Entergy

Entergy Nuclear Vermont Yankee, LLC
Entergy Nuclear Operations, Inc.
185 Old Ferry Road
Brattleboro, VT 05302-0500

September 28, 2005

Docket No. 50-271
BVY 05-088
TAC No. MC0761

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: **Vermont Yankee Nuclear Power Station**
Technical Specification Proposed Change No. 263 – Supplement No. 35
Extended Power Uprate – Response to Request for Additional Information

References:

1) Entergy letter to U.S. Nuclear Regulatory Commission, "Vermont Yankee Nuclear Power Station, License No. DPR-28 (Docket No. 50-271), Technical Specification Proposed Change No. 263, Extended Power Uprate," BVY 03-80, September 10, 2003

2) U.S. Nuclear Regulatory Commission (Richard B. Ennis) letter to Entergy Nuclear Operations, Inc. (Michael Kansler), "Request for Additional Information – Extended Power Uprate, Vermont Yankee Nuclear Power Station (TAC No. MC0761)," September 7, 2005

3) Entergy letter to U.S. Nuclear Regulatory Commission, "Vermont Yankee Nuclear Power Station, Technical Specification Proposed Change No. 263 – Supplement No. 30, Extended Power Uprate – Response to Request for Additional Information," BVY 05-071, August 1, 2005

This letter provides additional information regarding the application by Entergy Nuclear Vermont Yankee, LLC and Entergy Nuclear Operations, Inc. (Entergy) for a license amendment (Reference 1) to increase the maximum authorized power level of the Vermont Yankee Nuclear Power Station (VYNPS) from 1593 megawatts thermal (MWt) to 1912 MWt.

The attachments to this letter provide supplemental information in response to a request for additional information (RAI) from the NRC staff (Reference 2). Entergy previously responded to all but one of the individual RAIs in Reference 2 (i.e., NRC Reactor Systems Branch RAI SRXB-A-68). Attachment 1 provides Entergy's response to the remaining RAI. This RAI and the response thereto contain Proprietary Information as defined by 10CFR2.390 and should be handled in accordance with the provisions of that regulation. Attachment 1 is considered to be Proprietary Information in its entirety. Attachment 2 is a non-proprietary version of Attachment 1 and is suitable for public disclosure. An affidavit provided by General Electric Company (GE), supporting the proprietary nature of the document, is provided as Attachment 3.

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In response to NRC staff requests for information regarding GE's analytical methodologies for establishing fuel thermal limits, Entergy provided a VYNPS-specific approach to address postulated uncertainties in GE's methodologies in Reference 3. To provide additional conservatism and margin, Entergy also put forward the concept of an interim license condition that would impose an increase in the safety limit minimum critical power ratio for extended power uprate. Attachment 4 provides a re-statement of the proposed license condition.

There are no new regulatory commitments contained in this submittal.

This supplement to the license amendment request provides additional information to clarify Entergy's application for a license amendment and does not change the scope or conclusions in the original application, nor does it change Entergy's determination of no significant hazards consideration.

Entergy stands ready to support the NRC staff's review of this submittal and suggests meetings at your earliest convenience to resolve any remaining issues. If you have any questions or require additional information, please contact Mr. James DeVincentis at (802) 258-4236.

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

Executed on September 28, 2005.

Sincerely,

Jay K. Thayer
Site Vice President
Vermont Yankee Nuclear Power Station

Attachments (4)

cc: (see next page)

cc: Mr. Richard B. Ennis, Project Manager
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Mail Stop O 8 B1
Washington, DC 20555

Mr. Samuel J. Collins (w/o attachments)
Regional Administrator, Region 1
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406-1415

USNRC Resident Inspector (w/o attachments)
Entergy Nuclear Vermont Yankee, LLC
P.O. Box 157
Vernon, Vermont 05354

Mr. David O'Brien, Commissioner (w/o proprietary information)
VT Department of Public Service
112 State Street – Drawer 20
Montpelier, Vermont 05620-2601

Attachment 2

Vermont Yankee Nuclear Power Station

Proposed Technical Specification Change No. 263 – Supplement No. 35

Extended Power Uprate – Additional Information

Response to RAI SRXB-A-68

NON-PROPRIETARY VERSION

Total number of pages in Attachment 1
(excluding this cover sheet) is 17.

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RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
REGARDING APPLICATION FOR EXTENDED POWER UPRATE LICENSE AMENDMENT
VERMONT YANKEE NUCLEAR POWER STATION

PREFACE

This attachment provides a response to the NRC Reactor Systems Branch's (SRXB) request for additional information (RAI) SRXB-A-68 in NRC's letter dated September 7, 2005.[1] Upon receipt of the RAI, discussions were held with the NRC staff to further clarify the RAI. The intent of the RAI was clarified during these discussions, and the information provided herein is consistent with those clarifications.

The RAI is re-stated as provided in NRC's letter of September 7, 2005.

RAI SRXB-A-68

RAI SRXB-A-51 asked that Entergy provide an evaluation that demonstrates that the void reactivity coefficients are applicable and are developed for the range of core thermal-hydraulic conditions expected for the transient and accident conditions, including anticipated transients without scram (ATWS). The RAI response did not explicitly address the NRC staff question. The response instead discussed the conservative axial power distribution that is assumed (HBB and UB) that minimizes the scram reactivity worth. However, the staff RAI was focused on assessing ODYN's capability to simulate the change in core reactivity with the change in voids for the current EPU fuel and core designs. In addition, the objective of the RAI is also to determine if the void reactivity coefficient bias and uncertainty derived in the original ODYN licensing topical report remains valid and applicable for the EPU core and fuel designs.

The RAI response also referred to a sensitivity study performed during the initial ODYN licensing (NEDO-24154P-A, Volume III, page Q12) based on the Peach Bottom turbine trip transient simulation. The void coefficient was changed by [[ ]]. The sensitivity studies determined the impact changes in the void coefficient would have on the ΔCPR/ICPR response. The document concludes that a model uncertainty due to void reactivity response of [[ ]] is assumed. This sensitivity study [[ ]] It is also not clear that the void reactivity coefficients for the current fuel and core design are [[

[1] U.S. Nuclear Regulatory Commission (Richard B. Ennis) letter to Entergy Nuclear Operations, Inc. (Michael Kansler), "Request for Additional Information – Extended Power Uprate, Vermont Yankee Nuclear Power Station (TAC No. MC0761)," September 7, 2005

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As stated in the RAI response, it is true that ODYN AOO response is [[ ]] than TRACG. While TRACG applies a [[

]] Therefore, for the current EPU high energy core designs and the associated core thermal-hydraulic conditions, an uncertainty analyses is necessary in order to access the code's capability to model the changes in the core reactivity changes with changes in the void fractions.

The response to the staff's RAI 38 of the initial ODYN licensing topical report (NEDO-241154P-A, Volume 1) provides a void reactivity coefficient uncertainty analysis. The lattice k_∞ values at the three void fractions of [[

]] The following questions relate to the appropriateness of [[ ]] used in deriving the uncertainties and biases associated with the void reactivity coefficients.

a) Provide an uncertainty analyses of the changes in the core reactivity with changes in the void fractions. Include in the uncertainty analyses how the adequacy of ODYN's predications of the reactivity coefficients can be assessed for the current EPU fuel/ core designs and operating strategy.

b) The lattice void reactivity coefficient is [[ ]] Justify the use of [[ ]] for the derivation of the uncertainties for high void conditions.

c) Provide plots showing the linear void reactivity coefficient function extended to the higher void conditions for limiting lattices in your uncertainty analysis. Include plots providing the void coefficient changes with depletion at different void conditions for the full range of instantaneous void fractions. Evaluate the changes seen in the void coefficient values with the historical void fractions for the range of the instantaneous void fractions, using limiting GE14 lattices. Based on these plots, explain the void coefficient uncertainties that would be associated with the higher void conditions for the different historical void fraction cases.

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d) The response to the staff's RAI 12 of NEDE-24154P-A (page Q12-4) Volume II states that a void coefficient uncertainty of [[ ]] is applied as presented in RAI 38 (Volume I). However, the response to question 38 (page Q38-4) states that, [[

]] Explain this statement and state if any uncertainty is applied to the void coefficient in ODYN. If so, justify why the void coefficient calculational method currently employed in ODYN, if any, is [[ ]] for the core thermal-hydraulic conditions EPU boiling water reactors (BWRs) would experience and justify the uncertainties currently used in ODYN.

e) Provide a discussion of how the changes in the void coefficient uncertainties as seen from the lattice data would affect the different transient events, instability and ATWS response.

Response to RAI SRXB-A-68

Part (a)

See the response to part (d) below.

Part (b)

A void reactivity coefficient is not input as a linear function into ODYN. ODYN uses cross sections that are fit as a quadratic function of moderator density for each control state at each axial height as described in NEDO-24154-A, Vol. I, p. 5-11. The kinetics model diffusion parameters (Σ) are provided as quadratic functions of relative water density (u) as shown below for each control state at each axial node.

$$\Sigma = \Sigma_0\left(1 + a(u-u_0) + b(u-u_0)^2\right)$$
$$\Sigma_0 = \text{basestate diffusion cross section}$$
$$a = \text{linear coefficient}$$
$$b = \text{quadratic coefficient}$$
$$u = \text{average relative water density} = \rho/\rho_{ref}$$
$$u_0 = \text{basestate relative water density}$$

The fitting process utilizes the cross section parameter at the basestate (steady-state) relative water density and the parameter at several other relative water densities chosen to cover the

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expected range of *u* variation. The raw cross section data is defined by the TGBLA/PANACEA database. The nodal diffusion parameters will change as the relative water density varies during the transient. The resultant change in reactivity versus the water density (or void fraction) change can be interpreted as the ODYN void coefficient.

To further define high void fraction, the VYNPS (Vermont Yankee Nuclear Power Station) Cycle 25 transient results were reviewed to determine the time=0 ODYN predicted 1D axial void fraction. The maximum exit void fraction considering the variation in axial power shapes and core flow was [[ ]]. An exit void fraction of [[ ]] occurs for both CLTP/minimum core flow and EPU/minimum core flow since the void fraction is relatively constant along a rod line. The ODYN predicted axial void fraction remains essentially unchanged at EPU conditions.

Part (c)

VYNPS is applying TGBLA06 methodology in core design, transient analysis, stability analysis, and monitoring. Figure SRXB-A-68-1 provides TGBLA06 void coefficient data and Figure SRXB-A-68-2 provides the corresponding MCNP data for 5 representative 10x10 lattices for the full range of instantaneous void (IV) conditions. The calculations are based on a 40% void history (VH) depletion followed by branch calculations at 0, 40, and 70% IV. The results are extrapolated above 70% IV. In Table SRXB-A-68-1, the average bias over the full exposure range is approximately [[ ]] at 70% IV. The average bias at 40% IV is approximately [[ ]]. Over this IV range, the magnitude of the bias is considered [[ ]]. Table SRXB-A-68-1 shows the TGBLA06 vs. MCNP data at 70% IV. Table SRXB-A-68-2 provides the 5 lattice details for selected exposures (selection discussed later). The average uncertainty at 70% IV in Table SRXB-A-68-1 is [[ ]]. This uncertainty is representative of the 40% void fraction range (also [[ ]]). The value assumed in the Revised Supplementary Information Regarding Amendment 11 to GESTAR (Reference 68-1) is [[ ]].

The bias and uncertainty above 70% IV has two potential issues:

3. The void coefficient data in Figure SRXB-A-68-1 and SRXB-68-2 is [[ ]]

4. The data that is utilized to develop the cross section parameters is based on instantaneous void branch cases from a [[ ]]. Upper axial nodes are operating at [[ ]]

The following additional analyses have been performed for Vermont Yankee lattice 7009. MCNP calculations have been performed from 40% void history, 70% void history, and 90%

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void history. MCNP branch cases have been performed to instantaneous voids of 70%, 80% and 90%. These analyses were performed for lattice exposures of [[

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In summary, for transient applications that utilize TGBLA06 based modeling (PANAC11, ODYN, and ODYSY) the evaluation discussed above for [[ ]] void fraction (Table SRXB-A-68-1) is applicable to the consideration of both the TGBLA06 cross section extrapolation process and the TGBLA06 void history assumption. An assumption of [[ ]] bias and a 2σ uncertainty of [[ ]] is justified and is applied in the response to part (d) below.

Part (d)

As documented in Reference 68-1, the uncertainty in the ΔCPR/ICPR calculated by ODYN is determined by comparison of predictions with reactor data. The basis is the same as that used in NEDO-24154-A. The reactor data used for determining the uncertainty are the [[ ]]. To verify this model uncertainty is reasonable, a [[ ]] was performed on key parameters at a bounding value judged to be at the 2σ level including the void coefficient. The results from this study documented in Reference 68-1 showed that the model uncertainty based on the model perturbation analysis supports the model uncertainty determined from the comparison to plant data. It was concluded that the approved model uncertainty process is sufficient to account for void coefficient uncertainty along with the uncertainty in other nuclear and model parameters.

The model uncertainty [[ ]] was also updated with the latest TGBLA06 / PANAC11 methods following the approved process. With the updated model uncertainty the statistical adders were also updated. These were provided to the NRC in Reference 68-2.

An analysis was performed for VYNPS Cycle 25 to quantify the sensitivity of this core to void coefficient. The ΔCPR/ICPR uncertainty based on perturbations with a 2σ uncertainty of [[ ]] is approximately [[ ]]. This sensitivity is consistent with the sensitivity provided in Reference 68-1 [[

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]] (see Reference 68-1 Table 3-2). When combined with the other uncertainties in Reference 68-1 Table 3-2, the total uncertainty from the analytical perturbation analysis is negligibly impacted [[ ]].

Part (e)

These results indicate that the void coefficient uncertainty is not substantially different at the void fractions expected for EPU conditions. The data shows no evidence of new uncertainties that would invalidate the qualification basis for models applied to transient, ATWS, or stability analysis. The void reactivity coefficient bias and uncertainty derived in the original ODYN licensing topical report remains valid and applicable for the EPU core and fuel designs. The void reactivity coefficients are applicable for the range of core thermal-hydraulic conditions expected for the transient and accident conditions, including ATWS.

References:

68-1 "Revised Supplementary Information Regarding Amendment 11 to GE Licensing Topical Report NEDE-24011-P-A," MFN-003-86, January 1986

68-4 "ODYN Statistical Adders Update," FLN-2000-014, September 22, 2000

68-5 "TRACG Application for Anticipated Operational Occurrence Transient Analysis," NEDE-32906P-A, Revision 1, April 2003

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[[

(3)]]

Figure SRXB-A-68-1
Void Coefficient Averaged for 5 10x10 Lattices at Exposures of 0,5,10,15,20,25,30,50,70 GWd/ST – TGBLA06

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[[

[3]]]

Figure SRXB-A-68-2
Void Coefficient Averaged for 5 10x10 Lattices at Exposures of 0,5,10,15,20,25,30,50,70 GWd/ST – MCNP

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Table SRXB-A-68-1
Void Coefficient Comparison between TGBLA06 and MCNP for 5 10x10 Lattices at 70% IV

[[				
				]]

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Table SRXB-A-68-2
Void Coefficient Comparison between TGBLA06 and MCNP for 5 10x10 Lattices Details at 70% IV (10, 15, & 25 GWd/ST)

[[			
			]]

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**Table SRSB-A-68-3
Void Coefficient Comparison between TGBLA06 and
MCNP for Lattice 7009 at ≥ 70% IV**

[[			
			]]

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Table SRSB-A-68-3
Void Coefficient Comparison between TGBLA06 and MCNP for Lattice 7009 at ≥ 70% IV

[[			
			]]

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Figure SRXB-A-68-3

[[ ]]

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[[

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Figure SRXB-A-68-4

[[

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Table SRXB-A-68-4
TRACG Impact of High Exposure Void Coefficient Bias

Parameter (*)	Base	High Exposure Biased	** % Difference
[[			
			]]

* LRNBP is Generator Load Rejection without Bypass
MSIVF is MSIV Closure with Flux Scram

** % Difference is defined as ((High Exp Biased – Base) / (High Exp Biased)) X 100

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Attachment 3

Vermont Yankee Nuclear Power Station

Proposed Technical Specification Change No. 263 – Supplement No. 35

Extended Power Uprate – Additional Information

General Electric Affidavit

Total number of pages in Attachment 3 (excluding this cover sheet) is 3.

General Electric Company

AFFIDAVIT

I, Glen Watford, state as follows:

(1) I am General Manager, Performance Services, General Electric Company ("GE"), have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in Enclosure 2 of GE letter, GE-VYNPS-AEP-406, *Response to NRC RAI SRXB-68*, dated September 27, 2005. The proprietary information in Enclosure 2, *Responses to NRC RAI SRXB-68*, is delineated by a double underline inside double square brackets. Figures and large equation objects are identified with double square brackets before and after the object. In each case, the superscript notation{3} refers to Paragraph (3) of this affidavit, which provides the basis for the proprietary determination.

(3) In making this application for withholding of proprietary information of which it is the owner, GE relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4), and 2.390(a)(4) for "trade secrets" (Exemption 4). The material for which exemption from disclosure is here sought also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

(4) Some examples of categories of information which fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by General Electric's competitors without license from General Electric constitutes a competitive economic advantage over other companies;

b. Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;

c. Information which reveals aspects of past, present, or future General Electric customer-funded development plans and programs, resulting in potential products to General Electric;

d. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs (4)a., and (4)b, above.

(5) To address 10 CFR 2.390 (b) (4), the information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GE, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GE, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge. Access to such documents within GE is limited on a "need to know" basis.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist or other equivalent authority, by the manager of the cognizant marketing function (or his delegate), and by the Legal Operation, for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GE are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

(8) The information identified in paragraph (2), above, is classified as proprietary because it contains detailed results and conclusions from analyses supporting the extended power uprate of the Vermont Yankee Power Station utilizing analytical models and methods including computer codes and methods of applying these for safety analyses, which GE has developed. The development of these models and computer codes and methods was achieved at a significant cost to GE, on the order of several million dollars.

The development of the analytical methods and evaluation process along with the interpretation and application of the analytical results is derived from the extensive experience database that constitutes a major GE asset.

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GE's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of GE's comprehensive BWR safety and technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC-approved methods.

The research, development, engineering, analytical and NRC review costs comprise a substantial investment of time and money by GE.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

GE's competitive advantage will be lost if its competitors are able to use the results of the GE experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to GE would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive GE of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing these very valuable analytical tools.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information, and belief.

Executed on this 27th of September 2005

27 Sept 2005

Glen Watford
General Electric

Attachment 4

Vermont Yankee Nuclear Power Station

Proposed Technical Specification Change No. 263 – Supplement No. 35

Extended Power Uprate – Additional Information

Proposed License Condition – Minimum Critical Power Ratio

Total number of pages in Attachment 4 (excluding this cover sheet) is 1.

Vermont Yankee Nuclear Power Station

PROPOSED LICENSE CONDITION – MINIMUM CRITICAL POWER RATIO

In response to NRC staff requests for information regarding General Electric's (GE) analytical methodologies for establishing fuel thermal limits, and in support of its license application for extended power uprate (EPU), Entergy provided[1] a Vermont Yankee Nuclear Power Station (VYNPS)-specific approach to address postulated uncertainties in GE's methodologies. To provide additional conservatism and margin, Entergy has proposed an interim license condition that imposes an increase in the safety limit minimum critical power ratio. The proposed license condition is stated as follows:

> When operating at thermal power greater than 1593 MWt, the margin between the safety limit minimum critical power ratio (SLMCPR) specified in Technical Specification 1.1.A.1 and the operating limit minimum critical power ratio (OLMCPR) shall be increased by 0.02. This additional margin in the minimum critical power ratio shall be implemented by adding 0.02 ? CPR to the OLMCPR determined consistent with the NRC-approved methodologies documented in General Electric Licensing Topical Report (LTR), NEDE-24011-P-A, "General Electric Standard Application for Reactor Fuel," as amended, and documented in the Core Operating Limits Report.
>
> This license condition shall expire without the need for a license amendment upon:
>
> a) The issuance of an NRC safety evaluation accepting General Electric's LTR, NEDC-33173-P, "Applicability of General Electric's Methodologies to Expanded Operating Ranges," and
>
> b) The implementation of a reload licensing analysis that incorporates the methodologies specified in LTR NEDC-33173-P and accepted by the NRC.

[1] Entergy letter to U.S. Nuclear Regulatory Commission, "Vermont Yankee Nuclear Power Station, Technical Specification Proposed Change No. 263 – Supplement No. 30, Extended Power Uprate – Response to Request for Additional Information," BVY 05-071, August 1, 2005