressure boundary components. That for

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1 IP2, they have one value and for IP3, another
2 value.

3 And I think you raised the concern of
4 why that would be. And I guess I don't have an
5 explanation but I'm hoping that Entergy does.

6 DR. LAHEY: Let me tell you my guess
7 and they can tell you what really happened. I
8 think it's part of the game. They found in one,
9 they didn't have to be any lower so they left it
10 what it was and it wound up less than one. On
11 the other one, that wouldn't do it so they did
12 some averaging of strain rate or some other way
13 to reduce it and they reduced it. Maybe I'm
14 wrong, but I think that's just a reflection of
15 this iterative game.

16 JUDGE KENNEDY: I guess --

17 CHAIRMAN MCDADE: Can we substitute
18 part of the analysis for part of the game?

19 DR. LAHEY: What's that?

20 CHAIRMAN MCDADE: Can we substitute
21 part of their analysis?

22 DR. LAHEY: Yes, sir.

23 CHAIRMAN MCDADE: To part of their
24 game?

25 DR. LAHEY: Right. It's so much fun

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1 to do stress analysis, I can tell you.

2 JUDGE KENNEDY: I may not have been
3 clear on my question. I think you pointed to the
4 FEN values for these components. That you
5 indicate they differ substantially and you don't
6 understand why they would between IP2 and IP3.
7 And unfortunately, I didn't write down what this
8 component was. It's on Page 28 of New York State
9 568. Maybe we could look it up. I don't know.
10 Andy, is it something you could put up? 28 of
11 568, New York State.

12 DR. LAHEY: I have to get the -- oh
13 you're going to put it up? Okay. Is that not it
14 Andy, or was it? It's 568 which -- is it Dr.
15 Lahey's supplemental pre-filed testimony on the
16 cover?

17 567 has -- specifically 567, Page 28
18 it makes, for example, for the RHR accumulator
19 nozzle fatigue analysis for IP2, it has a FEN of
20 13.8 and for IP2, 7.79 for IP3.

21 DR. LAHEY: So I gave you my guess as
22 to why but I'd love to hear what the real reason
23 is.

24 MR. GRAY: May I offer an answer to
25 that?

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1 JUDGE KENNEDY: Answers are good.

2 CHAIRMAN MCDADE: We hope so.

3 JUDGE KENNEDY: Go ahead.

4 MR. GRAY: Yes. I think it's a
5 misunderstanding of the value that's in the table
6 in the report. The process that's used to
7 calculate the CUFen is using what the new regs
8 call the modified rate approach. The modified
9 rate approach actually calculates an integrated
10 Fen based on the details of the stress cycle
11 history for every fatigue pair.

12 And so, there's an integration done --
13 and this is described in our WCAP, of how that's
14 performed. There's an integration done for the
15 stress cycle applying the Fen equations for each
16 one of the fatigue pairs that are then summed to
17 give you a cumulative answer.

18 The details of all of that aren't,
19 they're in the calculations but they're not in
20 the final report. So that Fen is an effective
21 Fen that you get from dividing the integrated
22 CUFen that you did with that complicated process,
23 divide that by the CUF before you did that. So
24 that's an overall effective Fen.

25 So when you do that process for the

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1 two different units, the inputs for the two units
2 are different. They're a different number of
3 cycles of different transients. Different
4 transients will pair causing different strain
5 rates to be used in those integrated processes.

6 So because they're a different number
7 of cycles of different transients and all of
8 those different fatigue pairs, it's very
9 conceivable that you're going to get a final
10 answer that's different. And then when you
11 couple that with the fact that because the cycles
12 are different, the CUF without the environmental
13 factor, those were also different, that overall
14 effective ratio is going to be different.

15 JUDGE KENNEDY: So it comes down to
16 different transients for the two different
17 plants? Different operating history?

18 MR. GRAY: Yes.

19 JUDGE KENNEDY: Dr. Lahey, does that
20 help?

21 DR. LAHEY: Yes, I understood that.
22 I mean, sort of, I view Fen as an environmental
23 correction factor and it depends on various
24 variables like oxygen content. So I'm not sure
25 how all that is consistent but I understand what

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1 they've done.

2 JUDGE KENNEDY: Thank you.

3 CHAIRMAN MCDADE: Okay. Just a follow
4 up. I mean, on the face of it, it would seem
5 like these two would be relatively close given
6 the relatively similar history of the plants.
7 They would both have the same, basically the same
8 water chemistry program. Although IP2 went
9 online earlier, would have more transients. But
10 wouldn't it, why is the number so different? Mr.
11 Gray?

12 MR. GRAY: Mark Gray for Entergy.
13 This is mostly going to be a function of the way,
14 not only how long the plant ran but the way the
15 plant was operated. And especially on these
16 nozzles, you could have more safety injections,
17 for example, at the beginning in life from
18 testing or whatever other phenomena could happen
19 in the operation of the plant. So yes, these
20 things can be variable from unit to unit.

21 CHAIRMAN MCDADE: Okay. And there
22 would be a sufficient difference in the way the
23 plants were operated to, you know, explain the
24 significant difference or at least the size of
25 the difference between the two?

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1 MR. GRAY: Yes, there could.

2 CHAIRMAN MCDADE: Okay.

3 JUDGE KENNEDY: Entergy, in responding
4 to Dr. Lahey's interest in having an error
5 analysis performed, you responded that the EAF
6 calculation is deterministic and therefore, an
7 uncertainty analysis is not required. What do
8 you mean that the EAF analysis is deterministic?
9 And I'll take anybody.

10 MR. GRAY: Mark Gray for Entergy. The
11 term deterministic is in opposition to a
12 probabilistic method where in probabilistic
13 methods, error analyses are more appropriate and
14 often done. And deterministic approach, as we
15 have already discussed, chooses inputs that are
16 chosen to be conservative inputs to give you
17 conservative outputs.

18 JUDGE KENNEDY: So the uncertainty in
19 various parameters is dealt with by selecting
20 conservative inputs? Is that what you're saying?

21 MR. GRAY: The worst case or bounding
22 value, yes.

23 JUDGE KENNEDY: So by properly
24 selecting conservative inputs, you're suggesting
25 that an error analysis is unnecessary?

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1 MR. GRAY: Yes.

2 JUDGE KENNEDY: Dr. Lahey?

3 DR. LAHEY: Well I think we discussed
4 that in great detail this morning. And
5 hopefully, I allayed their fear that I was not
6 looking for a probabilistic analysis. What's
7 called an error analysis is this propagation of
8 error type of uncertainty analysis that you apply
9 to best estimate or such things.

10 And I gave the example of power equals
11 I square R. So everything's deterministic but it
12 gives you a measure of the uncertainty in the
13 prediction.

14 JUDGE KENNEDY: Do you feel that the
15 approach that Entergy has taken in performing
16 these calculations by using conservative
17 assumptions sufficiently covers the uncertainty
18 in the inputs?

19 DR. LAHEY: No, Your Honor. I still
20 have no clue as to what the margin really is. As
21 they get up very close to unity, I don't know
22 what the margin is compared to a best estimate
23 plus uncertainty. Is it more or less? I mean,
24 are they really where they think they are? Or
25 are they on the other side of the line?

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1 JUDGE KENNEDY: Thank you.

2 JUDGE WARDWELL: Can I interject some
3 additional for Mr. Gray if I might? I believe
4 your quote was, an uncertainty analysis is not
5 required for a deterministic evaluation. That
6 isn't necessarily an error propagation analysis,
7 is it? As was highlighted in our earlier
8 discussions looking at the cartoon that Dr. Lahey
9 had put up.

10 MR. GRAY: Mark Gray from Entergy. My
11 interpretation is that those would be synonymous
12 terms.

13 JUDGE WARDWELL: The error
14 propagation, as was discussed earlier, isn't that
15 almost limited to deterministic analyses? You
16 wouldn't need to do that with a probabilistic
17 uncertainty analysis, would you? It's just the
18 opposite of what you're stating it seems to me.

19 MR. GRAY: I don't see the connection
20 you're making, no.

21 JUDGE WARDWELL: Dr. Lahey?

22 DR. LAHEY: You're correct Your Honor.

23 JUDGE WARDWELL: Thank you. I'm not
24 thanking you saying I'm correct. I just wanted
25 to make sure what your opinion was.

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1 MR. COX: Alan Cox for Entergy. I'd
2 like to add one point. I mean, when we talk
3 about an error analysis, I mean what we're doing
4 with the approach that we're using for these
5 analyses, I want to say we're intentionally
6 introducing errors in the conservative direction.

7 So it's not clear to me how you could
8 get any benefit from an error analysis when
9 you've intentionally not chosen the best estimate
10 values. You have erred on the conservative side
11 in all of your inputs. So what, you know, I see
12 limited value in doing an error analysis when
13 you've intentionally skewed your results in that
14 direction.

15 JUDGE WARDWELL: Well okay. Let's
16 talk about that a bit then. Why couldn't you
17 come up with a best estimate, a best guess of
18 what you think the actual CUF calculation should
19 be? Is there any reason why you couldn't do
20 that?

21 MR. COX: Well I think Mr. Gray talked
22 about that a little bit this morning. It would
23 be a difficult task because of all the --

24 JUDGE WARDWELL: Regardless of the
25 difficulty. I understand why you may not want to

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1 do it. I'm interested in, could it not be done?
2 That is taking your best guess at all your input
3 parameters of what truth is.

4 MR. AZEVEDO: This is Nelson Azevedo
5 for Entergy. Yes, Your Honor, you could do a
6 best estimate analysis.

7 JUDGE WARDWELL: So by definition,
8 that best guess is your best guess with what
9 would be taking place there. And those input
10 parameters, even though you still have that, will
11 have some plus or minus associated with that.
12 Would that not be correct in some of the cases?
13 They're not absolutes.

14 MR. AZEVEDO: Well Your Honor, the
15 difficulty comes in how you quantify that. I
16 mean, if you have --

17 JUDGE WARDWELL: I fully understand
18 the difficulty. Don't get me wrong. I'm not
19 saying you should necessarily do this. But I'm
20 countering your testimony that says uncertainty
21 analysis isn't good for deterministic. And that
22 I understand. But I don't think that's the same
23 as an error propagation where it's only limited
24 to basically, deterministic analyses where you're
25 taking the error bars around a parameter input

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1 that you have and then seeing how that
2 propagates. So that you can have an estimate of
3 what is the total plus or minus once you're done
4 through your calculations. And I'm just saying,
5 could not that be done?

6 MR. AZEVEDO: This is Nelson Azevedo
7 for Entergy. Yes, Your Honor, it could be done.
8 Personally, I don't see how that would be
9 different from what we already do which we take
10 the penalty up front by assuming conservative
11 values and then just do it that way. Also, if I
12 may add --

13 JUDGE WARDWELL: Can I? Save your
14 thought because I want to address that comment
15 first and then give me your next comment.
16 Because you'll lose me and I'm going to put the
17 burden on you to remember what you were going to
18 say rather than me trying to remember when I'm
19 going to ask you a question on your first
20 statement. So I cheat because I've got the
21 gavel. Or he's got the gavel and will let me use
22 it.

23 Isn't the difference that with doing
24 it up front, when you get to the very end and you
25 have a number, you don't know what the plus and

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1 minus is around that number. Where if you did it
2 the other way, you would at least have some
3 estimate of what that might be. Would not that
4 be the case?

5 MR. AZEVEDO: That is true. We don't
6 know what the delta. However, what we do know is
7 that whatever that number is, its below what we
8 calculated.

9 JUDGE WARDWELL: Yes. And you know
10 that in both too. But I just, I wanted -- so you
11 do agree that at least there is some difference
12 because you at least have some estimate of that
13 number?

14 MR. AZEVEDO: Yes, I do agree.

15 JUDGE WARDWELL: Now what was your
16 second comment? And I hope you forgot it because
17 then I don't have to worry about it.

18 MR. AZEVEDO: What I was going to say
19 is both the paper that's referenced by New York
20 State on this issue and other papers that I've
21 looked at and on the internet, this idea of
22 propagation of error in similar evaluations are
23 really applicable to random data.

24 Like if you're doing a test, you're
25 collecting a lot of data and you want to analyze

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1 the data. This is definitely appropriate. In
2 this case, I really don't see how that's
3 appropriate.

4 JUDGE WARDWELL: Thank you. That's
5 helpful.

6 DR. LAHEY: Your Honor, that is really
7 incorrect statement. This is not for random
8 data.

9 JUDGE WARDWELL: Do you have a comment
10 on that Dr. Leahy?

11 DR. LAHEY: It's craziness, what you
12 just heard.

13 CHAIRMAN MCDADE: Do you want to
14 elaborate on that Dr. Leahy? You said this is
15 not random data.

16 DR. LAHEY: No. I think the real
17 confusion was -- I mean, I've been asking for
18 what's the uncertainty, what's in their analysis
19 for a long time. And I thought sort of everybody
20 knew what that meant. But apparently not because
21 when I send a reference, a book that we use at
22 university in sophomore level so people know how
23 to treat random data, how to treat deterministic
24 predictions with plus or minus uncertainty.

25 The comment that came back is we don't

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1 deal with random data, we do deterministic
2 calculations. So I thought okay, let's try it
3 again. And so finally, you know, I sent them the
4 formula. And so I don't see why they're still
5 thinking it's random data.

6 What I'm talking about is a
7 deterministic calculation. And then you have a
8 process which is called propagation of error.
9 Kline and McClintock goes way back in time, been
10 used for decades. And it will allow you to work
11 out what the plus or minus uncertainty is.

12 It's wide used by experimentalists.
13 That's how you get the error bars on your
14 experimental data. So it has nothing to do with
15 randomness.

16 CHAIRMAN MCDADE: Can you explain in,
17 say a minute or less, what a propagation of error
18 analysis would consist of?

19 DR. LAHEY: I didn't write it. Do you
20 want me to write it?

21 CHAIRMAN MCDADE: No. Just explain
22 it.

23 DR. LAHEY: It's the partial
24 derivatives. You have a function of a bunch, the
25 result is a function of a bunch of variables. So

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1 CUF N depends on a number of things. So you take
2 the partial of CUF N with respect to the first
3 variable times the uncertainty in that. All
4 right? You square it. Plus the partial of CUF
5 N with respect to the next variable.

6 CHAIRMAN MCDADE: And how do you
7 determine the uncertainty in each of these?

8 DR. LAHEY: It depends on what the
9 variable is. You know, depending on the
10 variable, you have information as to the
11 uncertainty.

12 For example, if you did a best fit
13 calculation, one of the parameters you'd have in
14 there would be the Dittus-Boelter correlation.
15 The Dittus-Boelter correlation has a plus or
16 minus uncertainty of 25 percent. So that would
17 be what you'd use there.

18 You go to the next variable that
19 they're using. What's your uncertainty in flow
20 rate, et cetera, et cetera. And you add them all
21 up and then you wind up with this final estimate
22 of the uncertainty. That's wide used.

23 The assumption behind it is you have
24 independent errors or independent errors in these
25 parameters. If you have couple errors, then

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1 there's another formula which has second
2 derivatives we could talk about. But this, I
3 think, would be a very useful exercise because
4 for the first time, we can see how they, where
5 they are when they're up against the limit.

6 Is there significant margin? If that
7 error bar is below the limit line, I for one am
8 pretty comfortable.

9 CHAIRMAN MCDADE: Okay. To Entergy,
10 in light of the way Dr. Lahey just explained the
11 propagation of error analysis as he understands
12 it and believes that it's documented. What does
13 that, what is random data? How does that fit in
14 or affect that?

15 MR. AZEVEDO: Well Your Honor, this is
16 Nelson Azevedo for Entergy. The basis for my
17 statement is New York State 347, Page 311. And
18 in the middle of the page, it says propagation of
19 error formulas. For 5.58, 5.59 and the box
20 starts, if X, Y, and Z are independent, random
21 variables and G is well behaved. So that's where
22 it comes from, from New York State Exhibit 347.

23 DR. LAHEY: So maybe I shouldn't have
24 used the word random. They're independent
25 variables. They're uncorrelated variables is

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1 what I meant.

2 CHAIRMAN MCDADE: Okay. But the
3 question is, in a deterministic analysis, why is
4 Entergy not doing a propagation of error
5 analysis?

6 MR. AZEVEDO: This is Nelson Azevedo
7 again. Again Your Honor, because we feel that
8 the conservative assumptions that we're making by
9 assuming conservative values bounds the problem
10 that we're solving. So doing a -- personally I,
11 maybe somebody else in the Entergy panel can
12 speak to.

13 But personally, I don't know how to
14 calculate these kinds of errors in a
15 deterministic manner. I know in a probabilistic
16 manner.

17 MR. STROSNIDER: This is Jack
18 Strosnider for Entergy. I have some experience
19 in performing probabilistic assessments of
20 structural integrity issues. So my perspective
21 on this -- and I think there may be some
22 semantics here.

23 But I think in the first case, when
24 you talk about a propagation of error analysis,
25 as Dr. Leahy said, that's typically the way

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1 experimentalists, that's what they talk about
2 doing. And it has to do with measuring. All
3 right? Measurement errors and the various, the
4 variables in an experiment that you're measuring
5 and how you propagate those errors through the
6 measurements.

7 If you want to look at a structural
8 analysis from an uncertainty point of view, what
9 you would do is a probabilistic assessment which
10 means that each variable in the analysis, you
11 treat as a random variable and then you put
12 together a distribution.

13 And that's one of the challenges here,
14 is if you really want to do an uncertainty
15 analysis on a structural evaluation, you need a
16 distribution. You need to know the shape of the
17 distribution, you need to know the parameters of
18 the distribution. And then you can go -- and you
19 need to know their dependencies, if there are
20 any.

21 Then you can go through and you can do
22 an analysis. And when you want to understand the
23 uncertainty in that, you do that by performing
24 sensitivity studies and by doing calculations,
25 for example, to look at confidence intervals

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1 based on the amount of data that you have and
2 those sort of things.

3 It's a very sophisticated analysis,
4 not easy to do, to collect all that information
5 and do it properly. Now when you look at the
6 deterministic analysis, you're taking each one of
7 those random variables, you're making an
8 assumption about what that variable is.

9 Typically and as explained in this
10 case, a conservative assumption. And you run
11 your analysis with that. One insight I want to
12 share is that what you typically find, any time
13 you compare deterministic analysis with a true
14 probabilistic assessment where you assess the
15 uncertainties.

16 If you look at, for example, a 9595
17 confidence level on an outcome from a
18 probabilistic assessment of a structure, it is
19 almost always lower than the numbers that you get
20 when you do the deterministic analysis and assume
21 all those bounding values.

22 When you assume all the founding
23 values as they're doing in these analyses, you
24 come out with things that are very, very high
25 confidence levels, 9999 kind of stuff which, you

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1 know, typically what's used in these in these
2 structural evaluations is 9595. That's what the
3 NRC has found as acceptable.

4 So I don't know if that helps. But I
5 think that's the range of the type of analyses
6 that you can do. There's no -- to come back to
7 doing this sort of uncertainty analysis which
8 would probably be the more appropriate. You
9 know, if you were going to do something, that
10 would probably be what you want to do.

11 First of all, there's no requirement
12 for it. The experience shows that when you do a
13 deterministic analysis with bounding values, that
14 you're going to come out with higher confidence
15 levels than you would by doing the random, you
16 know, the random probabilistic assessment.

17 And I just want to come back one more
18 time to re-emphasize that the margins that are
19 established in the regulations and the margins
20 that are established in the ASME code, those
21 things are not put in there lightly. All right?

22 There's a lot work. The ASME code is
23 a consensus code. You've got some of the best
24 people in the country. You've got the NRC
25 participating. And they're looking to put the

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1 right levels of conservatism in those
2 evaluations. And the NRC doesn't put it into
3 regulations until they have it there.

4 So I don't know if that's helpful.
5 But like I said, I've done probabilistic risk
6 assessments on pressure vessels and piping and
7 steam generator tubes. You know, when you do the
8 deterministic analysis, it comes out with a
9 higher confidence level than these other types of
10 evaluations. That's what you typically find.

11 CHAIRMAN MCDADE: Okay. And Dr.
12 Lahey, as I understand what your concern here is,
13 is that in the absence of a propagation of error
14 analysis, it's not possible to quantify with any
15 degree of certainty, the margin of error. And
16 that therefore, you are not sanguine that the
17 conservatives built in are adequate to ensure,
18 provide reasonable assurance with regard to the
19 continued viability of the component. Is that
20 correct?

21 DR. LAHEY: Yes. What I'm looking for
22 -- yes sir, it's correct. I'm looking for some
23 indication that the margin that they think is
24 there is really there. This is one idea to do
25 it. I don't disagree you can do a more

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1 sophisticated analysis. But that isn't what I
2 think we need to do here.

3 Rather, I think we should assume, in
4 the best estimate, the ASME code is there. All
5 right? So you take care of that there. Same in
6 your limit line. And then all the other
7 parameters that affect the CUF end, those are
8 things that you can get either analytically with
9 the derivatives or numerically by running it with
10 different ones and dividing it by the same and
11 you get the numerical derivative. All right?

12 It's a very doable thing and it would
13 give a lot of confidence in terms of where we're
14 at.

15 CHAIRMAN MCDADE: And Mr. Azevedo, as
16 I understand the position of Entergy is that
17 given the margins that are built into the code
18 and given the conservatives that are also present
19 in your analysis, that you are satisfied that
20 even with these adjustments, there are sufficient
21 margins and conservatives left that were not
22 close to falling out of, you know, that they
23 still provide reasonable assurance. And they do
24 it by, with a significant degree of reliability.

25 MR. AZEVEDO: Yes Your Honor, I agree

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1 with that.

2 CHAIRMAN MCDADE: That's your
3 position?

4 MR. AZEVEDO: Yes it is.

5 CHAIRMAN MCDADE: Okay. And Dr.
6 Hiser, Mr. Stevens, what's the view of the NRC
7 with regard to this?

8 MR. STEVENS: This is Gary Stevens of
9 the staff. I think I can point you to a couple
10 things in our testimony and in the exhibits
11 that'll help out with this. First I'll say that,
12 you know, the code approach that's being used to
13 calculate CUF is not unique to that.

14 There are many other integrity
15 evaluations that are done using code throughout
16 the regulation that are consistent. And the
17 intent is to use bounding values of inputs that
18 lead to very conservative results. That's the
19 definition of a deterministic evaluation.

20 I support the testimony regarding
21 probabilistic. But if I go with the flow here,
22 and I think what I'm hearing is what happens if
23 I tweak some of the inputs in the analysis? How
24 much does it affect the analysis?

25 And as you heard Entergy testify

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1 earlier in response to Dr. Wardwell's question,
2 yes it's possible to do that. It's very
3 difficult but it's possible. And in fact, over
4 the course of the history of the industry, there
5 have been some attempts to do that.

6 I'm going to refer you to our
7 testimony, Answer 163 on Page 177 of NRC 168. As
8 you can imagine, some of these analyses get quite
9 complicated. And the number of inputs you could
10 potentially adjust for best estimate is large.

11 Our testimony here talks about
12 adjusting one of the those which is the input
13 loading. There's been many studies and we point
14 out one, or actually two here, that looked at
15 instead of using bounding design basis
16 transients, what's the effect on CUF if we use
17 best estimate transients like those actually
18 experienced in a plant?

19 And so, if you will, the analysis
20 that's cited here which is in NRC Exhibit 175.
21 It's a 1973 pressure vessel and piping technical
22 paper. That was an example of analysis that
23 looked at, if all I did in the evaluation was to
24 change the transient definitions to best
25 estimate, what happens?

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1 And what's been shown for more than 30
2 years now throughout the industry, that has a
3 very overwhelming effect on CUF. It drops by as
4 much as two orders of magnitude. What you get
5 from these studies -- and there was also some in
6 new Reg CR6260. I don't have the exhibit number
7 for that off hand. It is one of the exhibits.

8 Similar things were done where they
9 looked at not only transient severity, but some
10 other inputs. And I'll put it in, they looked at
11 best estimate type adjustments to those. And
12 what you conclude from this wealth of experience
13 is that when you look at best estimate
14 evaluations of CUF, it drops substantially, if
15 you will, the delta bar down from what we're
16 calculating is orders of magnitude.

17 And what you conclude from those is
18 that the calculations we're doing are very, very
19 conservative. And if we were to go down the path
20 of doing an error propagation analysis, we in
21 fact would show that we have is very
22 conservative.

23 So I would direct you to our testimony
24 there. And that is just one example of how the
25 industry has looked at best estimate types of

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1 estimates of CUF and the impact of that and what
2 those errors might be.

3 CHAIRMAN MCDADE: Okay. Thank you Mr.
4 Stevens.

5 JUDGE KENNEDY: All right, thank you.
6 Moving on a bit, moving away from uncertainties
7 and margins. I have a couple questions for Dr.
8 Hopenfled. On Page 4 of your pre-filed testimony
9 which I believe is Riverkeeper 142, you raised
10 concerns about failing to consider the impact of
11 dissolved oxygen in the refined fatigue
12 evaluations.

13 First of all, is this in regard to the
14 environmental assisted portion of the
15 calculation?

16 MR. HOPENFELD: Yes, in regard to the
17 calculation of the Fen.

18 JUDGE KENNEDY: Relative to the Fen?
19 Is that what you said?

20 MR. HOPENFELD: The Fen, yes.

21 JUDGE KENNEDY: It appears to me that
22 the equations that Entergy's used for adjusting
23 for environmental factors accounts for dissolved
24 oxygen. Do you agree with that?

25 MR. HOPENFELD: No.

1 JUDGE KENNEDY: And why don't you
2 agree?

3 MR. HOPENFELD: The equation they're
4 using I agree. But how they use the equation, I
5 don't.

6 JUDGE KENNEDY: Okay. So the equation
7 is capable of accounting for dissolved oxygen?

8 MR. HOPENFELD: Oh sure.

9 JUDGE KENNEDY: Is that what you're
10 saying?

11 MR. HOPENFELD: Yes.

12 JUDGE KENNEDY: But Entergy, in their
13 calculations are not properly accounting for the
14 dissolved oxygen?

15 MR. HOPENFELD: That's correct.

16 JUDGE KENNEDY: And why is that?

17 MR. HOPENFELD: Okay. This is an
18 important subject and I feel that, from the
19 testimony that Entergy provided and NRC, they
20 don't understand how that Fen was obtained. So
21 give me a minute or second just to go through it.

22 These tests were conducted in the
23 little autoclave, like 20 gallon, little system
24 where the water was circulating. The
25 measurements temperature, the measurement of

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1 oxygen were extremely accurate. They were taken
2 all the time. They knew exactly what happens at
3 the surface with the oxygen.

4 So when the measurements of oxygen was
5 taken, that reflected what happened with oxygen.
6 Because this was a very small, small tiny little
7 system. The water was pure, everything was
8 clean, everything was known. And imagine if
9 there were billions. They're not using
10 continuous online but almost continuous online
11 measurements.

12 Now what they said, what Entergy says
13 or it's their perception that the Fens, as they
14 were generated in these little tests, are
15 directly applicable to the reactor system.
16 Because everything in the Fen that was measured
17 is really is directly applicable to the coolant
18 chemistry of the reactor. And this is absolutely
19 not true.

20 Again, what you are measuring, what
21 you're supposed to do in calculating the Fen,
22 you're supposed to put as specified by Argonne --
23 and they know what's involved in them, they ran
24 the test. They know what you have to do.

25 And what they specify that you have to

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1 calculate, you have to put it into the equation
2 the -- for carbon steel you have to put the
3 maximum oxygen during the transient. For
4 stainless steel, you have to put the minimum
5 oxygen you extract.

6 Now, they realized that we don't know
7 that. There's no mention of it. Nobody sits
8 there. In the plant, you measure the oxygen in
9 the bulk, sometimes for the sampling, which also,
10 you have to have a lot of correction. You do it
11 maybe once a week. I don't know how often they
12 do it but they don't do it during the transients.

13 So what Argonne has done and EPRI too,
14 they specified look, if you don't know what it
15 is, here's a guideline, use Form 4. And Entergy
16 looks at it and said, .4, I get numbers larger
17 than one if I use that. That is too
18 conservative.

19 In other words, what I'm saying, when
20 they talk about conservatism, they're not talking
21 about conservatism. They're talking a number
22 that they can adjust. And they're going to quote
23 something conservative that's not conservative.
24 The number they get to find an answer they want.

25 Now Argonne was very specific as to

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1 what number should be used during the transient.
2 EPRI was very specific. And they said no, we
3 don't have to worry about that because all we
4 have to do is use the steady state concentration
5 during the transient.

6 But this has nothing to do with what
7 happens at the surface. It's completely two
8 different animals. Furthermore, now somebody at
9 Westinghouse probably understood the problem.
10 And what he did and he realized it -- and from my
11 testimonies, I think other people in the country
12 realize the problem.

13 It's not a simple thing to do, the way
14 they are rationalizing it. What the person from
15 Westinghouse -- I spent three or four pages on
16 that. They said, look we know oxygen gets into
17 the system during the heat up period. And when
18 it gets in there, however, look at the equation.

19 The equation, it doesn't matter. In
20 other words, he's saying and then he calls down
21 and say, well the equation says that if the
22 oxygen -- when it gets in there, that a
23 temperature of 150 then the term in the
24 exponential cancels out and it doesn't matter.
25 And this is true.

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1 But then he says it doesn't matter.
2 He says well but, we have proven an assumption.
3 Because originally, they made an assumption that
4 oxygen is .05. What they said that we have
5 proven with this equation that oxygen in the
6 plant is .05.

7 That's equivalent to saying that you
8 can have some equation that was the Fen equation
9 that was done in laboratory as predicting its own
10 input. That's exactly what it says. And then
11 they extended that to the case that where they
12 applied zero oxygen throughout the transients.

13 Now I have asked, we've asked for the
14 last four or five years, please give us data on
15 the transients during the heat up and cool down.
16 We never got the answer. And I know there is
17 such a thing because EPRI produced such data for
18 BWRs.

19 And you can see that during the
20 transient, the oxygen changes by orders of
21 magnitude as the temperature changes. Now the
22 first criticism that we got was, well this is not
23 up to us because this is high oxygen, this is
24 BWR.

25 It was the principle that I was

1 showing. During the transients, things change.
2 Argonne, EPRI, all specified you have to account
3 for oxygen during the transient and you have to
4 use the maximum value. Well they say now the
5 maximum value is .005 which is the steady state
6 value. But that has nothing to do with the
7 transient.

8 Now I don't know the physics of it, of
9 oxygen mechanism during the transient for a
10 particular component. This is not, I hope so,
11 this is not a tiny little system about that size.
12 In comparison, it's smaller than that. But you
13 can get and you can see everything.

14 You're measuring and you say, well
15 that's what's going to happen somewhere in the
16 reactor vessel. These are two different animals.
17 And they keep coming back to it and using .005 in
18 the calculations. So when I put the number of .4
19 ppm which Argonne recommended, it's not my
20 number. I cannot put a factor of five on the Fen
21 which translates the factor and the CUF.

22 So you see, when I was telling you
23 this morning that uncertain in the Fen which is
24 a factor of three. That's just inherent
25 uncertainty of expressing the experimental data.

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1 That's all it is. That's in there, you can't get
2 away from that.

3 In addition to have, you have these
4 input calculations. Now if you go back -- if
5 they want to do a deterministic analysis, do you
6 say, look I don't know what the oxygen is but
7 it's my responsibility to look at the end point.
8 No matter what, even if I don't know, if you
9 would happen to describe it, I have to use .4.
10 That's what they're telling me that's an end
11 point.

12 But the person from Entergy looked at
13 it and said oh we're not going to use that,
14 that's too conservative. So you see, they choose
15 what conservatism that goes back to the modeling.

16 JUDGE KENNEDY: So Dr. Hopenfeld, your
17 concern is they're not using a proper transient
18 based dissolved oxygen content?

19 MR. HOPENFELD: I am concerned that
20 during the transient, they should be using,
21 during the transient they should not be using the
22 steady state value of .005. They should be using
23 the number that was specified by Argonne, the
24 people who designed and ran these experiments.
25 That's what they should be using instead of just

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1 I will use something that, theoretically, it was
2 calculated that we are running, that the reactor
3 runs at .005 during the transient. That's just
4 not true.

5 JUDGE KENNEDY: So the recommendation
6 of EPRI and the Argonne people is to use .4?

7 MR. HOPENFELD: Correct.

8 JUDGE KENNEDY: For this parameter if
9 you don't know the transient values?

10 MR. HOPENFELD: Yes. Take a look at
11 NUREG-6905. Hopefully I remember this, at 85.
12 Okay. 6909, I'm sorry, at A5.

13 JUDGE KENNEDY: Page 85?

14 MR. HOPENFELD: A5. A, it's Appendix
15 5 on the bottom.

16 JUDGE KENNEDY: All right, thank you.
17 Entergy, do you have a response to the transient
18 issue here, the issue with the transient
19 dissolved oxygen?

20 MR. COX: This is Alan Cox. Let me
21 start out and some of my colleagues may want to
22 jump in here. But the first point I'd like to
23 make is we're not using the steady state value.
24 We're using a value that is an order of magnitude
25 higher than the steady state value.

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1 The normal operating concentration is
2 .005 ppm, five ppb. And the threshold in the
3 equation that we're using is .05. So it's an
4 order of magnitude higher than our normal
5 operating concentration. And we've not seen
6 anything to indicate that, during a transient,
7 that oxygen spontaneously appears in the system
8 in such a way that it increases by an order of
9 magnitude to where it would exceed that
10 particular threshold.

11 JUDGE KENNEDY: Is it possible to
12 measure the dissolved oxygen during a transient?
13 I mean, is this being monitored continuously?
14 Would the system be able to pick up that
15 difference?

16 MR. COX: It's monitored at a point.
17 I don't know that we see any changes during
18 transients. It's monitored at one point in the
19 system. The other I'd like to point out, there's
20 a difference in BWRs and PWRs here.

21 In a PWR, you run with a hydrogen over
22 pressure so that scavenges the available oxygen.
23 That's what allows us to keep the numbers as low
24 as they are. In a BWE, your primary system goes
25 into, turns into steam, goes through the

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1 condenser. You can't fill your condenser with a
2 bunch of non-condensable hydrogen gas. So you
3 don't have that ability to control oxygen with
4 hydrogen.

5 So it's a completely different
6 scenario. In the BWR world, there is an EPRI
7 program that's used to calculate the oxygen at
8 different points in the system. Because it does
9 change much more drastically than it does in a
10 PWR.

11 JUDGE KENNEDY: Anything from anyone
12 else on the Entergy side?

13 MR. AZEVEDO: This is Nelson Azevedo.
14 Just to add to your question, Your Honor. We
15 monitor the oxygen about ten times a day.
16 They'll have a data sheet here in front of me.
17 I guess we could monitor more often but that's
18 how often we monitor now. So it's monitored
19 pretty often and we have actual values.

20 JUDGE KENNEDY: Do the values display
21 much variation through the day? This is an
22 example.

23 MR. AZEVEDO: No. They're obviously
24 different when we are shut down. But once we
25 start up, we add the hydrogen and the hydrazine

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1 to the primary side which essentially scavenges
2 all the oxygen. And then from there on, until we
3 open up the system again as Mr. Cox said, it's
4 about five ppd.

5 JUDGE KENNEDY: How would --

6 CHAIRMAN MCDADE: Is this all part of
7 that water chemistry AMP we discussed the other
8 day?

9 MR. AZEVEDO: That's correct.

10 JUDGE KENNEDY: If I understand what
11 Dr. Hopenfeld's saying, there's a recommendation
12 on the table from EPRI or Argonne or both that
13 indicates if you don't know the dissolved oxygen
14 during a transient, a value of .4 would be
15 applicable. Is this a case that's, should you be
16 using .4 for Indian Point?

17 MR. AZEVEDO: This is Nelson Azevedo
18 again. Mr. Gray or somebody can jump in. That
19 is when you don't have actual numbers. We have
20 actual numbers, measured numbers. And again, as
21 Mr. Cox said, during a transient, oxygen does not
22 spontaneously generate in the reactor coolant
23 system.

24 So we feel that we're very
25 conservative. In fact, an order magnitude higher

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1 than what we're measuring.

2 JUDGE KENNEDY: Mr. Gray?

3 MR. GRAY: This is Mark Gray for
4 Entergy. The reference in new reg CR6909 on Page
5 A5 says that the dissolved oxygen values obtained
6 from each transient constituting the stress cycle
7 for carbon and low alloy steels, the dissolved
8 oxygen content, DO, associated with the stress
9 cycle is the highest oxygen level in the
10 transient, et cetera.

11 That last sentence says a value of .4
12 ppm for carbon and low alloy steels and .05 ppm
13 for Austenitic steels can be used for the DO
14 content to perform a conservative evaluation. So
15 that implied that when you don't know the value,
16 when you have nothing to go by, that's the
17 conservative input to the equation.

18 They operate the plant according to a
19 spec that gives a maximum value for dissolved
20 oxygen. And I won't reiterate what these
21 gentlemen have already said.

22 The other important thing to recognize
23 though that may have been mischaracterized is the
24 new regs from Argonne have repeatedly said, not
25 just 6909, that in order to have this

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1 environmental effect, that you have to have a
2 combination of the parameters to be above their
3 threshold limits to have this environmental
4 effect.

5 We refer to that in our answer --
6 sorry, I have to put my glasses on. On our
7 answer 184 in our testimony. In new reg CR6815,
8 for example, that's Entergy 225 where the new reg
9 says that it's the product of the transformed
10 strain rate oxygen and temperature values is
11 based on experimental data.

12 And we quote that new reg that says
13 it's significant. The environmental factor is
14 significant only when four conditions are
15 satisfied simultaneously. When the strain
16 amplitude temperature and dissolved oxygen and
17 water are above certain threshold values, and the
18 strain rate is below a threshold value.

19 So going back to the point that was
20 made before, when the temperature is below it's
21 threshold value, even if I use this maximum DO
22 value, the Fen is still at its threshold value.
23 The equation that they've given us to use in the
24 new reg reinforces this statement that is made in
25 the new reg.

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1 That unless the product of those
2 parameters is non zero, I don't get a higher Fen.

3 JUDGE KENNEDY: Thank you. Maybe Mr.
4 Stevens or someone from the NRC, any concerns
5 with the application of the dissolved oxygen
6 factor for Indian Point?

7 MR. STEVENS: This is Gary Stevens for
8 the staff. No, Your Honor. In general, I agree
9 with what Entergy has testified and how they
10 characterized the statement in new reg CR6909.

11 JUDGE KENNEDY: All right, thank you.
12 Dr. Hopenfeld, the final word?

13 MR. HOPENFELD: My final word is that
14 they disregard the guidelines that both -- the
15 NPR47 I believe.

16 JUDGE KENNEDY: Could you say that
17 again? I missed that last --

18 MR. HOPENFELD: NPR 47, it's EPRI
19 guidelines also indicated that you have to input
20 into your equation the maximum oxygen, the oxygen
21 during the maximum -- the maximum amount of
22 oxygen during the transient.

23 But all they are talking about is
24 steady state. And EPRI made it very clear that
25 this has nothing to do with what we are talking

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1 about. The oxygen during the transient is not
2 what they are talking about.

3 Again, I was going back to this little
4 test. That little test is a measure value of
5 oxygen that really happens at the surface. He's
6 talking about adding hydrazine as a catalyst.
7 You have tons and tons of material. You've got
8 all kind of reactions going on in there. You
9 don't know what it is.

10 You cannot use this analytical
11 equation to tell me that it predicts what the
12 oxygen is in the plant. That's what they say.

13 MR. STEVENS: Your Honor, may I?

14 JUDGE KENNEDY: Go ahead Mr. Stevens.

15 MR. STEVENS: Gary Stevens, NRC staff.
16 I'll comment on NRP47 because I was a co-author
17 of that document. And I'll just say that in
18 there, there are some guidelines for treating
19 dissolved oxygen on a time averaged approach.
20 And I'll just say that from the testimony I've
21 heard and read, that Entergy's approach is
22 consistent with that.

23 Second thing, I think we need to
24 correct a few things for the record that were
25 stated here. I had some difficulty understanding

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1 Dr. Hopenfeld but there was a lot of discussion
2 regarding the experimental set ups that Argonne
3 National Laboratory used to collect this
4 information.

5 And I heard some mention that
6 dissolved oxygen was measured at the surface of
7 specimens and its relevance or lack thereof to
8 components. And that's not true. One of the --
9 in New York State 356, there's a good discussion
10 of the experimental setup and tests in Section 2
11 of new reg CR6583 which is New York State Exhibit
12 356.

13 And what you'll see in there very
14 clearly is that, that would be a very difficult
15 achievement to measure dissolved oxygen at the
16 surface of a component. It's measured, the bulk
17 dissolved oxygen content of the fluid in the
18 circuit is measured in those tests. There's a
19 figure that shows that in that section and a nice
20 write up on how those tests are conducted.

21 And that's entirely consistent with
22 how dissolved oxygen measurements are taken in
23 the plant. So there shouldn't be any concerns
24 about inconsistencies with dissolved oxygen
25 measurements between test setups and plant

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1 measurements.

2 JUDGE KENNEDY: All right. Thank you
3 Mr. Stevens.

4 CHAIRMAN MCDADE: It might be
5 appropriate, we're approaching 6:00, we've been
6 going for a while. It might be appropriate to
7 break until tomorrow morning. I would propose
8 that we start at 8:30. Does that pose any
9 problems?

10 MR. HARRIS: No, Your Honor.

11 MR. SIPOS: No, Your Honor.

12 MR. ROTH: No, Your Honor.

13 CHAIRMAN MCDADE: Okay. I believe we
14 had one homework assignment. I guess Mr. Gray
15 identifying documents about the way Entergy's
16 WESTEMS handles the coupling, thermal couple
17 data.

18 DR. LAHEY: I understand that to mean
19 how we treated the thermal couple data in the
20 development of the transients.

21 CHAIRMAN MCDADE: Okay. That said, we
22 are in recess until 8:30 tomorrow morning. Thank
23 you.

24 (Whereupon, the above-entitled matter
25 went off the record at 5:45 p.m.)

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