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CHAIRMAN SHACK: We are just a little bit ahead of schedule, five minutes. But we'll go ahead and take our break until 10:45.

(Whereupon at 10:22 a.m. the proceeding in the above-entitled matter went off the record to return on the record at 10:44 a.m.)

CHAIRMAN SHACK: I think we can come back into session.

Our next topic is the final review of the license renewal application for the Vermont Yankee Nuclear Power Station.

And Dr. Bonaca is lucky enough to lead us through this again.

FINAL REVIEW OF LICENSE RENEWAL APPLICATION FOR
VERMONT YANKEE NUCLEAR POWER STATION

VICE CHAIRMAN BONACA: It was kind of hard to keep FitzPatrick and Vermont Yankee apart.

We met a month ago to review the application for license renewal for Vermont Yankee. And I believe we covered pretty much every item of the agenda having to do with license renewal.

There was one remaining item that was left because of the time; we did not have a final SER. And

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U.S. NUCLEAR REGULATORY COMMISSION

In the Matter of Entergy Nuclear Vermont Yankee LLC

Docket No. 50-271 Official Exhibit No. EZ-36-V4

OFFERED by: Applicant/Licensee Intervenor _____

NRC Staff Other _____

IDENTIFIED on 7/21/08 Witness/Panel NEC 2

Action Taken: ADMITTED REJECTED WITHDRAWN

Reporter/Clerk MAC

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1 it has to do with the environmentally assisted fatigue
2 calculations.

3 I would just summarize very briefly what
4 has happened since. Entergy has chosen to address
5 environmentally assisted fatigue by demonstrating that
6 CUF and the most sensitive locations would remain
7 below one throughout the period of extended operation
8 considering both mechanical and environmental effects.

9 The analysis performed by the licensee are
10 supported also by assumptions that will be monitored
11 and verified during the period of extended operation.

12 The analysis performed by the licensee had
13 confirmed that in all locations CUF is going to be
14 below one throughout the period of extended operation.
15 This staff however has challenged the use of the
16 simplified methodology used by the licensee for those
17 locations which exhibit geometric discontinuities or
18 no symmetric loads such as the feedwater nozzle for
19 example or the circulation out that nozzle and the
20 coarse spray line nozzle.

21 At the request of the staff the licensee
22 has performed an analysis for the limiting location
23 which is the feedwater nozzle, using the methodology
24 at our command which is using ASME code Section 3.
25 The analysis has confirmed that CUF will be below one

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1 okay through the period of extended operation.
2 However I believe assuming the same environmental
3 multiplier, the result with more analysis show a
4 higher value of CUF though below one. And so the
5 staff has requested the licensee to perform also the
6 corresponding analysis for the two additional cases
7 where there are geometric discontinuities or no
8 symmetric loads and essentially the locations are the
9 circulation outlet nozzle and the coarse spray line
10 nozzle.

11 Today I believe the licensee wants to
12 present their methodology and make the case for the
13 analysis they performed originally. I believe the
14 issue so far as the SER is closed in the sense that
15 they have committed to perform the two additional
16 analyses as requested by the staff.

17 But we will hear both from the licensee
18 and the staff about this contention and it's an
19 important issue because it may affect other licensees
20 that have performed calculations before using the same
21 methodology used by Vermont Yankee.

22 We would like to introduce and turn over
23 to PT Kuo.

24 MR. KUO: Thank you, Bonaca.

25 Yes, this is indeed the last issue for the

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1 Vermont Yankee license renewal application review.

2 It has taken a long time, longer than what
3 we would like to, but I think at this point we believe
4 that the applicant has done what we have asked for,
5 and we are satisfied with what they have done.

6 We have supplemented our SER with our
7 writeup. It's just I believe a week or so ago. And
8 sent it to the committee members.

9 I believe that right now with the
10 additional calculations the applicant has done we
11 consider this issue is resolved, and the applicant
12 will first give you the story of how it is resolved,
13 and the staff will also give you the reason, the basis
14 of why we think this is acceptable.

15 Thank you.

16 With that, applicant, please, take over.

17 MR. DREYFUSS: Good morning.

18 Thank you, Dr. Bonaca, Mr. Chairman,
19 members of the committee.

20 My name is John Dreyfuss. I'm the
21 director of nuclear safety assurance for Vermont
22 Yankee.

23 Before we get going with the presentation
24 I do want to make sure that we introduce our Vermont
25 Yankee and Entergy team here.

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1 First, I'd like to recognize Ted Sullivan,
2 our site vice president.

3 MR. SULLIVAN: Good morning. I'd like to
4 thank the committee for allowing us to be here today
5 to continue the discussion on our license renewal
6 application. And I'd like the team to identify
7 themselves, and then we'll turn it back over to John.
8 John's our lead spokesperson.

9 MR. MANNAI: David Mannai, licensing
10 manager, Vermont Yankee.

11 MR. RADEMACHER: Norm Rademacher,
12 engineering director.

13 MR. FITZPATRICK: Jim FitzPatrick, design
14 engineer.

15 MR. STEVENS: Gary Stevens, structural
16 integrity associates, consultant to Entergy.

17 MR. GOODWIN: Scott Goodwin, design
18 engineer.

19 MR. METELL: Mike Metell, license renewal,
20 project manager.

21 MR. YOUNG: Garry Young, manager of license
22 renewal for the Entergy fleet.

23 MR. COX: Alan Cox, technical manager,
24 license renewal.

25 MR. LOCK: Dave Lock, I'm part of the

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1 Entergy license renewal team.

2 MR. DREYFUSS: All right, very good. Good
3 morning.

4 Next slide, Beth, please.

5 For the agenda for today we will go
6 through the environmentally assisted fatigue. And we
7 do recognize the last time we were here we went
8 through the rest of the SER and application and talked
9 about a lot of different issues.

10 Our focus here on our presentation is as
11 requested on the fatigue issue.

12 So we'll go through an overview of that,
13 some of the timeline, how we got to this point. We'll
14 talk about some of the bases, and go through both the
15 evaluation that we performed where there were
16 challenges from the staff, and confirmatory analysis.

17 And just from a nomenclature standpoint,
18 I did want to mention, a number of different terms
19 have been tossed out. What we will refer to during
20 the course of our presentation, we had original
21 analyses, for the license renewal we performed re-
22 analysis. I think we referred to that in the SER; you
23 may have seen the simplified analysis. So we've
24 called it a re-analysis.

25 And then the confirmatory analysis that we

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1 did I think is also referred to variously as the
2 updated analysis. So for us re-analysis and
3 confirmatory and we'll step through that as we go
4 through the presentation.

5 I think the key thing to talk about is
6 that for the license renewal the confirmatory analysis
7 that we performed for the feedwater nozzle is the
8 calculation of record for license renewal.

9 Additionally we'll talk about the license
10 condition. We do have a license condition where we
11 will perform calculations, confirmatory calculations,
12 for the remaining two nozzles that were the subject of
13 the challenges, and we will perform those calculations
14 prior to two years prior to entering into the extended
15 period of operations.

16 Next slide.

17 From an overview standpoint we did, as far
18 as the full scope of environmentally assisted fatigue,
19 we did the locations that are identified in the
20 governing NUREG 6260, and that was the focus and the
21 basis for the calculations that we did do.

22 Our original piping was designed to the
23 B31167 code so therefore we did not have the
24 calculations. That is what drove why we had to do
25 these calculations.

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1 From a timeline standpoint in September we
2 completed the re-analysis as well as all the rest of
3 the work that we did on environmentally assisted
4 fatigue. There was an audit by the staff of those
5 calculations in October. And really during the course
6 of that timeframe, from October through January of
7 2008, a lot of questions back and forth, and a number
8 of different RAIs and audits that were performed
9 questioning the approach that we had taken.

10 And the key challenge was how we treated
11 stresses at the blend radius for these three
12 particular nozzles, coarse spray, reactor recirc and
13 feedwater.

14 So what we'll do during the course of the
15 presentation is, we'll talk about what we did on that
16 reanalysis, and provide you with the basis for that.
17 We will also talk about what we did on the
18 confirmatory analysis as well.

19 We did complete - we had requested a
20 public meeting. And that public meeting was held on
21 January 8th, where we defined what approach we took
22 with the reanalysis method. At that meeting we also
23 said that we were working on a confirmatory analysis
24 for the feedwater nozzle.

25 We did complete that analysis on the

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1 nozzle and submitted that on February 14th - I'm
2 sorry, January 30th, Ray. And NRC, Dr. Chang, did an
3 audit of that calculation on Valentine's Day of 2008.

4 We also submitted an amendment that
5 provided some chemistry data. That was one of the key
6 questions on how we treated the chemistry effects, and
7 how it may have influenced environmentally assisted
8 fatigue.

9 So as far as basis for the evaluation, we
10 are consistent in our approach, consistent with the
11 Gall report. We did evaluate the specified locations
12 as I mentioned in the NUREG 6260, and the Fen
13 methodology that we used was appropriate and was
14 driven by the two cited NUREGs there for the different
15 materials, carbon steel and stainless.

16 Additionally we did use our as-built
17 drawings to do our analyses. We used the design.

18 MEMBER ABDEL-KHALIK: How different are the
19 as-built drawings from the design drawings?

20 MR. FITZPATRICK: There is additional
21 thickness for - this is Jim FitzPatrick - the shell
22 has additional thickness in it from the design for
23 rolling, like a quarter inch, and the nozzles have a
24 little additional thickness from the original design
25 provided on the fabrication drawings.

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1 MEMBER ABDEL-KHALIK: And when were those
2 as-built dimensions acquired?

3 MR. FITZPATRICK: They are on the GE
4 drawings of the design before the plant started up.

5 MEMBER ABDEL-KHALIK: Thank you.

6 MR. DREYFUSS: We did use design transients
7 versus the actual transients, so did not take credit
8 for any - we used the conservatisms associated with
9 design transients.

10 We'll talk a little bit more about cycle
11 projections, but we did project cycles for 60 years.
12 We'll talk about some conservatisms that we have
13 inherent in those projections as well.

14 We also assumed -

15 CHAIRMAN SHACK: So when you say design
16 versus accident transient severity, it means you are
17 using the stresses from the design transient, not the
18 numbers of the design transient?

19 (Simultaneous speakers)

20 MR. DREYFUSS: And again we did assume full
21 uprate conditions for the 60-year period. We did do
22 the uprate in 2006.

23 MEMBER ARMIJO: From day zero uprated
24 conditions, and put those into all of these analyses?

25 MR. DREYFUSS: That's correct. Assume from

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1 1972 up to this point and through the 60-year period.

2 Now we are going to talk about the
3 specifics of the evaluation itself, and Jim do you
4 want to talk on this a bit.

5 MR. FITZPATRICK: We used existing design
6 analysis for the RPB shell, the lower head, the
7 recirculant nozzles, and by the FEM to those existing
8 analysis, and for the fatigue analysis MB 3200 rules,
9 for three nozzles that entire original design fatigue
10 usage, we analyzed for new models, new analysis, for
11 the feedwater recirc outlet nozzles and the coarse
12 spray nozzles.

13 MEMBER ARMIJO: Was the feedwater inlet
14 temperature changed as a result of the uprate?

15 MR. FITZPATRICK: 372 to 392.

16 MEMBER ARMIJO: Now is that change in the
17 conservative direction as far as this analysis is
18 concerned?

19 MR. FITZPATRICK: It increases the stress
20 range from your normal operating down to your
21 injection. Delta T goes from, instead of 372 to 100,
22 it goes from 392 or 394 to 100. It's a small increase
23 in range.

24 MEMBER ARMIJO: Okay, thank you.

25 MR. FITZPATRICK: And then for the piping

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1 we performed new ASME class I fatigue analysis for the
2 recirc RHR.

3 On the reanalysis of the three nozzles, we
4 used 60-year cycles projected based on design
5 transient severity and the cycle. So basically
6 reviewed our design spec, and updated BWR for thermal
7 cycle definitions.

8 We had new answers, find out what models
9 are developed for these three nozzles using the as-
10 built drawings and the material specs for each one of
11 these nozzles.

12 Heat transfer coefficients were based on
13 the design report and design specifications.

14 A thermal stress response in the
15 reanalysis was developed from a step change in the
16 temperature. And Green's function was developed from
17 that.

18 Using the Green's function we developed
19 thermal transients, stresses, for each set of the
20 design transients for each nozzle.

21 And we calculated component stress
22 differences. This is where the difference between -
23 we'll explain a little further on, but this is where -

24

25

CHAIRMAN SHACK: Let me just come back to

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1 your Green's function. So you got your Green's
2 function essentially from a finite element analysis -

3 MR. FITZPATRICK: Yes.

4 CHAIRMAN SHACK: - with a step transient.

5 MR. FITZPATRICK: Yes, sir. And you pull
6 component stresses from there versus - it calculates
7 stress intensity. And that has led to some confusion
8 before.

9 Taking those, the thermal stresses, the
10 pressure stress intensities were directly from the
11 answers found with the models, and they were factored
12 to account for the actual pressure during the
13 transients, the unit load case and then factored up
14 for that.

15 Adjusting intensities to detached piping
16 loads were conservatively calculated and added to the
17 other stress intensities for each transient and each
18 temperature.

19 The maximum stress differences from the
20 temperature transients were combined directly with the
21 stress intensities from the pressure stresses, and the
22 detached piping loads.

23 And the ASME MB 3200 fatigue calculations
24 performed on the collective thermal transient stress
25 systems.

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1 And that gets rid of the ASME CUI. Then
2 we used a bounding fatigue life correction factor for
3 all the transients, one bounding number applied to
4 that CUF for the entire 60-year operating period.

5 And then the environmental CUF is that
6 bounding factor times the CUF.

7 We had a list of -

8 CHAIRMAN SHACK: One other - every time I
9 read the analysis it says, axi-symmetric ANSYS model.
10 This is a nozzle on a cylindrical shell. Why is it
11 axi-symmetric?

12 MR. STEVENS: It's a simplification to -
13 obviously when you model a nozzle axi-symmetric you
14 treat, the vessel then becomes a sphere. So we also
15 had to apply a correction factor to account for the
16 ovalization of two intersecting cylinders.

17 And that's just a traditional way of
18 industry way of modeling these nozzles.

19 MR. FITZPATRICK: Did that answer your
20 question?

21 Some of the conservatisms in the analyses,
22 the major ones -

23 MEMBER ARMIJO: Just before you go on, the
24 bounding fatigue life correction factor, you say you
25 calculated from water chemistry conditions expected to

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1 occur over the 60-year operating period. But you have
2 had major changes with the water chemistry with
3 hydrogen implemented many years after. So which is
4 the water chemistry you used? Did you use the
5 appropriate water chemistry for the normal water
6 chemistry period, and a different water chemistry
7 correction? Or the hydrogen water chemistry period?

8 MR. FITZPATRICK: Did both, and Gary can
9 give you a detail on that.

10 MR. STEVENS: We actually broke the
11 operating history up into three parts. The prior to
12 hydrogen water chemistry, or normal water chemistry,
13 where the factors, at least for the carbon and low
14 alloy would be much higher and the oxygen content was
15 higher.

16 Then we had the operation that was post
17 hydrogen water chemistry implementation, with the
18 historical duty if you will or availability of the
19 system.

20 And then in the future and what that's
21 projected to be. And that was based on water
22 chemistry guidelines that the plants are following.

23 CHAIRMAN SHACK: And you used bounding
24 strain rates for all these transients? Or you
25 actually tried to estimate strain rates?

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1 MR. STEVENS: We used bounding strain rates
2 for everything.

3 MR. DREYFUSS: And we will talk a little
4 bit more about chemistry during the course of the
5 presentation.

6 MR. FITZPATRICK: Some of the major
7 conservatisms in the nozzle reanalysis. The number of
8 transient cycles using analysis was greater than the
9 expected number of cycles for 60 years based on our
10 plant experience. For example, heat up and cool down,
11 there were 300 cycles - heat up cool down for the
12 feedwater nozzle includes heat up and then a turbine
13 roll. It's basically the major transient. We used
14 300 cycles of that. To date we've had 95 over 36
15 years of operation, and the original design was 200;
16 we don't even expect to hit that number, based on the
17 past history of 20 years of operation.

18 But the plant had more transients in the
19 beginning than they do in later life.

20 The transient severity is a conservatism
21 versus using actual transients. We used the bounding
22 values, the pressure and temperature of the EPU for
23 the entire life, and the bounding Fen multiplier. We
24 used values, the input stat, the temperature strain
25 rate, the sulfur content were chosen to maximize that.

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1 And that multiplier was basically applied
2 to all transient stresses, and that was the reanalysis
3 method that we used.

4 MR. DREYFUSS: We talked about the
5 chemistry itself. Bottom line is we chose our
6 chemistry factors conservatively, and chemistry
7 effects have been conservatively factored into the
8 analysis that we did.

9 We did use the Fen factors from the cited
10 NUREGs. Additionally we selected the various
11 parameters that you see here in such a way as to
12 maximize the effects and maximize the contribution
13 that they had in terms of their effect on the
14 environmental factors.

15 So strain rates, temperatures, dissolved
16 oxygen, were all factored in that way.

17 CHAIRMAN SHACK: Of course there is no
18 conservatism in that sulfur number since your sulfur
19 probably is well over .015. In the materials you
20 actually have in the plant.

21 MR. DREYFUSS: Correct.

22 MR. STEVENS: Plus that particular
23 parameter tends to have less effect on the relations
24 than some of these, oxygen and temperature and strain
25 rate for example.

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1 MEMBER ABDEL-KHALIK: Well, typically, how
2 long would these oxygen excursions last?

3 MR. FITZPATRICK: A couple of days when
4 there's the heating up, and you do a cycle flush, and
5 then you start heating the reactor up, conduits come
6 online. It takes awhile to get to the steady state on
7 the chemistry.

8 MR. DREYFUSS: The startup might be over an
9 18-hour period, but getting it back to a stable
10 condition will sometime take a day or two.

11 MEMBER ABDEL-KHALIK: So the different
12 between the value that you used and the analysis,
13 which is the mean plus one standard deviation, the
14 difference between that value and the nominal value
15 for dissolved oxygen, what would that be in
16 percentage?

17 MR. FITZPATRICK: It's a little different.
18 That number could be significantly higher, but there's
19 no transient occurring at that time. So looking at 60
20 years we tried to do a bounding number, a
21 representative number for all the transients expected
22 to occur over 60 years.

23 MR. CHANG: If I may interject something.
24 The staff did a focused review of what they did,
25 especially in the oxygen content and excursion.

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1 Now this is a BWR, not a PWR. The PWR,
2 the maximum transients for the most critical
3 components is during the heat up and cool down. The
4 PWI especially the feedwater nozzle - now excursion of
5 the oxygen content occurred during the heat up, but at
6 that time there are no significant transients. So
7 even excursion rate is high, applied to - if you apply
8 to zero it's still zero. I don't mean zero; I mean
9 small number.

10 MEMBER ARMIJO: So these excursions, these
11 oxygen excursions, really had a very small
12 contribution to the number that you used for the Fen?

13 MR. DREYFUSS: Right, it did not
14 significantly impact it.

15 So the summary here is that the cumulative
16 usage factors at Vermont Yankee under all analyses
17 that we did perform do remain below one for the full
18 60 years of extended operation with margin.

19 I'll talk a little bit about the audit
20 that NRC performed of the calculations. And the key
21 challenges really were when we had done the analysis,
22 we did the feedwater coarse spray and reactive recirc
23 nozzle corners. The challenges were at the nozzle
24 corners, the blend radius as it's referred to as well.

25 And the methodology by which we treated

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1 the stresses was really the key factor as Jim had
2 talked about as well. So we used component stresses,
3 stress difference versus the maximum stress
4 intensities. And what it comes down to is the
5 treatment of sheer stress and are you neglecting sheer
6 stress using this methodology.

7 That was the challenge. So we did submit
8 this amendment 33, based on or in response to an RAI.
9 And we documented the evaluation that we had performed
10 and the methodology by which we had treated the
11 stresses versus the component stress difference.

12 And we did essentially a sensitivity calc
13 that resulted in a change, a maximum difference
14 between the reanalysis that we had performed and the
15 sensitivity that resulted in a very small maximum
16 change, a .003 change which I think would have been
17 complete at that point. But we really only addressed
18 one element of the challenge.

19 And Gary, if you would explain a little
20 bit about that.

21 MR. STEVENS: Yes, I think what we really
22 addressed in that response was the effect of sheer
23 stress.

24 Another part of the challenge was on this,
25 it's been coined in several different ways, uni-axial

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1 stress, one-D virtual stress. And I think what I'd
2 prefer to do is, we have a slide coming up where we
3 show the analyses we did side by side, and I can get
4 into a little more detail on that one.

5 But for the purposes of this slide, I
6 think we generally agree that we might have satisfied
7 the shear stress issue, but we didn't satisfy the uni-
8 axial or one-D virtual stress issue. And we'll talk
9 about that in a few more slides.

10 MR. DREYFUSS: And Jim, if you could step
11 us through the approach that we did here on the
12 confirmatory calculation.

13 MR. FITZPATRICK: We did a confirmatory
14 calculation on one nozzle, a feedwater nozzle. It's
15 the controlling nozzle, because it is the most severe
16 in design transients; had the highest fatigue uses of
17 the three nozzles in question.

18 And we tried to put this, in simple terms,
19 basically it's cold return water and is the hot
20 vessel. That's why it is the more severe - the most
21 limiting nozzle.

22 A number of design transients at two to
23 three times the number of transients for the other
24 nozzles. All the injections occur at that nozzle,
25 versus the other ones feeling just the environment in

1 the vessel.

2 And industry experience has shown that the
3 fatigue usage is typically higher at the fatigue - at
4 the feedwater nozzle than any other nozzles.

5 We used the same ANSYS finite element
6 model, the same transients, the same cycles, and the
7 same water chemistry that is the previous nozzle
8 reanalysis.

9 And the confirmatory analysis, you combine
10 six stress components for NB-32, 16.2. The sheer
11 stresses are included for each stress.

12 And as the fatigue analysis was done for
13 NB-32 2.4 for all the stress pairs, and this is the
14 same methodology used in the reanalysis.

15 CHAIRMAN SHACK: What is the difference
16 between the confirmatory calculation and the
17 reanalysis?

18 MR. DREYFUSS: We are going to show that on
19 a slide. I make that very clear.

20 CHAIRMAN SHACK: Not the difference in the
21 results. What's the difference in assumptions?

22 MR. STEVENS: Should we go to that slide
23 now? So this slide has the two analyses in parallel,
24 the reanalysis, and the confirmatory calculation.

25 And what's in bold we'll talk about is

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1 going to answer your question on what the differences
2 are.

3 And I don't mean to simplify this
4 calculation, and this analysis; it's done in six
5 steps. We've simplified into six boxes, which in no
6 way indicates that there are six simple steps to this.
7 It's an ASME code analysis, and there is a lot of
8 rigorous detail built into this.

9 So let's start at the left, and we'll kind
10 of go through these both in parallel. Because you'll
11 see a lot of the boxes are identical.

12 On the left we have 60-year cycles in
13 design transients. That was the same and identical
14 for both analyses. We assumed the same transients and
15 the same quantity; we didn't differ on those.

16 We built an ANSYS finite element model.
17 It was the same for both analyses. There was no
18 different in model at all.

19 The model how we used it was, and the
20 stresses we obtained, is where it was different, and
21 that's the next one. So for in both analyses we'll
22 take the simple part first, pressure stresses and
23 piping stresses - pressure stresses were determined
24 from that finite element model, pressure stress
25 intensity, and piping stresses were done by hand.

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1 That was identical for both.

2 Now let's go to the first box, and here's
3 where we have the first difference. In the first
4 analysis rather than run all the transients, and we
5 have approximately 20 transients in the feedwater
6 nozzle - there's many and they are complicated -
7 rather than run all of those individually through the
8 finite element model, we used a Green's function to
9 generate the stress history for those transients.

10 That's - the Green's function is a well
11 known technique in most all college mathematical
12 textbooks. I don't think there is any controversy in
13 how the Green's function generates stresses. But
14 we'll talk about this uni-axial or one-D stress in a
15 minute, and that's really where the contention lies
16 there.

17 But in the first case, the reanalysis, we
18 used the Green's function to generate stress histories
19 for all those transients. That takes a significantly
20 less effort than running all those transients through
21 the finite element model.

22 CHAIRMAN SHACK: But this is purely an
23 elastic problem, right?

24 MR. STEVENS: That's correct, so Green's
25 functions would be appropriate for that. Everything

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1 is linear.

2 Now in the second case, the confirmatory
3 calculation, we ran everything, all the transients
4 individually through the ANSYS finite element model.
5 So up to now the only difference is, we used a Green's
6 function in the first case to generate stress
7 histories; in the second case the ANSYS finite element
8 model.

9 To your point the two should be identical,
10 because everything is linear.

11 So how did we combine - moving on to the
12 fourth box - how did we combine and determine maximum
13 stress intensities? Here is where we get into some
14 esoteric differences between the two.

15 I'll take the easy one first, which is the
16 lower one, the confirmatory calculation. We basically
17 take for all those transients, we get six stress
18 components out of the finite element program, X, Y, Z
19 and three shears. And we combine those for NB 32 16.2
20 of the code, which for every peak and valley you take
21 differences, in those six stress components, and you
22 rotate those into principal stress differences, and
23 it's stress intensity. And you use that history,
24 resultant history, to calculate fatigue usage.

25 What did we do with the Green's function?

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1 We'll move up to the reanalysis. The Green's
2 function, what we did there is, the Green's function
3 itself, the stress history we got out of the finite
4 element program, we could have had six Green's
5 functions to use to generate six stress histories, six
6 component stress histories for all the transients.

7 What we took out of the finite element
8 program was basically the maximum stress difference,
9 which is essentially equal to the stress intensity
10 from the finite element program.

11 So what we got from the Green's function
12 was a stress intensity history, and we used that to
13 integrate and come up with a stress intensity history
14 for all of the transients. So I think you can see
15 that the simplification here that was made, and there
16 are several, we are obviously by using the maximum
17 stress component difference we are ignoring sheer
18 stresses.

19 And in some of the responses to the RAIs,
20 and John mentioned on the one slide we showed the
21 sheer stresses were negligible.

22 But the other issue that we didn't address
23 in those RAIs is taking a single stress intensity
24 history and using that through a Green's function to
25 generate a stress intensity history for all these

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1 transients.

2 Is that identical or proximate or close to
3 taking all the six stress component histories and
4 doing differences and rotations into a stress
5 intensity difference? I think there is where the
6 difference and the contention really lay was that
7 approximation.

8 Both of these analyses, the intent is to
9 do an ASME code fatigue calculation. There was never
10 any intent not to do so.

11 The difference in that step I think is
12 really key to our differences. And obviously doing a
13 confirmatory calculation was intended to resolve that
14 issue, proof that how close these were.

15 So after that step then we have a stress
16 intensity history that was computed differently in
17 each of the techniques. But given that stress
18 intensity history, the fatigue usage analysis was
19 performed identically between the two.

20 There is a type on the slide here. It's
21 not NB 32 24, it's 32 22.4.

22 MR. RADEMACHER: So that is 32 22.24?

23 MR. STEVENS: Correct. So that step is
24 identical between the two. And then the last step is
25 - we get a fatigue usage out of that fifth box that we

1 then apply environmental factors to.

2 In the reanalysis, the first one we did,
3 the maximum Fen was applied to the total usage, to
4 come up with the environmentally assisted fatigue
5 number.

6 In the confirmatory calculation a maximum
7 Fen was computed for each load there, where the only
8 thing that was taken into account was the temperature.
9 We took the maximum temperature of each load, put the
10 strain rate and the sulfur and all the other primaries
11 were the same. And good or bad the intention of that
12 difference there was to demonstrate yet another
13 conservatism built into the analysis.

14 So the only thing different in the last
15 step, which is the environmental fatigue evaluation,
16 was one Fen applied to total usage in the reanalysis;
17 multiple bounding Fens applied to each load pair in
18 the confirmatory calculation.

19 MEMBER ARMIJO: So the more conservative
20 treatment was in the reanalysis?

21 MR. STEVENS: For that step.

22 MEMBER ABDEL-KHALIK: How much do the
23 material properties change over the temperature range
24 let's say for the feedwater?

25 MR. STEVENS: I can't give you a specific

1 answer, but generally speaking there could be 10 to 15
2 percent variation in the material properties over the
3 range of temperatures we are looking at.

4 MEMBER ABDEL-KHALIK: And how is that
5 accounted for in the analysis?

6 MR. STEVENS: In the reanalysis we picked
7 bounding temperature properties. Because of the
8 Green's function use, everything - you do one run and
9 everything is constant. So we tend to take the
10 bounding material properties and heat transfer
11 coefficients.

12 In the confirmatory calculation the
13 material properties are varied with temperature input
14 to the finite element program as well as heat transfer
15 coefficients.

16 And you are really touching on one key
17 element here, if you take these - we have identified
18 really just three bold spots where these analyses are
19 different. We identified on an engineering level 20
20 differences in these two analyses, things like you
21 just mentioned, material properties; they were treated
22 differently. Heat transfer coefficients were treated
23 differently. Twenty differences between the
24 reanalysis and the confirmatory calculation really
25 that were levels of conservatism built in to the

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1 analysis, approximations using a simplified approach
2 versus a very detailed approach.

3 So we did not go through exhaustively a
4 parametric study to understand which of those 20 items
5 caused the differences between the two. We were
6 satisfied at the end that the final result we got was
7 the same, usage factor less than one with margin.

8 MR. DREYFUSS: Do you want to move on to
9 the results?

10 MR. CHANG: Before moving on, could I put
11 in a couple of comments?

12 I think Gary have summarized what you call
13 the reanalysis and what you call the confirmatory
14 analysis very nicely.

15 But I'd like to bring out a couple of key
16 points that can facilitate going right through the
17 heart of the issue.

18 Actually applicant submitted two
19 reanalyses. One was submitted by amendment 31 which
20 is dated 9/17. The second refined analysis was
21 submitted December 11th; that was submitted by
22 amendment 33.

23 So those two I call them just reanalysis.
24 And then there is a final confirmatory - you call
25 final confirmatory analysis submitted by amendment 34

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1 on January 30, '08.

2 Now in our final SER, submitted to the
3 ACIS and it was issues, we call that analysis as
4 analysis of record for the feedwater nozzles. Why?
5 That's the point I'd like to point out. Missing this
6 phase, this is the opportunity, you may keep in mind,
7 reanalysis, analysis of record, which is not the case.

8 The - now let's call that analysis of
9 record. The analysis of record took all the unknowns
10 out of the place. You use six components, stress,
11 including sheer stress and nominal stress. Only thing
12 is you approximate the header effects by a spherical
13 header. That as Gary said is a very standard
14 industrial approach. We buy that.

15 The difference comes that the reanalysis
16 did not analyze every transient. From the base
17 transient case, and finite element results, from that
18 base case you project it to the other transient
19 stresses by the Green's function.

20 I don't dispute the Green's function
21 methodology at all; I love it. The only way is, how
22 do you apply it? Now you apply it by six components,
23 or you apply it by one-D virtual stress.

24 The reanalysis still have the one-D
25 virtual stress there. But the analysis of record do

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1 not have that.

2 So let's for the time being call the
3 analysis of record close to the reality. The outcome,
4 you don't see it at the amendment 34. Because
5 amendment 34 seems to indicate the analysis of record
6 always give you a lower answer. That means the
7 reference analysis is conservative.

8 But that is deceiving, because if you use
9 the same Fen as you used in the refined analysis, the
10 CUF will be higher. As I report it, as the staff
11 report it in the final SER, that number, the CUF, will
12 be .893. It's not .353 anymore.

13 So in other words, the analysis of record
14 gives you higher CUF for everything the same
15 condition.

16 In other words the refined analysis can be
17 conservative, can be not conservative; can be
18 conservative by a factor of two; and also can
19 underpredict by a factor of two.

20 For that reason we don't call that the
21 refined analysis or analysis of record. But for
22 Vermont Yankee the feedwater nozzle, the final
23 analysis, additional analysis, or whatever you call
24 it, still give you at least 10 percent margin to the
25 code CUF limits.

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1 For that reason I feel comfortable. Now
2 as long as you make this as the analysis of record.
3 For the future if you want to adjust anything you base
4 it on that. You don't back to the refined analysis.

5 On the same basis if this can produce
6 results like this, the same or similar results can
7 also be produced. I'm not sure, because I didn't do
8 that analysis on the other two nozzles.

9 For that reason we asked them to perform
10 similar analysis for the other two nozzles. When all
11 this is completed, we have three analyses of record.
12 Those are fully justified.

13 VICE CHAIRMAN BONACA: What I would like to
14 point out, however, is that this calculation results
15 seems to be consistent with the one that was in the
16 SER. So we would like to understand it better.

17 In the SER you asked the licensee to use
18 the same maximum Fen.

19 MR. KUO: Right, what we consider that is
20 acceptable is what the applicant calls confirmatory
21 analysis.

22 VICE CHAIRMAN BONACA: Yes, but here in the
23 confirmatory analysis I see the result being 0.35, and
24 you are quoting .893.

25 MR. CHANG: Eight nine three, we have both

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1 numbers reported in the SER, so it's on record that
2 the analysis of record, using the maximum Fen, you
3 will get .893. But you use 24 different values of Fen
4 which is appropriate, you will get .353.

5 In other words, the .353 is not wrong;
6 it's just compare the earlier analysis and the newer
7 analysis. The earlier analysis may not be
8 conservative. It depends on the final analysis which
9 we know is right and conservative.

10 CHAIRMAN SHACK: What you are arguing is
11 that his stress analysis could be nonconservative, and
12 he covers that up by using a conservative Fen, but
13 clearly his overall calculation is conservative but
14 he's piling it up in different ways, and I guess the
15 question is, is that always going to be the case?
16 It's certainly true in these two situations.

17 MR. CHANG: Normally staff do not second
18 guess what the future outcome will be. But since this
19 feedwater nozzle, the CUF, is five to 10 times higher
20 as compared to the others, I would imagine the other
21 two nozzles when you complete your analysis give us a
22 good foundation to work for the future. This number
23 will also be good.

24 MEMBER ARMIJO: I'm a little confused. The
25 mechanical analysis I think, the confirmatory

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1 calculations were done by the methods the staff was
2 comfortable with and were done with a lot of
3 conservatism as pointed out in some of these charts.

4 In addition they applied a more realistic
5 Fen for different periods as opposed to the original
6 reanalysis approach. But still conservative.

7 So I don't know, and there's a big
8 difference in CUF, right, .35 versus .89, that's a
9 very big difference. So what does the staff consider
10 to be the official number for CUF for this nozzle?

11 MR. CHANG: .353.

12 MEMBER ARMIJO: Okay.

13 VICE CHAIRMAN BONACA: Because in the SER
14 you state very clearly that any request of the
15 licensee to use a maximum Fen, and you got the value
16 of .89, okay, still using the confirmatory calculation
17 now it ends out to .89, and you are saying because it
18 is higher than what you calculated with the reanalysis
19 which was .64, then the analysis of record has to be
20 the one with the higher value.

21 So here we are talking about apples and
22 oranges. I mean I'm trying to understand what is the
23 confirmatory calculation result, and what is the basis
24 for forcing them to use the highest Fen? I mean
25 that's probably the best question.

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1 MR. CHANG: As many people call the fatigue
2 analysis, it's a black box. You can turn out
3 different results depending on the level of
4 sophistication that goes in there.

5 The first step we are trying to establish
6 is, is the Green's function methodology or the
7 confirmatory analysis methodology, which is correct.

8 We say the confirmatory analysis
9 methodology is correct. That's the purpose of
10 bringing the .893 up.

11 VICE CHAIRMAN BONACA: But you told me that
12 0.35 in the confirmatory analysis calculation is
13 conservative; that's what you said.

14 MR. CHANG: They are realistic.
15 Realistically speaking, the refined analysis do not
16 have to use F_{en} equal to 11 to all the transient
17 pairs. If you make every assumption the same,
18 confirmatory analysis will get you lower results.

19 MR. KUO: Just like you said, Dr. Bonaca,
20 comparing this two analyses here is comparing apples
21 and oranges, because the numbers involved are
22 different in terms of F_{en} .

23 For the reanalysis that they used, okay,
24 they used a bounding F_{en} value for all transient
25 pairs. But for the confirmatory analysis as they

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1 called it they used Fen, maximum Fen for each
2 transient pair.

3 VICE CHAIRMAN BONACA: that is what I
4 understood. And you said you have to assume the same
5 Fen for both methodology if you want to compare
6 results.

7 MR. KUO: If they were to use the same
8 bounding Fen for all transient pairs, using the
9 methodology in the confirmatory analysis, the number
10 would have been .893.

11 VICE CHAIRMAN BONACA: Okay, that's why you
12 are talking about -

13 MR. CHANG: Dr. Bonaca, Robert Schu, who
14 used to be on my staff and is fairly involved on this
15 topic, he may supplement some of the points.

16 VICE CHAIRMAN BONACA: No, I understand
17 now. But go ahead.

18 MR. SCHU: May I say something? Because
19 basically when you are doing the fatigue analysis
20 you've got to calculate the stress. And right now the
21 stress implemented by the applicant is not correct.
22 Compare - it's not adequate, because everybody believe
23 the ANSYS result is adequate. So we asked the
24 applicant to compare their methodology with the ANSYS
25 analysis. The result, there is no way they can match.

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1 So from that analysis record point of
2 view, their Green's function, any time they do a
3 Green's function analysis, they've got to redo the
4 traditional ANSYS analysis.

5 And actually the traditional ANSYS
6 analysis will create the correct results and that's
7 NRC accept.

8 MR. CHANG: The traditional ANSYS analysis
9 will create reasonable results. That result could be
10 higher; it could be lower. But that's reasonable.
11 That's correct. That's why we think our - that's will
12 be our future basis.

13 We want something to be correct.

14 MR. DREYFUSS: Garyk if we could summary?

15 MR. STEVENS: Okay, let's forget about the
16 sixth box here, which is the environmental fatigue,
17 and let's look at the fifth box, which is, we've got
18 the stress history. We calculated fatigue. And let's
19 write some numbers down and put everything in
20 perspective.

21 CHAIRMAN SHACK: That is the CUF in error
22 if we just quite at the fifth box.

23 MR. STEVENS: We will compare apples to
24 apples here, which is CUF from each analysis prior to
25 an application of environmental factors.

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1 Okay, the top box, the CUF for 60 years
2 from the reanalysis was .064.

3 The bottom analysis, fifth box, the CUF
4 for 60 years was .089. The difference between .025.

5 If we applied the same environmental
6 factor to both of those numbers, the difference in the
7 magnitude would be identical to comparing those two
8 numbers. So if I decided the environmental factor is
9 11, and I applied them to both, the ratio of the two
10 would be the same.

11 So comparing apples to apples here, the
12 confirmatory calculation, .089 versus the reanalysis
13 of .064, as I mentioned before there were 20 some odd
14 differences built into these two calculations, any one
15 of which could have contributed to that difference.

16 The use of a single stress intensity
17 history could be one. The material properties varying
18 with temperature could be one. The heat transfer
19 coefficients varying. Any of them. We did not do
20 exhaustive analysis to determine which one contributed
21 how much.

22 So I think what the staff is saying is
23 that that increase is what has led them to the license
24 condition for the other two nozzles.

25 MR. CHANG: You are correct.

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1 MR. DREYFUSS: This is what took from
2 September or so up to this point, going through this
3 and trying to address staff questions on it.

4 It became clear to us that a simpler
5 approach is to go with the confirmatory approach.
6 That is why we did that for the feedwater nozzle, and
7 we do have that license permission.

8 MR. CHANG: when all the three nozzles were
9 done, the three confirmatory analyses would become
10 three analyses of record; that's important.

11 MR. MANNAI: This is Dave Mannai, licensing
12 manager. I'd like to make one point, because I did
13 sense a little bit of concern on the part of the
14 staff, the ACRS committee. The bottom line is, we
15 agreed with the NRC in their request to make the
16 confirmatory analysis the analysis of record.

17 When we had performed the calculation and
18 then subsequently the NRC staff had ordered that
19 calculation, they looked at our methodology, and they
20 did not disagree with the fact that for the
21 confirmatory analysis that the maximum Fen factors had
22 to be chosen for each transient, but that was a more
23 realistic use of that calculation that was wholly
24 appropriate as Dr. Chang said a month ago.

25 And so if you stop in the middle of it

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1 you'd say oh there is this big difference. But as the
2 analysts went through and our own folks reviewed that
3 and then subsequently the NRC staff reviewed it, there
4 were no concerns with the use of that calculation or
5 those assumptions that were used.

6 MEMBER ARMIJO: Okay, so there is no
7 disagreement with the staff on the use of bounding
8 Fens for each transient pair as the right way to go;
9 correct?

10 MR. MANNAI: Right.

11 MR. KUO: It is more realistic. The reason
12 that we want to make this so-called confirmatory
13 analysis as the analysis of record is to prevent
14 future readers getting the wrong impression. The
15 original reanalysis is still the right reanalysis that
16 we accept.

17 MR. CHANG: If you only read this analysis
18 result once, you want to read the right one. You can
19 skip all the intermediate steps.

20 MR. DREYFUSS: Okay, next slide.

21 These are the results, we've talked about
22 them. And the next slide.

23 I'll speak a little bit about the license
24 condition. As discussed, the confirmatory analysis
25 for the feedwater nozzle is complete. It is the calc

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1 of record.

2 The reanalyses performed for coarse spray
3 and reactor recirc outlet you can see the CUFs
4 adjusted for environmental factors here. The .17 and
5 .08, we fully anticipate that as we perform the
6 confirmatory calculations, that we will again be below
7 one with plenty of margin, and that in fact the
8 feedwater nozzle is the controlling nozzle for us.

9 The license condition itself is, we will
10 perform the confirmatory analyses for coarse spray and
11 recirc outlet no later than two years prior to going
12 into the extended period of operation.

13 MEMBER ARMIJO: If you are already tooled
14 up for this analysis work, why don't you just do it?

15 MR. DREYFUSS: There is some additional
16 work to do, there's resources, there's modeling work
17 that needs to be done. We will be getting to work on
18 that. We just don't have those analyses complete yet.

19 Our intention is that we will be working
20 on these during the course of this year, and getting
21 that work complete.

22 VICE CHAIRMAN BONACA: Thank you for the
23 presentation. It was clear, and we begin to
24 understand what's happening here. And now we go to
25 the staff presentation, right?

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1 MR. ROWLEY: Good morning. My name is
2 Jonathan Rowley, and with me I have Dr. Kenneth Chang.
3 And we will discuss the environmental fatigue issue as
4 it pertains to the Vermont Yankee safety evaluation
5 report.

6 Next slide. I'd like to give you a quick
7 recap of this discussion from the February 7th, HRS
8 meeting. We talked about the resolution of this
9 concern, and the included license renewal, the license
10 condition that we have applied to Vermont Yankee.

11 Next slide.

12 As you can recall Vermont Yankee revised
13 their application to use the fatigue model for their
14 management of fatigue for the extended period of
15 operation. The corrective action element of that
16 program allows them to do a reanalysis of components.
17 They submitted those reanalyses to the NRC that
18 included incorporated environmental fatigue on
19 September 17th, 2007.

20 We performed an audit of those reanalyses
21 on October 9th and 10th. We asked six audit questions
22 during that audit. One was not answered to our
23 satisfaction, so we made that an RAI; we sent that on
24 November 27th, 2007.

25 The response to that RAI came back on

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1 December 11, 2007.

2 We had some discussions about this RAI.
3 There were some differences in nomenclature and other
4 things that we couldn't quite work out, so we decided
5 to have a face-to-face meeting on January 8th, which
6 was a public meeting on January 8th, 2008, at that
7 time they agreed to submit a confirmatory analysis of
8 the feedwater nozzle. Next slide.

9 That analysis was to include benchmarking
10 for the Vermont Yankee's feedwater nozzle using axi-
11 symmetric on that element model, taking full care of
12 all stress components of the nozzle using ANSYS code
13 for all defined transients; demonstrated that Vermont
14 Yankee specific benchmarking calculations bound the
15 coarse spray and the recirculation outlet nozzles,
16 calculated fatigue usage factors were done by ASME
17 code Section 3, and they can compare the results to
18 the previous calculations to determine if they were
19 conservative or not. Next slide.

20 On January 30th Vermont Yankee submitted
21 those what we called - a terminology change - updated
22 analysis, which is one and the same with the
23 confirmatory analysis. They proved to us that they
24 used the same parameters, same data, methodology, as
25 agreed upon.

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1 And the last slide, what was stated during
2 the January 8th meeting; determined that the CUFs were
3 the safe ends and then rated lower than the previous
4 analysis.

5 Next slide please. Supplemental
6 information was submitted to us on February 5th to
7 demonstrate that the updated feedwater analysis bounds
8 the recirculation outlet nozzle, and it described how
9 the water chemistry effects were accounted into this
10 analysis.

11 Next slide. We performed an audit on
12 February 14th, Valentine's Day, and we discussed the
13 things listed here. And I would like Ken Chang to
14 talk about what we did at that audit.

15 MR. CHANG: I will not follow these slides.
16 Instead I will go through the process of how we
17 performed the audit.

18 The audit, the main purpose to address the
19 concerns expressed during the previous ACIS meeting.
20 So really it's the chemistry, effect of chemistry on
21 this EF analysis.

22 So we spent a good time of the day
23 reviewing the absorbed oxygen content, the strain
24 rate, the temperature, the surface content, those
25 parameters that they used in the confirmatory analysis

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1 or the analysis of record.

2 Those parameters were properly used, like
3 the dissolved oxygen is average plus one standard
4 deviation. And then we asked about whether any
5 excursion was there, the excursion happened during the
6 heat up. During the heat up process we found that the
7 feedwater nozzle don't have any significant
8 transients, although it doesn't bound the oxygen level
9 during the heat up, so that doesn't really matter.

10 And we also looking at the strain rate, a
11 low strain rate to bound the value, to bound the Fen
12 value, was used all along.

13 And the temperatures, we assumed using 550
14 degree Fahrenheit for the nozzle, which is also
15 bounding.

16 For the surface content, for stainless
17 steel, surface content is not one of the parameters
18 evaluated by NUREG CR 5704. But for the carbon steel,
19 .015 percent was used to have the maximum impact on
20 the Fen.

21 We also look at how they performed this
22 confirmatory analysis. The confirmatory analysis and
23 the reanalysis use the same model, the axis-symmetric
24 finite element model, for which the branch site is
25 exact. You find the axis of symmetry. You do a

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1 revolution around it. But on the header pipe, on the
2 header side, you can only simulate with either the
3 flat plate or with a sphere.

4 Normally people do simulate the header
5 effects by using a spherical header. The right way to
6 do is to use two times the actual radius for the
7 sphere. That way you simulate to accurately predict
8 the pressure stress.

9 For Vermont Yankee there was a model using
10 1.5 radius already done, so I don't dispute that,
11 since they adjust the pressure stress by another
12 factor of 1.33, four thirds. Now four thirds times
13 three halves, that's a factor of two. That is a
14 typical number being used by the ASME stress analysis
15 simulating the 3-D effects.

16 We also look into what Fen value we used.
17 That has been already discussed in quite detail. I
18 really fully endorse them of using 24 training pairs
19 to come up the total CUF, and 24 Fens were calculated,
20 one for each training pair. That is the most
21 complete analysis I've seen so far. I hope we can
22 make this as analysis of the future, as a general
23 case.

24 Now, the - another question was asked
25 during the early meeting was how was film coefficient

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1 calculated? The film coefficient was calculated
2 correctly even including the gap between the thermal
3 sleeve and the nozzle wall. They estimated how does
4 the gap open or close, and calculated some film
5 coefficient to simulate inside of thermal sleeve,
6 between the thermal sleeve and the nozzle wall, and
7 after the nozzle wall. So that analysis was quite
8 accurate, and even by today's standards it's still
9 very good.

10 Other transients: the two analyses use the
11 same transients; otherwise you cannot compare.
12 Transients got to be the same. Cycle got to be the
13 same. Same training curves. Same number of cycles
14 was used in the refined analysis and in the
15 confirmatory analysis.

16 External piping loads, here is a little
17 deviation from the traditional MD 3200 analysis as
18 compared to this. Although Vermont Yankee did not
19 apply the external piping loads in a 3-D way, but they
20 calculated a stress intensity based on the external
21 load.

22 And that external load was added, that
23 stress intensity was added, to the stress intensity
24 calculated for the thermal transients. After that
25 stress intensity was calculated add on top, that is

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1 known to be conservative.

2 K sub e, ASME code requires elastoplastic
3 cycling penalty factor. In old analysis normally
4 people have K sub e equal to one. We look into it,
5 and for the feedwater nozzle, K sub e the worst
6 combination K sub e equals to 1.115. So in other
7 words this 11.5 percent penalty on that underlying
8 stress before you go into the -- allow the cycle to
9 stress to the allowable cycle curve. That is also
10 appropriate.

11 Young's modulus, ASME curve, the fatigue
12 curve, is based on certain Young's modulus. When you
13 are performing analysis you have to adjust your
14 Young's modulus to the ASME code value. That was done
15 also properly.

16 Six stress components, although it's not
17 a true 3-D analysis, but six components was used. For
18 the thermal transients, those components, in
19 particular the unit stress giving small or big is
20 included in their confirmatory analysis. That is, to
21 us that's acceptable.

22 Seismic loading, seismic is one of the
23 transients. Seismic, you cannot put on the 3-D
24 analysis and put in six components, because you don't
25 even know what it is. However, the seismic loads are

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1 small compared to similar transient loads. And
2 seismic loads, when seismic load occurs, the strain
3 rate is high, Fen is low. So by not considering the
4 seismic load in the combination, produce conservative
5 results.

6 Cycles: the two analyses use the same
7 cycles, the same transient cycles. That is
8 appropriate.

9 So based on these descriptions we felt
10 through deeper review and through the cooperation of
11 the applicant, by bringing two suitcases of material
12 into NEI, downtown office, we reviewed there; we are
13 very satisfied.

14 If you can make this as analysis of record
15 for the feedwater nozzle, we say, we have no further
16 questions.

17 On the same basis there are two other
18 nozzles, could result in a similar way. So we say, if
19 you perform this kind of confirmatory analysis as
20 described above, then you heard it twice already. You
21 heard it from the applicant; you heard from me. If
22 you do that kind of analysis for the two additional
23 nozzles, our confidence level also goes up for those
24 two nozzles. So the whole issue will be resolved.

25 Now I really want to thank the applicant

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1 for performing this analysis, because this, let me
2 remind you, yesterday we talk about whether on the
3 nozzle, they are one location or two locations or
4 three locations which you need to study.

5 This nozzle, the plan radius is not at the
6 safe end. Yesterday you hear about safe end. You've
7 got to evaluate your pipe to the nozzle well, you've
8 got to evaluate the safe end. You've got to judge
9 whether you have similar sleeve or not. You've got to
10 evaluate the plan radius.

11 It happens to be for this nozzle the plan
12 radius is the highest to CUF location. Did you see
13 that yesterday? I don't. That's why we insist on
14 performing similar analyses for similar kind of
15 conditions and terrains.

16 That concludes my presentation.

17 VICE CHAIRMAN BONACA: Could you go to page
18 nine?

19 MR. CHANG: Page nine?

20 VICE CHAIRMAN BONACA: Here you are talking
21 about previous analysis. Is this the reanalysis?

22 MR. CHANG: Previous analysis means the
23 reanalysis. The September 19 and December 11.

24 VICE CHAIRMAN BONACA: Okay. We got an
25 explanation of what we meant by reanalysis and

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1 confirmatory analysis. So the October analysis now is
2 the confirmatory analysis.

3 MR. CHANG: One and the same.

4 VICE CHAIRMAN BONACA: That's what I
5 thought.

6 MR. CHANG: Updated analysis, the
7 confirmatory analysis, and the analysis of record,
8 those three are equal right now.

9 MR. SHUN: I am sorry, Ken, why do you say
10 these three are equal? I thought they are different.
11 Reanalysis is reanalysis; normally reanalysis is -
12 they are not equal.

13 MR. CHANG: What Jonathan call is update
14 analysis, and what applicant call as confirmatory
15 analysis, we call them analysis of record.

16 MR. KUO: I would personally suggest, let's
17 not confuse the issue. We, at least from staff's
18 point of view, we stopped using the term, confirmatory
19 analysis. We have the analysis of record.

20 MR. CHANG: I agree.

21 VICE CHAIRMAN BONACA: Are we disagreeing
22 with the previous statement, that previous analysis
23 means reanalysis?

24 MR. ROWLEY: No.

25 MR. CHANG: For the feedwater nozzle, there

1 is only one analysis of record; that is submitted on
2 January 30, '08.

3 VICE CHAIRMAN BONACA: Still it says, the
4 confirmatory analysis which now has become the
5 analysis of record.

6 MS. FRANOVICH: If I may, this is Ronnie
7 Franovich, the reason that this has been such a strong
8 view by the staff is that we are establishing a new
9 licensing basis for license renewal, and so being very
10 clear on what the licensing basis is for this issue is
11 really important for the future regulation of the
12 facility.

13 I wanted to answer one question by the
14 gentleman, why wouldn't they do the analysis now for
15 the other two locations. The end of the current - the
16 period of extended operations really begins in 2012,
17 and so two years before that would be 2010. So it
18 won't be but for another couple of years that we will
19 get that analysis in for the other two locations.

20 Just wanted to clarify that too.

21 MR. ROWLEY: All right, next slide please.

22 Our conclusion is that the feedwater
23 analysis is the analysis of record, as performed in
24 accordance with ASME code Section 3, the coarse spray
25 and the reactor circulation nozzle analysis will be

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1 performed according to the fourth condition which is,
2 next slide, that the licensee perform and submit to
3 the NRC for review and approval an ASME code analysis
4 for the reactor circulation and outlet nozzle and the
5 coarse spray nozzle at least two years prior to the
6 extended period of operation. This analysis shall be
7 the analysis of record for these two analyses.

8 VICE CHAIRMAN BONACA: Now on the
9 conclusion on the second bullet, did you say that the
10 CUF was calculated in accordance with ASME code
11 Section 3. But the analysis was also in conformance
12 with the ASME code Section 3?

13 MR. ROWLEY: The entire analysis - the
14 entire updated - well, confirmatory analysis, yes.

15 VICE CHAIRMAN BONACA: Yeah, the claim was
16 made that the original analysis was also conforming to
17 ASME code Section 3.

18 MR. CHANG: to be precise, that should be
19 performed according to the ASME code without using
20 Green's function methodology.

21 VICE CHAIRMAN BONACA: Yes, okay. They
22 stated the same thing. So that is not the
23 distinguishing attribute

24 CHAIRMAN SHACK: Well, just to defend the
25 poor Green's function here for a second, poor Mr.

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1 Green, the Green's function is fine. It's how they
2 combine the stresses after the use the Green's
3 function that is the problem.

4 MEMBER BLEY: Calling that the Green's
5 function method is not right.

6 (Simultaneous speakers)

7 CHAIRMAN SHACK: I did have a question, if
8 I could ask Gary Stevens, this came up.

9 Does the location of the maximum fatigue
10 usage change when you do the individual transients,
11 decay Fen? You find that the actual location of
12 maximum usage has shifted? You didn't look at that?

13 MR. STEVENS: We did. I'm trying to figure
14 out the best way to answer your question without
15 confusing the whole room.

16 The answer would be no, but what location
17 we looked at we built into this going into the
18 analysis. And there were several considerations.

19 First and foremost would be looking at
20 what the original design analysis tells us about where
21 the high usage location is. And that's an appropriate
22 technique -

23 CHAIRMAN SHACK: Well, no, when we say high
24 usage location, I mean are we talking nozzle or are we
25 talking finite element location, et cetera.

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1 MR. STEVENS: I'm not sure I understand
2 that question.

3 CHAIRMAN SHACK: You get a different usage
4 factor for every finite element in this whole axis-
5 symmetric model, and I'm assuming the number you are
6 quoting here is the highest usage factor for any given
7 element that you are looking at.

8 MR. STEVENS: That's right. We based our
9 selection process on really three things: maximum
10 stress, which is going to give us high usage factor;
11 we also need to look at different materials. Some of
12 these nozzles have stainless steel safe ends and low
13 alloy steel nozzle forgings which have different Fen
14 factors associated with them. And we also have to
15 look at chemistry, as in water chemistry.

16 An example there would be the feedwater
17 nozzle where the incoming feedwater stream, the oxygen
18 content is significantly different than it is in the
19 vessel. So the environmental factor for the safe end
20 would be drastically different than it is for the
21 nozzle forging.

22 All that was built together, and that's
23 why for each of these nozzles we take two locations,
24 the limiting location in the safe end, and the
25 limiting location in the nozzle forging. And that is

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1 a composite of all those factors going together, that
2 collectively this gives us - between the two locations
3 we've covered the maximum possible usage factor for
4 the whole component.

5 If I - I would come up with a different
6 conclusion if the chemistry was constant for all
7 locations, the material was constant, I might pick one
8 location in a safe end, in a PWR for example,
9 especially where stratification loading is present,
10 and it drives you back to the safe end.

11 In this situation here, with different
12 materials and different chemistry, we chose to
13 evaluate two locations to bound it.

14 MR. CHANG: Dr. Chang. If I may supplement
15 what Gary says. You vary two locations, but when they
16 say safe end, actually they evaluate three locations
17 in the safe end; the pipe end, the pipe to nozzle
18 weld; and the transition. Consider, next to that
19 transition there is a thermal sleeve which can change
20 temperature diffusion pattern.

21 So one location covers three areas which
22 they did not advertise. I just tried to clarify.

23 MR. ROWLEY: So that ends our presentation
24 unless there are more questions.

25 VICE CHAIRMAN BONACA: Thank you for your

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1 presentation. And are there any questions? Or
2 further comments?

3 I guess not, so I'll give it back to you.

4 CHAIRMAN SHACK: Gentlemen, I think we can
5 break for lunch until 1:15. And again I'd like to
6 thank the licensee and the staff for very interesting
7 presentations. It did help clarify an issue that was
8 quite confusing.

9 (Whereupon at 12:04 p.m. the proceeding in
10 the above-entitled matter went off the record to
11 return on the record at 1:15 p.m.)

12 CHAIRMAN SHACK: We can come back into
13 session.

14 Our next topic today are some selected
15 chapters of the SER associated with the ESBWR design
16 certification applications. And Dr. Corradini will
17 lead us through that.

18 MEMBER CORRADINI: Thank you, Mr.
19 Chairman. I'll just give a short reminder to the
20 Members about where we are in this. So the purpose of
21 this portion of the meeting is to review four chapters
22 of the design certification document and the
23 associated SERs that we have talked about in
24 subcommittees. Those chapters of the SERs are
25 chapters 9, 10, 13, and 16, with open items related to

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