UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

Before Administrative Judges:

Alex S. Karlin, Chairman
Dr. Richard E. Wardwell
Dr. William H. Reed

In the Matter of ENTERGY NUCLEAR VERMONT YANKEE, L.L.C., and ENTERGY NUCLEAR OPERATIONS, INC. (Vermont Yankee Nuclear Power Station)	Docket No. 50-271-LR ASLBP No. 06-849-03-LR December 3, 2008

Memorandum
(Submission of Proposed Questions into the Official Record)

The Board hereby provides to the Secretary of the Commission, for inclusion in the official record of this proceeding, the questions submitted by the parties in this proceeding, pursuant to 10 C.F.R. § 2.1207(a)(3)(i)-(ii). Appendix A is a list of the sets of questions proposed by the parties prior to the evidentiary hearing. Appendix B is a list of the sets of questions proposed by the parties during the evidentiary hearing.

FOR THE ATOMIC SAFETY
AND LICENSING BOARD[1]

/RA/

Alex S. Karlin, Chairman
ADMINISTRATIVE JUDGE

Rockville, Maryland
December 3, 2008

[1] Copies of this order were sent this date by Internet e-mail transmission to counsel for (1) licensees Entergy; (2) intervenors Vermont Department of Public Service and New England Coalition of Brattleboro, Vermont; (3) the NRC Staff; (4) the State of New Hampshire; and (5) the Commonwealth of Massachusetts.

Appendix A
(Sets of Questions Proposed Prior to the Evidentiary Hearing)

1. New England Coalition, Inc.'s Direct Examination Plan (June 23, 2008).

2. Entergy's Proposed Board Examination Questions to Direct and Rebuttal NEC Witnesses on NEC Contentions 2A and 2B (June 23, 2008).

3. Entergy's Proposed Board Examination Questions to Direct and Rebuttal Witnesses on NEC Contention 3 (June 23, 2008).

4. Entergy's Proposed Board Examination Questions to Direct and Rebuttal NEC Witnesses on NEC Contention 4 (June 23, 2008).

5. NRC Staff Proposed Questions Regarding Direct and Rebuttal Testimony (June 20, 2008).

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and ENTERGY NUCLEAR OPERATIONS, INC.	)	ASLBP No. 06-849-03-LR
	)	
(Vermont Yankee Nuclear Power Station)	)	

NEW ENGLAND COALITION, INC's DIRECT EXAMINATION PLAN

New England Coalition, Inc. ("NEC") submits the following direct examination plan pursuant to 10 CFR § 2.1207(a)(3), and the Initial Scheduling Order ¶ 10(F).

I. CONTENTIONS 2A AND 2B (CUFen Analysis)

A. CALCULATION OF ENVIRONMENTAL CORRECTION FACTOR (Fen)

Witnesses: James C. Fitzpatrick, Gary L. Stevens, John Fair, Kenneth Chang, Joram Hopenfeld

Issue: Validity of the Environmental Correction Factor, Fen, calculated by Entergy

Objective: The ASLB should explore how Entergy's calculation of Fen values accounted or did not account for the following uncertainty factors: Oxygen Concentration, Cracks in Cladding and Base Metal, Surface Temperature, Loading History, Heat to Heat Variation, Surface Roughness, Data Scatter, Mean Stress, Size, Flow Rate.

1. OXYGEN

James C. Fitzpatrick:

EPRI (NEC-JH-64 at 4-27 & 28) stated that experts believe that electrochemical potential is the controlling parameter in determining Fens in BWR's rather than measured dissolved oxygen concentrations. Dr. Hopenfeld also shares this view. You testified that the dissolved oxygen is the controlling parameter. Please discuss the reasons why you disagree with Dr. Hopenfeld on this point, with reference to specific data.

Joram Hopenfeld:

Why do you disagree with Entergy's view that oxygen concentrations and not the Electrochemical Potential (ECP) is the controlling parameter in determining the Fens? Why is this important or relevant?

Gary Stevens:

You testified that the Fen=17 proposed by NEC is not applicable to VY because it is valid only for very high oxygen concentrations and temperatures. Please explain the basis for your statement, citing references if possible, that the Fen value of 17 is restricted to high oxygen and temperature levels.

How was the negative solubility of oxygen (dissolved oxygen increases with the decrease in temperature) accounted for when you applied the ANL 1998 equations to calculate the Fens. (Fen depends directly on DO which is amplified by a term that contains the corresponding temperature).

Joram Hopenfeld:

Please explain why you disagree with Entergy that the Fen value of 17 is restricted to high oxygen and high temperature environments.

Kenneth Chang:

Based on the results obtained using the BWRVIA computer code, Entergy stated that the oxygen concentrations that have been used to calculate the Fen factors in the 1998 ANL equations were bounding. Entergy claims that the BWRVIA provided conservative predictions of oxygen concentrations during transients at the surface of all NUREG-6960 locations.

Has the NRC evaluated the BWRVIA computer code in accordance with the NRC requirements as described in NEC-JH-35 at 190?

Was the BWRVIA code peer reviewed?

Entergy stated in License Renewal Application Amendment 35 that the steady state oxygen concentrations that were used in the BWRVIA code provided bounding Fen values. What is the justification for using steady state oxygen concentrations and not transient oxygen concentrations, which vary with temperature and are an order of magnitude higher than steady state concentrations (*See,* NEC-JH-65 at 53)?

James Fitzpatrick:

Entergy's License Renewal Amendment 35 states that Entergy applied **steady state oxygen concentrations** to calculate the Fen values even though the oxygen concentrations **during transients may be an order of magnitude higher** than the steady state value (NEC-JH-69).

Since the CUFen of the FW nozzle is already close to one (0.8930) and since the Fen is very sensitive to oxygen concentrations, small changes in oxygen concentrations (on the order 15%) may cause the CUF to exceed unity. In light of this:

Why do you believe that using **steady state oxygen** concentrations in the BWRVIA code bounds the **transient oxygen concentrations** which are, according to EPRI, an order of magnitude higher during startup and shutdown transients than during steady state?

Was the BWRVIA code benchmarked under steady state conditions or during transients? What parameters were measured?

Has there been any analysis to determine that the Fen is conservative with respect to the uncertainty in oxygen concentrations?

John Fair:

Entergy stated in License Renewal Amendment 35 that: "Approximately 13 years of recorded feedwater dissolved oxygen, DO measurements, including excursions, were evaluated for input to the EAF analysis. A DO value (50 ppb) was used to calculate bounding Fen values for the feedwater piping."

Given that Vermont Yankee has been operating for 35 years, and the DO during transients can be considerably higher than 50 ppb (up to 1000 ppb), why have you accepted Entergy's contention that a DO value of 50ppb is bounding for the feedwater piping? What about for other piping in the reactor system?

Has the NRC audited the oxygen concentrations that were used by Entergy in the ANL equations to ensure that they bound the oxygen concentrations during transients?

Joram Hopenfeld:

Do you think Entergy used bounding oxygen concentrations to calculate Fen values?

2. CRACKS IN CLADDING AND BASE METAL

James Fitzpatrick:

Entergy stated in RAI 4.3-H—02 that the feedwater nozzle cladding may contain cracks that could grow into the base metal. Given that the ANL equations are based on tests on specimens that did not have surface cracks, please explain why the ANL equations conservatively account for feedwater nozzle cracking at Vermont Yankee.

Kenneth Chang:

The ASME Code allows one to disregard the cladding (if its thickness is less than 10% of the wall thickness). Do you believe that surface cracks in the feedwater nozzle clad can be disregarded in the fatigue analysis?

With regard to the presence of cracks at the cladding and the base metal of the Vermont Yankee feedwater nozzle, Exhibit 2-33 at 4 states that "No relevant information was recorded." What criteria does the NRC use to determine whether the cladding and the base metal are free of surface cracks?

3. SURFACE TEMPERATURE

James Fitzpatrick:

The ANL 1998 equations for calculating the Fen are based on the assumption that the Fen is independent of the temperature below 150C. Dr. Chopra, the developer of the ANL equations, told the ACRS that a decrease in life by a factor of two is possible below 150C, NEC-JH-27 at 25. Please explain why this factor was not included in Entergy's calculations of the Fen.

4. SURFACE FINISH

James Fitzpatrick:

You stated that the effects of surface finish are properly factored into the ASME design fatigue curves. These curves were obtained for **machined** surfaces in **air.** Please explain what data support your statement that corroded surfaces in **water** would exhibit the same fatigue characteristics as **machined** surfaces in **air?**

5. LINKING TRANSIENT PAIRS

Kenneth Chang:

NEC-JH-64 at 4-29 shows that linking end point heat up loads with initial point cool down loads is not simple and can lead to significant errors. What criteria were used to determine

that Entergy's results are conservative in the light of the many uncertainties in the linking of transients?

6. LOADING HISTORY, MEAN STRESS, HEAT TO HEAT VARIATION, SIZE, FLOW RATE

James Fitzpatrick:

Do you agree that the 1998 ANL equations are not adjusted for the variables listed in NEC-JH-63 at 5 and 6? Please explain, as quantitatively as possible, why conservative Fen values can be calculated using the 1998 ANL equations if these equations are not adjusted for the variables listed in NEC-JH-63 at 5 and 6.

Kenneth Chang:

You testified that: "Error analysis is not necessary because conservatism is built into the design fatigue curves for carbon steel/stainless steel in the light water environment. As stated in NUREG/CR-6583 and NUREG/CG-5704, (ANL 1998 equations), these design curves have been adjusted for uncertainties that are associated with material and loading conditions."

Please explain the inconsistency with NUREG 6909, which listed nine uncertainties that **were not used to adjust** the NUREG/CR-6583 and NUREG/CG-5704, ANL 1998 equations. Additional uncertainties were listed in (NEC-JH-63 at 5 and 6).

EPRI stated that Fen values can vary between **2.0 to 15** for stainless steel and between **1 to 70** for carbon steel for a range of strain rates and oxygen combinations below 550F. NEC-JH-64 at 4-18. These Fen values may exceed those calculated by Entergy by as much as a factor of 7. What assessment was conducted by the NRC to ensure that VY can use less conservative values than those specified by EPRI?

John Fair:

Given that the ANL 1998 equations result in more conservative Fen values for some materials and in less conservative values for others, and given all the factors that were not included in the above equations but may affect the Fen, please describe the assessments and the studies that the NRC conducted prior to telling the ACRS that the ANL1998 equations generally result in more conservative Fens than the ANL 2007 equations.

B. CALCULATION OF 60-YEAR CUF VALUES

Witnesses: James C. Fitzpatrick, Gary L. Stevens, John Fair, Kenneth Chang, Joram Hopenfeld

Issue: Validity of uncorrected 60-year CUF values, as calculated by Entergy.

Objective: The ASLB should evaluate the conservatism of Entergy's calculation of uncorrected 60-year CUF values. It should specifically explore Entergy's use of simplified assumptions in calculating heat transfer coefficients and the number of plant transients, and its use of Green's Function.

1. GREEN'S FUNCTION

Kenneth Chang:

The NRC approved multiple License Renewal Applications that relied on the simplified Green's Function to reduce the cost of the fatigue analysis prior to the present proceedings. In spite of the fact that Entergy was not able to explain differences between its results with and without Green's function at the January 2008 NRC meeting, Mr. Chang told the ACRS in early February that Entergy's results were conservative. It was only later in February when it was discovered that Entergy obtained conservative results by using the wrong Fen value that the NRC reversed its position and concluded that Green's Function may yield non-conservative results.

Why did the NRC approve multiple license renewal applications before discovering that the use of Green's Function was not bounding?

Were you convinced following the January 8, 2008 NRC/Entergy meeting by Entergy's assertion that its results using Green's Function yielded bounding CUFens for all three nozzles?

Why did you tell the ACRS in February, prior to the NRC's audit, that the Entergy's fatigue analysis was adequate?

Why was reanalysis of the recirculation and spray nozzles deferred to some future time?

Joram Hopenfeld:

Please explain your view of the validity of using Green's function for fatigue analysis and why NEC raised this issue.

2. HEAT TRANSFER COEFFICIENTS

To simplify their numerical analysis, Entergy assumed that the stresses in the three nozzles are distributed uniformly both circumferentially and axially. NEC claims that this simplifying assumption must be justified because the flow through the nozzles is not fully developed and the heat transfer coefficient would therefore vary in the axial direction. When the flow is governed by natural convection and condensations during the transient, the heat transfer coefficient would vary in the vertical direction. Since the stress is very sensitive to the variations in the heat transfer coefficient, the thermal stresses will vary both axially and circumferentially.

James Fitzpatrick and Gary Stevens:

You have stated that the straight section of the pipe upstream of the nozzles is 48 inches and therefore the flow would be fully developed throughout the nozzle. According to Dr. Hopenfeld, the flow is not fully developed in any of the nozzles because the smallest diameter of any of the nozzles is 10 inches and according to the data on flow in pipes (NEC-JH- 29) it takes up to 60 diameters for the flow to be fully developed. Please explain the reasons for your opinion on this issue.

According to Dr Hopenfeld, the equations you are using to calculate natural convection heat transfer coefficients are based on average heat transfer coefficients instead on local heat transfer coefficients, which would vary in the vertical direction. Please explain why it is justified to use average heat transfer coefficients instead local heat transfer coefficients, which vary in the vertical position.

Joram Hopenfeld:

Please explain how Entergy's use of a simplified axisymetric model that neglected heat transfer variations affected its analysis, including with respect to the locations chosen for conducting the analyses of the feedwater, recirculation outlet and core spray nozzles.

Is there sufficient data to definitely conclude that 48 inches of straight piping **is not sufficient to allow** a fully developed flow in all three nozzles? Why is this important?

Kenneth Chang:

Why do you believe it was not necessary to conduct an error analysis to determine the degree to which the location and the magnitude of the maximum thermal stresses for all three nozzles would be affected if:

(i) instead of using average heat transfer coefficients for fully developed forced flow, Entergy had used local heat transfer coefficients properly adjusted for the high local turbulence at the entrances and exits from the nozzles?; and

(ii) instead of using average natural convection coefficients, Entergy made adjustments for local variations as required by basic considerations of gravity driven flows?

3. NUMBER OF TRANSIENTS

James Fitzpatrick:

You have stated that,

> VY projections for 60 years were made based on all available sources, including the numbers of cycles for 40 years in the VY reactor pressure vessel Design Specification, the numbers

of cycles actually analyzed in the VY Design Stress Report, and the numbers of cycles experienced by VY after approximately 35 years of operation (July 2007).

Please explain in more detail how the number of transients was determined. What do you mean by "all available sources?" Please explain why the projected number of transients is conservative.

In Table 4.3-2 of the License Renewal Application, Note 2 and Table 3-10 (NEC-JH-18 at 18), Entergy stated that the number of transients was based on "actual cycles to date and projected to 60 years" by linear extrapolation. Please explain why Entergy described two different methods to arrive at the number of transients. Which method was used in the determination of the final CUFen values?

Kenneth Chang:

You testified that the NRC staff cannot determine whether the number of transients that were used by Entergy for the calculations of the uncorrected 60-year CUF is conservative. Please explain why you cannot confirm the conservatism of the transient projection.

Since the environmentally corrected 60-year CUFen is the product of the CUF and the Fen for each transient, how did you reach the conclusion that the CUFens are conservative if you don't know whether the uncorrected 60-year CUFs are conservative?

Has there been an audit of how Entergy determined the number of transients, component by component, for each of the NUREG 6260 locations?

Did Entergy commit to using actual thermal transient histories for its refined fatigue analysis? Is so—where is this documented?

What major transients did the Vermont Yankee plant experience beginning with original heat-up through today? How was each transient incorporated in the fatigue cycle analysis? Which documents that are part of the record before the Board support this analysis?

Was the actual number of transients since implementation of power uprate (2004) factored into the transient cycle count?

C. TIMING, CONTENT, AND IMPACT of NRC STAFF ACCEPTANCE of LICENSEE COMMITMENTS

Witnesses: NRC Staff witnesses and counsel

Issues: NRC Staff's policies regarding the acceptance of licensee "commitments" as a means to resolve issues in the license renewal process.

Objective: The NRC Staff has taken the position that Entergy can complete or correct its CUFen analyses pursuant to a licensing commitment, and as a component of its metal fatigue aging management program under 10 CFR § 54.21(c)(1)(iii). In light of this, the Board should further explore the NRC Staff's policy regarding the role of licensing commitments, and the impact of this policy on the due process rights of intervenors.

Questions for NRC Staff:

1. Entergy Nuclear Vermont Yankee's (ENVY) License Renewal Application (LRA) was accepted for NRC Review in March of 2006, was it not?

2. What is the administrative target for completion of review?

3. Why has this review taken longer? How have the contentions filed by NEC affected the Review? What parts of additional review relate to issues raised in NEC contentions, that is, pipe thinning, metal fatigue, steam dryer integrity?

4. Were complete responses to all Requests for Additional Information (RAI) completed before issuance of the Staff's Safety Evaluation Report (SER)?

5. How many RAI's were answered with Licensee offers of "Commitments" ?

6. Does NRC treat all licensee commitments as binding and enforceable?

7. Are any outstanding ENVY commitments related to the subject matter of New England Coalition's Contentions, that is, pipe thinning, metal fatigue, steam dryer integrity? Please identify them.

8. How many of these commitments were accepted after NEC filed its 'Motion for Leave to Intervene', May 26, 2006?

9. What are the review and acceptance criteria for 'commitments'? What goes into the Staff's consideration of accepting, for example, the promise of some future data gathering or analysis instead of requiring that it be provided within the two-year review period?

10. Are all relevant Vermont Yankee extended power uprate (EPU) phenomena incorporated in aging management programs of the LRA and its amendments and reviewed in preparation of the SER? Do any considerations of the effects of EPU remain to be considered and/or incorporated?

Questions for NRC Counsel:

1. NRC Counsel (OGC) has asserted that it has the authority to provide official interpretations of NRC regulations:

...Rather, the Office of the General Counsel has the authority to provide official interpretations of NRC regulations...
NRC Staff's Motion in Limine To Strike Testimony And Exhibits Filed By New England Coalition, Inc. , Pg.10
Is this correct?

2. What are the legal implications for timely and technically defensible completion of 'commitments'? Are all licensee commitments binding and enforceable? What is NRC's record of enforcement of licensee commitments?

3. Please give us your opinion on how the NRC Staff acceptance of 'commitments,' relevant to NEC Contentions, to be completed after the record on this proceeding is closed, affects the intervenor's hearing rights?

    a. Should fulfillment of the 'commitments' appear to the intervenors to be inadequate, should they then move to reopen these proceedings? What is their legal recourse?

    b. Isn't removal of relevant issues from consideration after contentions have been filed, in fact, a denial of due process?

    c. If you were to recommend redress under 10 C.F.R. 2.206, would you be then requiring intervenors to abandon the rights to disclosure, motions, and review by a non-biased judicial panel in favor of going back-as-it-were to square one, review by NRC Staff?

    d. Why should this panel not require that all relevant commitments of data gathering, inspection, and analysis be fulfilled in a timely manner that would permit the intervenors to review the material, and file if indicated, additional or amended contentions prior to closing these proceedings?

II. CONTENTION 4
(Flow-Accelerated Corrosion)

A. RECALIBRATION OF CHECWORKS MODEL

Witnesses: James C. Fitzpatrick, Jeffrey S. Horowitz, Kaihwa Hsu, Jonathan Rowley, Joram Hopenfeld

Issue: Entergy relies on the computer code **CHECWORKS** to define the scope of component inspection for wall thinning. Entergy and NEC positions differ regarding the reliability of **CHECWORKS** as an aging management tool.

a. **Entergy Position: CHECWORKS** is a reliable code which is based on 30 years of research and plant experience. No recalibration of the code is required following the 20% power uprate at VY.

b. **NEC Position: CHECWORKS** has no demonstrated capability to predict wall thinning. Because it is an empirical code, it must be recalibrated each time velocities, temperatures and oxygen concentrations change in the plant.

Objective: To understand the reasons for these two different positions, one must first understand the factors that control FAC. The Board should explore NEC's and Entergy's use of different data bases on how the following factors affect FAC: velocity, local turbulence, oxygen, and time. The Board should also explore the Vermont Yankee plant experience with CHECWORKS.

1. DEFINITION

Jeffrey Horowitz:

Your definition of FAC excludes wall thinning by cavitations, droplet impingement, or shear forces that could damage the protective oxide layer. Please describe,

(a) How wall thinning rates caused by the above phenomena are affected when the velocity is increased by approximately 20%. What is the impact on the inspection program at the VY plant?

b) Have there been studies showing conclusively that the FAC process is strictly controlled by the chemical dissolution of the oxide layer, and not by its simultaneous removal by shear forces?

How would you define FAC: phenomenologically, kinetically, chemically

How would you describe erosion-corrosion, phenomenologically, chemically, kinetically?

Describe cavitation: phenomenologically, chemically, kinetically.

At what point does FAC transition into erosion corrosion, impingement, or cavitation?

Are there truly inherent differences in these four manifestations of metal deterioration or are they indeed all related with each other?

Joram Hopenfeld:

Your definition of FAC includes wall thinning by electrochemical dissolution as well as by cavitations, droplet impingement, and oxide abrasion by shear forces. Please explain why you have selected this definition.

2. FLOW VELOCITY

Jeffrey Horowitz:

You disagreed with Dr. Hopenfeld that the corrosion rate varies with the velocity to a power between 2.6 and 6. You indicated that the corrosion rate varies weakly with the velocity, to a power of less than 0.8. To support your theory, you cited FAC tests of **copper in hydrofluoric acid.** Please explain why the corrosion behavior of copper in hydrofluoric acid is prototypical of the behavior of carbon steel in high purity water.

Joram Hopenfeld:

Please explain why your theory about the dependence of the wall thinning rate on the velocity is considerably different than Dr. Horowitz's theory.

Jeffrey Horowitz:

Equation 7.7 (E4-08) defines the corrosion rate CR, in terms of eight empirical factors. The factor F3 is the mass transfer factor which contains the velocity term. Do you have any plant data that would demonstrate how the CR varies with F3 and with the velocity alone, when all the other seven factors are kept constant?

EPRI NSAC-202L-R3 under 4.3.1 FAC Analysis and Power Upgrade states: "***It is recognized that even small power upgrade can have a significant effect on FAC rates.*** This can be caused by changes to equipment and changes to system operating conditions such as flow rates etc." How could a small power upgrade have a significant effect on FAC rates if wear rates are proportional to flow rate, as you have contended?

Joram Hopenfeld:

Please explain why the data on CHECWORKS wall thinning predictions (NEC-JH-37) cannot be used to determine the effect of velocity on the corrosion rate.

Jeffrey Horowitz:

Please explain why CHECWORKS does not have to be recalibrated following the Vermont Yankee power uprate, even though CHECWORKS is an empirical code and the NRC requires that such codes be benchmarked when plant conditions change. NEC-JH-35 at 190.

Joram Hopenfeld:

Please explain why you differ with Dr. Horowitz concerning the need to recalibrate CHECWORKS following a 20% change in velocity.

James Fitzpatrick

How does the VY FAC program account for flow velocity increases of 129% for main steam?

3. LOCAL TURBULENCE

Jeffrey Horowitz:

Table 7.1 (E4-08) lists the average mass transfer coefficients for various geometries that are used in CHECWORKS. You apparently disagree with Dr. Hopenfeld that it is the local velocity and not the average velocity that affects local turbulence. Please comment on Dr. Hopenfeld's observation that wall thinning rates at the outer surfaces of elbows and curved pipes are much higher than those on the inner surfaces?

Joram Hopenfeld:

Please explain why you believe that it is the local velocities and not the average velocities that control wall thinning rates. Why is that important?

Jeffrey Horowitz:

According to E4-08, Figure 7-2, the equation A=A+BxA accounts for local variations between two fittings. Please explain the meaning of this equation, and how the values of A are determined? Was this equation verified against plant data?

Joram Hopenfeld:

Does the equation A=A+BxA account for the type of local behavior of FAC that you have discussed in your report, Exhibit NEC-JH-36?

James Fitzpatrick:

In Entergy's answer to NEC contention 4, filed June 22, 2006, Entergy stated regarding the increase in inspection scope following the 20% power increase:

> "We'll be looking at the highest length locations and the highest velocity locations in the next three outages."

Please describe the process of looking i) at the highest velocity locations and ii) at the highest length locations.

What is your reason for believing that "the highest length locations" is an important factor affecting FAC?

Jeffrey Horowitz:

You made a distinction between pipe failures by leaks and pipe failures by rupture. You stated:

> "With respect to the allegedly local nature of FAC wear, although local FAC wear is occasionally seen – normally near a geometric discontinuity – such local wear usually results in only minor effects (e.g., leaks). The normal feature of FAC wear – widespread wear over an extended area – is what causes significant problems (e.g. the need for pipe replacements or the occurrence of pipe ruptures)."

According to a TVA document (NEC-JH-70 at 2), the Surry accident was caused by "localized wall thinning at a pipe to elbow weld. The thinning was identified as erosion-corrosion." In the light of the TVA report, please explain why you believe that localized corrosion leads to minor leaks and widespread wear leads to ruptures.

Joram Hopenfeld:

Please describe how your definition of "local corrosion" differs from Dr. Horowitz's.

4. OXYGEN CONCENTRATIONS

Jeffrey Horowitz:

Would Vermont Yankee's switch to hydrogen water chemistry affect oxygen levels in the plant?

You stated that the oxygen level in the feedline has never changed but you did not address the other piping in the plant. Should oxygen levels in other parts of the plant not be of concern?

5. FAC VARIATION WITH TIME

Jeffrey Horowitz:

You supported your view that the rate of FAC is constant with time (E4-08, Figs 3.6 and 3.7, and 4-19 Fig.7-6) with laboratory data of relatively short duration, 500-2000 hrs. Why is it reasonable to extrapolate this data to time periods which are on the order of 300,000 hrs?

Joram Hopenfeld:

Please explain why you believe that the corrosion rate may not be constant with time and why this is important.

6. VERMONT YANKEE PLANT EXPERIENCE WITH CHECWORKS

Jeffrey Horowitz:

You have stated that,

> "the correlations built into CHECWORKS are based on laboratory experiments on modeled geometries, published correlations, and operating data from many nuclear units."

Please explain why you have not presented to the ASLB a comparison of CHECWORKS predictions with Vermont Yankee plant data.

Joram Hopenfeld:

Please discuss your familiarity with CHECWORKS predictions.

Jeffrey Horowitz:

You have stated that there is no reason to calibrate CECKWORKS following the uprate. What is the reason for increasing the inspection scope at VY by 50% if CHECWORKS does not need calibration?

Please estimate what the 50% increase means in terms of the total number of inspection points and the number of components inspected.

What uncertainty assessments have been conducted to determine that CHECWORKS will detect wall thinning before the wall thickness falls below the minimum design value? If such assessments are available, why have the results of such assessments not been provided to the ASLB?

Why was the ASLB not provided with any data verifying that CHECWORKS will be able to predict reliably wall thinning following the uprate?

Joram Hopenfeld:

What is your understanding of how Entergy determines the scope of the inspection program during a typical outage?

James Fitzpatrick:

To justify the use of CHECWORKS at VY you stated that no one was ever killed in plants that used CHECWORKS, and you also cited a document (E4-09) that states that since CHECKWORKS was introduced in 1987 no plant has experienced FAC pipe failures in pipes larger than 2 inches. You have not provided data showing a comparison of CHECWORKS predictions with VY plant data. Do you have other technical reasons for relying on CHECWORKS to define the inspection scope at VY?

What is the maximum post-EPU flow velocity of any VY system – in particular the main steam? How did Entergy incorporate this number into the CHECWORKS model. When did it first use this value? Does the SER credit this number? Where?

Jeffrey Horowitz:

You stated that "the successful use of CHECWORKS and its predecessor programs for more than 20 years provides additional support for the claim that CHECWORKS is an effective tool for inspection planning." What criteria did you apply to reach the above conclusion?

Joram Hopenfeld:

Please explain why you believe that 12 to 15 years would be required to establish corrosion rate trends at the VY plant?

B. COMPLIANCE OF ENTERGY FAC MANAGEMENT PROGRAM UNDER CURRENT VY LICENSE WITH NRC AND INDUSTRY GUIDANCE

Witnesses: James C. Fitzpatrick, Jeffrey S. Horowitz

Issues: Is Entergy's implementation of its FAC management program under its current license consistent with industry and NRC guidance? Has Entergy established an accurate baseline for aging management and use of CHECWORKS as an aging management tool?

Jeffrey Horowitz and James Fitzpatrick:

What were the results of Entergy's susceptibility and predictive analysis for:

a. Power uprate

b. Geometry changes

c. Component changes

d. Chemistry changes

e. Temperature changes

f. Pressure changes

g. Dissolved copper.

Is this analysis part of the record evidence before the Board? How are does Entergy incorporate these results into either its engineering judgement or NSAC 202L analysis?

Is documentation of Entergy FAC inspection point counts part of the record before the Board?

What was the actual full count of points inspected in rfo24 rfo 25 and rfo 26?

When was the CHECWORKS software updated at VY—(version 1.0 through 1.G for example, then upgraded to 2.0 through 2.x)? Is the Software Quality Assurance documentation for each of these upgrades part of the record before the Board?

When did Entergy update the CHECWORKS model with plant inspection data from 1993 to the present?

What is the basis for declaring the program unsatisfactory in the QA audit of 2004—yet then claiming that the program was adequate based upon Entergy's own review of its own document?

Who is responsible for program implementation?

Explain why Entergy did not prepare Condition Reports when CHECWORKS predicted negative time to failure of components, as required by Appendix B.

Exhibit NEC-UW-14 is an e-mail by the VY Resident Inspector, which suggests Entergy was still updating the CHECWORKS model as of February, 2008. Please explain.

Did Entergy transition its FAC inspection procedure from PP7028 to the fleet-wide procedure, but then subsequently performed at least one FAC inspection under the superseded PP7028. Please explain.

How and when did the licensee transition from old plant-specific FAC inspection procedures to new corporate procedures? How was this accomplished without a transition plan—given that the effective date of the new procedure was the same date as the date that it was signed off.

When and how did Entergy update the CHECWORKS model with EPU plant parameters?

How many CRs were written against the FAC program since 1999? What is the complete list of action items, and current status?

What are the weakest, most FAC-susceptible 10 components in the system? How has that changed since power uprate? Where is this documented?

CONTENTION 3
(Steam Dryer)

Witnesses: Mr. John Hoffman, Mr. Larry Lukens, Dr. Joram Hopenfeld

Issue: The ability of Entergy's Monitoring Program to prevent safety risk due to formation of loose parts.

Objective: To determine whether Entergy's fatigue analysis of the dryer is based on inadequate knowledge of the stresses due to flow induced vibrations, FIV.

John Hoffman

You stated that the analytical tools used to estimate stress loads on the steam dryer during the power ascension phase of EPU implementation demonstrated that loads on the dryer would be below the endurance limit.

NEC-JH-63 at 34 claims that the ACRS questioned the scaling laws that were used to determine steam dryer loads from the steam line instrumentation. What is the uncertainty in predicting the loads on the dryer? Have there been any simultaneous pressure measurements on the steam lines and the surface of the dryer?

What methods were used to validate the predictions of the natural frequencies of the various parts of the dryer?

Joram Hopenfeld

Please describe why you do not believe that Entergy's steam dryer fatigue calculations are reliable.

John Hoffman

You stated that: "[c]onfirmation that stresses on the VY steam dryer remain within fatigue limits is provided daily by the fact that the dryer has been able to withstand without damage the increased loads imparted on it during power ascension and for the two years of operation since EPU was implemented."

Since vibrations of dryer parts can persist for the entire duration of the 20 years extended life, the number of stress cycles that is relevant is much larger than the number that has been accumulated to date. Why is the number of cycles that was accumulated during the first two years without failures proof that a larger number of accumulated cycles would not produce failures?

Has there been an analysis to determine how a dryer weakened by cracks would respond to DBA loads? Were there any studies done to determine load uncertainties on the dryer?

Joram Hopenfeld:

Do you believe that Entergy's observation that the Dryer has not failed so far is a guarantee that Entergy complies with the General Design Criteria requiring that protection must be provided against the dynamic effect of LOCA ?

Larry Lukens:

Please describe the procedures for ensuring that the loads on the dryer do not change when repairs are made to reactor components such as the relief valve, for example?

A draft Entergy Engineering report, Exhibit NEC-JH_68, states that the possibility of continued growth of IGSCC cracks by fatigue could not be ruled out. What was the basis for this statement in the draft report? What was the basis for omitting it from the final version of this same report?

John Hoffman:

NEC cited a Pacific Northwest National Laboratory study that stated: **"Unlike the previously discussed mechanisms (corrosion) vibration fatigue does not lend itself to periodic in-service examinations (volumetric, surface, etc) as a means of managing this degradation mechanism."** The main reason for this is: **"Once a crack initiates failure quickly follows."**

Since Entergy's methodology rests entirely on periodic in service examination, please discuss why you disagree with the above conclusions.

Joram Hopenfeld:

Please describe whether you believe that the Entergy program is inadequate to prevent steam dryer failure during Design Basis Accidents.

June 23, 2008 New England Coalition, Inc.

by: _____

Andrew Raubvogel
Karen Tyler
SHEMS DUNKIEL KASSEL & SAUNDERS PLLC
For the firm

Attorneys for NEC

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
Entergy Nuclear Vermont Yankee, LLC	)	Docket No. 50-271-LR
and Entergy Nuclear Operations, Inc.	)	ASLBP No. 06-849-03-LR
	)	
(Vermont Yankee Nuclear Power Station)	)	

CERTIFICATE OF SERVICE

I, Christina Nielsen, hereby certify that copies of NEW ENGLAND COALITION, INC.'S DIRECT EXAMINATION PLAN in the above-captioned proceeding were served on the persons listed below, by electronic mail on the 23rd of June, 2008; copies were also sent out by U.S. Mail, first class, postage prepaid, on the 24th of June, 2008.

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June 23, 2008

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

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and Entergy Nuclear Operations, Inc.	)	ASLBP No. 06-849-03-LR
	)	
(Vermont Yankee Nuclear Power Station)	)	

ENTERGY'S PROPOSED BOARD EXAMINATION QUESTIONS TO DIRECT AND REBUTTAL NEC WITNESSES ON NEC CONTENTIONS 2A AND 2B

Pursuant to 10 C.F.R. § 2.1207(a)(3)(i) and (ii), paragraph 10.F of the Atomic Safety and Licensing Board ("Board")'s Initial Scheduling Order dated November 17, 2006, and the Board's December 13, 2007 Order (Addressing Scheduling Issues for Evidentiary Hearing), Entergy Nuclear Vermont Yankee, LLC and Entergy Nuclear Operations, Inc. (collectively "Entergy") submit hereby their proposed questions for the Board to consider propounding to the New England Coalition ("NEC") witnesses on NRC Contentions 2A and 2B in this proceeding.

As directed by the Board in the Initial Scheduling Order, the sets of questions contained herein are prefaced by a brief description of the issues that Entergy contends need further examination, the objective of the examination, and the proposed line of questioning (including specific questions) that may logically lead to achieving the objective.

Entergy is filing separately sets of proposed questions on NEC Contention 3 and NEC Contention 4.

I. QUESTIONS TO BE POSED TO NEW ENGLAND COALITION'S WITNESS DR. JORAM HOPENFELD

Dr. Hopenfeld is the chief witness of intervenor NEC regarding NEC Contentions 2A and 2B.[1] Dr. Hopenfeld addresses these contentions in his pre-filed direct testimony (NEC Exhibit NEC-JH_01 at 3-7), in a report entitled "Review of Entergy Nuclear Vermont Yankee, LLC and Entergy Nuclear Operations, Inc. ("Entergy") Analyses of the Effects of Reactor Water Environment on Fatigue Life of Risk-significant Components During the Period of Extended Operation," NEC Exhibit NEC-JH_03 (Corrected) (April 21, 2008) ("Report"), and in his rebuttal testimony, NEC Exhibit NEC-JH_63.

Dr. Hopenfeld has alleged that a number of deficiencies exist in Entergy's calculations of environmentally assisted fatigue ("EAF") of critical reactor components. EAF is the phenomenon of fatigue occurring on components operating in a reactor coolant environment. The EAF of a component over the operating life of a reactor is obtained as the product of two parameters: the cumulative usage factor or "CUF" for the component over the operating life period, and an environmental correction factor F_{en} that accounts for the reactor coolant environment to which the component is exposed.

Both aspects of the determination of a component's potential vulnerability to EAF can be addressed separately. The following questions are intended to explore the objections to Entergy's methodology for calculating the CUF and the F_{en} for the analyzed VY components and locations, and to clarify other aspects of his testimony.

[1] Mr. Ulrich Witte submitted late rebuttal testimony on June 6, 2008 in which he addresses Contentions 2A and 2B. Mr. Witte's rebuttal testimony is discussed below.

A. FAILURE TO RECEIVE NEEDED INFORMATION

Dr. Hopenfeld alleges that Entergy failed to provide in discovery all the information necessary to establish the validity of Entergy's EAF analyses. Since this is a leading claim in Dr. Hopenfeld's Report and in his direct and rebuttal testimony, it would be useful for the Board to probe into the circumstances relating to this alleged failure and its consequences.

1. Importance of Information

a. In your Report you indicate on p. 8 that Entergy did not provide all the information needed to establish the validity of Entergy's analyses. Did you consider that information to be important for your review?

b. Isn't it true that Entergy provided to NEC its final refined fatigue calculations in August 2007? [Joint Declaration of James C. Fitzpatrick and Gary L. Stevens on NEC Contentions 2A and 2B – Environmentally Assisted Fatigue (May 12, 2008) ("Fitzpatrick – Stevens Dir.") at A26]

c. When did you realize that the calculations did not contain the information you describe as missing?

d. Your questions were posed to Entergy in mid-April of this year, only a few days before you provided your sworn declaration and your Report. How was it that you did not ask for the missing information until then?

e. Isn't it true that the inputs, reference documents, applicable plant drawings, and the transient definitions for 60 years for the VY EAF analyses performed in 2007 are defined in Entergy's Design Input Record (DIR), Rev.1, EC No.1773–Rev.0 "Environmental Fatigue Analysis for VYNPS" 7/26/07 SI file VY-16Q-209?

f. Isn't it true that the DIR was referenced in eight of the final refined fatigue calculations produced in August 2007? [Entergy Exhibits E2-11, E2-16, E2-17, E2-18, E2-20, E2-22, E2-23 and E2-24]

g. Isn't it true that on May 26, 2008 you requested through counsel and obtained, the location of the DIR in the documents produced in discovery?

h. Other parties, such as the NRC Staff, have been able to conduct thorough reviews of Entergy's refined calculations without recourse to anything further than the references cited in those calculations. Why is it that you could not similarly conduct your review?

2. Piping Layout Drawings

a. Your Report states on p. 8 that Entergy did not provide adequate layout drawings of plant piping. Were you aware during your investigations that such layout drawings existed?

b. Were you aware that Entergy had not provided them?

c. Did you ask your counsel to try to obtain them for you?

d. Were you aware that the Design Information Record lists all drawings and other inputs used in the refined fatigue calculations? Did you review the DIR?

e. Were any of the drawings you wanted to review listed in the DIR?

f. If they were, why did you not ask your counsel to seek their production?

3. Description of the Methods Used to Determine Velocities and Temperatures During Transients

a. Your rebuttal testimony (at A19) acknowledges that you requested through counsel that Entergy provide information on the methods used to determine flow velocities and temperatures during transients. Isn't it true that Entergy responded to your counsel's request and provided information on how the temperatures and velocities are computed? [Fitzpatrick - Stevens Dir. at A48]?

b. Your rebuttal testimony at A19 does indicate that you still had a question as to how the flow velocity is computed when the flow is zero. Did you ask your counsel to go back to Entergy and ask for further clarification?

B. COMPUTATION OF CUF

The CUFs for the various reactor components and locations of interest are computed based on the estimated number of transients to occur through sixty years of plant operation, and

include consideration of both the historical plant operating experience and the pressures and temperatures experienced by the components of interest during each transient. Dr. Hopenfeld raises several concerns about how the CUFs for the components and locations of interest are obtained. The questions below are intended to explore some of the issues raised by Dr. Hopenfeld.

1. Number of Transients

   a. In your rebuttal testimony at A21, you state that Entergy has not indicated whether it has made any allowance for the likely increase in plant transients resulting from the uprate or the fact that the number of transients is likely to increase as the plant ages. Isn't it true that in the Stevens/Fitzpatrick supplemental testimony[2] at A17, the Entergy witness indicated that, in some cases, the number of assumed stress cycles in the calculations was obtained by extrapolating to 60 years the number of stress cycles assumed in the design specification, even though the number of cycles experienced to date, if extrapolated to 60 years, would be lower than that assumed in the design specification?

   b. In your Report at p.16 you state that in your opinion the number of transients proposed by Entergy should at a minimum be multiplied by 1.2 to account for the probability of an increase in anticipated failures due to the 20% power uprate. What is your basis for assuming that operation at 20% higher power will result in 20% more transients?

   c. Entergy witnesses testify [Fitzpatrick – Stevens Supp. at A17] that bounding EPU conditions were used for all transient definitions for all assumed cycles, even though EPU operation did not apply to the first 35 years of plant operation. Doesn't that added conservatism help resolve your concern?

   d. In any event, isn't it true that Entergy intends to monitor, throughout the period of extended operations, the actual number of plant transients that VY experiences and make sure the number of transient cycles experienced by the plant does not exceed the assumed number of transients used in the fatigue analyses [Fitzpatrick – Stevens Supp. at A17]?.

[2] Joint Supplemental Declaration of James C. Fitzpatrick and Gary L. Stevens on NEC Contentions 2A and 2B – Environmentally Assisted Fatigue (May 30, 2008) ("Fitzpatrick – Stevens Supp.")

2. Use of Green's Functions

a. You indicate in your rebuttal testimony at A20 that the refined analysis using Green's functions generates non-conservative results because it yields CUF_{en} values that are lower than those obtained by using the classic NB-3200 analysis as a more exact methodology. Isn't it true that two methodologies based on different mathematical modeling would be unlikely to give the same results?

b. Isn't it true that in neither case did the computed CUF_{en} exceed the Code limit of 1.0?

C. ENVIRONMENTAL CORRECTION FACTOR

Dr. Hopenfeld criticizes the calculation of F_{en} that Entergy applies in its analyses, alleging that the methodology used by Entergy is obsolete and does not take into account a number of factors that influence the value of $F_{en.}$ He claims that it is impossible to compute values of F_{en} that are tailor made to the particular application, so he proposes that "bounding values" be used. The following questions are intended to explore Dr. Hopenfeld's position on the proper application of F_{en} factors for use at VY.

1. Appropriate Guidance to Use

a. In your rebuttal testimony at A5 you refer to the guidance documents used by Entergy to compute the F_{en} factors, NUREG/CR-6583 and NUREG/CR-5704, as providing a "developing methodology still unfinished." Isn't it true that the NRC Staff has for many years endorsed the use of that methodology in performing F_{en} analyses for license renewal applications?

b. Isn't it true that the methodology in NUREG/CR-6583 and NUREG/CR-5704 has been used throughout the industry for years?

c. Isn't it true that the principal guidance for license renewal analyses, the GALL Report, recommends the use of those NUREGs?

d. You make reference to a 2007 Report, NUREG/CR-6909, as identifying many factors that affect fatigue life that are not included in the methodology of the earlier NUREGs. What evidence do you have that these same factors were not also considered in NUREG/CR-6583 and NUREG/CR-5704?

e. Can you cite any industry reference that recommends that the NUREG/CR-6909 methodology be used in place of that in NUREG/CR-6583 and NUREG/CR-5704 in computing the EAF for operating plant components?

f. Isn't it true that in A7 of your rebuttal testimony you yourself do not recommend using the procedure for determining the Fen multipliers specified in NUREG/CR-6909?

g. In A6 of your rebuttal testimony you stated "one cannot expect the decision makers such as the ACRS to understand the degree of uncertainty in Entergy's methodology." What is your basis for stating that the ACRS does not understand Entergy's EAF methodology?

h. Are you aware that Dr. W.J. Shack, the chairman of the ACRS, was co-author or both NURG/CR-6853 and NUREG/CR-6909? [See Entergy Exhibits E2-06 and E2-30]

2. Factors to be incorporated into F_{en} computation

a. Table 1 in your rebuttal testimony identifies thirteen factors whose use you recommend. Isn't it true that, as you recognize in your rebuttal testimony at 4, neither the NUREG/CR-6909 analyses nor those in NUREG/CR-6583 and NUREG/CR-5704 incorporate most of the factors whose use you advocate?

b. What is your justification for not recommending using NUREG/CR-6909 but criticizing Entergy for not incorporating the factors cited there in its the fatigue analyses?

c. Your Report and your rebuttal testimony do not identify how each of these thirteen factors should be incorporated into the analyses. Have you developed recommendations for how each of these factors should be integrated into the analyses? For example, factor 6, "heat to heat variation," how would you account for this factor?

d. Have you done any sensitivity analysis to determine how the results of the F_{en} factor computation would change if each factor was taken into consideration?

e. Other than identifying the potential influence of these factors, can you shed any light on their practical significance in terms of the CUF_{en} analyses performed by Entergy?

f. With respect to data scatter, NUREG/CR-6909 (at 3, 19, and 78) states that data scatter is included in the ASME fatigue curves. The ASME fatigue curves are used in both the NUREG/CR-6583 and NUREG/CR-5704 F_{en} calculations. Based on this statement, why do you feel that data scatter effects are not incorporated into Entergy's analyses?

g. With respect to surface finish, NUREG/CR-6909 states that "[t]he effect of surface finish is not considered in the environmental fatigue correction factor; it is included in the subfactor for "surface finish and environment" that is applied to the mean data curve to develop the Code fatigue design air curve." Based on this statement, why do you feel that surface finish effects are not incorporated into Entergy's analyses?

h. Regarding size, NUREG/CR-6909 states that "the current ASME Code requirements of a factor of 20 on cycle to account for the effects of material variability and data scatter, as well as size, surface finish, and loading history…" Based on this statement, why do you feel that size effects are not incorporated into Entergy's analyses?

i. Regarding flow rate, NUREG/CR-6909 states that "the beneficial effect of flow rate on fatigue life is presently not included in fatigue evaluations." If the effect of flow rate is beneficial, and would therefore increase the fatigue life, why is it non-conservative on the part of Entergy not to include flow rate effects into its fatigue analysis?

j. With respect to strain rate, NUREG/CR-6909 states that "[t]he effects of strain rate are not explicitly considered in the fatigue design curves, they are accounted for in the subfactor for "data scatter and material variability." Based on this statement, why do you feel that strain rate effects are not incorporated into Entergy's analyses?

k. With respect to heat to heat variation, NUREG/CR-6909 states that "heat-to-heat variability is included in the subfactor that is applied to the mean data curve to account for "data scatter and material variability." Based on this statement, why do you feel that heat-to-heat variability effects are not incorporated into Entergy's analyses?

l. Regarding loading history, NUREG/CR-6909 states that "such effects are accounted for in the factors of 20 on life and 2 on stress that are applied to the mean data curve to obtain the Code fatigue design curve." Based on this statement, why do you feel that loading history effects are not incorporated into Entergy's analyses?

m. About cyclic strain hardening, NUREG/CR-6909 states that "variations in fatigue life due to the effects of strain hardening …are accounted for in the subfactor for "data scatter and material variability." Based on this statement, why do you feel that cyclic strain hardening effects are not incorporated into Entergy's analyses?

n. With respect to the effect of temperature below 150°C, NUREG/CR-6909 states that "variations in fatigue life due to temperature are accounted for in the subfactor for "data scatter and material variability." Based on this statement, why do you feel that temperature effects below 150°F are not incorporated into Entergy's analyses?

o. With respect to sulfide morphology, NUREG/CR-6909 states that "variations in fatigue life due to differences in sulfide morphology are accounted for in the subfactor for "data scatter and material variability." Based on this statement, why do you feel that sulfide morphology effects are not incorporated into Entergy's analyses?

3. Cracking of Cladding and Base Metal

a. In your Report at p. 16 you fault Entergy for not providing any proof that the base metal of the feedwater nozzle at VY is not cracked. In response, Entergy's witnesses have testified in their direct testimony at (A53) that VY inspects the feedwater nozzle for potential cracks in the base metal and in the most recent inspection in 2007 it established there were none. Do you have any evidence that this practice will not continue to be carried out during the period of extended operations after license renewal?

b. Entergy also provided an exhibit (E2-33) showing results from the 2007 inspection, which appears to conclude that there are no cracks in the base metal of the feedwater nozzle. However, in your rebuttal testimony, you challenge the results of the 2007 inspection because they conclude that "[n]o relevant information was recorded." Isn't it true that the Report actually concludes that "[n]o relevant indications were recorded? Isn't "indications" an ASME Code, Section XI nomenclature used to refer to

potential cracks? [This is discussed in the testimony on NEC Contention 3] And isn't it true that the inspection was conducted to look for cracks, and concluded that "[u]ltrasonic examination results were acceptable to the requirements of ASME B&PV Code Section XI", etc.?" How else could that inspection report be interpreted than as a finding that there are no cracks in the feedwater nozzle base metal?

c. Isn't it true that the Staff's SER that you cite in your rebuttal testimony does not say that there are fatigue cracks in the cladding of the VY feedwater nozzle, but on p. 4-26 it states that "VYNPS has conservatively assumed that fatigue cracks may be present in the clad?"

d. Isn't the purpose of requiring that CUF_{en} not exceed the Code limit of 1.0 that of ensuring that no cracks form in the components' base metal?

4. Oxygen Levels During Transients

a. In your rebuttal testimony at A14, you indicate that there are "high oxygen concentrations" in the feedwater during transients, which Entergy does not take into account in its F_{en} factor computations. What data do you have to support this claim?

b. In the same testimony, you indicate that there is no technology that can predict the oxygen concentration at a given surface during reactor transients. Does that mean you do not know what the concentration of oxygen during transients at VY is?

c. Have you determined what the impact of the oxygen concentrations during transients would be on the fatigue life of reactor components?

d. In your rebuttal testimony at A9 you indicate that your choice of F_{en} factors of 12 for austenitic stainless steel and 17 for carbon and low alloy steel "is not overly conservative because these values do not account for the presence of cracks in the cladding and base metal of the feedwater nozzles, or for high oxygen concentrations during transients." Does that mean that if there are no cracks in the cladding or the base metal and if high oxygen concentrations did not exist during transients, that your use of those values would be overly conservative?

5. Use of Bounding Values

   a. In A7 of your rebuttal testimony you recommend the use of F_{en} factors of 12 for austenitic stainless steel and 17 for carbon and low alloy steel based on the bounding values contained in NUREG-CR/6909. Isn't it true that those values are provided without elaboration in the abstract to NUREG-CR/6909 as potentially applying to "certain environmental and loading conditions" that are not discussed anywhere in the document?

   b. Isn't it true that the NUREG-CR/6909 does not use or recommend using these F_{en} factors?

   c. You indicate in your testimony at A11 that Dr. Chopra, the author of NUREG-CR/6909, is in no position to recommend the use of bounding F_{en} factors. Isn't it true, however, that Appendix A to NUREG-CR/6909 does in fact contain sets of recommended F_{en} curves, which the authors consider "acceptable for incorporating the effects of reactor coolant environments on fatigue usage factor evaluations of metal components for new reactor construction?"

   d. What are the environmental and loading conditions to which the bounding values you advocate would apply?

   e. Do those environmental and loading conditions exist at VY? Do you know one way or another?

6. Conservatism of ASME Code

   a. You assert in your rebuttal testimony at A12 that there is no general agreement among researchers that the current ASME code fatigue curves are conservative. What evidence have you provided in support of that statement?

   b. Isn't it true that NUREG-CR/6909 concludes after some analysis that the ASME code curves are conservative by a minimum factor of 1.7? [Exhibit NEC-JH_26 at Section 4.1.10, p. 19; 5.8, p.48; p.78]

   c. Have you yourself done any analysis to determine whether the ASME code curves are conservative?

D. LACK OF ERROR ANALYSIS

Dr. Hopenfeld's Report criticizes Entergy's EAF calculations for not including an error analysis to show the admissible range of each variable. The following questions are intended to explore this criticism.

1. Where required or recommended?

   a. Your Report at 18 and your rebuttal testimony state that Entergy should have performed an error analysis to validate its CUF_{en} calculations. Is the performance of such an analysis part of the recommendations in the GALL Report or any other NRC publication?

   b. Can you cite to any technical publication that recommends the performance of error analyses to validate CUF_{en} calculations?

   c. Can you cite to any instance in which such an analysis was performed?

2. Methodology

   a. Can you cite to any reference that describes how such an analysis should be conducted?

   b. Is there any NRC or industry guidance on the acceptance criteria for such an error analyses?

   c. Is there any NRC or industry guidance on the interpretation of the results of such an error analyses?

E. DR. HOPENFELD'S OWN EAF COMPUTATION

Dr. Hopenfeld's Report includes (Table 3, p. 20) his own recalculation of the CUF_{en}s for the critical VY components and locations. Other than stating that his recalculation is an "alternative" to Entergy's, Dr. Hopenfeld does not explain what use is to be made of his recalculation. The following questions might clarify whether Dr. Hopenfeld's calculation is of any practical use.

1. CUF and F_{en}s Used

a. In your rebuttal testimony you acknowledge that the set of CUF_{en} values you developed (which is shown on Table 3 on page 20 of your Report) uses the cumulative usage factors from Section 4.3.3 of the VY license renewal application. Isn't it true that nearly half of those values were not specific to VY but were generic CUF values taken from NUREG/CR-6260 for B31.1-designed components?

b. And you used what you describe as the bounding values of 17 and 12 for the F_{en}s for carbon steel and stainless steel, right?

c. Given those assumptions, can you represent to this Board that the CUF_{en} values in your calculation are realistic assessments of the potential fatigue risks for each component and location over the period of extended VY operations?

II. QUESTIONS TO BE POSED TO REBUTTAL WITNESS ULRICH WITTE

NEC has moved for the Board's acceptance for filing of the late-filed rebuttal testimony and exhibits submitted by Ulrich Witte on behalf of NEC in this proceeding, Exhibit 3 to NEC's June 6, 2008 Motion to Late-File Rebuttal Testimony of Ulrich Witte ("Witte Rebuttal Testimony"). The Witte Rebuttal Testimony addresses NEC Contentions 2A and 2B in Q/A 4 through 6, p. 2-7.

Entergy is opposing NEC's motion and is also filing a Motion in Limine to exclude the Witte Rebuttal Testimony because Mr. Witte is not qualified to opine as an expert on the contentions addressed in the testimony and because he fails to provide any factual support for his opinions. If either NEC's late filing motion is denied or Entergy's Motion in Limine is granted, there will be no need for the Board questions that follow.

A. MR. WITTE'S EXPERIENCE AND QUALIFICATIONS ON ENVIRONMENTALLY ASSISTED FATIGUE

1. Education and Work Experience

a. Your curriculum vitae indicates that you received a B.A. degree in Physics in 1983. Did you receive any other college degrees prior to that date?

b. According to A4 of your rebuttal testimony and your curriculum vitae, the work that qualifies you as an expert on environmentally assisted fatigue took place between 1979 and 1981, while you were a Senior Engineer at ABB-Impell. What kind of position was Senior Engineer? Did the job require an engineering degree? Was it a start-up job as a junior technical person?

c. What were the qualifications for that position?

d. What was the nature of your "pipe stress analysis and support placement work" for the Catawba plant? Did you write computer code or did you run existing applications? Did you provide numerical inputs for existing programs?

e. Your curriculum vitae only mentions that work for the Catawba plant, whereas A4 of the rebuttal testimony mentions the Maguire and V.C. Summer plant as well. Why the difference?

f. Your rebuttal testimony states that you have "performed non-linear finite element analysis for a number of components" and that you are "familiar with Swanson's computer algorithms such as ANSYS, RELAP, and other commercial analytical computer programs."

(1) What was the nature of the non-linear finite element analysis you performed? For what components?

(2) When and how did you use ANSYS? RELAP? What other commercial analytical computer programs did you use? For what application?

(3) What structures or components have you modeled using any computer program? Which program?

g. According to your curriculum vitae your next assignment involved performing non-linear element finite element analysis

of large diameter piping for EPRI. What was the nature of the analysis? What piping was involved?

h. Your rebuttal testimony at A4 describes the same work as performing "detailed correlation studies of non-linear finite element analysis code predictions against actual in situ testing of piping and components at the Indian Point 1 nuclear facility." What components are these?

i. You also indicate that you performed an analysis of production stress code versus non-linear evaluation techniques, versus in situ testing of the system. What was the nature of the analysis? Was it in the nature of a comparison of the piping stress results obtained by various methods?

j. Isn't it a good summary of the prior experience that you cite as qualifying you as an expert on NEC Contentions 2A and 2B that the work in question was performed about thirty years ago, while you were a college student, and was not the type of work that would require being an experienced practicing engineer?

2. Performance of work on reactor vessel components

a. Have you ever performed any evaluation of the stresses to which reactor components are subjected during plant operations in accordance with ASME Code, Section III, Subparagraph NB-3200 methodology?

b. Have you ever analyzed any of the following components: (1) the reactor vessel shell and lower head, (2) the reactor vessel feedwater nozzle, (3) the reactor recirculation piping (including the reactor inlet and outlet nozzles), (4) the core spray line reactor vessel nozzle and associated Class 1 piping, (5) the residual heat removal ("RHR") return line Class 1 piping, and (6) the feedwater line Class 1 piping?

c. Have you ever modeled, or reviewed the mathematical model, of any of these components?

d. How does your piping analysis experience relate to evaluation of vessel components?

3. Performance of environmentally assisted fatigue evaluations

a. Have you ever evaluated the fatigue of reactor components?

b. Have you ever performed any evaluations of environmentally assisted fatigue of reactor components?

B. TRANSIENT CYCLE COMPUTATIONS

Mr. Witte's rebuttal testimony on NEC Contentions 2A and 2B addresses the operational time histories used by Entergy for its confirmatory environmentally assisted fatigue analysis of the feedwater nozzle. The following questions are intended to explore the bases for his testimony and the extent to which his opinions have a factual basis.

1. Experience

a. Your rebuttal testimony on NEC Contentions 2A and 2B addresses the operational time histories used by Entergy for its confirmatory environmentally assisted fatigue analysis of the feedwater nozzle. In particular you state at A5 of your rebuttal testimony that the causal relationship between the event as found and historical records and the consequences in terms of thermal shock is key. Have you ever analyzed a historical transient and derived its consequences in terms of thermal shock to the reactor components?

2. History

a. What is the factual support for your statement in A5 that GE and the Licensee did not fully predict all of the events in their shutdown estimates?

b. What do you mean by the statement in A5 "[t]he simplified method was shown to be overly dependent on skillful and experienced engineering? What simplified method was this? What is your factual support for this statement?

c. What do you mean by the statement in A5 "[n]ew methods removed the uncertainties and doubts of accuracy in CUFs and CUF_{en}. Not just cycle counting but examination of derivative temperature changes forced on the reactor vessel, the associated safe end, and, of course, the feedwater nozzle as well." When were these new methods developed? What were they? How were they applied?

d. You state in A5 that "it appears to me that the major thermal transients have likely not been incorporated into the VY operational history, as referenced in the SER." To what "major thermal transients" do you refer?

e. Did you try to determine whether those "major thermal transients" were incorporated into the VY operational history? Did you succeed? Do you know for a fact one way or another?

f. On page 5 of your rebuttal testimony you refer to an operational event that occurred at VY in December 1972. What is your source for your description of the event? You indicate that odds for a core melt for that event were 1.4E-3. What is the basis for that estimate? How does the nature of the event correlate with the shortening of the fatigue life of the components of interest in NEC Contentions 2A and 2B? What evidence do you have that Entergy did not consider this event?

g. You say that "[m]ore significant to the issue of fully recovering the record of all transients and accurately incorporating them in assessing the remaining fatigue life is the assessment of wear, damage, and stress on each relevant component during each transient event." Assuming this is true, was it or was it not done at VY with respect to the December 1972 transient?

h. You go on to indicate that "[t]here are other examples of transients that appear not to have been incorporated as input in the refined fatigue analysis." What are the other examples, and can you testify for a fact as to whether they were incorporated in the VY fatigue analysis?

i. You assert that during the period 1973 through 1977, VY experienced 42 unplanned forced shutdowns, which "expended much of the fatigue life of the reactor vessel and feedwater nozzle." What is the source of the 42 unplanned forced shutdowns statistic? What is the factual basis for your statement that they expended much of the life of the reactor vessel and feedwater nozzle? How much of the life, and how was it estimated?

j. What evidence do you have that Entergy did not consider these events?

k. You refer to a July 6, 1976 event at VY. What is your source for your description of the event? You indicate that odds for a core melt for that event were 6.25E-2. What is the basis for that estimate? How does the nature of the event correlate the event with shortening of the fatigue life of the components of interest in NEC Contentions 2A and 2B? Have you done an analysis? What evidence do you have that Entergy did not consider this event?

l. More generally, do you know one way or the other whether any of the transients discussed in your testimony were incorporated into Entergy's environmentally assisted fatigue analyses for VY and if so, how?

3. Implications for the validity of the VY environmentally assisted fatigue analyses

a. At the end of A5 in your rebuttal testimony you state that "[i]t appears that, in Entergy's calculation of 60-year CUFs in its CUF_{en} reanalyses, operational histories were not properly or accurately compiled and that instead of documented transients, estimated thermal transients were used to predict the number of Reactor Thermal Cycles for 60 years." Do you know for a fact what Entergy did?

b. If Entergy used estimated thermal transients as you suggest, do you know how far off were those from the actual operational histories?

c. Assuming Entergy did as you suggest, how much of an error was introduced in the counting of number of transient cycles?

d. The conclusion of your testimony, in A6 at p.7, is that "by using estimated histories as opposed to actual history, specific transients that shorten the component fatigue life appear not to be acknowledged or included in the Applicants fatigue analysis." Do you know for a fact whether specific transients were not acknowledged or included in VY's fatigue analyses? Do you know for a fact of any one transient that was not acknowledged or included in the fatigue analyses?

e. Entergy states in its direct testimony [Fitzpatrick – Stevens Dir. at A55] that to date VY has experienced only 95 startup - shutdown cycles after 36 years of operation as opposed to 200 postulated in the VY design basis, and has made its fatigue analysis based on 300 startup – shutdown cycles. So what difference does it make if one or more transient cycles were not properly or accurately compiled?

Respectfully Submitted,

/Original Signed by Matias F. Travieso-Diaz/

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Dated: June 23, 2008

June 23, 2008

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
Entergy Nuclear Vermont Yankee, LLC	)	Docket No. 50-271-LR
and Entergy Nuclear Operations, Inc.	)	ASLBP No. 06-849-03-LR
	)	
(Vermont Yankee Nuclear Power Station)	)	

ENTERGY'S PROPOSED BOARD EXAMINATION QUESTIONS TO DIRECT AND REBUTTAL WITNESSES ON NEC CONTENTION 3

Pursuant to 10 C.F.R. § 2.1207(a)(3)(i) and (ii), paragraph 10.F of the Atomic Safety and Licensing Board ("Board")'s Initial Scheduling Order dated November 17, 2006, and the Board's December 13, 2007 Order (Addressing Scheduling Issues for Evidentiary Hearing), Entergy Nuclear Vermont Yankee, LLC and Entergy Nuclear Operations, Inc. (collectively "Entergy") submit hereby their proposed questions for the Board to consider propounding to the New England Coalition ("NEC") and NRC Staff witnesses on NRC Contention 3 in this proceeding.

As directed by the Board in the Initial Scheduling Order, the sets of questions contained herein are prefaced by a brief description of the issues that Entergy contends need further examination, the objective of the examination, and the proposed line of questioning (including specific questions) that may logically lead to achieving the objective.

Entergy is filing separately sets of proposed questions on NEC Contentions 2A/2B and NEC Contention 4.

I. QUESTIONS TO BE POSED TO NEW ENGLAND COALITION'S WITNESS DR. JORAM HOPENFELD

A. DR. HOPENFELD'S EXPERIENCE WITH THE ANALYSIS, MONITORING AND INSPECTION OF STEAM DRYERS IN BOILING WATER REACTORS

Dr. Hopenfeld is the sole witness of intervenor NEC regarding NEC Contention 3 (steam dryer). Dr. Hopenfeld addresses that contention in his pre-filed direct testimony (NEC Exhibit NEC-JH_01 at 7-10), in April 25, 2008 report "Assessment of Proposed Program to Manage Aging of the Vermont Yankee Steam Dryer due to Flow-Induced Vibrations," NEC Exhibit NEC-JH_54, and in his rebuttal testimony, NEC Exhibit NEC_JH_63.

Dr. Hopenfeld's *curriculum vitae* (NEC Exhibit NEC-JH_02) does not state that he has any professional experience or training on matters relating to the performance of steam dryers in boiling water reactors ("BWRs"). Dr. Hopenfeld has not provided in his testimony any links between his experience and expertise on the evaluation of the performance of steam dryers.

Dr. Hopenfeld's familiarity with the issues related to the performance of the Vermont Yankee ("VY") steam dryer during the period of extended plant operations after license renewal is an area that warrants illumination at the hearing, so the weight of his testimony and opinions can be assessed. The following lines of inquiry would assist the Board in determining what weight should be given to Dr. Hopenfeld's testimony regarding NEC Contention 3.

1. Familiarity with methods of monitoring steam dryer performance in BWRs

    a. Have you ever written a procedure for monitoring the performance of a steam dryer during plant operations?

    b. Have you ever written a procedure for evaluating the data obtained through monitoring the performance of a steam dryer during plant operations?

    c. Have you developed any programs to monitor the performance of steam dryers in BWRs?

d. Have you ever written a procedure for determining what actions to take in response to data obtained through monitoring the performance of a steam dryer during plant operations?

e. Other than in connection with his testimony at the VY license renewal proceeding, have you ever reviewed any programs to monitor steam dryer performance?

f. Have you ever developed procedures for actions to be taken in response to the values of the monitored parameters?

g. Other than in this proceeding, have you ever reviewed procedures governing the actions to be taken in response to the values of the monitored parameters?

h. Have you ever monitored the stresses in an operating steam dryer?

2. Familiarity with steam dryer inspections

a. Have you ever written a procedure for conducting a steam dryer inspection?

b. Other than in connection with the testimony at the VY license renewal proceeding, have you ever reviewed a steam dryer inspection procedure?

c. Have you ever performed an inspection of a steam dryer?

d. Have you witnessed any part of a steam dryer inspection?

e. Have you evaluated the results of a steam dryer inspection?

f. Have you evaluated a steam dryer indication to determine whether it constitutes a crack, and if so, of what type?

B. SUCCESS OF VY DRYER MONITORING AND INSPECTION PROGRAMS

Dr. Hopenfeld states in his pre-filed report on NEC Contention 3 that "[t]he history of steam dryer cracking at the VY plant indicates that Entergy's program to date of visual inspection and moisture monitoring have [sic] been ineffective in identifying cracking at the time it occurs, when it occurs between inspections." "Assessment of Proposed Program to Manage Aging of the Vermont Yankee Steam Dryer due to Flow-Induced Vibrations" ("Steam Dryer

Report"), NEC Exhibit NEC-JH_54 at 2-3. The questions that follow are intended to elucidate whether Dr. Hopenfeld's allegation has a basis in fact and if so what is its significance.

1. You state in your pre-filed report on NEC Contention 3 (NEC Exhibit NEC-JH_54) at 2-3 that "[t]he history of steam dryer cracking at the VY plant indicates that Entergy's program to date of visual inspection and moisture monitoring have [sic] been ineffective in identifying cracking at the time it occurs, when it occurs between inspections." You cite four exhibits, NEC-JH_57 through NEC-JH_60. Let's take a look at those.

    a. NEC Exhibit NEC-JH_57 is an internal NRC e-mail dated April 16, 2004 summarizing the cracks found at the VY steam dryer. Isn't it true that subsequent to this e-mail VY made a number of modifications to its steam dryer and instituted the steam dryer monitoring program?

    b. Did VY have a steam dryer monitoring program in effect at the time this e-mail was written? [Dr. Hopenfeld should know that the VY dryer modifications were implemented in the Spring 2004 refueling outage, Testimony of John Hoffman and Larry D. Lukens on NEC Contention 3, Entergy Exhibit E3-01 at A16. A dryer monitoring program was instituted at approximately the same time. See id.]

    c. NEC Exhibit NEC-JH_58 is a report of an NRC inspection at VY conducted by the NRC between April and June 2004. The report states: "In response to Entergy's extended power up-rate request and recent industry experience, the inspectors observed portions of the steam dryer visual testing (VT) type 1 and 3 examinations and reviewed the documented examination reports. The examination reports documented that cracks were identified on both the internal and external surfaces of the steam dryer." NEC Exhibit NEC-JH_58 at 4-5. Do you know whether VY had a steam dryer monitoring program in place at the time of the inspection?

    d. NEC Exhibit NEC-JH_59 has apparently been superseded by NEC Exhibit NEC-JH_68. Both Exhibits are copies of a 2007 Entergy Condition Report CR-VY-2007-02133, issued in June 2007. Doesn't the report conclude that no fatigue cracks were detected in the inspection conducted during the 2007 refueling outage at VY?

    e. Isn't it true that the report references the GE evaluation of the indications found during the steam dryer inspection and concludes that none of them were fatigue cracks?

f. Does the report conclude that the identified indications were IGSCC and required no repair?

g. Doesn't the report state that the same indications had been detected two years earlier in the 2005 refueling outage inspection and had not grown in the intervening two years?

h. Does the report indicate that any of the plant parameters tracked by the VY monitoring program were exceeded at any time?

i. If the indications described in the report were IGSCC, would they have resulted in any of the monitored parameters being exceeded?

j. NEC Exhibit NEC-JH_60 is an excerpt of the 2006 testimony by an Entergy official before the Vermont Public Service Commission, in which the official states that "sometimes it very difficult to distinguish or differentiate between the type of cracking that you see with this intergranular stress corrosion cracking, IGSCC, and fatigue cracking." How does that statement support your thesis that monitoring at VY has been ineffective in detecting cracks at the time they occur, if they occur between inspections?

k. Can you cite an instance in which a fatigue crack occurred at VY between inspections and was not detected by VY's monitoring program?

l. Can you cite any instance in which steam dryer inspections during refueling outages identified a fatigue crack that had gone undetected?

2. You state in your report at p. 5 that "Plant parameter monitoring is not effective to prevent the generation of loose parts that can damage safety-related plant components. Most parameter monitoring (moisture, steam flow, water level, dome pressure) may indicate the formation of only those steam dryer cracks that increase moisture carryover; those cracks that do not lead to significant moisture carryover may continue to grow undetected."

a. What cracks are those that do not lead to significant moisture carryover?

b. How can you have a growing crack of sufficient size that may lead to a failure of the steam dryer without its resulting in the release of moisture through the crack?

c. If the crack is not large enough to result in the escape of moisture through it, why would it be a concern?

d. Isn't it true that all the reported instances of dryer failure were accompanied by large increases in moisture carryover? [See, e.g., discussion in Appendices A and B of GE SIL-644].

e. Isn't it true that the parameters that are being monitored at VY (see Hoffman/Lukens Direct Testimony at A24 and Entergy Exhibit E3-07) are those recommended by GE in SIL-644 (at p. 31)?

f. What operational parameters should be added to the VY monitoring program that would detect the existence of cracks that did not result in increase in moisture carryover?

g. You express the concern on p. 5 of your report that "[m]oisture monitoring only indicates that a failure has occurred; it does not prevent the failure from occurring." How is this concern consistent with your rebuttal testimony (NEC Exhibit NEC-JH_63) where you agree that "no one can predict the exact time for transition from crack initiation to crack propagation." Aren't you agreeing that what is important is not to prevent cracks from forming but detecting them before they grow to a size where they can cause structural failure of the dryer?

3. In your Report at 5-6 you quote the GE-SIL-644 guidance document as stating that "monitoring steam moisture content and other reactor parameters does not consistently predict imminent dryer failure nor will it preclude the generation of loose parts." (GE-SIL-644, NEC Exhibit NEC-JH_55 at 6). Isn't it true that the GE document goes on to state, immediately after the wording you quote: "Monitoring is still useful in that it does allow identification of a degraded dryer allowing appropriate action to be taken to minimize the damage to the dryer and the potential for loose parts generation."? Do you disagree with GE's conclusion that monitoring is useful in that it allows identification of a degraded dryer allowing appropriate actions to be taken?

4. In your Report you indicate at 4 that "GE-SIL-644 recommends visual inspections during each refueling outage, but does not require any measurements that could indicate whether existing cracks in the dryer grow in number or length."

a. Isn't it true that SIL-644 [NEC Exhibit NEC-JH_55, Entergy Exhibit E3-06] requires on p. 6, item A1.c that "Flaws left as is should be inspected during each scheduled refueling outage until it has been demonstrated that there is no further crack growth and the flaws have stabilized?

b. Isn't that what Entergy does as part of its inspection plan? [Refer, e.g., to NEC Exhibit NEC-JH_68, which is an evaluation during RFO 26 in 2007 of flaws identified in RFO 25 and left as is]

c. Isn't it true that Entergy's inspections since implementation of the EPU have looked at potential crack growth and have detected no significant growth in existing cracks?

C. MECHANISM OF CRACK FORMATION AND GROWTH[1]

In his initial Declaration in support of the admission of NEC Contention 3 Dr. Hopenfeld testified that implementation of the VY power uprate was accompanied by a 20% increase in flow velocity. The increase in velocity, stated Dr, Hopenfeld, "is accompanied by an increase in flow induced vibrations, FIV, which in turn may have a marked effect on the cyclic loads that act on the steam dryer. These loads may cause a break up of the dryer, creating loose parts which would be free to be transported by flow or gravity to various parts of the reactor system." Declaration of Dr. Joram Hopenfeld, Exhibit 7 to NEC's Petition for Leave to Intervene, Request for Hearing and Contentions (May 26, 2006) ("First Hopenfeld Declaration"), at ¶ 16. The phenomenon of concern to Dr. Hopenfeld, therefore, was the effect of flow-induced vibrations on the dryer, which may ultimately cause the dryer to fail by fatigue.

In his Report, Dr. Hopenfeld describes this failure mechanism as "high cycle fatigue." Report at 2. However, both in his Report and in his rebuttal testimony Dr. Hopenfeld seeks to postulate another failure mechanism, growth through fatigue of cracks due to IGSCC. That failure mechanism is both newly expressed by Dr. Hopenfeld and unsupported. Dr. Hopenfeld should explain the bases for this asserted expansion and whatever technical support exists for it.

[1] Entergy has a filed a motion in limine to exclude, inter alia, Dr. Hopenfeld's new claim that IGSCC provides a mechanism for fatigue cracks to develop. If that motion is granted, questions 1 through 5 in this section will not be necessary.

1. Isn't it true that, according to GE-SIL-644 at 1, 2, and 3 and Appendices A and B all steam dryer failures have been attributed to "higher fluctuating pressure loads at extended power uprate operation"?

2. In your rebuttal testimony at A31 you state that "In stating that the IGSCC cracks are not active, Mr. Lukens essentially dismissed the possibility of continued growth of cracks by fatigue. He apparently did not recognize that IGSCC can provide sites for corrosion attack which in turn would accelerate crack growth under cyclic loading." Can you point to any reported incident in which IGSCC led to crack growth through fatigue?

3. You refer in your rebuttal testimony at A29 to a statement attributed to GE that said that, for steam dryer unit end plates at VY exhibiting IGSCC indications, "continued growth by fatigue cannot be ruled out" and cite Exhibit NEC-JH_68 as the source of the statement. Isn't it true that GE never made such a statement?

4. Isn't it true that the statement appears in a draft of a VY (not GE) engineering report, and was removed in the final version of the report?

5. Isn't it true that cracks due to IGSCC grow very slowly, if at all? [In Entergy Exhibit E3-16 GE concludes that "These indications are most likely IGSCC and therefore they will propagate very slowly if at all. These indications have little or no structural impact on the steam dryer assembly and do not pose a risk of creating lost parts during the next operating cycle."]

6. Your report indicates at p. 2 that in cases where there were steam dryer failures "small pressure fluctuations on the dryer can generate altering [sic] stresses that exceed the endurance limit at some dryer locations." Where in GE-SIL-644, which you cite as the source for this statement, is the information found?

7. Can you refer to any technical reference that supports your statement that even small pressure fluctuations on the dryer can cause stresses that exceed the dryer's endurance limit?

8. What is the technical basis for your assertion that even small pressure fluctuations on the dryer can cause stresses that exceed the dryer's endurance limit?

9. Your report at p. 5 indicates that "[s]mall changes in local velocity may cause pressure frequencies of local pressure fluctuations to approach the natural frequency of the dryer." You make the same assertion in A28 and A33 of your rebuttal testimony. What is your support for these statements? What is their technical basis?

10. Your rebuttal testimony at A35 faults Entergy for not providing "a quantitative estimate of the probability of crack detection, POD."

    a. Is there any regulatory requirement to provide this information?

    b. Are there any industry standards for estimating POD?

    c. How would the POD be computed?

    d. How would the POD results be used?

D. MEASUREMENT OF STRESSES ON DRYER

1. You state in your report and your testimony that there is a need to estimate the stresses on the dryer as an ongoing proposition. You acknowledge in A28 of your rebuttal testimony that there is no regulatory requirement to do so. Is there any practice in the industry to estimate dryer stresses?

2. Does GE recommend that dryer stresses be estimated?

3. Is there any guidance in the applicable technical literature recommending that steam dryer stresses be computed as an ongoing matter?

4. Can you cite any component in a nuclear power plant for which stresses are monitored on an ongoing basis?

5. What is the technical basis for requiring monitoring stresses on the dryer when this is not done for any safety-related components, including safety-related piping?

6. Are you aware of any NRC requirements or industry guidance calling for the continuous monitoring of stresses on any nuclear power plant component?

7. How would you go about actually measuring stresses on the dryer on a continuing basis?

    a. What equipment would you use?

    b. How would it be installed?

    c. How would it be qualified for use in a reactor environment?

    d. How would the stresses be monitored?

    e. How would the accuracy of the measurements be checked?

f. What safety issues would be raised by installing instrumentation on or near the reactor vessel?

g. How would the possibility of failure of the instrumentation and generation of loose parts be avoided?

h. What occupational dose exposures would be raised by the need to periodically calibrate, repair, or replace the instrumentation in a high radiation reactor environment?

II. QUESTIONS TO NRC STAFF WITNESSES K.R. HSU, JONATHAN G. ROWLEY, AND THOMAS SCARBOROUGH CONCERNING NEC CONTENTION 3

A. STATUS OF VY STEAM DRYER

The NRC Staff conducts periodic inspections of VY operations, including the status of the steam dryer. Those inspections provide confirmation of the absence of fatigue cracks on the dryer after implementation of the EPU.

1. In A17 of your prefiled direct testimony you indicate that "the staff reviewed the plant data and analyses to confirm that the pressure loads during EPU operation did not result in stress on the steam dryer that exceeded the ASME fatigue stress limits. Further, the staff reviewed the results of the Vermont Yankee steam dryer inspection in spring 2007 to verify that no significant fatigue cracking occurred during EPU operation." Were you able to establish through these reviews that no fatigue cracks exist at VY?

2. Is it your conclusion from your inspections and reviews that the programs that Entergy will implement at VY during the period of extended operations after license renewal will be sufficient to assure that the steam dryer supports safe plant operations during that period?

3. Are you aware of any nuclear power plants where there is monitoring of actual stress loads on the steam dryer during plant operations?

Respectfully Submitted,

/Original Signed by Matias F. Travieso-Diaz/

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Dated: June 23, 2008

June 23, 2008

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
Entergy Nuclear Vermont Yankee, LLC	)	Docket No. 50-271-LR
and Entergy Nuclear Operations, Inc.	)	ASLBP No. 06-849-03-LR
	)	
(Vermont Yankee Nuclear Power Station)	)	

ENTERGY'S PROPOSED BOARD EXAMINATION QUESTIONS TO DIRECT AND REBUTTAL NEC WITNESSES ON NEC CONTENTION 4

Pursuant to 10 C.F.R. § 2.1207(a)(3)(i) and (ii), paragraph 10.F of the Atomic Safety and Licensing Board ("Board")'s Initial Scheduling Order dated November 17, 2006, and the Board's December 13, 2007 Order (Addressing Scheduling Issues for Evidentiary Hearing), Entergy Nuclear Vermont Yankee, LLC and Entergy Nuclear Operations, Inc. (collectively "Entergy") submit hereby their proposed questions for the Board to consider propounding to the New England Coalition ("NEC") witnesses[1] on NEC Contention 4 in this proceeding.

As directed by the Board in the Initial Scheduling Order, the sets of questions contained herein are prefaced by a brief description of the issues that Entergy contends need further examination, the objective of the examination, and the proposed line of questioning (including specific questions) that may logically lead to achieving the objective.

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[1] The entirety of NEC witnesses Dr. Joram Hopenfeld's and Dr. Rudolf Hausler's testimony on NEC Contention 4 is subject to exclusion under a Staff's motion in limine, and portions of Dr. Hopenfeld's direct and rebuttal testimony on NEC Contention 4 are subject to exclusion through motions in limine by both Entergy and the Staff. Likewise, both the direct and rebuttal testimony of Mr. Ulrich Witte on Contention NEC 4 are subject to exclusion through motions by Entergy and the Staff. The questions presented herein assume all motions are denied; to the extent, however, that portions of the motions are granted, the corresponding suggested examination questions become moot.

Entergy is filing separately sets of proposed questions on NEC Contentions 2A/2B and NEC Contention 3.

I. QUESTIONS FOR NEC WITNESSES DR. JORAM HOPENFELD AND DR. RUDOLPH HAUSLER

Dr. Hopenfeld, the first NEC witness on NEC Contention 4 (Flow-Accelerated Corrosion ("FAC")), addresses the contention in NEC Exhibit NEC-JH_01 (at 10-14), in an April 24, 2008 report, "Review of License Renewal Application for Vermont Yankee Nuclear Power Station: Program for Management of Flow-Accelerated Corrosion," NEC Exhibit NEC-JH_36, and in his rebuttal testimony, NEC Exhibit NEC-JH_63. Dr. Hausler is the second NEC witness regarding NEC Contention 4.[2] Dr. Hausler addresses NEC-4 in his pre-filed direct testimony (NEC Exhibit NEC-RH_01), in an April 25, 2008 report "Discussion of the Empirical Modeling of Flow-Induced Localized Corrosion of Steel under High Shear Stress," NEC Exhibit NEC-RH_03, in his rebuttal testimony, NEC Exhibit NEC-RH_04, and in his Report "Flow Assisted Corrosion (FAC) and Flow Induced Localized Corrosion: Comparison and Discussion," NEC Exhibit NEC-RH_05 ("Hausler Rebuttal Report"). Because Dr. Hausler offers no independent opinions, but rather provides theoretical discussions in his reports and then agrees with the opinions in Dr. Hopenfeld's direct and rebuttal testimony, the following questions are appropriately applicable to both Dr. Hopenfeld and Dr. Hausler, unless otherwise noted.

A. DR. HOPENFELD AND DR. HAUSLER HAVE NO OR LIMITED EXPERIENCE WITH FLOW-ACCELERATED CORROSION MONITORING AND INSPECTION OF SUSCEPTIBLE PIPING IN BOILING WATER REACTORS

Dr. Hopenfeld's *curriculum vitae* (NEC Exhibit NEC-JH_02) does not state that he has any professional experience or training on matters relating to the modeling related to a FAC

[2] Questions for the third NEC witness on NEC Contention 4, Mr. Ulrich Witte, are provided in Section II.

management program. Likewise, Dr. Hausler's *curriculum vitae* (NEC Exhibit NEC-RH_02) does not state that Dr. Hausler has any professional experience or training on matters relating to modeling related to a FAC management program or matters having to do with FAC itself.

Dr. Hopenfeld's and Dr. Hausler's familiarity with issues related to the Vermont Yankee ("VY") FAC program, and particularly the use of CHECWORKS, during the period of extended plant operations after license renewal is an area that warrants inquiry at the hearing, so the weight of their testimony and opinions can be assessed. The following lines of inquiry would assist the Board in determining what weight should be given to Dr. Hopenfeld's and Dr. Hausler's testimony regarding NEC Contention 4.

1. Familiarity with FAC management programs

    a. Have Dr. Hopenfeld or Dr. Hausler ever written a procedure for selecting components for inspection as part of a FAC program?

    b. Have Dr. Hopenfeld or Dr. Hausler ever written a procedure for inspecting components for FAC?

    c. Have Dr. Hopenfeld or Dr. Hausler ever written a procedure for evaluating the data obtained through inspection of components as part of a FAC program?

    d. Have Dr. Hopenfeld or Dr. Hausler ever used a computer program as part of a FAC program to select components for inspection?

2. Familiarity with CHECWORKS

In his First Declaration ("Declaration of Dr. Joram Hopenfeld, Exhibit 7 to NEC's Petition for Leave to Intervene, Request for Hearing and Contentions) (May 26, 2006)," Dr. Hopenfeld states (at ¶ 24) that CHECWORKS accurately predicts pipe wall thinning, as long as provided with adequate historical data: "The [CHECWORKS computer] code can be used to predict pipe wall thinning as long as plant parameters (velocity, coolant chemistry, etc.) do not

change drastically and the data has been collected for a long period of time."[3] However, Dr. Hopenfeld in his recent rebuttal testimony (Exhibit NEC-JW_63 at 30) attacks the reliability of CHECWORKS. Dr. Hopenfeld's understanding of CHECWORKS is thus germane to whether his lately-found concerns regarding the accuracy of CHECWORKS should be accorded any weight and whether such assertions have any significance.

a. Neither Dr. Hopenfeld nor Dr. Hausler ever received any formal training in the use of CHECWORKS, is that correct?

b. Nor have either of you done any analyses using CHECWORKS, correct?

B. NEC WITNESSES SEEK TO EXPAND THE ACCEPTED INDUSTRY AND NRC DEFINITIONS OF FAC TO INCLUDE PROCESSES OTHER THAN FAC

Dr. Hopenfeld states for the first time in his rebuttal testimony (NEC-JH_63 at 26, 31-32) that the definition of FAC used in NRC guidance, in EPRI Report NSAC-202L, and in Dr. Horowitz's testimony is "narrow" and that there is "no theoretical justification" for such a definition (id. at 31). This re-definition of FAC results, among other things, in expanding the number of "examples" of reported piping failures to be classified as "FAC-related". The following lines of inquiry would assist the Board in determining whether Dr. Hopenfeld's re-definition of FAC should be accepted.

1. Definition of FAC

a. Is it not correct that NUREG/CR-6936, cited by Dr. Hopenfeld in his rebuttal testimony, defines FAC as follows:

5.3.1 Flow-Accelerated Corrosion(b)

[3] Dr. Hopenfeld reiterated this position in the Fifth Declaration of Dr. Joram Hopenfeld, dated July 16, 2007, filed as Exhibit 1 to NEC's "Opposition to Entergy's Motion for Summary Disposition of NEC's Contention 4 (Flow Accelerated Corrosion)" ("Fifth Hopenfeld Declaration"): "I continue to maintain that CHECWORKS is not a mechanistic model, and therefore it requires considerable benchmarking to be used as a reliable predictive tool." Fifth Hopenfeld Declaration at ¶ 10.

Flow-accelerated corrosion (FAC) is defined as a chemical process whereby the normally protective oxide layer on carbon or low-alloy steel dissolves into a stream of flowing water or water-steam mixture. FAC corrosion rate controlling conditions are primarily electrochemical. FAC occurs in high-energy piping systems and can occur in single- and two-phase flow regions. The cause of FAC is a specific set of water chemistry conditions (for example, pH, level of dissolved oxygen), and absent of any mechanical contribution to the dissolution of the normally protective iron oxide (magnetite) layer on the inside pipe wall (as in pipe degradation by erosion-corrosion). The cause and effect of FAC is well understood, and the industry has implemented FAC inspection programs, as well as piping replacements using FAC resistant materials such as stainless steel, carbon steel clad on the inside diameter with stainless steel, or chrome-molybdenum alloy steel.

[b] In the United States, flow-accelerated corrosion (FAC) is commonly but incorrectly known as "erosion-corrosion." Unlike FAC, the accelerated corrosion rates in the erosion-corrosion process are dominated by mechanical factors such as the impact of water droplets on the surface in two-phase flow steam systems, cavitation effects, or entrained particles.

("Probabilities of Failure and Uncertainty Estimate Information for Passive Components – A Literature Review," NUREG/CR-6936 at 5.24 – 5.25.)?

b. Dr. Hopenfeld, on page 32 of your rebuttal testimony (at A45), you state that: "Other causes of wall thinning (droplet impingement, cavitation, erosion, pitting) should not be excluded from inspection programs because CHECWORKS predictions of wall thinning do not account for such mechanisms." Is it not correct that those mechanisms are expressly excluded from the definition of FAC in NUREG/CR 6936?

c. Dr. Hausler, starting at page 6 of the Hausler Rebuttal Report you state that phenomena, in addition to FAC, may occur that "are described as erosion corrosion, impingement corrosion, and finally cavitation" is that correct?

d. And those phenomena are excluded from the definition of FAC in NUREG/CR-6936, correct?

e. Is it not correct that EPRI Report NSAC-202L-R2 includes EPRI's definition of FAC, which is "wall thinning (metal loss) of steel piping exposed to flowing water or wet steam." (EPRI Report NSAC-202L-R2, Entergy Exhibit E4-33, at v)?

f. Is it not correct that NSAC-202L-R2 makes it clear that FAC "is sometimes, but incorrectly, called erosion-corrosion. Erosion, it should be noted, is not part of the degradation mechanism." (Id. at 1, n.1)?

g. Is it not correct that the definitions of FAC in NSAC-202L-R2 and NUREG/CR-6936 are consistent with one another?

h. Is it not correct that impingement or droplet impingement is mechanical damage to a surface caused by the impact of high water droplets, not corrosion, as stated in NUREG/CR-6936?

i. Is it not correct that cavitation or cavitation erosion is mechanical damage to a surface caused by the collapse of bubbles, not corrosion, as indicated in NUREG/CR-6936?

j. Is it not correct that entrained particles may cause damage to a surface in a process of mechanical damage known as solid particle erosion, which is not corrosion, as indicated in NUREG/CR-6936?

C. NEC WITNESSES' NEW ASSERTIONS REGARDING THE USE OF NSAC-202L AS GUIDELINES FOR A FAC MANAGEMENT PROGRAM AND THE ACCURACY OF CHECWORKS DEMONSTRATE A LACK OF KNOWLEDGE OR MISUNDERSTANDING REGARDING THE USE OF BOTH AT VY

Dr. Hopenfeld states in his pre-filed report on NEC Contention 4 that "NEC is concerned with the FAC program because its validity is based in large part on the use of CHECWORKS, which NEC considers unreliable." Exhibit NEC-JH_63 at 32. Dr. Hopenfeld further asserts that the entire VY FAC Program itself is insufficient because ". . . it is based on EPRI guidelines NSAC-202 L, which largely rely on an unproven computer code called CHECWORKS to predict corrosion rates and therefore the scope of the inspection." Exhibit NEC-JW_63 at 25. Dr. Hopenfeld's understanding of NSAC-202L and the role of CHECWORKS in those guidelines are important to determine the weight to give his testimony. The questions that follow are intended to probe into Dr. Hopenfeld's new challenges to NSAC-202L and the reliability of CHECWORKS, and their significance to the VY FAC Program.

1. Use of NSAC-202L and CHECWORKS at VY

   a. Is it not correct that Dr. Hopenfeld stated (Exhibit NEC-JW_63 at 25) that the VY FAC Program itself is insufficient because ". . . it is based on EPRI guidelines NSAC-202 L, which largely rely on an unproven computer code called CHECWORKS to predict corrosion rates and therefore the scope of the inspection."?

   b. Isn't it correct that the VY FAC Program document EN-DC-315 (Exhibit E4-06, Sec. [6](e)) provides that component selection is based on ten separate criteria, only one of which is "Components ranked high for susceptibility from current CHECWORKS evaluation"?

2. Grid Size Selection

   a. Dr. Hopenfeld, you stated in your Report (NEC-JH_36 at 7) that you were concerned about the grid size selection as being "one of the most critical inspection tasks. If the selected grid size is too large, local corrosion in a form of small pockets would escape detection. Such pockets have escaped detection in a plant that used 4x4 inch inspection grid on a 30-inch size component."?

   b. Is it not correct that Section 4.5.1 of NSAC-202L calls for the inspection of components and a portion of the attached piping using a grid?

   c. Have you reviewed ENN-EP-S-005, "Flow Accelerated Corrosion Component Scanning and Gridding Standard," Exhibit E4-25?

   d. Isn't it true that Exhibit E4-25 provides (at Sec. 5.4.3.1) that "a 100% scan of the grid area or square shall be performed for the lowest wall thickness reading contained within the area"?

   e. Isn't it true that if the entire surface area of a component and portions of the attached piping are scanned and the thinnest part of any part of that component and attached piping is identified by the scan that there are no "small pockets" that will "escape detection"?

3. Dr. Hopenfeld, you state in your pre-filed report on NEC Contention 4 (Exhibit NEC-JW_63) at 27 that Dr. Horowitz ". . . fails, however, to credibly explain away CHECWORKS' failure to predict the hundreds of unanticipated FAC-related failures that occurred in PWRs and BWRs."

   a. Is it not correct that if we use the definition of FAC in NUREG/CR-6936 or NSAC-202L and limited to reactors in the United States that many of your "hundreds" of "FAC-related" failures would be just a handful, not "hundreds"?

b. Is it not correct that in your statement regarding "hundreds of failures" that you do not know whether all of those units were using NSAC-202L or CHECWORKS?

4. Dr. Hopenfeld, on page 9 of your Report (NEC-JH_36 at 9) you state that your review of data presented in NUREG/CR-6936 leads you to calculate that "[o]n a yearly basis, …" there has been the equivalent of a "a reduction of 2 failures per year during the 1988-2005 period compared to the previous period . . ." Isn't it true that those failure rates include foreign units [see NRC Staff Rebuttal Testimony of Kaihwa R. Hsu Concerning NEC Contention 4 at 4-5 (A7)]? And that you do not know for each reported failure whether the plant was following NSAC-202L or using CHECWORKS?

Dr. Hopenfeld cites a number of examples of what he claims are FAC-related failures that call into question the use of CHECWORKS. These examples, however, do not support Dr. Hopenfeld's statements. Questions regarding Dr. Hopenfeld's examples will clarify whether CHECWORKS or the guidelines in NSAC-202L were involved in the failures.

5. <u>Questions Regarding December 1986 Incident at Surry Unit 2</u>

a. Dr. Hopenfeld, you state (NEC-JH_36 at 9) that "EPRI guidelines regarding FAC were available to the industry about two years before the Surry accident occurred" and you repeat this in your rebuttal testimony (NEC-JH_63 at 34) (A49). Is it correct that the "EPRI guidelines" to which you refer is EPRI Report NP-3944 and that NSAC-202L had not yet been written in December 1986?

b. Is your testimony that EPRI Report NP-3944 had anything to do with the December 1986 incident at Surry Unit 2?

c. Is it not correct the pipe rupture at Surry Unit 2 in December 1986 was in the condensate pipe?

d. Is it not correct that EPRI Report NP-3944 addresses only two-phase (i.e., steam-water) FAC and is not applicable to single-phase (i.e., water) FAC, to which a condensate pipe is subject?

e. Isn't it true that neither CHECWORKS nor its predecessor codes were written at the time of the condensate pipe rupture at Surry Unit 2 in December 1986?

6. Questions concerning Millstone Unit 3, December 1990

a. Dr. Hopenfeld, the incident you refer to as a failure of the "EPRI Guidelines and the CCCs Codes" (NEC-JH_36 at 9-10) includes "[t]wo six inch pipes [that] were damaged as a result of wall thinning at Millstone 3." These pipes were in the moisture drain system, also singe-phase, correct?

b. Meaning that EPRI Report NP-3944 was not applicable to those pipes, correct?

c. And isn't it also correct that NSAC-202L was not written until after December 1990?

d. Isn't it also true that CHECWORKS was not used to analyze the two pipes that were damaged at Millstone 3?

7. Questions regarding May 1992 Susquehanna Incident

a. Dr. Hopenfeld, you also refer to the incident at Susquehanna in May 1992, where the licensee found what you describe as "[u]nexpected high erosion rates in the feedwater piping" (NEC-JH_36 at 10). And the feedwater piping carries water, it is a single-phase pipe, correct?

b. EPRI Report NP-3944 was not applicable to those pipes, correct?

c. NSAC-202L was written after May 1992, correct?

d. As far as you are aware, CHECWORKS, or its predecessors, were not used at Susquehanna prior to May 1992, were they?

8. Questions regarding August 2004 Mihama Unit 3 Failure

Dr. Hopenfeld uses the August 9, 2004, incident at the Mihama plant in Japan as an example of a failure of the "EPRI Guidelines" and "CCC" Codes. NEC-JH_36 at 10.

a. With respect to your example of the August 2004 incident at the Mihama plant in Japan, you state (NEC-JH_36 at 10) that "MIHAMA did not use EPRI guidelines or CHECWORKS," is that correct?

b. Is it not correct that, as stated in the final report on the Mihama incident (Exhibit E4-24, Sec. 3.7.3) that the pipe wall thinning that occurred was in single-phase water flow piping and that EPRI Report NP-3944, which deals with two-phase (i.e., steam-water) FAC is not applicable to the August 2004 Mihama incident?

c. And you acknowledge (NEC-JH_36 at 10) that neither NSAC-202L nor CHECWORKS were used by the operator of Mihama prior to the failure at Mihama Unit 3 in August 2004, isn't that right?

d. Is it not correct that the Japanese approach used by FAC programs at the time of the Mihama accident, described in Exhibit E4-24 at Section 4, differed from the NSAC-202L approach (E4-33 at Section 4) in several respects, including: (1) how susceptibility was determined; (2) how inspection locations were selected and (3) the methodology used for predicting FAC wear?

II. QUESTIONS FOR MR. ULRICH WITTE

Mr. Witte addresses NEC Contention 4 in his pre-filed direct testimony (NEC Exhibit NEC-UW_01), in an April 25, 2008 report "Evaluation of Vermont Yankee Nuclear Power Station License Extension: Proposed Aging Management Program for Flow Accelerated Corrosion," NEC Exhibit NEC-UW_03, and in his late-filed rebuttal testimony, Exhibit 3 to NEC's June 6, 2008 Motion to Late-File Rebuttal Testimony of Ulrich Witte ("Witte Rebuttal Testimony").[4]

A. MR. ULRICH HAS NO EXPERIENCE, TRAINING, OR EDUCATION REGARDING FLOW-ACCELERATED CORROSION MONITORING AND INSPECTION OF SUSCEPTIBLE PIPING IN BOILING WATER REACTORS

Mr. Witte's *curriculum vitae* (NEC Exhibit NEC-UW_02) does not state that he has any professional experience or training on matters relating to a FAC management program, modeling of FAC, or use of engineering judgment related to a FAC management program. Mr. Witte has not provided any explanation regarding how his experience, which does not touch upon any aspect of the development or implementation of a FAC management program, relates to the VY FAC Program. Mr. Witte further admits that he has no experience or training relevant to FAC in his late-filed rebuttal testimony in his answer to question 8 where the basis for his testimony

[4] As noted earlier, the entirety of Mr. Witte's direct and rebuttal testimony on NEC Contention 4 is subject to be stricken by motions in limine by Entergy and the NRC Staff.

comes down to Mr. Witte's claim that "[a]s a seasoned engineer, manager, and problem solver, my expertise and track record demonstrate successfully implemented solutions to complex organizational, technical, or regulatory challenges in nuclear plant operations." Nowhere in that statement, or any other statement of his, is there a reference to actual experience, training or education related to any aspect of FAC management.

Mr. Witte's lack of experience and familiarity with the VY FAC program during the period of extended plant operations after license renewal warrants inquiry at the hearing, so the weight of his testimony and opinions can be assessed. The following are lines of inquiry that would assist the Board in determining what weight should be given to Mr. Witte's testimony regarding NEC Contention 4.

1. <u>Familiarity with and Training Regarding FAC management programs.</u>

    a. Isn't it true that you have not written a procedure for selecting components for inspection as part of a FAC program?

    b. Isn't it true that you have not written a procedure for inspecting components for FAC?

    c. Isn't it true that you have not written a procedure for evaluating the data obtained through inspection of components as part of a FAC program?

    d. Isn't it true that you have not used a computer program such as CHECWORKS as part of a FAC program to select components for inspection?

2. In his late-filed rebuttal testimony, Mr. Witte claims for the first time in his answer to Q/A No. 8 an ability to independently assess the "fidelity of a comprehensive FAC program," that includes CHECWORKS. Mr. Witte, however, appears to have no familiarity with CHECWORKS.

    a. Mr. Witte, in your rebuttal testimony (at 8-10) (A8), you state how you think your training and experience relate to the VY FAC program, is that correct?

    b. Mr. Witte, is it correct that you have no experience using CHECWORKS?

c. Mr. Witte isn't it true that in your rebuttal testimony (at 10 ("While I do not purport to be intimately familiar with the empirically based CHECWORKS algorithm ….")) (A8) you don't claim to have an understanding of how CHECWORKS models FAC?

d. And you do not know what, if any, differences there are between various versions of CHECWORKS – 1.0D, 1.0F, and 1.0G – with respect to water chemistry and wear rate predictions for BWRs?

3. CHECWORKS Results

Mr. Witte asserts that CHECWORKS results that present a "negative time to Tmin" demonstrate that: (1) the component "should be considered unsafe with potential rupture at anytime;" (NEC-UW_03 at 16); (2) "'Negative cycles of operations,' mean[s] wall thinning beyond acceptable code limits, were also predicted;" (id. at 16-17); (3) the results "predict[ed] potential code violation or failure could have occurred 3 000+ hours previously to October 23, 2006;" (id. at 17); and (4) condition reports should have been written "relevant to this significant indication by CHECWORKS predicting substantial wall thinning beyond code limits to occur with negative margin of this magnitude" (id.). These assertions demonstrate a fundamental misunderstanding of the results produced by CHECWORKS that the following questions explore:

a. Mr. Witte can you explain the difference between the terms "Average Wear Rate" and "Predicted Wear Rate" as shown in CHECWORKS output in Exhibits E4-28, E4-29, E4-30)?

b. In your direct testimony (NEC-UW_03 at 16-17) you refer to your concerns regarding the CHECWORKS results reported in NEC-JH_42 at NEC 17893 that indicate that there are components with negative time to Tmin, you interpret these results as indicating a problem with the VY FAC program. Is it not correct that the same document you cite (id.) states with the first component in the Condensate System that "The inspections on this system in 2001, 2004, and 2005 indicate minimal wear"?

c. Likewise, as to the three components in the extraction steam system (id.) that the document indicates that "The piping is [chromium molybdenum]," which is FAC-resistant material?

4. Conservatism of CHECWORKS predictions

a. Isn't it true that in your testimony with respect to the VY FAC program that you do not identify a single instance where CHECWORKS underestimated the actual rate of FAC wear on a component?

b. Are you aware of any such instance?

B. MR. ULRICH ASSERTIONS REGARDING THE COMPLIANCE OF THE VY FAC PROGRAM WITH NSAC-202L AS GUIDELINES FOR A FAC MANAGEMENT PROGRAM DEMONSTRATE A LACK OF KNOWLEDGE OR MISUNDERSTANDING OF THE VY FAC PROGRAM, NSAC-202L, OR BOTH

Mr. Witte asserts that the current VY FAC program does not comply with NSAC-202L. In his discussion in his rebuttal testimony (at 8-10) (A8) with respect to how Mr. Witte believes his experience can be related to a FAC program, Mr. Witte does not provide any indication he has any experience with or understanding of NSAC-202L. The questions that follow are intended to determine whether Mr. Witte's allegations regarding compliance with NSAC-202L and the reliability of CHECWORKS have a basis in fact and, if so, whether the allegations have any significance.

1. Familiarity with NSAC-202L

a. Mr. Witte in your testimony you do not claim that you have ever administered a FAC program conducted under NSAC-202L, is that correct?

b. Is it not correct that NSAC-202L recommends (Exhibit E4-07, Sec. 4.3) performing FAC "analysis be performed for each system and line with known operating conditions using a predictive methodology such as CHECWORKS"?

c. Is it correct NSAC-202L (Exhibit E4-07, Sec. 4.3) states that "[t]he purpose of a quantitative analysis is to predict the FAC wear rate and to determine the remaining service life for each piping component, including uninspected components" and that's what EN-DC-315 (Exhibit E4-06) does?

2. Inspections

Mr. Witte asserts in his Report (NEC-UW_03 at 6-7) that ". . . under the 2005 scoping document, the rationale for selection of grid points relied on (1) length of time since the lapsed inspections had ceased to examine a particular inspection point, (2) CHECWORKS User Groups, (CHUG) suspects found at other plants, (3) exclusion of components that were intended to be replaced based upon another regime or degraded condition." Mr. Witte asserts that (id. at 7) "[h]ad data from previous FAC inspections routinely been entered into CHECWORKS, the selection of grid points and ranking would have provided a better historical perspective on where to inspect in successive outages …."

a. Mr. Witte, you state in your report (NEC-UW_03 at 6-7) that "grid points" were selected for inspection on three criteria: (1) length of time since the lapsed inspections had ceased to examine a particular inspection point, (2) CHECWORKS User Groups, (CHUG) suspects found at other plants, (3) exclusion of components that were intended to be replaced based upon another regime or degraded condition." Doesn't EN-DC-315 (Exhibit E4-06, Sec. [6](e)) provide that component selection is based on ten separate criteria and that those include:

(1) Components selected from measured or apparent wear found in previous inspection results;

(2) Components ranked high for susceptibility from current CHECWORKS evaluation;

(3) Components identified by industry events/experience via the Nuclear Network or through the EPRI CHUG;

* * *

(5) Components subjected to off normal flow conditions. … ; and

(6) Piping identified from Condition Reports/ Corrective action, Work Orders?

b. In your direct testimony (NEC-UW_03 at 7), you state that "[h]ad data from previous FAC inspections routinely been entered into CHECWORKS, the selection of grid points and ranking would

have provided a better historical perspective on where to inspect in successive outages … ." Is it correct that NSAC-202L (Exhibit E4-07, Sec. 4.3) states that "[t]he purpose of a quantitative analysis is to predict the FAC wear rate and to determine the remaining service life for each piping component, including uninspected components"?

c. Have you reviewed ENN-EP-S-005, "Flow Accelerated Corrosion Component Scanning and Gridding Standard," Exhibit E4-25?

d. Isn't it true that Exhibit E4-25 provides (at Sec. 5.4.3.1) that "a 100% scan of the grid area or square shall be performed for the lowest wall thickness reading contained within the area"?

e. Isn't it true that if the entire surface area of a component and portions of the attached piping is scanned to determine the thinnest part of each grid area or square that the thinnest part of that component and attached piping will be identified by the scan?

f. Doesn't such a selection procedure eliminate concerns about the selected size of the grid?

3. Evaluation of VY FAC Program

Mr. Witte asserts with respect to the VY FAC program (NEC-UW_03 at 2) that "the oversights are substantial in program scope, application of modeling software, and finally necessary revisions to the program not implemented as was promised to support the power uprate." Mr. Witte's understanding of the VY FAC program and the documents he uses as support of these allegations is central to the weight to be given to Mr. Witte's testimony. The following line of questions explores Mr. Witte's understanding of those documents.

a. QA-8-2004-VY-1

(1) Mr. Witte, you cite NEC-UW_09 as the basis for Entergy being "aware of the problematic state of the program (NEC-UW_03 at 15), but that document is a quality assurance audit, No. QA-8-2004-VY-1 (Exhibit E4-26), Isn't it true that at page 2 of that document (NEC-UW_09 at 2), it states that "[n]one of the findings or areas for improvement, individually or in the aggregate, were indicative of significant programmatic weaknesses which

would impact the overall effectiveness of the Engineering Programs assessed."?

b. FAC Program Health Report, "Cornerstone Rollup"

(1) Mr. Witte, you state (NEC-UW_03 at 19) that "The 2006 cornerstone report shows a number of indicators as yellow, with lists of open CR corrective actions, and a new CR written in August 30, 2006. Isn't it true that the FAC Program Health Report, "Cornerstone Rollup" (Exhibit NEC-UW_07 at 1) shows the overall VY FAC Program status as Green?

c. Small Bore Piping

(1) Mr. Witte, you state (NEC-UW_03 at 20) that "Ranking of small bore piping was not done. With no ranking, the basis for selection of high susceptible points for small bore piping is not evident." Isn't it true that Exhibits E4-41 and E4-42 demonstrate that the initial scoping and inspection selection of small bore piping was performed at VY in 1993 and 1995?

Respectfully Submitted,

/Original Signed by Matias F. Travieso-Diaz/

_____

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Dated: June 23, 2008

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NUCLEAR REGULATORY COMMISSION
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OFFICE OF THE
GENERAL COUNSEL

June 20, 2008

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In the Matter of
ENTERGY NUCLEAR VERMONT YANKEE, LLC
AND ENTERGY NUCLEAR OPERATIONS, INC.
(Vermont Yankee Nuclear Power Station)
Docket No. 50-271-LR; ASLBP No. 06-849-03-LR

Dear Administrative Judges:

In accordance with the Initial Scheduling Order (Nov. 17, 2006) (unpublished), please find enclosed the "NRC Staff Proposed Questions Regarding Direct and Rebuttal Testimony" (June 20, 2008).

Pursuant to 10 C.F.R. § 2.1207(a)(3)(i), the enclosed questions are being submitted only to the Board at this time. The Staff understands that, consistent with § 2.1207(a)(3), the questions will be confidential until propounded by the board or until issuance of an initial

decision, at which time they will be forwarded to the Secretary of the commission for inclusion in the official record of this proceeding.

Sincerely,

Susan L. Uttal
Counsel for NRC Staff

Enclosure: NRC Staff Proposed Questions Regarding Direct and Rebuttal Testimony

cc w/ encl.: Marcia Carpentier Lauren Bregman

cc w/o encl.: Ronald A. Shems, Esq. Diane Curran David R. Lewis, Esq.
Elina Tepinsky, Esq. Blake J. Nelson, Esq. Off. of the Secretary
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Matthew Brock, Esq. Office of Appellate Adjudication

June 20, 2008

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
ENTERGY NUCLEAR VERMONT YANKEE, LLC	)	Docket No. 50-271-LR
AND ENTERGY NUCLEAR OPERATIONS, INC.	)	
	)	ASLBP No. 06-849-03-LR
(Vermont Yankee Nuclear Power Station)	)	

NRC STAFF PROPOSED QUESTIONS
REGARDING DIRECT AND REBUTTAL TESTIMONY

Pursuant to 10 C.F.R. § 2.1207(a)(3) and the Atomic and Safety Licensing Board's ("Board") Initial Scheduling Order (Nov. 17, 2006) (unpublished), the staff of the U.S. Nuclear Regulatory Commission ("Staff") hereby submits proposed questions for the Board to pose to the witnesses.

I. Questions for Dr. Joram Hopenfeld

a. Questions for Dr. Hopenfeld Regarding NEC Contentions 2A and 2B

i. Questions regarding Dr. Hopenfeld's expertise on metal fatigue.

NEC relies upon the testimony of Dr. Hopenfeld to support its contention that Entergy has failed to demonstrate that key reactor components will not fail due to metal fatigue during the period of extended operation. Experts, however, must be qualified by knowledge, training, education, or experience. *Duke Cogema Stone & Webster* (Savannah River Mixed Oxide Fuel Fabrication Facility), LBP-05-04, 61 NRC 71, 80 (2005). Both the Staff and Entergy have questioned Dr. Hopenfeld's expertise on the topic of metal fatigue. *See* NRC Staff's Motion in Limine to Strike Testimony and Exhibits Filed by New England Coalition, Inc. ("Staff Motion in Limine") (June 12, 2008) at 12; Entergy's Initial Statement of Position on New England Coalition Contentions (May 13, 2008) at 34, ¶2. Therefore, the following questions are intended to

explore Dr. Hopenfeld's expertise.

1. Dr. Hopenfeld, in your rebuttal testimony (Exhibit NEC-JEH_63 at A4), you state that you have reviewed and approved "metal-fatigue related issues" for the fast flux test facilities (FFTF) and controlled recirculation boiling water (CRB) reactors. Please describe those "metal fatigue related issues."

1a. What do you mean by metal fatigue issues?

1b. When did you review these issues?

1c. What was your role?

1d. Was environmental correction of cumulative usage factors considered?

2. Also in A4 of your rebuttal testimony, Dr. Hopenfeld, you state that you have "participated in the development of related codes and standards."

2a. Describe these codes and standards.

2b. How were these codes and standards "related" to metal fatigue?

2c. Did your participation include membership on a code or standards committee?

2d. If you were a member of a code or standards committee, was that committee's work related to metal fatigue?

2e. If yes, when were you a member of that committee?

3. Have you ever been a member of an ASME Code Committee?

3a. If yes, did that committee's work relate to metal fatigue? Explain.

4. Prior to this proceeding, was reviewing Cumulative Usage Factors (CUF) or environmentally corrected cumulative usage factor (CUFen) calculations ever part of your professional responsibilities?

4a. If yes, explain when, where, and why.

4b. If no, why do you think you are qualified to provide testimony concerning

Entergy's calculations?

ii. Questions for Dr. Hopenfeld regarding NEC's Position on the use of NUREG/CR-6583 and NUREG/CR-5704 Equations to compute Fen Multipliers

NEC and Dr. Hopenfeld have asserted that the equations for calculating metal fatigue in NUREG/CR-6583 and NUREG/CR-5704 are out of date and that Entergy should have used the bounding environmental correction factor (Fen) values in NUREG/CR-6909. *See, e.g.* Exhibit NEC-JH_03 at 10. The Staff and Entergy disagree with NEC's and Dr. Hopenfeld's insistence on using the bounding Fen values from NUREG/CR-6909 and have questioned Dr. Hopenfeld's understanding of these NUREGs. *See* Staff Exhibit 3 at A.5; Applicant Exhibit E2-01 at A50. The Staff has also questioned Dr. Hopenfeld's understanding of and familiarity with the ASME code related to metal fatigue. *See* Staff Motion in Limine at 9. The following questions are intended to explore the basis of NEC's and Dr. Hopenfeld's insistence on applying the bounding NUREG/CR-6909 to Vermont Yankee; Dr. Hopenfeld's understanding of NUREGS/CR-6909, NUREG/CR-6583, and NUREG/CR-5704; and the requirements of the ASME Code.

1. Dr. Hopenfeld, in A5 of your rebuttal testimony (Exhibit NEC-JH_63) you state that the ASME Code "requires that in situations where the environment is more aggressive than air the owner must account for such conditions" and reference ASME Code, Appendix B at B-2131. The Staff asserts that Appendix B of the ASME does not contain mandatory requirements. *See* Staff Motion in Limine at 9; Staff Exhibit D.

1a. Isn't it true that Appendix B of the ASME code offers non-mandatory guidance for the preparation of the Owner's design specifications?

1b. If no, explain why you believe that Appendix B contains requirements.

2. Dr. Hopenfeld, you state that equations in NUREG/CR-6583 and NUREG/CR-5704 are out of date and Entergy should use NUREG/CR-6909, even though the Staff has determined that it is acceptable for license renewal applications to use NUREG/CR-6583 and

NUREG/CR-5704.

2a. What is your basis for challenging the Staff's determination in GALL (NUREG-1801) that the use of NUREG/CR-6583 and NUREG/CR-5704 is acceptable?

2b. What established scientific studies have you identified that support your opinion?

2c. Does anyone else, qualified by knowledge, training, experience, or education, share your view? If yes, explain.

3. Dr. Hopenfeld, on page 6 of your rebuttal testimony, you suggest that the methodology described in NUREG/CR-6583 (carbon and low alloy steel) and NUREG/CR-5704 (stainless steel) ignores factors affecting fatigue that are considered in NUREG/CR-6909 and therefore the method describe in NUREG/CR-6583 and NUREG/CR-5704 is not in agreement with the ASME Code.

3a. Isn't it true that the ASME Code does *not* require consideration of environmental factors when calculating CUFs?

3b. If you believe that the Code *does* require consideration of environmental factors, explain your basis and reference the Code provision(s) imposing the requirement.

4. Dr. Hopenfeld, in A5 of your rebuttal testimony (Exhibit NEC-JH_63) you provide a table listing what you believe to be the most significant factors that affect fatigue life and opine that Entergy must account for all of these factors and should do so by using the bounding Fen values in NUREG/CR-6909. Identify which of the factors in your table that are included in the NUREG/CR-6909 Fen calculation but not included in the NUREG/CR-5704 and NUREG/CR-6583 Fen factors?

5. Dr. Hopenfeld, you state that Entergy should use the bounding Fen values from NUREG/CR-6909 because the equations for Fen values in NUREG/CR-6583 and NUREG/CR-5704 are out of date and do not consider all factors affecting fatigue life. Isn't it true that

NUREG/CR-6909 also contains new curves for fatigue life in air?

5a. If no, Dr. Hopenfeld, please turn to page A4 of NEC-JH_26 and describe what you see. Isn't that a revised fatigue design curve for carbon and low-alloy steels in air?

5b. If yes, Dr. Hopenfeld, please turn to page A4 of NEC-JH_26. If you believe that Entergy uses the bounding Fen values from NUREG/CR-6909 for carbon and low-alloy steel, why do you not also believe that Entergy also use the fatigue design curves provided by NUREG/CR-6909?

5c. (Follow-up to 5b): Isn't it true that the Fen equations in NUREG/CR 6909 were developed to be used with the revised fatigue air curves in NUREG/CR-6909, not with the ASME Code fatigue air curves?

5d. (Follow-up to 5b): If Entergy uses the Fen values from NUREG/CR-6909, why shouldn't Entergy also use the fatigue air curves in NUREG/CR-6909? In other words, why should Entergy be required to use half of one procedure and half of another?

5e. What is your basis for insistence that Entergy use the ASME Code fatigue air curves and the bounding Fen values of NUREG/CR-6909?

6. Dr. Hopenfeld, you have criticized the Staff for asserting that the CUFens generated using the ASME Code fatigue design curve for carbon and low allow steel in air (not stainless steel) and the equations in NUREG/CR-6583 and NUREG/CR-5704 are more conservative than the results using the method in NUREG/CR-6909.

6a. Have you performed the calculations?

6b. If not, what is the basis for your conclusion?

6c. If so, what were the results of your calculations?

7. Dr. Hopenfeld, in the first paragraph of A10 of your rebuttal testimony, you say that you do not agree that Fen = 17 derived from NUREG/CR-6909 is restricted to high temperature and high oxygen environments.

7a. Please turn to page A1 of NUREG/CR-6909. Doesn't that page indicate that for low oxygen the factor in the Fen formula is zero?

7b. What is the resulting Fen when the factor for oxygen is zero?

8. Dr. Hopenfeld, in the second paragraph of A10 of your rebuttal testimony, you reference a paper by Garry Wire and William Mills (Exhibit NEC-JH_66). The referenced paper discusses fatigue crack propagation, not fatigue crack initiation.

8a. Isn't true that the CUFen calculation is about determining when cracks are likely to initiate?

8b. What is the difference between crack propagation and initiation?

8c. Why is crack propagation relevant?

9. Dr. Hopenfeld, in A11 of your rebuttal testimony, you state that the author of NUREG/CR 6909, "understands the limitation of the Fen methodology very well" but "he is not in a position to recommend or not to recommend the use of bounding Fen values" and, therefore, "it is up to the user to assess his specific conditions and make the appropriate corrections to the ANL equations."

9a. Doesn't the appendix to NUREG/CR-6909 recommend a procedure for calculating Fens?

9b. If, as you suggest, NUREG/CR-6909 does not specify the use of bounding Fen values, why do you insist that Entergy must use the bounding values from NUREG/CR-6909?

10. Dr. Hopenfeld, in A13 of your rebuttal testimony, you state that you disagree with Mr. Fitzpatrick's statement that Entergy's CUFen analyses properly accounted for surface roughness effects through the use of the ASME Code design fatigue curves. You further state that until data shows that corroded surfaces and machine surfaces equally effect fatigue, possible differences cannot be ignored.

10a. Does the data from the Argonne National Laboratory tests reported in NUREG/CR-6909 support you assertion?

10b. Isn't it true that the data reported on page 34 of NUREG/CR-6909 show that the fatigue lives of rough and smooth specimens are about the same in high dissolved oxygen water, where the Fen factor is maximum.

b. Questions for Dr. Hopenfeld Regarding NEC Contention 3

NEC relies upon the expert testimony of Dr. Hopenfeld to support its position that Entergy has not demonstrated an adequate plan to monitor and manage aging of the steam dryer during the period of extended operation. The factual basis for an expert's opinion must be adequately stated and explained. *Duke Cogema Stone & Webster* (Savannah River Mixed Oxide Fuel Fabrication Facility), LBP-05-04, 61 NRC 71, 80-81 (internal citations omitted). The following questions are designed to explore Dr. Hopenfeld's factual bases, reasoning, and conclusions regarding NEC Contention 3.

i. Questions Regarding Dr. Hopenfeld's "Assessment of Proposed Program to Manage Aging of the Vermont Yankee Steam Dyer Due to Flow-Induced Vibrations" (Exh. NEC-JH_54)

The following questions are intended to explore the factual basis relied for the assertions Dr. Hopenfeld makes in Exhibit NEC-JH_56.

1. Dr. Hopenfeld, in Section I of Exhibit NEC-JH_54, you refer to vortices shed by flow over the surface of the steam dryer matching the natural frequency of the steam dryer, but you do not discuss potential pressure pulses on the steam dryer that can result from acoustic resonance in the main steam lines caused by flow over the branch lines to the safety relief valves, such as that which occurred at the Quad Cities nuclear power plant prior to the steam line modifications.

1a. Are you aware of the pressure pulses that resulted from acoustic resonance in the main steam lines caused by flow over the branch lines to the safety relief

valves at Quad Cities?

1b. Is your concern focused on the possible effects of vortices shed by flow over the surface of the steam dryer at Vermont Yankee?

1c. If not, then what is the focus of your concern?

2. Dr. Hopenfeld in Exhibit NEC-JH_54 at Section II you state that a "public safety hazard would result if the dryer was damaged and some of its parts broke loose and were transported by flow or gravity to other areas of the reactor system."

2a. Are you trying to assert that a public safety hazard would result in any instance of loose parts from the steam dryer at Vermont Yankee?

2b. If yes, how do you explain the fact that the steam dryers in the two reactor units at the Quad Cities nuclear power plant were damaged and resulted in loose parts during power uprate operation, however no public safety hazard resulted from the presence of the loose dryer parts?

3. Dr. Hopenfeld, in Section II of Exhibit NEC-JH_54, you state that loose parts may block flow channels in the reactor core, block spray cooling nozzles, or prevent the main steam isolation valves from isolating the system during loss of coolant accidents (LOCAs).

3a. Do you agree that if the steam dryer at Vermont Yankee failed to the extent that loose parts were released, the moisture carryover would increase through the failed steam dryer?

3b. If moisture carryover increased through the failed stream dryer, is it plausible to suggest that the licensee would not shut down the reactor to evaluate the cause of increased moisture carryover or is NEC asserting that the licensee would continue to operate the reactor with a failed steam dryer such that loose parts might impact the performance of safety systems during a possible LOCA at some later time?

3c. If NEC is not asserting that the licensee would continue to operate under

such failed conditions, is NEC concerned with structural capability of the steam dryer during a LOCA when the reactor coolant system would be depressurizing?

4. Dr. Hopenfeld, in NEC-JH_54 at page 2 you state that "small pressure fluctuations in the steam lines (3-4 psi) indicate that even small pressure fluctuations on the dryer can generate altering stresses [sic] that exceed the endurance limit at some dryer locations" and cite to Exhibit NEC-JH_55, which is GE SIL No. 644. Can you please specify the precise location in GE SIL No. 644 that supports your statement?

ii. Questions for Dr. Hopenfeld Regarding Stress Analysis Performed by Vermont Yankee during EPU Implementation

NEC asserts that the Entergy and the Staff argue that Entergy's steam dryer AMP *does* rely on the steam dryer modeling conducted during EPU implementation for knowledge of dryer stress loads. NEC Rebuttal Statement of Position at 18-19. In support of this statement, NEC refers to the NRC Staff Initial Statement of Position at page 19, which states that stress analysis "is not necessary because the results of the EPU power ascension program demonstrated that the pressure loads during the EPU operations do not result in stress on the steam dryer that exceed ASME fatigue stress limits." NEC has further asserted that Entergy's steam dryer AMP must include some means of estimating and predicting stress loads on the steam dryer. *See e.g.*, Exh. NEC-JH_54 at 5. The following questions are proposed to explore the bases for NEC's assertion.

1. Dr. Hopenfeld, are you aware that the monitoring of strain gauges on the main steam line piping during EPU power ascension did not reveal any significant pressure fluctuations that could impact the structural integrity of the upgraded Vermont Yankee steam dryer?

2. What changes in plant performance do you believe could cause pressure fluctuations that would result in a long-term fatigue concern for the steam dryer?

3. Dr. Hopenfeld, when you state that, "[t]he only way of determining stresses on the dryer is to actually measure them," Exhibit NEC-JH_63 at A29, are you proposing the installation of strain gauges on the radioactive steam dryer at Vermont Yankee?

4. Dr. Hopenfeld, in your rebuttal testimony (Exh. NEC-JH_63 at A33) you assert that a small increase in steam velocity in the Vermont Yankee reactor vessel can cause severe vibrations of the steam dryer in light of plant-specific and industry experience.

4a. Are you aware that during the EPU power ascension at Vermont Yankee, no significant excitation of plant performance parameters was observed during monitoring of the main steam line strain gauges or component accelerometers?

4b. Are you aware of the fact that experience from other nuclear power plants shows that severe pressure loading on the steam dryer only occurred as a result of a large increase in flow from power uprate operation?

4c. In light of the above facts, please explain the basis for your assertion that a small increase in steam velocity in the Vermont Yankee reactor vessel can cause severe vibrations of the steam dryer in light of plant-specific and industry experience.

II. Questions for Dr. Rudolf Hausler

a. Questions Regarding Dr. Hausler's Qualifications for Providing Testimony Concerning NEC Contention 4

In support of Contention 4 (flow-accelerated corrosion), NEC relies, in part, on the testimony of Dr. Rudolf Hausler. In his testimony, Dr. Haulser opines on Vermont Yankee's ability to effectively use CHECWORKS to predict FAC-susceptible locations during the period of extended operations, including the number of cycles worth UT inspection data Vermont Yankee will need to "recalibrate" CHECWORKS to EPU conditions. *See* NEC-RH_01 at A.6. Because experts must be qualified by knowledge, training, education, or experience, in order to provide testimony in support of NEC Contention 4, Dr. Hausler should be familiar with the

CHECWORKS model. *See Duke Cogema Stone & Webster* (Savannah River Mixed Oxide Fuel Fabrication Facility), LBP-05-04, 61 NRC 71, 80 (2005). Based upon his *curriculum vitae,* it is not apparent that Dr. Hausler is familiar with CHECWORKS. Thus, the following questions are intended to explore Dr. Hausler's qualification to provide testimony concerning NEC 4.

1. Have you ever used CHECWORKS?

1a. If you have used CHECWORKS, describe when, where, how often and why you used it.

1b. If you have never used CHECWORKS, what is the basis for your expert testimony concerning the use of CHECWORKS?

b. Questions for Dr. Hausler Regarding His Testimony in Support of NEC Contention 4

Dr. Hausler expresses concern for uncertainties in the methodology of ultrasonic thickness ("UT") measurements. *See* NEC-RH_03 at Appx. A. Dr. Hausler does not, however, articulate a basis for his assumption. Unsupported statements are of little assistance to the trier of fact because the decision should be based on information that is included in the record. *See Pacific Gas & Electric Co.* (Diablo Canyon Nuclear Power Plant, Units 1 & 2), ALAB-580, 11 NRC 227, 230 (1980) (stating that "it is a statutory requirement that the adjudicatory decisions of this Commission stand or fall on the basis of the record on which they rest"). Thus, the following questions are designed to assist the Board in understanding the basis for Dr. Hausler's assertion.

1. Dr. Hausler, you express a concern with the methodology for UT measurements, but you do not provide any supporting evidence or documentation for your concern. NEC-RH_03 at Appx. A. Please explain what your concern is based on.

1a. Dr. Hausler, you specifically state that one of your concerns is the inherent difficulty in taking measurements in the same location. Are you aware that Entergy has

a painted a grid on the pipe to help ensure that UT measurements are taken in the same place?

1b. Isn't it true that a painted grid would help alleviate this concern?

2. You state, Dr. Hausler, that UT wall thickness technology is capable of attaining measurement accuracy for high frequency UT transducer of +/- 1% to 2%. NEC-RH_03 at Appx. A. Please explain how you arrived at this number and what this number is based on.

III. Questions for Mr. Ulrich Witte

a. Questions for Mr. Witte Regarding NEC Contentions 2A and 2B

In his late-filed rebuttal testimony, Ulrich Witte makes a number of statements regarding NEC Contentions 2A and 2B that appear to be irrelevant, unsupported, or both. Experts, however, must provide and explain the basis for the opinions. *See Savannah River*, LBP-05-14, 61 NRC at 80-81. Thus, the following questions are intended to assist the Board in understanding the relevance and factual basis of Mr. Witte's assertions.

1. Mr. Witte, in A4 of your rebuttal testimony you assert that you are qualified to provide testimony concerning NEC contentions 2A and 2B and, in support of that assertion, state that you conducted detailed correlation studies of non-linear finite element analysis code predictions against actual in situ testing and components at Indian Point 1 after the plant was closed and the results of your work were published in EPRI Report Number 8450.

1a Explain how this work is relevant to your testimony on Vermont Yankee fatigue calculations.

1b. Explain how this work qualifies you to testify about Vermont Yankee's metal fatigue calculations.

2. Mr. Witte, in A5 of your rebuttal testimony on the top of page 4, you refer to an event at another facility on December 26, 1986 at 6 am where you were required to notify the Technical Support Center.

2a. What facility are you talking about?

2b. What is the relevance of that event to Vermont Yankee's calculations?

3. Mr. Witte, in A5 on page 5 of your rebuttal testimony you refer to a scram event at Vermont Yankee on December 1, 1972. How does that event impact the fatigue analysis?

4. Mr. Witte, in A5 of your testimony on page 5 you state that Vermont Yankee had 42 unplanned forced shutdowns between 1972 and 1977. In support of your statement you reference Exhibit UW-25.

4a. Isn't it true that UW-25 simply lists the number of shutdowns per year?

4b. Isn't it true that UW-25 does not indicate the reason for the shutdowns?

4c. What then is your basis for asserting that every shutdown between 1972 and 1977 was a forced shutdown?

4d. What is your basis for asserting that the 10 shutdowns in 1976 were unplanned?

5. Mr. Witte, in A5 on page 5 of you rebuttal testimony, you state that number of shutdowns Vermont Yankee experience between 1973 and 1977 is "significant" and expended much of the fatigue life of the reactor vessel and feedwater nozzles.

5a. What is your basis for assertion that the number of shutdowns was "significant"?

5b. Is the number of shutdowns Vermont Yankee experienced between 1973 and 1977 unusual for a plant during its first five years of operation?

5c. What is your basis for asserting that the shutdowns expended much of the fatigue life of the reactor vessel and feedwater nozzles?

6. Mr. Witte, in A5 on page 5 of your rebuttal testimony, you state that there are transients that appear to have not been incorporated as input in the refined fatigue analysis.

6a. In your testimony, you do not provide a reference for your assertion. What is the basis for your assertion that Entergy did not consider these transients?

7. Mr. Witte, in A5 of your rebuttal testimony on the bottom of page 5 top of page 6, you refer to an event on July 6, 1976 but you do not explain the relevance of the event to Vermont Yankee's fatigue calculations. What is the relevance of this event to Vermont Yankee's calculations?

8. Mr. Witte, in A6 of your rebuttal testimony you state that the estimated transient history may or may not be conservative.

8a. What is the basis for your assertion?

8b. Can you provide specific examples?

b. Questions for Mr. Witte Regarding NEC Contention 4

i. Questions Regarding Mr. Witte's Qualifications

NEC relies upon the testimony of Mr. Witte to support its contention regarding FAC. Experts, however, must be qualified by knowledge, training, education, or experience. *Duke Cogema Stone & Webster* (Savannah River Mixed Oxide Fuel Fabrication Facility), LBP-05-04, 61 NRC 71, 80 (2005). In addition, a number of Mr. Witte's statements are not supported by evidence and therefore, may provide little use to the trier of fact. Therefore, the following questions are intended to explore Mr. Witte's expertise and to gain a better understanding for the bases of his assertions.

1. Mr. Witte, in your rebuttal testimony, you admit that you are not "intimately familiar with the empirically based CHECWORKS algorithm." NEC Exhibit 3 at 10. Can you please explain the extent of your knowledge and understanding of CHECWORKS.

2. Mr. Witte, is it fair to say that if you are not intimately familiar with CHECWORKS, you may not be aware of the significance of all inputs into the model?

3. Despite the fact that you are not intimately familiar with CHECWORKS, you testify that Entergy improperly updated the program. *See* NEC-UW_01 at 4. If you are not intimately familiar with CHECWORKS, what is the basis for your conclusion?

4. Mr. Witte, throughout your rebuttal testimony you make a number of observations and conclusions, but fail to provide any supporting evidence for these statements. Can you please describe the reasoning and bases for the following statements:

4a. "Entergy apparently failed to update CHECWORKS" and this "lapse may have significantly weakened the trending and predictive capability of the software." NEC-UW_01 at 4.

4b. Entergy "apparently used an outdated version of the CHECWORKS software." *Id.*

4c. There appears to have been a pipe rupture in 2006. *Id.* at 5.

ii. Questions for Mr. Witte Regarding NRC "Commitments"

In his initial testimony and written analysis, Mr. Witte makes a number of statements regarding "commitments" Entergy has made. Mr. Witte does not, however, seem to understand the proper definition of commitment. By definition, a commitment is made by a licensee "in docketed licensing correspondence such as licensee responses to NRC bulletins, generic letters, and enforcement actions, as well as licensee commitments documented in NRC safety evaluations or licensee event reports." 10 C.F.R. § 54.3; *see also* SECY-00-0045, *Acceptance of NEI 99-04, Guidelines for Managing NRC Commitments* (Feb. 22, 2000). The following questions are intended to explore Mr. Witte's understanding of commitments.

1. Mr. Witte, throughout your initial testimony and written analysis you reference a number of commitments Entergy has made. Exhibits NEC-UW_01 at 5; NEW-UW_03 at 11, 20.

1a. Isn't it true that a Generic Letter *from* the NRC to licensees cannot be a commitment?

1b. Isn't it true that in your initial testimony your indicate that Generic Letters from the NRC to licensees, including Vermont Yankee, contain commitments?

1c. Isn't it true that commitments must be made by a licensee in writing in

docketed correspondence to the NRC?

1d. If you disagree with the proposition that commitments must be in writing in docketed licensing correspondence with the NRC, what is your understanding of commitments?

1e. What is the basis for your understanding of what constitutes a commitment?

2. Also on the topic of commitments, Mr. Witte, you asserted in your initial testimony that "Entergy apparently reduced the number of FAC inspection data points between the 2005 refueling outage and the 2006 outage, in violation of its commitment to increase inspection data points by 50%." Exh. NEC_UW-03 at ¶17. You made this assertion again in "Prefiled Rebuttal Testimony of Ulrich Witte Regarding New England Coalition, Inc.'s Contentions 2A, 2B, and 4" at A15 but you fail to provide a reference for your assertion. What is the basis for your assertion?

iii. Questions for Mr. Witte Regarding the Availability of Benchmarking Data

Mr. Witte asserts that "given the uniqueness of the design of Vermont Yankee's power uprate, CHECWORKS has little industry benchmarking data, and is of marginal use." NEC-UW_03 at 8. Mr. Witte, however, fails to articulate a basis or provide evidence to support his assertion. Unsupported statements are of little assistance to the trier of fact because decisions should be based on information that is included in the record. *See Diablo Canyon*, ALAB-580, 11 NRC at 230. The following question is posed so that the Board can understand the issue of the availability and use of benchmarking data.

1. Mr. Witte, you state that there is little benchmarking data and it is of marginal use given the uniqueness of Vermont Yankee's power uprate. NEC-UW_03 at 8. Can you please explain the basis for this statement?

IV. Questions for Entergy

Questions for Entergy Regarding Contention 4

i. Questions for Entergy Regarding UT Measurements

Dr. Hausler expresses concern for uncertainties in the methodology of ultrasonic thickness ("UT") measurements. NEC-RH_03 at Appx. A. Dr. Hausler does not, however, articulate a basis for which this assumption is based. The following questions are designed to allow the Board to explore the methodologies which Entergy uses and to gain a better understanding of Dr. Hausler's concerns.

1. Can you please explain the methodology Vermont Yankee uses to take ultrasonic thickness measurements?

1a. Dr. Hausler expresses two areas of concern regarding UT methodologies: 1) the inherent variability of the instrument, and 2) inherent difficulty of placing the probe in the same location for repeat measurements. Exhibit NEC-RH_03 at Appx. A. Do you agree that these are areas of concern?

1b. Isn't it true that there is a painted grid at Vermont Yankee which helps alleviate concerns for placing the probe in the same location?

1c. Describe the type of training that UT technicians at Vermont Yankee receive.

1d. Dr. Hausler asserts that UT wall thickness technology is capable of attaining measurement accuracy of +/- 1-2%. NEC-RH_03 at Appx. A. Do you agree?

1e. If not, in your experience, what is the level of accuracy that UT wall thickness technology is capable of attaining?

ii. Questions for Entergy Regarding the Availability of Benchmarking Data

Mr. Witte asserts that "given the uniqueness of the design of Vermont Yankee's power

uprate, CHECWORKS has little industry benchmarking data and this data is of marginal use." NEC-UW_03 at 8. Mr. Witte, however, fails to articulate a basis or provide documentation to support his assertion. Unsupported statements are of little assistance to the trier of fact because decision should be based on information that is included in the record. *See Pacific Gas & Electric Co.* (Diablo Canyon Nuclear Power Plant, Units 1 & 2), ALAB-580, 11 NRC 227, 230 (1980) (stating that "it is a statutory requirement that the adjudicatory decisions of this Commission stand or fall on the basis of the record on which they rest"). The following questions are posed so that the Board can understand the issue of the availability and use of benchmarking data.

1. The Staff suggests that there is enough benchmarking data. Do you agree? Please explain.

2. Does the plant's operating power level matter when it comes to using CHECWORKS? Please explain.

Respectfully submitted,

Susan L. Uttal
Counsel for NRC Staff

Dated at Rockville, Maryland
this 20th day of June, 2008

Appendix B
(Sets of Questions Proposed During the Evidentiary Hearing)

1. New England Coalition's Proposed Follow-up Questions for the ASLB (Contention 2A/2B Panel) (July 22, 2008).

2. New England Coalition's Proposed Follow-up Questions for the ASLB (Contention 3 Panel) (July 23, 2008).

3. New England Coalition's Proposed Follow-up Questions for the ASLB (Contention 4 Panel) (July 24, 2008).

4. State of New Hampshire's Questions on Contentions 2A + 2B (undated) (handwritten).

5. Questions by State of New Hampshire on Contention 3 (July 23, 2008) (handwritten).

6. Questions by State of New Hampshire on Contention 4 (July 24, 2008) (handwritten).

7. Entergy's Proposed Followup Questions on Contention 2 (undated).

8. Entergy's Proposed Follow-Up Questions on Contention 4 (undated).

9. NRC Staff Question for Entergy (Contention 3) (undated) (handwritten).

10. NRC Staff Questions for Staff (Contention 4) (undated) (handwritten).

FOR ASLB REVIEW ONLY

New England Coalition's Proposed Follow-up Questions for the ASLB – 7/22/08
(Contention 2A/2B Panel)

1. Entergy claimed that the affected components have undergone 96 transients, 1972-2008:
   - What is Entergy's definition of transient for purpose of the cycle count; is it only zero to full power or full power to zero; are all transients included or only "major" transients?
   - If all actual transients are not included, why not?
   - Are the documents from which Entergy determined the number of transients VY has experienced in the testimony/exhibits, or disclosures?
   - If not, can Entergy provide its list or accounting of all transients?
   - Have you had any actual thermal transients throughout the life of the plant that are outside the DBA as provided by the designer?

2. Mr. Fitzpatrick testified that there has been only 1 transient since the Uprate has occurred. Haven't there been a number of other less-than-full transients since Uprate modifications began, including:
   - The July 2008 a recent power down to 25% because of cooling tower leaks.
   - The August 2007 cooling tower collapse that resulted in a 50% power down.
   - The Aug 2007 turbine stop valve incident resulting in 100% power down.
   - The 2004 condenser leak, resulting in a 50% power down.

3. How are chemical kinetics characterized during transients?

4. Is there data in the record to demonstrate that the DO values don't go up in the transients, how many environmental conditions existing during a transient impact the Do value at the relevant component other than just pressure, how many of those have been measured at VY during transients (and how many such measurements), and does the DO value remaining constant through the transient depend on precisely the kind of transient and its duration? Are there transients that have occurred or can occur at the VY that would result in the DO values increasing at the relevant component and if so, what are those transients and how often have they occurred or how often are they predicted to occur?

5. Has Entergy ever quantified the potential impact of the 13 uncertainty factors identified by Hopenfeld?
   - Why is it so difficult to perform an error propagation analysis for the calculation based upon the standard deviation of all 13 parameter identified by Hopenfeld?

6. Was there an independent design review done within Entergy of the Stevens analysis?

7. Stevens testified that trace elements and impurities are not considered because it is unlikely they would be present during a transient. Did Entergy redo it calculations to consider this factor in light of the recent in-leakage of service water through the condenser?

8. If NUREG 6909 is not more conservative than what older reactors did in the past (See Staff Ex. 13 at 2), what tests have been run using 6909 and showing that the old reactors were conservative and how were those tests, if any, shown to be applicable to all reactors, particularly VY?
    - Current tests (6909) would produce less conservative results according to VY witness (Stevens) at all 9 locations because he did the calculations very recently and analysis changed both the CUF and Fen curves. Can we see the entire calculations he performed so we can understand the methodology he used and the input values for all variables? Can he identify all the issues on which he used judgment, as opposed to actual measured values?

    - If the failure occurs at one of the 9 locations, what is the worst possible consequence?

    - If a crack occurs without a failure, is it capable of being detected in all cases and if so, how would that be done?

    - How long does it take for a crack to become a failure?

9. How did ASME develop the fatigue curves - e.g. source of data points, role of nuclear industry and public in development of curves, how was the conversion from the specific facts of the tests to an operating nuclear reactor occur and what tests were done to verify that conversion?

    - What factors in the ASME curves are based on assumptions rather than specific experimental data results?

10. Since real data at VY were used to make the refinements as to some factors, what other VY-specific data, if any, were used to modify assumptions that underlie all elements of the CUFen analyses, not just the one chosen in the refined analysis process? Relate to this question is the more general question of how Mr. Stevens did his refinement analysis regarding the following points:

    - Did Mr. Stevens have an assignment to find the correct CUFen numbers or was it only to see if he could get the numbers below 1?

    - In doing the refinement, how were the inputs chosen for which "realistic" values would be substituted - for example, were the inputs that were chosen those where Mr. Stevens believed it was most likely that "realistic" numbers

would lower the CUFen number?

- Isn't it possible that some of the inputs, when evaluated against "realistic" numbers, will turn out to be not conservative and if that is so, shouldn't the refinement process have involved a complete application of "realistic" numbers to the analysis to produce an entirely new calculation and not merely proving "acceptability" by a partial reanalysis?

- When the refinement was done, for those assumptions for which no new data was available, were those assumptions left as they were in the original analysis in all cases?

- In taking "realistic" numbers from VY operation, identify those values for which the worst case number from VY was used and those for which something less than worst case chosen and how would the results have differed, if at all, if the worst case value was used in every instance?

11. Has Mr. Stevens' company been ask to do the confirmatory analyses for the remainder of the relevant components and if so, when were they requested to do this, what is their schedule for completing the work and who is controlling that schedule?

12. When Mr. Stevens did the recent 4 hour analysis by just substituting the 6909 curves, what would have been the result had he done everything that 6909 requires relating to all other aspects of the CUFen analysis - i.e. what would have been the outcome had all of 6909 been applied to the CUFen analysis for VY?

13. If the Entergy position is that the analyses they have done are the best possible, given the available information, what basis exists for concluding that the "best available information" is sufficient information to avoid choosing the nozzle replacement option rather than the refined calculation option?

14. Reference was made to all the prior calculations of CUFen for reactors and that studies have been done to show all those calculations are very conservative and that current techniques would make for lower numbers not higher numbers. As to those studies:

    a. What peer reviewed journal or other public forum has published those results?

    b. Who conducted these analyses and were any of them specific to VY?

    c. Who supervised these studies and validated the methodologies used?

    d. Explain the details of the methodologies used in these analysis.

15. If 6909 says you "can" use 400 ppb for dissolved oxygen, if you do not have more specific numbers, does it allow for numbers that are not based on actual measured

data such as the estimates used by VY for dissolved oxygen levels based not on measurements at the site of concern or during a transient, or are those the cases when it says the 400 ppb can be used?

FOR ASLB REVIEW ONLY

New England Coalition's Proposed Follow-up Questions for the ASLB - 7/23/08 (Contention 3 Panel)

1. If you believed there were a higher chance of a crack occurring in the steam dryer than you currently believe, would you have a different monitoring/inspection program? If so, what would it be?

2. Is it the case that the closed crack (as opposed to an open) won't cause moisture carryover that parameter monitoring would detect?

3. How long can a crack get before it actually opens?

4. In the 2007 inspection, were there cracks that couldn't be immediately classified as IGSCC and took further evaluation? If so, what was the nature of that further evaluation.

5. If a large crack occurs five years into the license extension, and it is repaired, how do you know whether the repair is adequate or whether it will cause more problems, without knowing the stresses on the dryer?

6. NRC stated that Design Basis Accident steam flow was "Out" away from reactor core. Has NRC analyzed the implications of a loose part jamming a relief valve in open position?

7. Is GE-SIL-644 part of VY's Current Licensing Basis only via Steam Dryer Monitoring Plan Revisions 3?

8. Are there plant malfunctions other than a steam dryer failure that would cause moisture carryover, and if so, in what order will Entergy evaluate the causes?

9. Will Entergy immediately shut down the plant if moisture is detected, or will it undertake an evaluation process? If so, how long would such an evaluation take?

10. For NRC Staff: Isn't it true that the NRC does not require nor expect that licensees be in complete conformance with its licensing basis at all times?

11. For NRC Staff: Isn't it the NRC's position that the generation of loose parts could affect safety-related equipment?

12. Isn't VY switching from an 18 month to a 24 month interval between refueling outages and therefore inspections?

13. For NRC Staff: Why can't Entergy be required to commit to comply with the new guidance - BWRVIP 139?

14. If VIP 139 is approved by the staff with modifications that VY believes are unacceptable and if VY asks for an exemption to the requirements of VIP 139 what is the Staff position on the following issues:

    a. Will there be an opportunity for any public participation in the Staff determination of whether to grant an exemption under 50.13 in response to VY's request?
    b. Will there be an opportunity for a hearing on the issue of whether the exemption should be granted?
    c. Will the staff determination be appealable to the Commission or a Court?

FOR ASLB REVIEW ONLY

New England Coalition's Proposed Follow-up Questions for the ASLB - 7/24/08
(Contention 4 Panel)

1. Fitzpatrick has testified about what "we" are going to do, what he is observing, and what he would do. Given that he is no longer working for Entergy, is he authorized to make statements on behalf of the company and what it intends to do?

2. How does Entergy know where to inspect for mechanical corrosion? How exactly is operating experience used to define the scope of inspection for mechanical corrosion?

3. Didn't the scope/ locations of mechanical damage most likely change after uprate? How is Entergy accounting for this?

4. Mr. Fitzpatrick testified that he thinks he has enough data on the VY lines to know whether to believe CHECWORKS results indicating failure before next inspection period. How does he account for changes in rate or location of wear after the uprate? Does he have enough data post-EPU?

5. Dr. Horowitz: how often do you recommend a plant update CHECWORKS for optimal use?

6. Mr. Fitzpatrick: You first testified that the CHECWORKS model wasn't updated after every FAC inspection if data did not show significant wear. You later testified that the model wasn't updated because of resource limitations. Which is it?

7. Has there been a pipe burst against which you have correlated your data? Did the model predict it?

8. Has the NRC, EPRI or any other auditing, consulting or peer entity ever indicated weaknesses, defects, or potential for improvement in the FY FAC program? What items were identified?

9. There was a question about the relative significance of leaks and breaks - Isn't it true that leaks in high energy lines can result in injury to personnel and damage to safety-related equipment (leakage and spray hazards)?

   [Ref: LRA, pg 2. 1-6: Therefore, as long as the effects of aging on the supports for these piping systems are managed, failing of piping sections, except for FAC failures, is not considered credible, and the piping section itself would not be in scope for 10 CFR 54.4(a)(2) due to the physical impact hazard although the leakage or spray hazard may still apply).

10. In 2005, the Mihama Nuclear Plant in Japan had a pipe rupture that resulted in injuries and death of several workers. The unanticipated thinning and rupture was downstream of a small pipewall orifice. Can you describe the FAC phenomena in that or similar situation? Would CHECWORKS have predicted this thinning?

a. Has there been any demonstration by NRC Staff or Entergy as to what sort of program failed to predct the pipe burst at Mihama? Was their program similar to CHECWORKS? If not, what were the differences?

11. Is it not the case that certain accident scenarios result in precipitous challenges to the pressure boundary (closure of MSIVs for example)? Isn't it therefore vital that pipewall thinning be limited to that able to withstand accident pressures?

12. Regarding the relative significant of pipe leaks vs. breaks: Isn't it true that leaks in high energy lines can result in injury to personnel and damage to safety-related equipment through leakage and spray hazards?

13. For Horowitz: Previously testified that re FAC, normally large areas affected, but that with respect to pinholes, other mechanisms are involved. Is this always so? Quantify.

14. What is the scientific basis for a belief that CHECWORKS does not create false negatives, particularly since it apparently produces false positives?

    a. Since there has not been independent verification/validation of the model and since the principle source of confirmatory data of the model matching reality has come from the plant operators who, like Mr. Fitzpatrick, do inspections primarily where the model shows a potential problem, what scientifically competent basis is there for believing that CHECWORKS is not missing areas where corrosion is occurring, particularly since it appears to be overstating the potential problems it does identify, thus suggesting that the model is not an accurate predictor of reality, nor that it is always a conservative predictor of reality?

15. Where is the commitment in the application to use other screening measures besides CHECWORKS, and where is the data/analysis to support the validity of those methods.

Question Regarding Entergy's Inaccurate Response
to a Contention 2A/2B Followup Question:

Question Proposed by NEC on 7/22: Stevens testified that trace elements and impurities are not considered because it is unlikely they would be present during a transient. Did Entergy redo it calculations to consider this factor in light of the recent in-leakage of service water through the condenser?

Question as asked by Judge Reed: **Has service water containing impurities ever leaked into the steam system through the condenser?**

Fitzpatrick response: there is no way for service water to get into the system.

Available Information: news article from 4/3/08 stated that VY was trying to determine where cooling water from the Ct River was leaking into the reactor's coolant system and its condenser.

Request witness to clarify his answer.

Article published Apr 3, 2008

Yankee workers can't find leak

Herald Staff

BRATTLEBORO — Work was continuing Wednesday at the Vermont Yankee nuclear plant to determine where cooling water from the Connecticut River was leaking into the reactor's coolant system.

Uldis Vanags, the state nuclear engineer with the Department of Public Service, said Entergy Nuclear had isolated the source of the leak to one section of the condenser, which cools the steam as it leaves the turbine, so it can return to the reactor as water.

Vanags said that Entergy Nuclear told him Wednesday that it had tested 75 percent of the 5,500 tubes in the section of the condenser where the problem was believed to be coming from, but that the company hadn't found the source of the leak or leaks yet.

The plant is operating at about 43 percent power so that repairs can be made to the condenser.

Vermont Yankee provides about one-third of all of the state's electricity.

State of New Hampshire's
Questions
Contentions 2A & 2B

For Mr. Fair

would it be most conservative for VTY to apply Nureg 6909's DO value of .4 ppm?

Also realistic?

For Mr. Stevens

When you did the computations to show the plant would not experience metal fatigue at unacceptable levels in the PEO, did you reach any conclusions as to the outside expected life of the plant beyond the PEO?

If so what is it?
and based on what?

If not, why not?

New Hampshire

For Mr. Fitzpatrick

In calculating the postulated damage (cracks) to the FW nozzle caused by the leakage from the thermal sleeve, what effect did that factor in to the analyses?

Why doesn't VTY simply replace the FW nozzles and other potential fatigued parts/components?

Stevens

Question 30 conservatisms

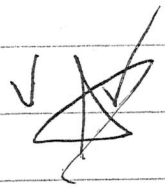
Testimony was that "assumed" transients in revised calculation was more conservative than "expected" transients used in previous calculations —

How is the use of "assumed" transients any more conservative than "expected" ones?

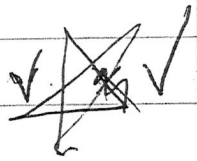
Aren't they all just engineering assumptions?

Questions by state of New Hampshire
Contention 3 - July 23, 2008

For Entergy or Staff or NEC:



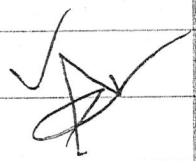
① Can IGSCC cracking eventually result in sudden breaking apart of steam dryer components? If so, how long before it occurs? How does it occur?



② Can Entergy inspect the dryer whenever the plant shuts down, such as a parameter exceedance shut down?

For Entergy:

① How large or small of a loose part would a parameter monitoring detect?



② After 2003 BWR-3 event, a number of corrective actions were taken to fortify the steam dryer (see E3-06, pg. 17). How did Vermont Yankee perform similar corrective actions?

③ In the operative analysis conducted when parameters exceeded, how high up the decision tree is dryer failure in relation to other possible causes?

(next)

XX ?

④ How long does this process take before shut down? who ultimately decides?

Questions By State of New Hampshire
7/24/08 — Contention 4

1. For Dr. Horowitz:

a.) Does Entergy's decision not to enter inspection data into program unless it indicates wear have an impact on the accuracy of the program's predictions?
→ what are those impacts and implications

b.) Is not doing that consistent with technical manuals or instructions that come with the program?

2. For Staff:

a) ~~Did~~ Staff discover Applicant's updating strategy (i.e. wait until subsequent refuelings) during an audit?

If so,
b) was corrective action required as a result?

ENT

Entergy's Proposed Followup Questions on Contention 2:

Dr. Reed asked Mr. Fair about the following statement on page 17 NRC Staff's Initial Statement of Position on NEC Contentions 2A, B, 3 and 4 (May 13, 2008):

> Although the "Confirmatory Analysis" was acceptable to the Staff, and the CUF for the feedwater nozzle was less than 1.0, the CUF produced by the "Confirmatory Analysis" was greater than that produced by the September 2007 analysis and therefore not bounding.

Entergy believes that this statement (specifically the last four words), which is in a brief and is not in the testimony, is erroneous and has created confusion.

The NRC Staff 's Initial Position Statement cites two sources for this assertion. One is Dr. Chang's testimony at A-20. Dr. Chang's testimony at A-20 states in pertinent part:

> The [confirmatory] analysis submitted for staff review on January 20, 2008 (Exh. NEC-JH_34) showed that the simplified 1-D stress input approach was not conservative for the FW nozzle and does not validate the analysis submitted on December 11, 2007 for the CS and RR outlet nozzles.

The second source cited in support of the NRC Staff's Initial Position Statement is the SER at pages 4-42 to 4-43. At those pages, the SER states:

> The staff asked the applicant to provide the CUF value at the FW nozzle blend radius using the maximum Fen value used in the previous analyses. With the maximum Fen value used, the new EAF CUF is 0.893 (this value was verbally provided during the audit), which is greater than the previous value of 0.639 reported by using the Vermont Yankee Green's function application. This indicates that the results of the Green's function application using the specific software could underestimate the CUF, and therefore, cannot be the analysis-of-record. However, the updated analysis, whether using the maximum Fen or appropriate Fen, yields CUFs lower than the Code allowable. The staff concludes that this updated analysis is the analysis-of-record for the FW nozzle.

Thus, Entergy believes that the NRC Staff's Initial Statement of Position should have stated:

> Although the "Confirmatory Analysis" was acceptable to the Staff, and the CUF for the feedwater nozzle was less than 1.0, the CUF produced by the "Confirmatory Analysis" was greater than that produced by the September 2007 analysis and therefore ***the prior refined analyses were*** not bounding.

To resolve this confusion, Entergy requests that the following additional questions be asked to Mr. Fair:

1. Mr. Fair, you were asked about the following statement in the NRC Staff's Position Statement:

> Although the "Confirmatory Analysis" was acceptable to the Staff, and the CUF for the feedwater nozzle was less than 1.0, the CUF produced by the "Confirmatory Analysis" was greater than that produced by the September 2007 analysis and therefore not bounding.

Isn't it true that if the Confirmatory Analysis produced a CUF **greater than** that obtained in the prior Refined Analysis, the Confirmatory Analysis would be more conservative and therefore bounding?

~~2. Do you agree that the Confirmatory Analysis is a valid and conservative analysis of the feedwater nozzle?~~

2 3. Do you also agree that since the Confirmatory Analysis shows that the CUFen for the feedwater nozzle will be below one, it is reasonable to conclude that the CUFen for both the core spray nozzle and recirculation outlet nozzle will also be below 1?

3 4. Therefore, are we correct that your position is still as stated in A6 of your testimony:

> Nevertheless, since the FW nozzle bounds the CUF for these two nozzles, it is reasonable to believe that these two components' locations will not reach the limit of 1.0 as well when the analysis is completed and therefore the Staff has reasonable assurance that CUFs for key components will not reach unity during the PEO.

Entergy's Proposed Follow-Up Questions on Contention 4

I. Questions for NRC Staff Witnesses:

1. Dr. Hsu, you testified that the GALL Report defines FAC. Is the definition to which you were referring the one on page IX-30 of the GALL Report (NUREG-1801, Rev. 1, Vol. II) as follows?

Flow-accelerated corrosion (FAC)	Also termed erosion-corrosion. A co-joint activity involving corrosion and erosion in the presence of a moving corrosive fluid, leading to the accelerated loss of material. Susceptibility may be determined using the review process outlined in Section 4.2 of NSAC-202L-R2 recommendations for an effective FAC program. [22]

2. Is there a separate definition of "erosion" on page IX-29 of the GALL Report?

3. Am I correct that the definition of "erosion" is:

> Progressive loss of material from a solid surface due to mechanical interaction between that surface and a fluid, a multicomponent fluid, or solid particles carried with the fluid.

4. Am I correct that the license renewal process requires an applicant, as a general matter, to (1) identify structures and components within the scope of the license renewal rules that need to be managed for aging; (2) identify the materials and environments for each (3) determine what aging effects are applicable to each; and (4) then establish aging management programs to address such effects?

5. So if a license renewal application identifies that loss of material due to "erosion" is an aging effect is applicable to some structure or component, the application would have to identify an aging management program to manage that effect?

6. And that program would be different from the FAC program?

II. Questions for Entergy Witnesses

1. Dr. Horowitz, we heard that CHECWORKS is not used to establish inspections for piping less than 2 inches in diameter. Does NSAC-202L provide inspection recommendations for piping less than 2 inches in diameter?

2. Mr. Fitzpatrick – you were questioned about certain condition reports relating to FAC program at Vermont Yankee and indicated that there was a resource issue. Did you ever write any condition reports to identify this issue?

3. Do you believe that effective corrective action has been taken to address this issue?

4. What was that corrective action?

Staff

Entergy: What modifications did you make to the steam dryer prior to EPU?

COPY

STAFF

Questions for staff

During your testimony it was stated that the GLB will continue through the period of extended operation. How do you know this?

Does the GALL program distinguish between mechanical and chemical corrosion?

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of	)	
	)	
ENTERGY NUCLEAR VERMONT YANKEE, LLC,	)	
	)	
and	)	
	)	
ENTERGY NUCLEAR OPERATIONS, INC.	)	Docket No. 50-271-LR
	)	
(Vermont Yankee Nuclear Power Station)	)	

CERTIFICATE OF SERVICE

I hereby certify that copies of the foregoing LB MEMORANDUM (SUBMISSION OF PROPOSED QUESTIONS INTO THE OFFICIAL RECORD) have been served upon the following persons by U.S. mail, first class, or through NRC internal distribution.

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LB MEMORANDUM (SUBMISSION OF PROPOSED QUESTIONS
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[Original signed by Nancy Greathead]

Office of the Secretary of the Commission

Dated at Rockville, Maryland,
this 3rd day of December 2008