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OFFICE OF SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

UNITED STATES
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 ENTERY NUCLEAR OPERATIONS, INC.)	ASLB No.06-849-03-LR
Vermont Yankee Nuclear Power Station)	
License Renewal Application	

NEW ENGLAND COALITION, INC.'S REPLY TO ENTERGY AND NRC STAFF ANSWERS TO PETITION FOR LEAVE TO INTERVENE, REQUEST FOR HEARING, AND CONTENTIONS

Entergy and the NRC Staff argue that New England Coalition, Inc.'s (NEC) Contentions 3-6 are inadmissible for failure to state a factual basis demonstrating a material dispute with the Application. Entergy objects to admission of Contention 1 and 2 on these same grounds, and also argues that Contention 1 is barred by the Clean Water Act, and constitutes an inadmissible challenge to NRC's license renewal rules. The NRC Staff does not object to the admission of Contentions 1 and 2, with certain limitations to scope.

NRC rules governing NEC's Petition to Intervene are intended to ensure that "full adjudicatory hearings are triggered only by those able to proffer at least some *minimal factual and legal foundation* in support of their contentions." *Duke Energy Corp. (Oconee Nuclear Station, Units 1, 2, and 3),* 49 N.R.C. 328, 334 (1999)(emphasis added). An intervenor is not required to prove its case at the contention filing stage: "the factual support necessary to

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show that a genuine dispute exists need not be . . . of the quality as that is necessary to withstand a summary disposition motion." Statement of Policy on Conduct of Adjudicatory Proceedings, 48 N.R.C. 18, 22 n.1 (1998), *citing, Rules of Practice for Domestic Licensing Proceedings – Procedural Changes in the Hearing Process*, Final Rule, 54 F.R. 33168, 33171 (Aug. 11, 1989). A petitioner is only required to make "a minimal showing that the material facts are in dispute, thereby demonstrating that an inquiry in depth is appropriate." *In Gulf State Utilities Co.*, 40 N.R.C. 43, 51 (1994), *citing, Rules of Practice for Domestic Licensing Proceedings – Procedural Changes in the Hearing Process*, Final Rule, 54 F.R. 33168, 33171 (Aug. 11, 1989).

I. ENVIRONMENTAL CONTENTION

A. Contention 1: Entergy Failed to Assess Impacts to Water Quality.

NRC Staff does not object to admission of NEC's Water Quality/NEPA contention. Entergy does. Both, however, make the mistaken assertion that Entergy's NPDES permit – an expired permit that, if renewed, may not be renewed under the same terms and would expire before any license renewal issues --- is somehow dispositive of whether Entergy meets its NEPA obligation of assessing the cumulative impacts of its dramatically increased thermal discharge during the 20-year period starting in 2012. Indeed, the thermal discharge will be a plume hot enough to raise the temperature of the Connecticut River, at least 1.4-miles downstream of the discharge pipe, by up to *five* degrees between May 16 and October 14 of any year (and by as much

as 13.4° F between October 15 and May 15) until 2032. Entergy fails to specify the full stretch that will be heated, but common sense dictates that heat five degrees above ambient 1.4 miles downstream of the VY discharge means that a much longer stretch of the River will be unnaturally heated .[1]

Both also mistakenly assert that NEC's contention is somehow vague because NEC should have effectively performed the work required of Entergy and the NRC in compiling an EIS. It is very well settled that it is the NRC's obligation to prepare a proper EIS and that NEC need only raise a reasonable issue. NEC has done so.

1. Entergy and Staff Reliance on an NPDES Permit is Misplaced.

Ironically, just the opposite of Entergy's argument that NEC's contention is "barred by the Clean Water Act" is true. *See* Entergy Answer at 11. In fact, renewal of Entergy's license is presently barred by the Clean Water Act (CWA). Any federal license for "any activity . . . which may result in any discharge" requires State water quality certification under the CWA. 33 U.S.C. § 1341(a), CWA § 401. A federal agency is barred from issuing a license in the absence of a § 401 Certification. 33 U.S.C. § 1341(a). Entergy has neither applied for, nor received a CWA § 401 Certification. Until and unless that happens, the NRC cannot renew Entergy's license. *Id.*; *S.D. Warren v. State of Maine*, 547 U.S. ___, 126 S.Ct. 1843, 1846 (2006); *Alabama Rivers v. FERC*,

[1] Monitoring station 3 is located1.4 miles downstream from the discharge. Entergy provides no information or much less an assessment of whether the thermal plume extends beyond that station and into Massachusetts and any resulting impacts.

325 F.3d 290, 293 (D.C. Cir. 2003). *See also* *In the Matter of Sequoyah Fuels Corp.*, *38* N.R.C. 304, ___, 1993 NRC LEXIS 55 at *40-*46.

Entergy, and to a lesser extent NRC staff, appear to argue that the recently issued NPDES permit is dispositive of whether the application contains an appropriate assessment of the license renewal's water quality impacts. NRC Staff Answer at 8 ("The Environmental Report . . . did not include the discharge permit that authorizes the one degree increase" to a significant portion of the Connection River); Entergy Answer at 15 ("The NPDES permit for the VYNPS and the supporting documentation . . . provide such an assessment).

Entergy and Staff are flat wrong for several reasons. First, the Entergy's amended NPDES permit expired on March 31, 2006. *See* Entergy Answer, Attachment 2, Amended Discharge Permit (3/30/06). Entergy's discharge is authorized solely pursuant to Vermont's Administrative Procedure Act that allows an expired license to remain effective if a timely application for renewal was filed prior to expiration. 3 Vt. Stat. Ann. § 814(b). No current discharge permit has issued.

Second, assuming the maximum five-year duration of an NPDES permit, 33 U.S.C. § 1342(b)(1)(B); 10 Vt. Stat. Ann. 1263(d)(4), any new license would expire prior to 2012 when Entergy's current NRC license expires. Such a discharge permit obviously would not permit any discharge during a renewed license term commencing in 2012 (or later).

Third, the March 30, 2006 permit amendments (that continue in effect) require extensive monitoring and monitoring studies to determine whether there will be any long-term adverse affect of the significantly increased thermal discharge. Entergy Answer, Attachment 2, Permit at Part IV, at 22. "The environmental monitoring and studies specified in Part IV are intended to assure that the discharges authorized by this permit do not violate applicable Vermont Water Quality Standards and are not adverse to fish and other wildlife that inhabit the Connecticut River in or around the vicinity of Vernon." *Id* at 19. To claim that this (expired) permit that requires further studies provides the requisite NEPA assessment of cumulative water quality impacts that will occur between 2012 and 2032 is, to say the least, silly.

The need for these studies only underscores Entergy's failure to provide a sufficient assessment of its discharge's impacts. Huge amounts -- 800 cubic feet per second -- of up to 100 degree F water will be discharged that will heat a large, undefined (but over 1.4-mile) stretch of the Connecticut River by up to 5 degrees, 1.4 miles downstream of the discharge, from May 16 to October of any year (and by as much as 13.4° F between October 15 and May 15). Amended Permit at 4-5, ¶ c. Significant portions of the Vernon Pool will be heated by several degrees. If such monitoring shows this discharge's incompatibility with water quality criteria or designated uses, the discharge permit may not be renewed, or if renewed, renewed with significantly different conditions. Therefore, this permit does not and cannot

fully assess the impacts of Vermont Yankee's increased thermal discharge: it does not address cumulative impacts, nor does it address impacts into and through the proposed renewed license's twenty-year duration.

Fourth, any determination of whether a federally permitted activity complies with water quality standards must be made pursuant to CWA § 401, 33 U.S.C. § 1341. Indeed, that is § 401's exact purpose. *See* S.D. Warren, 126 S.Ct. at 1846.[2] And, as mentioned above, Entergy has not applied for a § 401 Certification.

The Staff may argue that the NPDES permit is functionally equivalent to a § 401 Certification. *See Sequoyah Fuels Corp.*, *38* N.R.C. at ___, 1993 NRC LEXIS 55 at *42. However, the NPDES permit is not functionally equivalent to a § 401 Certification for all of the above reasons, and particularly for the reasons that: (1) the NPDES permit has expired, (2) any new permit must be based on studies that have not yet occurred, and (3) any new permit will expire prior to 2012 and have no bearing on the relicensing period or the discharge's cumulative impacts. Simply put, the expired permit has no bearing on discharges from 2012 to 2032 and wholly fails to discharge either Entergy's or the NRC's NEPA obligations.

Fifth, the NPDES permit amendments allowing a greater thermal discharge are not final. They are under appeal, and a stay has been requested. Therefore it does not provide the authority purported by Entergy.

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[2] *See also* 18 C.F.R. 4.38(f)(7)(FERC rules requiring 401 certification or proof of the request for certification as part of application for FERC license.

2. Entergy and Staff Fundamentally Miscomprehend NEPA and NRC Rules Implementing NEPA.

Entergy effectively argues that because NEC failed to perform the analysis actually required by NEPA, it does not show a genuine dispute as required by 10 C.F.R. § 2.309(f)(2)(iv). Staff, while agreeing that NEC's contention should be adopted, notes that NEC "questions whether the impact of a one degree increase has been assessed and wants further study on the American shad's life cycle, but [NEC] does not provide information that disputes Entergy's conclusion that the Impact would be SMALL."

Entergy's claim of a "SMALL" impact has no foundation. NEC, through its expert, Dr. Ross Jones, provided unambiguous information that Entergy's conclusion is unfounded because it failed to perform the minimum studies requisite to such a determination. Further, Dr. Jones cites the specific literature and studies backing his opinions' validity.

And, it is fundamental that NEC need not provide the information, but only raise a substantial question as to whether a project *may* have a significant effect:

> An EIS must be prepared if 'substantial questions are raised as to whether a project . . . may cause significant degradation of some human environmental factor.'" *Idaho Sporting Cong. v. Thomas*, 137 F.3d 1146, 1149 (9th Cir. 1998) (quoting *Greenpeace Action v. Franklin*, 14 F.3d 1324, 1332 (9th Cir. 1992)). "To trigger this requirement a 'plaintiff need not show that significant effects will in fact occur,' [but] raising 'substantial questions whether a project *may* have

> a significant effect' is sufficient." *Id.* at 1150 (quoting *Greenpeace*, 14 F.3d at 1332).

Ocean Advocates v. United States Army Corps of Eng'rs, 402 F.3d 846, 864-865 (9th Cir. 2005) (emphasis in original). In requiring "'proof' that the challenged federal project will have particular environmental effects, we would in essence be requiring that the plaintiff conduct the same environmental investigation that he seeks in his suit to compel the agency to undertake [under NEPA]." *Citizens for Better Forestry*, 341 F.3d 961, 972 (9th Cir. 2003) (quoting *City of Davis v. Coleman*, 521 F.2d 661, 670-71 (9th Cir. 1975)).

NRC requirements for raising a NEPA contention are entirely consistent with NEPA case law. All that is needed is "a minimal showing that the material facts are in dispute, thereby demonstrating that an inquiry in depth is appropriate." *In Gulf States Utilities Co.*, 40 NRC 43, 51 (1994), *citing, Rules of Practice for Domestic Licensing Proceedings – Procedural Changes in the Hearing Process*, Final Rule, 54 F.R. 33168, 33171 (Aug. 11, 1989); 10 C.F.R. § 2.309(f)(v) (only a "concise" statement of fact or expert opinion is required). Likewise, NRC NEPA implementation rules place the burden of assessing the environmental effects of any license renewal squarely on the applicant. 10 C.F.R. §51.53(c)(2) & (3). *See also* 10 C.F.R. §51.71(d) (detailing NRC's obligations in preparing DEIS).

Further, Dr. Jones' Declaration squarely addresses all of Entergy's claims. First, Entergy asserts that NEC does not "show that a genuine dispute exists with the applicant/licensee on a material issue of law or fact" as required by 10 C.F.R. § 2.309(f)(2)(vi). Entergy answer at 17. Dr. Jones' assertion is not based on "mere speculation" or "conclusory assertions," but is based on the best current scientific information on the adverse effects of increasing water temperature on American shad physiology and behavior and supported by citations to the most recent and relevant peer-reviewed literature. It is also based on the fact (as documented in Entergy's own 2004 Demonstration Report) that the relevant water temperature is not just the 1° to 5° F increase at Station 3 (compared to Station 7), but the 80-100° F water that Entergy will discharge during the summer months, significantly heating the River downstream. Demonstration Report (April 2004) at p.11.

In other words, the actual temperature of the discharged water is much greater than the 1°F over ambient that Entergy refers to. The 80 to 100 degree water heats the Connecticut River 1 to 5 degrees above ambient from May 16 to October 14, at least 1.4 mile point downstream from the discharge.

Entergy also asserts that Dr. Jones' assertions are "contradicted by the plethora of information and studies concerning the thermal discharge on which the VANR relied in issuing the amended discharge permit." *Id.* at 17. However, the permit, on its face, demonstrates that VANR does not have

sufficient information because it requires significant further study for the expired permit to be renewed. Certainly, it does not (and cannot) endorse the propriety of Entergy's discharge for the 20 years commencing in 2012.

Further, the "plethora of information and studies" that Entergy refers to is almost exclusively limited to fish counts collected over several years, which do show a decline in the American shad population. They do not cite to nor use any of the recent scientific studies of the adverse effects of temperature increase on American shad. They have not done (nor do they cite) any studies on how their thermal discharge effects the physiology and behavior of individual fish that come into contact with the increased water temperature.

Entergy also argues that:

> The only instances of demonstrated adverse temperature effects on shad population cited by Dr. Jones are those of "temperature shock" caused by rapid temperature increases of nine degrees (68° to 77° F) or eighteen degrees (68° to 86° F). Jones Decl. ¶ 10. Such temperature increases are not allowed under the NPDES Permit. Under the NPDES Permit, when the ambient river temperature is 63° F or greater, the maximum water temperature increase above ambient from VYNPS discharge is limited to 3° F. See Final Amended Discharge Permit at 4-5. Thus, Dr. Jones' references to rapid 9 and 18 degree increases are irrelevant and establish no genuine material dispute.

Entergy Answer at 18.

However, Entergy is referring only to the increase in temperature at Station 3 (compared to Station 7) and not to the actual temperature (and temperature increase) that American shad (or other fish) will experience in the discharge pipe's vicinity in lower Vernon Pool. Adult shad migrating upstream (or spawning) and juvenile shad feeding (and migrating downstream) in lower Vernon Pool, near the discharge pipe will experience much greater than 3°F increases in temperature. For example, by their own admission, Vermont Yankee's discharge (during open cycle cooling) is somewhere between 80 - 100° F during the summer months. If water of this temperature is discharged when the ambient water temperature is 63°F, then the increase in water temperature, adjacent to the discharge point, will be between 17-37° F. The water will then cool as it moves away from the discharge pipe and mix with ambient river water. However, by Entergy's own admission, the water can still be up to 5°F over ambient 1.4 miles downstream (at Station 3) (Entergy Answer at Attachment B, NPDES Permit at 4, ¶ b). The relevant temperature for American shad in lower Vernon Pool (and the fish ladder at Vernon dam) is the actual water temperate that they experience near the discharge point -- not just the temperature at Station 3.

The Staff comments (even though they agree that the contention should be admitted) are likewise without merit. Staff asserts that NEC "... does not squarely address why the impacts of the one degree increase would significantly differ from impacts under the prior discharge permit." As stated

above, (1) the permit is irrelevant, and (2) it is not NEC's task to draft the EIS. NEC met its burden by raising the substantial issue that Entergy failed to assess thermal discharge impacts.

Further, it is not, as Staff asserts, a one degree increase --- the amount of and temperature of the actual discharge must also be considered. By Entergy's own admission (2004 Demonstration Report, page 11), the discharge temperature is at least 80-90 degrees F. and sometimes up to 100 degrees F. during the summer months with a maximum discharge rate of over 800 cubic feet per second with the significant above-described heating of a lengthy stretch of the River.

The relevant fact is how much more hot water Entergy may be allowed to discharge to allow the Station 3 temperature to increase by another 1 to 5 degrees F from May 16 to October 14 and by even more at other times of the year. Entergy does not answer that question, but clearly, it is a lot of hot water (800 cfs) that will significantly heat an unspecified (but over 1.4-mile segment) of the Connecticut River.

It is also worth noting that Entergy and others have documented a LARGE decline in American shad that began after their last thermal discharge increase (not the SMALL impact that they state), but do not assess the discharge's role. Since their past thermal discharge is correlated with a LARGE effect (the decrease in shad population) it is reasonable to conclude that a further increase may cause an even greater decline. At the very least,

studies of the effects of the thermal plume (the 80 - 100 degree F water that is discharged) AND the overall increase in temperature in Vernon Pool and downstream on shad physiology and behavior needs to be studied BEFORE anyone knows if they are having a SMALL or LARGE impact.

Staff also asserts that NEC provides only speculation, and no studies of its own, about possible other causes of this decline or to dispute Entergy's conclusion that the impact would be "SMALL." Again, Dr. Jones demonstrates that the conclusion of a "SMALL" impact is unfounded and the studies are the agency's obligation – not NEC's. Further, all the studies cited by Dr. Jones predict LARGE impacts of a 80-100 degree F discharge (and an overall increase in river temperature) on American shad physiology and behavior that can cause increased mortality. For example, juvenile shad begin downstream migration when water temperature drops to about 66 degrees F. However, if these juvenile shad then come into contact with 80-100 degree F discharge, their downstream migration is disrupted. Entergy wholly fails to address this basic issue.

3. Entergy's Other Arguments Are Wholly Without Merit.

Entergy raises a host of other minor arguments that NRC Staff does not raise. First, Entergy argues that NEC is challenging an NRC Rule, 10 C.F.R. § 51.53(c)(ii)(B). Entergy Answer at 12. This rule requires Entergy to provide appropriate state CWA authorization or alternatively, an appropriate assessment of heat shock and impingement. As explained above, Entergy has

done neither. Pointing out Entergy's failures does not amount to a rule challenge.

Entergy also argues that the CWA precludes NEPA review from looking beyond an NPDES permit. Entergy Answer at 12-13 (citing 33 U.S.C. § 1371(c)(2). Entergy misreads this provision. It only states that NEPA shall not be deemed to authorize federal agencies to review a state's water quality standards (effluent limitations) established under the CWA or the adequacy of a § 401 water quality certification. *Id. See also S.D. Warren*, 547 U.S. at ___, 126 S.Ct. at 1852, n.8. Requiring an adequate assessment is not a challenge to Vermont's Water Quality standards or the effluent limitations they establish. Further, even if 33 U.S.C. § 1371 applies to particular permits (which it does not), there is no permit establishing effluent limitations for the license renewal period. And, as explained above, Entergy does not have a § 401 Certification the adequacy of which can be challenged. If anything, Entergy's argument underscores the need for a § 401 Certification. Entergy's reliance on this provision of the CWA is wholly misplaced.

Entergy also makes the astonishing argument that water quality impacts are not material to its license renewal. Entergy Answer at 11. The license, if renewed as Entergy requests, will allow much hotter water to be discharged into the Connecticut River for an additional twenty years. Hence, Entergy includes an Environmental Report (albeit inadequate) of this impact

in its license renewal application. It is part of Entergy's application and particular to this plant and Entergy itself concedes that it is a Category 2 issue here. Indeed, Entergy seeks to discharge hotter water for a longer period of time than currently allowed into a unique environment. This Contention arises from Entergy's Environmental Report (included as part of its license renewal application) and is material to this proceeding.

NEC relies on its initial contentions in response to any other argument made by Entergy.

II. SAFETY/AGING MANAGEMENT CONTENTIONS

A. Contention 2: Entergy's License Renewal Application Does Not Include A Plan to Manage Aging Due to Metal Fatigue During the Period of Extended Operation.

Contention 2 states that data describing the impact of environmentally assisted metal fatigue, stated in Table 4.3-3 of Entergy's License Renewal Application, indicate that a number of reactor components will crack during the period of extended plant operation. Such cracking may result in safety hazards including pipe ruptures, component malfunctions, and migration of loose pieces of metal through the reactor system. Entergy's aging management plan to address this problem, stated at page 4.3-7 of the License Renewal Application, is vague, incomplete and lacking in transparency. Specifically, (1) NEC is unable to evaluate Entergy's proposal to "refine" its analyses to lower predicted CUFs to less than one, as the license renewal application does not explain how Entergy calculated CUFs, or how it proposes

to adjust its analysis; and (2) the proposed management plan fails to specify a monitoring program and inspection schedule.

NEC responds in turn to Entergy and the NRC Staff Answers to Contention 2, and submits the Second Declaration of Dr. Joram Hopenfeld, Exhibit 1, ¶¶ 5-10, to point out technical mistakes made in Entergy's Answer.

1. Reply to Entergy

Entergy argues that Contention 2 is inadmissible for failure to state a factual basis demonstrating a material dispute with the Application. Regarding its proposed "refinement" of CUF analysis, Entergy cites NRC guidance providing that "more rigorous analysis of a component" to show that the CUF will not exceed unity is an acceptable option for managing aging effects of environmentally assisted fatigue, and argues that reanalysis is appropriate because some studies suggest that existing fatigue analyses are excessively conservative. Regarding its failure to specify a monitoring program or inspection schedule, Entergy states that it has elected to postpone development of a monitoring and inspection program pending year-end revisions to the ASME Appendix that addresses flaw tolerance evaluation methods. Finally, Entergy argues that Contention 2 does not raise a significant safety concern for two reasons: (1) CUFs in excess of 1, reported in Table 4.3-3, do not really indicate that components will crack or fail, because these analyses are "conservative"; and (2) the NRC's decision not to issue a

generic rule addressing environmentally assisted fatigue proves that failure of components described in Table 4.3-3 will not create unsafe conditions.

Entergy, however, does not address the failure of its License Renewal Application to explain how CUFs were calculated or adjusted for environmentally assisted fatigue, why refinement of this analysis might be appropriate, or how it proposes to refine this analysis. Entergy's claim that its CUF calculations are excessively "conservative" is unsupported and conclusory. Entergy fails to quantify the degree of "conservatism" or provide analyses (technical justification) to demonstrate that allegedly "conservative" CUFs published in the License Renewal Application are authentic, especially for projected 20-year service under EPU conditions. Without this, no one – NRC, ASLB, intervenor, or licensee – can determine what realistic or actual CUFs may be. For this same reason, Entergy's citation to a Sandia study addressing conservatisms in some fatigue analyses is unilluminating. NEC does not and cannot evaluate the relationship of this study to Entergy's undisclosed methods. In short, Entergy's proposal to manage environmentally assisted fatigue through reanalysis of CUFs is impermissibly vague and lacking in transparency.

Entergy's alleged decision to postpone development of a monitoring program and inspection schedule to manage problem components identified in Table 4.3-3 pending revisions to an ASME Appendix indicates, if anything, that Entergy's application is premature. Entergy employed a similar

strategy in the Vermont Yankee EPU proceeding, providing information in piece meal fashion over a period of more than two years. Such practices confuse the process, obscure the issues, and impede public participation. They should not be condoned.

Finally, Entergy has not demonstrated that failure of components described in Table 4.3-3 would not create unsafe conditions. As stated above, Entergy's claim that components with reported CUFs over 1 probably will not actually crack or fail because CUF analyses are "conservative" is entirely without support in the Application. Nor does the NRC's decision not to address environmentally assisted fatigue on a generic basis demonstrate that failure of components described in Table 4.3-3 would not create unsafe conditions under Vermont Yankee's specific circumstances. The GSI-190 study to which Entergy refers scoped generically the effects of fatigue on selected components on core damage frequency, but "did not address all aspects of fatigue related degradation." NRC Memorandum from Thadani, A., Director, Office of Nuclear Regulatory Research, to W. Travers, Executive Director of Operations, Attachment 1, Resolution of GSI-190, "Fatigue Evaluation of Metal Components for 60-Year Plant Life", Adams Accession No. ML031480383. Entergy has not shown that the wall thickness and the CUFs of the components considered in the GSI-190 study are the same or similar to those of components described in Table 4.3-3. Entergy's reliance on this study is therefore unfounded.

Standard engineering practice is that, when the CUF exceeds unity, the risk of component failure and resulting unsafe conditions must be considered and appropriately mitigated. Entergy has not done so.

2. Reply to NRC Staff

The NRC Staff does not oppose the admission of Contention 2, provided that it is limited to the following bases: "whether Entergy has provided information on how CUF values are calculated and whether Entergy's aging management plan includes a monitoring plan with an inspection schedule and criteria for the inspection frequency." NRC Staff Answer at 12. The NRC Staff also states that Contention 2 is supported by only a thin basis in that NEC does not provide any substantive information regarding why Entergy's program is inadequate other than to identify omissions from the application.

If the Staff is suggesting that Contention 2 is only marginally admissible because NEC does not address the substance of Entergy's aging management plan, then the Staff puts NEC in quite a "Catch 22" situation – *i.e.* NEC's contention is insufficiently supported because NEC fails to address specifics of Entergy's aging management plan that Entergy has not provided, and apparently has not developed. This is not a reasonable interpretation of NRC rules governing NEC's petition to intervene.

In summary, NUREG-1800 Section 4.3.2.2 requires that "the applicant's consideration of the effects of coolant environment on component

fatigue life for license renewal is an area of review." Entergy must demonstrate that:

> (i) the TLAA remains valid for the period of extended operation,
>
> (ii) the TLAA can be projected to the end of the period of extended operation, or
>
> (iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

10 C.F.R. § 54.21(c)(1). The CUFs of several reactor components described in Table 4.3-3 exceed unity and Entergy has not demonstrated an adequate program to manage aging of these components.

NEC's Contention 2 makes "a minimal showing that the material facts are in dispute" and that "an inquiry in depth is appropriate." *In Gulf State Utilities Co., Supra.* Contention 2 should be admitted.

B. Contention 3: Entergy's License Renewal Application Does Not Include an Adequate Plan to Monitor and Manage Aging of the Steam Dryer During the Period of Extended Operation.

Contention 3 states that Entergy's License Renewal Application does not describe an adequate plan to manage aging of the steam dryer during the period of extended operation, for the reason that Entergy's proposed program relies on the use of computer models subject to large uncertainties, and does not provide for "hands on" measurement of crack propagation and growth.

NEC responds in turn to Entergy and the NRC Staff Answers to Contention 3, and submits the Second Declaration of Dr. Joram Hopenfeld, Exhibit 1, ¶¶ 12-15, to clarify a number of technical issues.

1. Reply to Entergy

First, it is important to note that the Vermont Department of Public Service has recently asked the Public Service Board to investigate the steam dryer's integrity. Its basis is stated in the attached pleading filed before Vermont's Public Service Board. Exhibit 1, Attachment A. Vermont's nuclear engineer believes that there is sufficient reason to believe that the steam dryer could soon fail.

Entergy argues that Contention 3 is not supported by a factual basis demonstrating a material dispute with the application for the reason that, as part of its application for extended power uprate (EPU) at Vermont Yankee, Entergy addressed uncertainties inherent in the Computational and Fluid Dynamic Model and Acoustic Circuit Model by development of a more involved program to monitor the steam dryer during the remaining six years of its current license term.

Entergy's program to monitor its steam dryer during the remaining six years of its current license term, developed in the EPU proceedings, does not address NEC's concern that Entergy has not developed an adequate program to monitor aging of the steam drying during the additional twenty years of its requested second license term. Management of aging pursuant to NUREG 1800 and 10 C.F.R. § 54.21(a)(3) was not a consideration with respect to the EPU. The ASLB should not accept Entergy's apparent assertion that the EPU proceedings established the technical basis for life extension.

Entergy's EPU steam dryer program consists of monitoring during the ascension to full uprate power; operational surveillance and visual inspection during three scheduled refueling outages, and through completion of one full operating cycle at EPU; and continued operational surveillance and visual inspection for a second full operating cycle until the visual inspection standard of no new flaws/ flaw growth based on visual inspection is satisfied. Entergy Answer at 29, citing Safety Evaluation by the Office of Nuclear Reactor Regulation Related to Amendment No. 229 to Facility Operating License No. DPR-28 Entergy Nuclear Vermont Yankee, LLC and Entergy Nuclear Operations, Inc. Vermont Yankee Nuclear Power Station Docket No. 50-271 (Mar. 2006), ML600500280 at 49.

The duration of this program is finite – Entergy will apparently suspend "operational surveillance and visual inspection" once the "visual standard of no new flaws/flaw growth based on visual inspection is satisfied during a full operating cycle." *Id.* Entergy's license renewal application does not incorporate or extend this or any other program, and Entergy has not committed to the continuation of "operational surveillance and visual inspection" over the full twenty year period of extended operation.

NEC's Contention 3 questions the validity of the Computational Fluid Dynamic Model, and Acoustic Circuit Model for use as aging management tool. The documents Entergy cites in its Answer confirm NEC's concern. Specifically:

> Entergy has performed hydrodynamic, acoustic and structural resonance analyses to assess the potential for stimulation of a resonant mode of the dryer. These analyses indicate that there is a margin between the magnitude of the potential stresses imposed on the steam dryer and the level at which fatigue failure would occur. However, <u>the state of validation of these methods is poor</u>.

Entergy Answer at 27, quoting Letter from G. Wallis, ACRS, to N. Diaz, Chairman, NRC (Jan. 4, 2006), ML60040431 (emphasis added); *See Also*, Entergy Answer at 29, Safety Evaluation by the Office of Nuclear Reactor Regulation Related to Amendment No. 229 to Facility Operating License No. DPR-28 Entergy Nuclear Vermont Yankee, LLC and Entergy Nuclear Operations, Inc. Vermont Yankee Nuclear Power Station Docket No. 50-271 (Mar. 2006), Adams Accession No. ML0600500280 at 49 ("[S]ignificant uncertainty exists regarding the licensee's method for calculating specific stress values on the VYNPS steam dryer from its CFD and ACM analyses. . . .").

Indeed, Entergy's inability to predict dryer failure was plainly illustrated during Vermont Yankee's ascension to 120% power when the measured limiting curve was exceeded three times. *See*, Exhibit 1, Attachment A, testimony of William K. Sherman, Vermont State Nuclear Engineer (June 21, 2006).

2. <u>Reply to NRC Staff</u>

NRC Staff argue that Contention 3 is not supported by a factual basis demonstrating a material dispute with the application on the grounds that

NEC expert, Dr. Joram Hopenfeld's, criticisms of the Computational and Fluid Dynamic Model and the Acoustic Circuit Model are conclusory, and NEC does not provide information demonstrating that Entergy's monitoring techniques are not based on actual measurements.

As stated above and in Dr. Joram Hopenfeld's Declaration in Support of NEC's Petition to Intervene, Dr. Hopenfeld's criticism of the Computational and Fluid Dynamic Model and the Acoustic Circuit Model is not conclusory. Dr. Hopenfeld draws from his 45 years relevant experience as a mechanical engineer in industry and government. The ACRS and the NRC Office of Nuclear Reactor Regulation concur in his conclusions. Dr. Hopenfeld also bases his conclusions on his in-depth review of Entergy's test documentation produced in the Vermont Yankee EPU proceedings and in Entergy's EPU License Application, and on the NRC Staff EPU Safety Evaluation Report, as well as the instant Application. With respect to the instant application, Dr. Hopenfeld has so stated in his Declaration. In sum, he raises a material issue through his expertise. The standard for an admissible contention is thus met.

Regarding the NRC Staff's second concern, NEC's Contention 3 addresses Entergy's program to manage aging of the steam dryer during the period of extended operation as it is described in Entergy's application for license renewal. As described in the application, this program does not include monitoring techniques based on actual measurements.

At the very least, NEC's Contention 3 makes "a minimal showing" that material facts regarding the nature and adequacy of Entergy's proposed program to manage the Vermont Yankee steam dryer during the period of extended operation are in dispute, and that "an inquiry in depth is appropriate." *See, In Gulf State Utilities Co., Supra.* Contention 3 should be admitted.

C. Contention 4: Entergy's License Renewal Application Does Not Include an Adequate Plan to Monitor and Manage Aging of Plant Piping Due to Flow-Accelerated Corrosion During the Period of Extended Operation.

Contention 4 states that Entergy's proposed plan to manage flow accelerated corrosion of the plant's piping during the period of extended operation is inadequate because it hinges on use of CHECWORKS. This empirical computer model is not reliable to determine inspection frequency at Vermont Yankee because the EPU changed plant parameters needed to benchmark the model.

NEC responds to Entergy and the NRC Staff's answers in turn, and submits the Second Declaration of Dr. Joram Hopenfeld, Exhibit 1, ¶¶ 17-22 to clarify a number of technical issues.

1. Reply to Entergy

Entergy argues that Contention 4 is vague and unsupported by a factual basis demonstrating a material dispute with the application for the following reasons: (1) NEC does not identify a particular system or

component of concern; (2) information submitted in the Vermont Yankee EPU proceeding states that, in addition to CHECWORKS, Entergy currently inspects for FAC based on actual inspection data, operating experience and engineering judgment; (3) NRC Staff concluded in the EPU proceedings that Entergy has an adequate program to manage FAC during the remainder of its current license term; (4) it is not necessary to benchmark CHECWORKS because the maximum increase in projected wear rates is in proportion to the velocity increase and FAC can be projected on that basis; and (5) Dr. Hopenfeld's statement that it will take 10-15 years to benchmark CHECWORKS to uprate conditions at Vermont Yankee is conclusory.

EPU findings regarding management of FAC during the remaining six years of Vermont Yankee's current license term do not resolve this issue for purposes of the license renewal. FAC is an aging phenomenon; the EPU proceedings assumed that the plant would operate six years, not 26 years at the high EPU velocities. The possibility of undetected wall thinning increases substantially with age. Therefore, it may be necessary to modify the FAC program as a plant ages. Entergy's license renewal application does not explain how it proposes to use CHECWORKS as an aging management tool during the period of extended operation, or how it will overcome the problem of establishing valid trends at higher EPU velocities, as discussed in NEC's Petition to Intervene. Further, NEC takes issue with Entergy's simplistic application of FAC analyses insofar as they have not been shown to

adequately assess the effects of localized disturbances in laminar flow due to intrusive features, such as piping joints, bends, and instrument probes.

Entergy's claim that FAC can be reliably projected at Vermont Yankee under uprate operation based on the fact that the maximum increase in projected wear rates is in proportion to the velocity increase is entirely unsupported. NEC's expert, Dr. Joram Hopenfeld, disputes this assumption. *See,* Exhibit 1, Second Declaration of Dr. Joram Hopenfeld ¶¶ 21,22.

Contention 4 is not impermissibly vague. NEC has identified specific components that may be compromised by FAC – plant piping and valve components. Finally, Dr. Hopenfeld's opinion that it will take 10-15 years to benchmark CHECKWORKS to EPU conditions at Vermont Yankee is not conclusory. Rather, Dr. Hopenfeld bases this statement upon his 45 years experience as a mechanical engineer in industry and government with particular expertise in the areas of thermal hydraulics, corrosion, and nuclear safety, and specifically in the study of FAC.

2. <u>Reply to NRC Staff</u>

The NRC Staff oppose Contention only on the grounds that Dr. Hopenfeld's assertion that 10-15 years of site-specific inspection data is necessary to benchmark CHECWORKS is conclusory and provides an inadequate basis to question the use of CHECWORKS. This issue is addressed in the above discussion of Entergy's Answer.

D. Contention 5: The License Renewal Application Does Not State an Adequate Plan to Manage and Monitor Aging of the Condenser.

Contention 5 states that the license renewal application does not include an adequate plan to monitor and manage aging of the plant condenser, which was poorly constructed initially, and is already significantly degraded by corrosion and stress cracking, such that its integrity to mitigate the leakage of radioactive gases in the event of an accident at Vermont Yankee cannot be assured during the period of extended operation.

NEC responds to Entergy and the NRC Staff's Answers in turn. Entergy submits the Second Declaration of Arnold Gundersen, Exhibit 2, to clarify technical issues.

1. Reply to Entergy

Entergy argues that Contention 5 is unsupported by a factual basis demonstrating a material dispute with the application for the following reasons: (1) NEC's claim that the condenser must remain intact to perform its post-accident function is incorrect; (2) NEC does not explain how the condenser might be damaged in an accident; and (3) the condenser's integrity to perform its post-accident function is continually verified by its ability to support normal plant operation.

Entergy's current claim that condenser integrity is not necessary to the condenser's ability to perform its post-accident function directly conflicts with the License Renewal Application. Regarding this issue, the Application

states that "[c]ondenser integrity required to perform the post-accident intended function (holdup and plateout of MSIV leakage) is continuously confirmed by normal plant operation." NEC disputes the assumption that condenser integrity is confirmed by normal plant operation. Entergy has not, until now, suggested that condenser integrity is unnecessary, and offers no support for this proposition.

NEC's expert, Arnold Gundersen, notes that Entergy's assumption that a condenser that holds vacuum while the plant is operating is certain to perform its accident mitigation function is inconsistent with operating experience at Energy's own facilities. Mr. Gundersen specifically notes an incident at Entergy's Grand Gulf plant, a Boiling Water Reactor like Vermont Yankee, in which the plant condenser imploded while the plant was in operation, causing an emergency shutdown. This supports Mr. Gundersen's contention that an unexpected transient could simultaneously cause both implosion of the condenser and a release of radioactive gas. Mr. Gundersen also cites, as he did in his initial Declaration, the documented opinions of Entergy's own staff and consultants that the Vermont Yankee condenser is significantly degraded, and that an "unusual accident or occurrence" could destroy its integrity. Mr. Gundersen's Second Declaration includes examples of the type of "unusual accident or occurrence" that could both compromise the condenser and trigger a Design Basis event, including a full load rejection, and a broken turbine disk. Thus, condenser integrity to perform

the post-accident function is not necessarily confirmed by normal plant operation, and Entergy's failure to develop an aging management plan for the condenser warrants admission of this contention.

2. Reply to NRC Staff

The NRC Staff argues that Contention 5 lacks an adequately specific basis because NEC should have explained why backpressure on the condenser should be avoided, and does not explain why loss of condenser integrity would prevent the condenser from performing its accident mitigation function. The Staff also note that some components of the Main Condenser and MSIV Leakage Pathway are subject to aging management programs for Flow-Accelerated Corrosion, System Walkdown, Water Chemistry Control – BWR, and Water Chemistry Control – Closed Cooling Water. License Application at Table 3.4.2-1.

License Application Table 3.4.2-1 and note 401 plainly state that the Condenser itself is not subject to any aging management program. The other programs to which the Staff refer do not address NEC's contention that the Condenser itself is significantly degraded, and that its conditions must be monitored and managed during the period of extended operation.

As Mr. Gundersen explains in his Second Declaration, Exhibit 2, it is not NEC's position that backpressure on the condenser should be avoided, but rather that fluctuations in backpressure caused by the plant EPU are likely to stress the condenser, making it all the more important that Entergy

implement a comprehensive program to monitor and manage condenser integrity during any renewed license term.

The Staff argument regarding whether the condenser's integrity is necessary to its post-accident function is addressed above, in NEC's Reply to Entergy.

E. Contention 6: Primary Containment Corrosion Including But Not Limited to the Dry Well.

Contention 6 states that the license renewal application does not include an adequate plan to monitor and manage aging of the primary containment boundary during the period of extended operation, particularly in areas that are difficult to inspect, maintain and repair because of limited access.

Both Entergy and the NRC Staff cite a May 15, 2006 amendment to the License Renewal Application, providing additional information concerning the Vermont Yankee drywell. Letter from T. Sullivan to U.S. Nuclear Regulatory Commission, BVY 06-043, Vermont Yankee Nuclear Power Station, License No. DPR-28 (Docket No. 50-271), License Renewal Application, Amendment No. 2 (May 15, 2006), Adams Accession No. ML06380079.

This supplement to the Entergy application does not alleviate NEC's concerns regarding the condition of the lower drywell shell, and the adequacy of Entergy's plan to monitor and inspect less accessible areas. This

supplement fails to include consideration of historically reported leaks and/or maintenance or operational activities that may have resulted in water or water vapor contact with primary containment metal surfaces (*See,* NEC Petition for Leave to Intervene at 23-24). Entergy does not include aging management plans for gaskets or seals at piping joints, water barriers and/or water containments (such as the spent fuel transfer canal) where leakage may impact the primary containment shell (dry well, torus and associated piping) environment. Entergy does not include consideration of maintenance activities and/or modifications (such as the installation of snubbers to preclude torus lift) that require welding on the torus, dry well shell, and/or associated piping, which may have assisted the initiation of corrosion through reduction of the integrity of coatings, or unrelieved stresses that may have induced stress corrosion and the initiation of ordinary or accelerated corrosion in affected areas. Entergy reports UT thickness testing of transition areas and crevice areas, but provides no details that would enable a reviewer to determine if those UT tests were adequate, what physical phenomena they actually tested, or what assumptions, standards, and quality criteria were applied.

The primary effect of Entergy's Amendment Two with respect to NEC's proposed contention is to underscore and affirm that a material dispute exists with respect to whether or not there is adequate assurance that the primary containment integrity will be maintained beyond 2012.

III. NEC RELIES ON ITS PETITION TO INTERVENE

NEC relies on its initial Contentions in response to any argument not addressed in this Reply, made by either Entergy or NRC Staff.

IV. CONCLUSION

NEC's Contentions 1-6 satisfy requirements of 10 C.F.R. § 2.309(f)(1). NEC's Contentions should be admitted and NEC's Petition to Intervene and Request for Hearing should be granted.

June 29, 2006 New England Coalition

by: For Shems by/ Karen Tyler

Ronald A. Shems
Karen Tyler (on the brief)
SHEMS DUNKIEL KASSEL & SAUNDERS PLLC
For the firm

Attorneys for NEC

EXHIBIT 1

UNITED STATES
NUCLEAR REGULATORY COMMISSION

In the matter of		
ENTERGY NUCLEAR VERMONT YANKEE, LLC	)	No. DPR-28
and ENTERY NUCLEAR OPERATIONS, INC.	)	No. 50-271
Vermont Yankee Nuclear Power Station	)	
License Renewal Application	)	

SECOND DECLARATION OF DR. JORAM HOPENFELD

1. My name is Dr. Joram Hopenfeld. The New England Coalition, Inc. (NEC) has retained me as an expert witness in proceedings concerning the application of Entergy Nuclear Operations, Inc. ("Entergy") to renew its operating license for Vermont Yankee Nuclear Power Station ("Vermont Yankee") for twenty years beyond the current expiration date of March 21, 2012.

2. I am a mechanical engineer and hold a doctorate in mechanical engineering. My curriculum vitae was attached to my first declaration in support of NEC's Petition to Intervene, filed May 26, 2006.

3. I submit the following comments regarding technical issues discussed in Entergy's Answer to New England Coalition's Petition for Leave to Intervene, Request for Hearing, and Contentions, filed June 22, 2006.

CONTENTION TWO

4. Paragraphs 5-10 of this declaration address issues pertaining to NEC's Contention 2: Metal Fatigue.

5. Entergy states that the CUFs in Table 4.3-1 of its application for license renewal do not exceed unity. NEC's concerns, however, relate CUFs adjusted for environmentally assisted fatigue, stated in Table 4.3-3, which do exceed unity. Entergy further notes that the ASME Code does not require inclusion of environmental effects in CUF calculations. The ASME code is silent regarding environmental effects on fatigue because these are specific to a given component and environment. It is the responsibility of the user to account for environmental effects. Recognizing this, NUREG -1800 Section 4.3.2.2 requires that "the applicant's consideration of the effects of coolant environment on component fatigue life for license renewal is an area of review".

6. Entergy states that "[b]ecause of the conservatism in existing fatigue analyses, all that Section 4.3.3 shows is that there are certain components that must be properly managed." Entergy Answer at 23. This statement is entirely without supporting analysis. Entergy's license application does not explain how CUFs were calculated, or specifically how they were adjusted for environmental conditions. Entergy's application indicates that it used generic correction factors to calculate environmentally assisted fatigue. Generic correction factors do not necessarily account for the actual environment, or the surface conditions of a given component at Vermont Yankee. CUFs stated in Table 4.3-3 could therefore be either lower or higher depending on the aggressiveness of the specific local environment at Vermont Yankee and the state of stress and chemical composition of the given component.

7. Entergy states that NEC has not challenged the determination in Section 4.3.1 and 4.3.2 that the design–basis fatigue analysis will remain valid through the extended life of

the plant. Entergy Answer at 21. In fact, NEC's Petition to Intervene notes that the License Renewal Application provides no information about the analytical techniques used to predict the CUF values, and therefore it is not possible to estimate how far the CUFs in Table 4.3-3 deviate from unity. Environmentally adjusted CUFs stated in Table 4.3-3 incorporate uncorrected CUFs stated in Table 4.3-1. NEC's Contention 2 challenges the validity of the entire Entergy analysis.

8. Entergy makes general observations concerning the alleged conservatism of fatigue analysis, citing a 1994 report of Sandia National Laboratories. Entergy Answer at 22. Fatigue life of components subject to cycling loads depends upon crack propagation. In addition to magnitude and frequency of the applied loads, crack propagation depends on the chemistry of the environment at the tip of the crack. Entergy has not shown that the Sandia study bounds the fatigue characteristics of the components described in Table 4.3-3. Instead of relying on general observations, Entergy should reanalyze the components in Table 4.3-3 based on plant-specific conditions, and indicate both reasons why CUFs exceed one, and the magnitude by which they exceed one.

9. Entergy states that the resolution of GSI-190 proves that failure of components described in Table 4.3-3 due to metal fatigue will not damage the reactor core, or create unsafe conditions. Entergy Answer at 23. It is standard engineering practice to operate components only with a CUF of less than unity. When the CUF exceeds unity, as is the case here, the risk of component failure and the potential increase in core damage frequency, CDF, must be considered.

10. The GSI-190 study scoped generically the effects of fatigue of selected components with small leakage on CDF. It concluded that, in most instances, failure of the selected components, did not increase CDF. Entergy has not shown that the wall thickness and the CUFs of the components considered in the GSI-190 study are the same or similar to those of components described in Table 4.3-3. Unless Entergy can demonstrate by analysis that the GSI-190 study applies to the components described in Table 4.3-3, Entergy's statements that these components will not fail catastrophically and will have no effect on the CDF should be disregarded.

CONTENTION THREE

11. Paragraphs 12-15 of this declaration address issues pertaining to NEC's Contention 3: Management of the Steam Dryer.

12. Conclusions regarding the Vermont Yankee steam dryer developed in proceedings concerning the extended power uprate (EPU) at the plant during the remaining six years of its current license term pertain only marginally to consideration of the steam dryer in this relicensure proceeding. Management of aging pursuant to NUREG 1800 is not a factor in the EPU proceeding.

13. Entergy cites an ACRS letter regarding the EPU (ML060040431) to support its claim that it is capable of properly monitoring the fatigue failure of the dryer. Entergy Answer at 27. However, regarding the theoretical methods Entergy uses to predict fatigue failure of the dryer, this ACRS letter states that: "[T]he state of validation of these

methods is poor". NECs Contention 3 concurs with ACRS that Entergy has no valid theoretical method to predict steam dryer fatigue.

14. Entergy cites the ACRS reliance on monitoring and strain measurements during the power ascension program to compensate for the shortcomings of the analytical tools used by Entergy. Entergy Answer at 28. Entergy's monitoring equipment does not measure crack propagation directly (because the strain gages are a distance away from the dryer) and therefore analytical tools would be required to interpret the data. Entergy's inability to predict dryer failure was demonstrated during the accession to 120% power when the measured limiting curve was exceeded three times. The testimony regarding this issue of William K. Sherman, Vermont State Nuclear Engineer, filed with Vermont's Public Service Board in recently initiated proceedings to investigate the reliability of the Vermont Yankee steam dryer under uprate operation, is attached to this declaration (Attachment A).

15. Entergy also discusses its visual inspection program. Entergy Answer at 28. Entergy has not demonstrated that the dryer will not fail and scatter loose parts in between the visual inspections, especially during design basis accidents, DBA.

CONTENTION FOUR

16. Paragraphs 17-22 of this declaration address issues pertaining to NEC's Contention 4: Management of Flow Accelerated Corrosion.

17. Conclusions regarding flow accelerated corrosion during the remaining six years of Vermont Yankee's current license term, reached in the EPU, do not resolve this issue

for purposes of the license extension. FAC is an aging phenomenon; the EPU proceedings were based on the assumption that the plant will operate six years, not 26 years at the high EPU velocities. The possibility of undetected excessive wall thinning increases substantially with aging and therefore time is an important factor in the formulation of an effective FAC program.

18. Unlike the EPU, the license renewal application is reviewed in accordance with NUREG 1800 and NUREG 1801. NUREG 1801 XI.M17 states that the FAC program "relies on implementation of the Electric Power Research Institute (EPRI) guidelines in the Nuclear Safety Analysis Center (NSAC)-202L-R2 for an effective flow-accelerated corrosion (FAC) program. The program includes performing (a) an analysis to determine critical locations, (b) limited baseline inspections to determine the extent of thinning at these locations, and (c) follow-up inspections to confirm the predictions, or repairing or replacing components as necessary." Entergy has not presented a valid program to determine critical locations and inspection frequencies.

19. Entergy states that "neither NEC nor Dr. Hopenfeld knows how CHECWORKS is used in this FAC program." Entergy Answer at 31. I will be the first to admit that I do not know how Entergy uses CHECWORKS, because Entergy's application does not describe how this will be done to overcome the problem of establishing valid trends by the code at the higher EPU velocities, as discussed in NEC's Petition to Intervene.

20. Entergy states that: "Were Dr. Hopenfeld correct in his opinion that it takes 10-15 years of accumulated data before CHECWORKS can be used reliably, every plant that has been using CHECWORKS in the last ten to fifteen years has been in error in doing

so." Entergy Answer at 33. NEC's Petition to Intervene in fact provides a number of references demonstrating that costly and catastrophic accidents from FAC have occurred in the last 15 years. Since CHECWORKS is not based on a mechanistic model, the failure of the code at several plants can be attributed to the difficulty of obtaining sufficient data to establish reliable FAC trends.

21. Entergy states that: "As the testimony before the ACRS indicates, generally the increase in wear is less than the increase in velocity; and typically, from EPU studies, the maximum increase in projected wear rates is in proportion to the velocity increase." Entergy Answer at 34. This statement is entirely unsupported. At the November 2005 NRC meeting in Brattleboro, Vermont, I questioned the validity of this very contention concerning velocity dependence for the following reason. It is commonly accepted that mass transfer phenomena play an important part in the mechanism of FAC. As such, the mass transfer coefficient would control FAC when the process is not controlled by chemical kinetics. At high turbulence, such as flow around bends and in pipe enlargements, the mass transfer coefficient is proportional to the velocity square and not to the velocity. Subsequently, the ACRS also challenged the ENVY contention regarding the low dependence of wear on velocity. Such dependence may be true only in straight, smooth pipe sections.

22. Entergy states that it "will be looking at the highest length locations and the highest velocity locations in the next three outages." Entergy Answer at 35. I strongly disagree with Entergy that evaluation of the highest velocity and the highest length locations would ensure sufficient data by 2012 to benchmark CHECWORKS. It is not

clear at all how the highest length is related to FAC. As already mentioned above, the mass transfer coefficient is not only a function of velocity, but also of the geometry. I strongly recommend that Entergy review the failure from FAC of the Surrey pipe elbow, which reveals that Entergy's approach is oversimplified. ENVY also indicated that, in addition to using CHECWORKS, they would depend on "operating experience and engineering judgment". Entergy's EPU presentations do not demonstrate that ENVY has an understanding of FAC.

I declare under penalty of perjury that the foregoing is true and correct.

Executed this 27th day of June, 2006 at Rockville, Maryland.

Joram Hopenfeld

Joram Hopenfeld, Ph.D.

ATTACHMENT A

STATE OF VERMONT

PUBLIC SERVICE BOARD

Investigation into the reliability of the steam dryer and resulting performance of the Vermont Yankee Nuclear Power Station under uprate conditions	))))	Docket No. _____

Direct Testimony on Steam Dryer Reliability of

William Sherman

on behalf of the

Vermont Department of Public Service

June 21, 2006

Summary: Mr. Sherman provides testimony regarding steam dryer performance and reliability concerns associated with operation at power uprate conditions based on new information.

Direct Testimony on Steam Dryer Reliability
of
William Sherman

Q. Please state your name and occupation.

A. My name is William Sherman, and I am an engineer with the Department of Public Service ("The Department"). My responsibilities include oversight for the state of the activities of the Vermont Yankee Nuclear Power Station and the nuclear power industry in general.

Q. Please describe your educational background and experience.

A. I have a B.S. Degree in Mechanical Engineering from The University of Michigan. I have been with the Department for over seventeen years in the position of state nuclear engineer. Prior to coming to the Department I had 18 years of licensing, engineering, and design experience in the nuclear industry. I am a registered professional engineer in three states.

Q. What is the purpose of your testimony?

A. On February 14, 2006, the Department entered into a memorandum of understanding ("the steam dryer MOU") with Entergy Nuclear Vermont Yankee, LLC, and Entergy Nuclear Operations, Inc. (together, "Entergy VY") pertaining to an appurtenance of the Vermont Yankee nuclear reactor, the steam dryer (Exhibit DPS-WKS-1). The steam dryer MOU identified that

the Department had concerns regarding the performance of the steam dryer at uprated power levels and the potential for steam dryer performance to adversely affect Station reliability. It was acknowledged that power ascension tests for power uprate, required by the Nuclear Regulatory Commission, would provide additional information regarding the performance of the steam dryer at uprated power levels. Considering the information from the power ascension tests, the Department still has concerns regarding steam dryer performance under uprated power conditions. Based on the performance of similar steam dryers under uprated conditions and the information from the tests, the potential exists that structural failures of the steam dryer could adversely effect Vermont ratepayers. This testimony identifies concerns regarding the reliable performance of the Vermont Yankee steam dryer during power uprate conditions.

Q. What are your conclusions regarding the reliability of the steam dryer during power uprate operation?

A. Based on reliability problems caused by the steam dryers at Quad Cities Units 1 and 2 and Dresden Units 2 and 3, and the lack of resolution of these concerns in either the NRC staff review or the power ascension tests, additional means should be provided in order for Entergy's certificate of public good to be considered and determined to remain in the public good.

Q. Please describe the testimony regarding the steam dryer which was provided in Docket No. 6812.

A. At the time of the close of the evidentiary record in Docket No. 6812, the steam dryer at Quad Cities Unit 2 had failed twice, in June 2002 and May 2003, as a result of operating at higher, uprated power levels. Despite this repeat failure at Quad Cities Unit 2, the expectation at the close of the evidentiary record was that, once identified, the steam dryers would be modified and repaired to prevent further failure. Power uprate related failure of the steam dryer at Quad Cities Unit 1 in October 2003 was an emerging issue at the close of the evidentiary record. The following are findings in this area from the Board's Order of March 15, 2004:

> 56. Plants which have implemented 20 percent power uprates have experienced forced outages and power reductions as a result of the modifications made for power uprate. Sherman pf. 5/9/03 at 14.
>
> 58. Eight nuclear plants have undergone extended power uprates of 17 percent or greater. Two of these, the Quad Cities Units 1 and 2, have experienced extended outages as well as periods of derates. Exh. EN-JKT-7; Sherman pf. 11/5/03 at 8; tr. 6/19/03 at 191.
>
> 59. Quad Cities 2 has experienced 42 days of uprate-related outages, along with additional lost generation through a period of derating. Sherman pf. 8/19/03 at 22.
>
> 60. The cost risk for Vermonters occurs from having to purchase replacement power at prices potentially higher than those set out in the Power Purchase Agreement. The cost of this replacement power would most likely be defined by market prices since uprate-related outages would most likely be unplanned. *Id.*
>
> 61. Market prices are expected to exceed the prices in the Power Purchase Agreement for the remaining operating life of Vermont Yankee. Exh. DPS-DFL-4.

> 62. The major reliability effects associated with uprate or major plant changes, inputting major equipment, are likely to occur within the first eighteen months. Two operating cycles, or 3 years, is a good surrogate for when the highest percentage of run-in problems occur. Tr. 1/15/04 at 222 (Sherman).

Q. Please describe the performance of steam dryers at power uprate plants subsequent to the close of the evidentiary record in Docket No. 6812.

A. Subsequent to the close of the evidentiary record, it became evident that extensive, power uprate related cracking in the Dresden Unit 2 and Unit 3 steam dryers had been discovered in October and November 2003. Dresden Unit 3 was derated to its original full power level for a period of three weeks until its steam dryer was modified. In Fall 2003, the Dresden Units implemented the same steam dryer modification that Vermont Yankee implemented. However, during the November 2005 refueling outage, it was discovered that the modified parts had again cracked as a result of power uprate loads.

In addition, the Quad Cities Unit 2 steam dryer that was twice repaired previously (in June 2002 and May 2003), was found in February 2004 to have cracking in areas of the steam dryer that were previously modified. As a result of the cracking discovered in October 2003 in the Unit 1 steam dryer, and the ongoing cracking in the Unit 2 steam dryer, the Quad Cities Units were limited to operating at their former full power level before power uprate. Quad Cities Units 1 and 2 were derated to their former full power levels for periods of 78 weeks (18 months) and 58 weeks (13-1/2 months), respectively. At that time, Quad Cities owner, Exelon, elected to

replace the steam dryers at both units. The replacements were installed in May 2005 in special outages for Quad Cities Unit 2 and Unit 1 of 10 days and 6 days respectively.

Also, inspections were made of the Vermont Yankee steam dryers during the Fall 2004 and Spring 2005 outages. In 2004, twenty steam dryer cracks were discovered. Sixteen of these cracks were characterized as "hairline" cracks. Two 14-inch cracks were found in the skirt of the dryer were left "as-is." Two additional 3-inch cracks were repaired. In 2005, a total of 62 steam dryer cracks were discovered. Entergy stated that the additional discoveries were a result of higher resolution inspection devices.

Q. Why do you only mention the Quad Cities and Dresden units when there have been other boiling water reactors that have had power uprates?

A. There are several different steam dryer designs in boiling water reactors. One design - the square-hood design - has proven susceptible to failure under power uprate conditions. There are only five square-hood steam dryers in U.S. reactors - the two at Quad Cities, the two at

Dresden and Vermont Yankee's steam dryer. The Quad Cities and Dresden experience is applicable to Vermont Yankee[1].

Q. Please describe the NRC headquarters staff review of the steam dryers for power uprate.

[1] Even though Quad Cities and Dresden units are larger units that Vermont Yankee (approximately 770 MW vs. 510 MW - before uprate), their steam dryer experience is applicable to Vermont Yankee. It is even possible that Vermont Yankee's smaller size could exacerbate the problem.

A. The NRC headquarters staff review of the steam dryer is summarized on Exhibit DPS-WKS-2 ("Steam Dryer Slides")[2]. This Exhibit consists of slides by Mr. Thomas G. Scarbrough, entitled Component Evaluation for Vermont Yankee Proposed EPU Amendment, presented to the ACRS Power Uprates Subcommittee on November 29, 2005. NRC assembled of team of eight highly qualified specialists (Steam Dryer Slides, p. 4-8,9) that requested and reviewed a great amount of steam dryer information (Steam Dryer Slides, p. 4-12).

Q. Please summarize the results of the NRC staff review of the steam dryer.

A. As shown in the Steam Dryer Slides, after numerous rounds of requests for additional information and responses, NRC staff could not confirm and did not agree with Entergy's evaluation of the steam dryer.

Q. Please describe the results of the NRC staff review in more detail

A. Regarding Entergy's steam dryer analysis, the NRC determined that excitation sources were not adequately identified, a technically justifiable load definition was not provided, the analysis methodology was not justified as realistic, potential non-conservative assumptions were

[2] Certain of the Steam Dryer Slides have been labeled, "Slides Might Contain Proprietary Material." Entergy has certified that the slides do not contain proprietary material.

used and extrapolation of pressure peaks were not validated (Steam Dryer Slides, p. 4-11). Available margin to stress limits are not verifiable because of analysis uncertainties (Steam Dryer Slides, p. 4-20).

Entergy's steam dryer evaluation consisted of 1) a computational fluid dynamics (CFD) analysis, 2) an acoustical circuit model (ACM) review by scale model testing, and 3) an ACM review from the Quad Cities Unit 2 instrumented steam dryer.

The NRC staff found significant uncertainties associated with the CFD predictions. Sensitivity studies were not performed and comparison to other plant data was not sufficient. CFD uncertainty was underestimated. Steam Dryer Slides, p. 4-15.

For the ACM validation by scale model testing, NRC staff found significant uncertainties with the scale model because of the relative low flow used in the scale model test. The scale model measured results had substantial deviations from predicted results by calculations. Steam Dryer Slides, p. 4-16.

For ACM validation from the Quad Cities Unit 2 instrumented steam dryer, NRC staff concluded an assumption of even 100% uncertainty was an underprediction. Steam Dryer Slide, p. 4-17.

Because none of these analytical techniques were successful, the only basis for NRC acceptance of the steam dryers in power uprate conditions was the added instrumentation and the power ascension tests[3].

Q. Please identify how the ACRS characterized Entergy's steam dryer evaluation.

A. In its letter of January 4, 2006 (Exhibit DPS-WKS-3), at 5, the ACRS stated:

> [T]he state of validation of these [steam dryer analysis] methods is poor.

Q. Since the NRC could not confirm and did not agree with Entergy's evaluation of the steam dryer, what did the NRC staff require in order to provide reasonable assurance of public health and safety

[3] Each of Steam Dryer Slides, p. 4-15, 17, 18, 19, and 20, end with the statement, "License condition addresses this finding."

A. As a result, NRC staff required special instrumentation for steam dryer performance and a series of closely monitored power ascension tests. In other words, because Entergy could not confirm steam dryer adequacy by analysis and model testing, Entergy's power ascension tests were a carefully monitored test to determine, at least in part, Entergy's methods of analysis. The initial power ascension test plan is provided as Exhibit DPS-WKS-4[4].

Q. The power ascension plan describes various instrumentation and measurements. Please describe the steam line acoustical instrumentation and measurements.

A. Entergy provided acoustical monitoring instrumentation at eight locations on its four steam lines. The instrumentation measured strain[5] at the locations along the steam line per frequency. A finite element model of the steam dryer was created of calculated stress levels on the dryer. The maximum code allowable stress at the highest stressed element on the steam dryer was used to determine, through complex calculations, the maximum allowable strains per

[4] Exhibit DPS-WKS-4 consists of the main body of the steam dryer monitoring plan and Appendix D to that plan which includes layouts of the steam lines and instrumentation. The other omitted Appendices can be provided if desired.

[5] The instruments provide a representative measurement of strain, and by complex correlation, stress. The actual measurement is strain squared divided by frequency.

frequency for the acoustical monitors on the steam lines. These maximum allowable strains per frequency were represented by a set of eight limit curves for the eight steam line instrument locations. As stated in the power ascension plan (Exhibit DPS-WKS-4), if the measured strain exceeded the limit curve value, action was required.

Q. Please summarize the results of the power ascension tests with regard to the steam line acoustical monitoring.

A. In the power ascension tests, strain measurements reached or exceeded the limit curves at 105% power, 112.5% power, 117.5% power and 120% power[6]. As a result, Entergy recalculated and adjusted its limit curves three times in order to accommodate measured strains. Overall, the power ascension tests were successful and NRC was satisfied that catastrophic failure of the steam dryer would not occur. Operation at 120% power is considered acceptable because any failure of the steam dryer is expected to be detected by measuring moisture carryover, and power would be reduced if necessary to a known, safe operating range. Thus, NRC is confident that there is reasonable assurance that nuclear safety will not be compromised.

[6] Each steam line location had two sets of limit curves. Level 1 curves are based on the ASME allowable stress. Level 2 curves were set at 80% of ASME allowable stress. During the power ascension tests, Entergy reached or exceeded Level 2 curves which required evaluation while remaining at the given power level.

Q. Please describe your involvement in the power ascension tests.

A. I reviewed data that Entergy provided to the NRC and participated in Entergy/NRC technical conference calls at each step level. I also visited the site during a number of power increases.

Q. Please describe in more detail the strain measurements that exceeded limit curves and the recalculations that were done.

A. Exhibit DPS-WKS-5 consists of nine pages of results from the strain measurements. These curves, as described below, represent the cases where the measured results reached or exceeded the limit curves. The color presentation on the curves has the following meaning:

- Bright red - top curve-labeled LC1_Ave_[location]

  This curve is the Level 1 limit curve for the given location.

- Dark red - second curve from top-labeled LC2_Ave_[location]

  This curve is the Level 2 limit curve - it is this curve which is exceeded on the pages provided.

- Medium red - third curve from top-labeled Ave_MSL_[location]_with_Excita

  This curve presents the measured results from the stain gages at the given location for that particular power level.

- Blue - bottom curve-labeled AVE_MSL_[location]_No_Excita

  This curve represents the natural frequencies or "electrical noise" that is present at the location that are not related to the acoustical forces that cause stress on the steam dryer. Along these blue curves are peaks which represent known electrical noise frequencies,

along with their resonant frequencies. For example, the most prominent peak is at 60 hz, representing that our AC power is 60 cycle/sec power.

- The curves also have a barely visible pink line which represents the strain gage readings at the previous step level.

There are two presentations included in Exhibit DPS-WKS-5. Pages 1 through 5 are a wide range presentation of frequencies from 0 to 250 hz. Pages 6 through 9 are a narrow range presentation of frequencies from 130 to 150 hz, the frequencies at which the limit curves were reached or exceeded. The wide range presentations have peaks in which the blue curve and the medium red curve exceed the limit curves together. These are not considered real strain signals, but rather noise, and therefore are not considered of concern. Signals of concern are those where the medium red curve reaches or exceeds the limit curve while the blue curves are at low levels at the bottom of the presentation. The following describes the curves provided:

Page 1 - 105% power (1671 MWt), main steam line A - lower location,

The measured results reached the limit curve at a frequency of 137 hz. As a result, the tests were put on hold while Entergy recalculated its limit curves by creating a more detailed model of the steam dryer (a finer finite element model) and by reducing uncertainties. Overall, the new limit curves were higher, and the allowed peak was higher at the 137 hz level to accommodate peak measured at 105% power and its expected further increase throughout the remaining step increases.

Page 2 - 112.5% power (1792 MWt), main steam line A - lower location

This curve shows the overall raised limit curves and the increased allowable peak at 137 hz that was recalculated at 105% the power level. However, at 112.5% power, the strain results had changed with a minor peak at 137 hz, and a higher peak at 142-3 hz that exceeded the limit curve. This resulted in another hold while Entergy again recalculated its curves to accommodate these new peaks. The new curves for this recalculation were generally lower than the 105% power curves, with higher peaks where measured peaks had developed.

Page 3 - 112.5% power (1792 MWt), main steam line D - lower location

In addition to the main steam line A - lower location item above, the limit curve was reached, or nearly so, at the main steam line D - lower location at 137 hz.

Page 4 - 117.5% power (1872 MWt), main steam line A - lower location

Even though the limit curves had been recalculated twice before, the results at 117.5% power saw the limit curve again reached at 142-3 hz. The curve was also reached at the main steam line A - upper location as described below. Once again, the tests were placed on hold and recalculations were done for a third time.

Page 5 - 117.5% power (1872 MWt), main steam line A - upper location

At this power level, for the first time, the upper location of main steam line A had a frequency (142-3 hz) that exceeded its limit curve.

Page 6 - 120% power (1912 MWt), Set 1, main steam line B - lower location

The limit curve was exceeded on main steam line B for the first time at full (120%) uprate power at 142-3 hz. This is set 1 of 5 sets of data taken. The Department was only provided sets 1, 2 and 5. The results for main steam line B - lower exceeded the limit curve at 143 hz in sets 1 and 2 but not in set 5.

Page 7 - 120% power (1912 MWt), Set 2, main steam line A - upper location

Although recalculated at 117.5% power to account for this peak (see page 5 above), the limit was exceeded for 143-4 hz. The results for sets 1 and 5 did not exceed the limit curves at this location.

Page 8 - 120% power (1912 MWt), Set 2, main steam line B - upper location

At this location, the limit curve was exceeded at 143-4 hz. The results for sets 1 and 5 did not exceed the limit curves at this location.

Page 9 - 120% power (1912 MWt), Set 2, main steam line B - lower location

Just as in set 1, the limit curve was exceeded at this location at 143 hz. Since the locations exceeded at 120 % power did not exceed the Level 1 limit (top curve), no further recalculations were necessary.

Q. What conclusions do you draw from the acoustical strain measurement results of the power ascension tests?

A. The original limit curves presented in the initial power ascension test plan (Exhibit DPS-WKS-4) carried the expectation that steam line/steam dryer phenomena were sufficiently understood analytically and that the limit curves were conservative. The fact that limit curves had to be recalculated three separate times demonstrates to me that steam line/steam dryer interactions are not well understood analytically. Based on not being able to predict the uncertainties related to how steam line frequencies would perform, there exists sufficient doubt in the steam line strain/steam dryer stress correlation to merit additional protection for ratepayers.. The complete translation of frequency data into actual loads on the steam dryer is theoretical. While I agree that catastrophic failure of the steam dryer is unlikely, Entergy has not conclusively demonstrated that steam dryer cracks resulting in power derates will not occur.

Q. Besides the acoustical strain measurements, was there another aspect of the power ascension test in which limits were exceeded?

A. Yes. As stated on Table 2 of the power ascension plan (Exhibit DPS-WKS-4), moisture carryover[7] was monitored and had a Level 2 limit of 0.1%. This limit was exceeded starting at the 117.5% (1872 MWt) power level of the power ascension.

Q. What is conclusion regarding the moisture carryover exceeding limits?

A. The fact that moisture carryover exceeded its Level 2 limit is further demonstration to me that Entergy does not fully understand the uncertainties regarding steam dryer performance at uprate conditions. There was an expectation that the 0.1% carryover limit would be conservative.

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[7] Moisture carryover is the percentage of moisture remaining in the steam delivered to the steam line. The purpose of the steam dryer is to remove moisture from the steam developed in the reactor. Moisture carryover is the percentage of the weight (or mass) of water to the overall weight (or mass) of the saturated steam and water mix for of a given volume. For example, 100% moisture carryover would be all water. Zero percent moisture carryover would be all saturated steam with no water portions.

Q. Do you believe the instances of exceeding test limits, and the resulting multiple recalculation of acoustical strain measurement limit curves represents a condition adversely affecting the reliability of the steam dryer?

A. Yes. This terminology is used in stipulation 2 of the Steam Dryer MOU. As I have stated, the multiple exceeding of limits demonstrates that steam dryer analytical uncertainties are not well understood. These multiple exceeding of limits constitutes a condition adversely affecting the reliability of the steam dryers.

Q. Has the NRC staff concluded from its review that derates will not occur?

A. No. NRC is concerned with safety, and does not try to guarantee reliable operation at full 120% uprate power. Part of the NRC's conclusion of reasonable assurance that steam dryer will meet safety requirements is that cracking can be detected by increases in moisture carryover, and the plant power can be reduced to a known, safe power level[8] until the steam dryer can be evaluated and repaired. NRC relies on the possibility of a derate in its safety determination.

Q. Please explain how Vermont ratepayers would be affected if power were required to be reduced because of steam dryer problems.

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[8] The most likely known, safe power level is the former 100% power level.

A. Article 8 of the power purchase agreement (PPA) between Entergy Nuclear Vermont Yankee, LLC, and Vermont Yankee Nuclear Power Corporation (Exhibit DPS-WKS-6) provides that a Capability Audit will be performed after uprate power level is achieved. Based on the Capability Audit, the Company Entitlement fraction will be changed.

The current Company Entitlement is 100% (510 MW) - Vermont Yankee Nuclear Power Corporation currently takes 100% of Vermont Yankee power at fixed prices established by the PPA. Assuming that power is uprated by 20% (102 MW), the new Company Entitlement fraction would be 100% divided by 120%, or 83%. Vermont Yankee Nuclear Power Corporation would get 83% of 612 MW, or 510 MW, while Entergy would be able to sell 17% of 612 MW, or 102 MW - the uprate power.

However, if the plant were required to reduce power, or derate, because of steam dryer problems, Vermont Yankee Nuclear Power Corporation would get less than its former entitlement. For example, if the plant were required to derate to the old 100% power level of 510 MW, Vermont Yankee Nuclear Power Corporation would get 83% of 510 MW, or 425 MW. Entergy would get 17% of 510 MW, or 85 MW. In this condition, Vermont Yankee Nuclear Power Corporation would lose 17% of its former power[9].

[9] While there is the provision in Article 8 to modify the company entitlement fraction based on the claimed capability audit following power uprate, there is no provision to adjust the fraction if Vermont Yankee is later derated. Following the modification of the company

Vermont Utilities receive 55% of the power taken by Vermont Yankee Nuclear Power Corporation. In the above example, Vermont Utilities would lose 17% of the power currently received from Vermont Yankee at favorable PPA prices, and would have to make up this power at market prices. Using current power price forecasts, the costs to Vermont Utilities of derating back to the current 100% power level is estimated to be approximately (see Exhibit DPS-WKS-7):

$54,000 per day

$376,000 per week

$19,573,000 per year

Q. Would these amounts be covered by the current rate payer protection plans?

---

entitlement fraction, Vermont Yankee Nuclear Power Corporation will receive only approximately 83% of the output, even if Vermont Yankee is permanently returned to the old 100% power level.

A. The rate payer protection plans implemented in this docket are capped at a maximum value of $4.5 million. Considering previous uses of these funds, approximately $2 million remains in the rate payer protection plan. This amount would accommodate less than 6 weeks of derate back to the current full power level[10].

Q. Please describe the provision in the Steam Dryer MOU related to changing the Company Entitlement Fraction.

A. If the Board opens a docket within 30 days following the completion of the power ascension tests (May 9, 2006), Entergy has agreed not to modify the Company Entitlement Fraction until 120 days following the completion of the power ascension tests.

Q. Do you have a suggestion for the protection required for Vermont ratepayers?

A. Yes. Vermont Utilities should be protected for a period ending two months after the startup from the first refueling outage for a cycle in which no derate has occurred. The Vermont Utilities should be protected for economic losses that result from decreases of power delivery

[10] By comparison, the Quad Cities Units 1 and 2 were derated back to old 100% power for a period of 78 weeks and 58 weeks, respectively.

associated with the steam dryer, with consideration of the risk that Entergy has undertaken to develop uprate power and continue electric generation service to Vermont Utilities.

Q. Why do you choose the period ending two months after the startup from the first refueling outage for a cycle in which no derate has occurred?

A. If Entergy operates through its current cycle, inspects the steam dryer during its 2007 refueling outage, and is not derated within the two months following, I believe this would serve as a demonstration that steam dryer performance under uprate conditions was satisfactory. If derate occurred during the period, I would expect dryer repairs to be made, and an additional cycle without derate would be necessary to demonstrate performance.

Q. Do you have opinions on how Entergy could provide the necessary protection for Vermont Utilities for economic losses from steam dryer problems?

A. I have no specific opinion at this time. There are likely a number of different ways this could be accomplished. For example, Entergy is a power supplier in the Northeast region. Entergy might be able to agree to supply power lost to Vermont Utilities as a result of steam dryer problems from other sources at the PPA prices. It is possible Entergy could procure or assist with payments for a type of reliability insurance policy.

Another manner that Entergy might provide protection to Vermont Utilities could be to conduct an additional Capability Audit of the type discussed in Article 8 of the PPA if the plant is derated because of steam dryer problems, and to readjust for the Vermont Utilities the Company Entitlement fraction in the manner discussed in Article 8.

Q. Does this conclude your testimony?

A. Yes, it does.

EXHIBIT 2

UNITED STATES
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 ENTERY NUCLEAR OPERATIONS, INC.	)	ASLB No. No. 06-849-03-LR
Vermont Yankee Nuclear Power Station	)	
License Renewal Application	)	

DECLARATION OF ARNOLD GUNDERSEN SUPPORTING
NEW ENGLAND COALITION INC.'S REPLY TO
ENTERGY AND NRC STAFF ANSWERS TO
NEW ENGLAND COALITION'S PETITION FOR
LEAVE TO INTERVENE, REQUEST FOR HEARING, AND CONTENTIONS

I, Arnold Gundersen, declare as follows:

1. My name is Arnold Gundersen. I am sui juris. I am over the age of 18-years-old. I have personal knowledge of the facts contained in this Declaration.

2. The New England Coalition has retained me as an expert witness in the above captioned matter.

3. I have a Bachelor's and a Master's Degree in Nuclear Engineering from Rensselaer Polytechnic Institute (RPI) cum laude.

4. My Curriculum Vitae and my qualifications were submitted to this venue May 26, 2006, and are part of the record.

5. My declaration is intended to support New England Coalition's Reply To Entergy And NRC Staff Answers To New England Coalition's Petition For Leave To Intervene, Request For Hearing, and Contentions.

6. Entergy and the NRC Staff have ignored, or minimize without justification, the importance of numerous facts included in my May 26, 2006 Declaration. I am particularly concerned with three issues:

6.1 First, both Entergy and the NRC Staff fail to acknowledge that both an Entergy consultant and a Vermont Yankee employee alerted Entergy to the fact that Vermont Yankee's condenser is vulnerable to failure. As set forth in my Declaration filed May 26, 2006, Entergy's consultant Karl Kuester noted that an "*unusual accident or occurrence*" might destroy the integrity of the condenser, and a Vermont Yankee employee, E Betti, noted in a separate report that "*[t]he original condenser welds were very poor*", and that "*[t]he original Westinghouse bracing system had deficiencies...*" that are contributing factors to two long cracks. Betti also noted that while the "*very poor*" welds can support primary loads like gravity, these same welds are problematic when one considers "*secondary loads*." These "*secondary loads*" are precisely the same loads on the "*very poor*" welds which would be imposed by Kuester's "*unusual accident or occurrence*". Moreover, both Entergy's consultant and Entergy's employee are in agreement that the tubes, tube sheets, and condenser welds and bracing are likely to be damaged during a transient. Thus, the engineering analysis conducted by Entergy's staff and consultant does not support Entergy's assumption that normal plant operation will assure "*adequate condenser pressure boundary integrity*", because the disruption of normal operation during a transient has been identified by Entergy's consultant as a likely cause of loss of condenser integrity. Entergy has failed to prepare for this scenario in its application for life extension to 2032 at Vermont Yankee.

6.2 Second, Entergy fails to address the fact that transients that may cause Vermont Yankee's weak, old condenser to fail may also precipitate a Design-basis event during which the condenser must retain its integrity, as the condenser plays a critical role in dose mitigation if an accident were to occur. The NRC's generic approval for Quad Cities, Dresden and other units is not relevant to this application, because, as Entergy's own expert and employees have stated, and as I

delineated in my May 26, 2006 declaration, in the event of a transient, the integrity of this particular and already weak condenser may not be assured. It is the degraded condition of Vermont Yankee's condenser that makes it impossible to compare Vermont Yankee to Quad Cities or Dresden.

6.3 Third, according to NRC regulations, a design-basis accident is a postulated accident that a nuclear facility must be designed and built to withstand without loss to the systems, structures, and components necessary to assure public health and safety. There are several scenarios in which the condenser may fail just when it is needed most to mitigate the dose from a Design-basis accident. Below are two of many operational transients that may damage the condenser and simultaneously cause Design-basis events:

6.3.1 A full load rejection, which is the inability of the nuclear power plant to export power because the grid has gone down or there is some other type of turbine failure, may seriously impact condenser integrity. The sudden pressure and flow transients within the steam, condensate, and feedwater systems during a full load rejection would adversely impact the integrity of the already weakened condenser and, at the same time, precipitate a Design-basis event. Thus, the condenser would be vulnerable to failure just when it is needed to function as part of the dose mitigation system in the event of an accident. (Note that Entergy did not perform a full load rejection as part of its start-up testing program for the EPU.)

6.3.2 A broken turbine disk (not a blade) may seriously impact condenser integrity. One-third of the disk would fly downward and directly impact the already weak welds and cracks in the condenser, which would adversely impact the integrity of the already weakened condenser, making it vulnerable to complete failure. Simultaneously with the destruction of the condenser, the resulting emergency shutdown, or the other two-thirds of the turbine disk could precipitate a Design Basis event. Since Vermont Yankee's turbine hall is tangential to the containment and not radial, the disk fragments may impact safety-related

equipment or the control room itself. Please note that I hold a patent for an energy absorbing turbine missile shield, a device that protects a nuclear power reactor from this type of accident.

6.3.3 In the event that either of these situations involving emergency shutdowns occurs, it is imperative that the condenser maintain its integrity, yet that is unlikely given its weakened condition as described by Entergy's consultant Kuester and employee Betti.

7. While relying upon NRC accommodations at Quad Cities and Dresden, Entergy failed to alert this venue to the critical fact that loss of condenser integrity occurred at another reactor while it was in operation. That condenser failure occurred at Grand Gulf Nuclear Plant in Mississippi, which Entergy owns, and which is a Boiling Water Reactor (BWR) like Vermont Yankee. The Grand Gulf condenser, which is significantly newer, more modern and better-constructed than Vermont Yankee's condenser, failed while the reactor was in operation. This incident, of which Entergy was well aware, is concrete evidence controverting Entergy's assumption that "*normal plant operation assures adequate condenser pressure boundary integrity*".

8. In my Declaration of May 26, 2006, I cited the report of Kuester, an Entergy consultant retained to review technical and engineering issues at Vermont Yankee. Kuester stated that, "barring an unusual accident or occurrence", the condenser will remain intact at the 100% rated power level. In other words, Kuester states that the condenser will maintain its integrity <u>except</u> if there is an unusual occurrence or an accident.

9. At page 39 of the Entergy Answer to NEC's Petition to Intervene, Entergy states that there is no basis for the suggestion that a design-basis accident might prevent the condenser from performing credited function. This is not correct. As discussed in paragraph 7 of this Declaration, Entergy's own fleet record shows that it takes much

less than a design basis accident to *"prevent the condenser from performing the credited function"*.

10. The NRC Staff point to aging management programs addressing Flow-Accelerated Corrosion, System Walkdown, Water Chemistry Control - BWR, and Water Chemistry Control - Closed Cooling Water. These programs do not address NEC's concern that the Condenser itself is degraded and that its condition should be monitored and managed during the period of extended operation.

11. The NRC Staff also question my analysis of the significance of backpressure on the condenser. I have not suggested that backpressure should be avoided. What I did say, however, is that the fluctuations in backpressure caused by the EPU, coupled with an already feeble condenser, make it critically important to monitor and manage condenser integrity.

12. I stress that, in my Declaration of May 26, 2006, I cited Entery's own analysis identifying **four** significant flaws compromising the integrity of the condenser, which indicate that the condenser could reasonably be expected to fail during a transient prior to decommissioning in 2032: the condenser is "*corroded*", the "*original condenser welds were very poor*", the condenser has several enormous cracks, and the *"condenser bracing system had deficiencies*".

13. In conclusion: following a complete review of the evidence presented and by relying upon my nuclear safety and nuclear engineering experience in my review of the documents referenced herein above, it is my professional opinion that the issues discussed above are serious safety considerations germane to the subject of the license application in this case. Similarly, after reviewing all the evidence presented, it is my professional opinion that the condenser at Vermont Yankee cannot be relied upon to mitigate the consequences of an accident during the renewed license term, through 2032.

I declare under penalty of perjury that the foregoing is true and correct.

Executed this day, June 29, 2006 at Burlington, Vermont.

Arnold Gundersen, MSNE 6/29/06

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, Ron Shems, hereby certify that copies of the NEW ENGLAND COALITION, INC.'S REPLY TO ENTERGY AND NRC STAFF ANSWERS TO PETITION FOR LEAVE TO INTERVENE, REQUEST FOR HEARING, AND CONTENTIONS in the above-captioned proceeding were served on the persons listed below, by U.S. Mail, first class, postage prepaid; by Fed Ex overnight to Judge Elleman; and, where indicated by an e-mail address below, by electronic mail, on the 29nd day of June, 2006.

Administrative Judge
Alex S. Karlin, Esq., Chair
Atomic Safety and Licensing Board
Mail Stop T-3 F23
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
E-mail: ask2@nrc.gov

Administrative Judge
Thomas S. Elleman
Atomic Safety and Licensing Board Panel
5207 Creedmoor Road, #101
Raleigh, NC 27612
E-mail: elleman@eos.ncsu.edu

Office of Commission Appellate
Adjudication
Mail Stop: O-16C1
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
E-mail: OCAAmail@nrc.gov

Administrative Judge
Dr. Richard E. Wardwell
Atomic Safety and Licensing Board Panel
Mail Stop T-3 F23
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
E-mail: rew@nrc.gov

Office of the Secretary
Attn: Rulemaking and Adjudications Staff
Mail Stop: O-16C1
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
E-mail: hearingdocket@nrc.gov

Sarah Hofmann, Esq.
Director of Public Advocacy
Department of Public Service
112 State Street, Drawer 20
Montpelier, VT 05620-2601
E-mail: sarah.hofmann@state.vt.us

Mitzi A. Young, Esq.
Steven C. Hamrick, Esq.
Office of the General Counsel
Mail Stop O-15 D21
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
E-mail: may@nrc.gov; sch1@nrc.gov

Diane Curran, Esq.
Harmon, Curran, Spielberg & Eisenberg, LLP
1726 M Street NW, Suite 600
Washington, DC 20036
E-mail: dcurran@harmoncurran.com

Callie B. Newton, Chair
Gail MacArthur
Lucy Gratwick
Marcia Hamilton
Town of Marlboro Selectboard
P.O. Box 518
Marlboro, VT 05344
E-mail: cbnewton@sover.net; marcialynn@ev1.net

Marcia Carpentier, Esq.
Jonathan M. Rund, Esq.
Atomic Safety and Licensing Board Panel
Mail Stop T-3 F23
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
E-mail mxc7@nrc.gov; Jmr3@nrc.gov

Anthony Z. Roisman, Esq.
National Legal Scholars Law Firm
84 East Thetford Road
Lyme, NH 03768
E-mail:
aroisman@nationallegalscholars.com

Matthew Brock, Esq.
Assistant Attorney General
Office of the Massachusetts Attorney General
Environmental Protection Division
One Ashburton Place, Room 1813
Boston, MA 02108-1598
E-mail: matthew.brock@ago.state.ma.us

Dan MacArthur, Director
Town of Marlboro
Emergency Management
P.O. Box 30
Marlboro, VT 05344
E-mail: dmacarthur@igc.org

David R. Lewis, Esq.
Matias F. Travieso-Diaz
Pillsbury Winthrop Shaw Pittman LLP
2300 N Street NW
Washington, DC 20037-1128
E-mail: david.lewis@pillsburylaw.com
matias.travieso-diaz@pillsburylaw.com

SHEMS DUNKIEL KASSEL & SAUNDERS, PLLC

by: Ron Shems by/ Karen Tyler

Ronald A. Shems
Karen Tyler (admission pending)
91 College Street
Burlington, VT 05401
802 860 1003
802 860 1208 (fax)
rshems@sdkslaw.com
ktyler@sdkslaw.com

for the firm
Attorneys for New England Coalition, Inc.

SHEMS DUNKIEL KASSEL & SAUNDERS PLLC

RONALD A. SHEMS

BRIAN S. DUNKIEL*

JOHN B. KASSEL

MARK A. SAUNDERS

GEOFFREY H. HAND
KAREN L. TYLER
ASSOCIATE ATTORNEYS

ANDREW N. RAUBVOGEL
EILEEN I. ELLIOTT
OF COUNSEL

June 29, 2006

Office of the Secretary
Attn: Rulemaking and Adjudications Staff
Mail Stop O-16C1
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Re: In the Matter of Energy 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 Sir or Madam:

Please find enclosed for filing in the above stated matter New England Coalition, Inc.'s (NEC) Reply to Entergy and NRC Staff Answers to Petition for Leave to Intervene, Request for Hearing, and Contentions.

Thank you for your attention to this matter.

Sincerely,

Karen Tyler
SHEMS DUNKIEL KASSEL & SAUNDERS PLLC

Cc: attached service list
Enclosures (3)

91 COLLEGE STREET - BURLINGTON, VERMONT 05401
802 / 860 1003 802 / 860 1208 www.sdkslaw.com