RAS 11808

June 14, 2006

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

DOCKETED
USNRC

June 14, 2006 (3:20pm)

OFFICE OF SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	Docket No. 50-271
ENTERGY NUCLEAR VERMONT YANKEE, LLC and ENTERGY NUCLEAR OPERATIONS, INC.	)	ASLBP No. 04-832-02-OLA (Operating License Amendment)
(Vermont Yankee Nuclear Power Station)	)	

ENTERGY'S REBUTTAL STATEMENT OF POSITION ON
NEW ENGLAND COALITION CONTENTION 3

Pursuant to 10 C.F.R. § 2.1207(a)(2) and the Atomic Safety and Licensing Board's ("Board") Revised Scheduling Order dated April 13, 2006 ("Revised Scheduling Order"),[1] Entergy Nuclear Vermont Yankee, LLC and Entergy Nuclear Operations, Inc. (collectively "Entergy") hereby submit their Rebuttal Statement of Position ("Rebuttal Statement") responding to the arguments, factual assertions and supporting materials filed by the New England Coalition ("NEC") on May 17, 2006 with respect to its Contention 3 ("NEC Contention 3").[2] This Rebuttal Statement is supported by the "Rebuttal Testimony of Craig J. Nichols and Jose L. Casillas on NEC Contention 3 – Large Transient Testing" ("Entergy Reb.") and exhibits thereto, being filed simultaneously herewith.

---

[1] As directed by the Board, "[t]he written response should be in the nature of a response brief that identifies the legal and factual weaknesses in an opponent's position, identifies rebuttal witnesses and evidence, and specifies the precise purpose of rebuttal witnesses and evidence." Revised Scheduling Order at 3.

[2] NEC's May 17, 2006 filing consisted of a "New England Coalition's Statement of Position" ("NEC's Statement") and the "Prefiled Direct Testimony of Dr. Joram Hopenfeld Regarding Contention 3" ("Hopenfeld Testimony") dated May 17, 2006. The Hopenfeld Testimony also "incorporates by reference" the "Declaration of Dr. Joram Hopenfeld Supporting New England Coalition's Response to ENVY's Motion for Summary Disposition" ("Hopenfeld Declaration") dated December 21, 2005.

Template=SECY-055 SECY-02

I. INTRODUCTION

The procedural history of NEC Contention 3, which asserts that Entergy's application for an extended power uprate ("EPU") for the Vermont Yankee Nuclear Power Station ("VY") ("EPU Application") should not be approved unless performance of Large Transient Testing ("LTT") is a made a condition of the uprate, is discussed in Entergy's Initial Statement of Position on New England Coalition Contention 3 (May 17, 2006) ("Entergy's Initial Statement")[3] and will not be repeated here. The scope of NEC Contention 3, as clarified by the Board, is limited to the main steam isolation valve closure test and the turbine generator load rejection test. Memorandum and Order (Clarifying the Scope of NEC Contention 3) (April 17, 2006), slip op. at 3.

As discussed below, NEC's May 17, 2006 filing is replete with erroneous, unsupported and irrelevant assertions. The filing also seeks to interject into this proceeding a new, previously unasserted, claim as to the performance of the VY steam dryer which is both irrelevant and untimely, and must therefore be rejected.[4]

II. APPLICABLE LEGAL STANDARDS

NEC does not address in its initial filing what legal standards would be contravened by the granting of the exception from LTT at VY. Entergy restates that the legal standard for determining whether the EPU should be approved without the performance of LTT is whether, in the absence of LTT, the test program implemented by Entergy for the EPU complies with Criterion XI of Appendix B to 10 C.F.R. Part 50 by demonstrating that structures, systems, and components will perform satisfactorily in service at the proposed EPU power level.

[3] Entergy's Initial Statement was supported by the Testimony of Craig J. Nichols and Jose L. Casillas on NEC Contention 3 – Large Transient Testing (May 17, 2006) ("Entergy Dir.") and exhibits thereto.

[4] NEC has twice previously sought to introduce an untimely steam dryer contention in this proceeding. The first attempt was dismissed, see Memorandum and Order (Ruling on the Admissibility of Three Additional Contentions), LBP-06-14, 63 NRC ___ (May 25, 2006), slip op. at 23-26. NEC's second attempt to litigate steam dryer issues is still pending. New England Coalition's Request for Leave to File a New Contention, filed on April 20, 2006.

III. ENTERGY'S REBUTTAL STATEMENT OF POSITION ON FACTUAL ISSUES

A. Entergy's rebuttal witnesses and evidence

Entergy's rebuttal testimony on NEC Contention 3 is presented by the same two experts who submitted direct testimony in support of Entergy's Initial Statement on this contention: Messrs. Craig J. Nichols, the EPU Project Manager for VY, and Jose L. Casillas, the Plant Performance Consulting Engineer in the Nuclear Analysis group of the Engineering organization of General Electric Nuclear Energy ("GE"). As demonstrated in their direct testimony, Messrs. Nichols and Casillas have extensive experience in boiling water reactor ("BWR") operations and the response of BWRs like VY to large transients, and are well qualified to offer testimony on this contention based on both their technical expertise and experience and their first hand knowledge of the issues raised in NEC Contention 3.

By contrast, NEC's witness on this contention, Dr. Joram Hopenfeld, has provided no indication that he has any experience or expertise concerning BWRs in general, nor any experience or expertise in the analysis or evaluation of large operational transients at BWRs, nor does he profess to have any familiarity with the operational experience at either VY or other comparable plants with large transients. See "Curriculum Vitae for Dr. Joram (Joe) Hopenfeld," Exhibit A to NEC's Answer to Entergy's Motion for Summary Disposition of New England Coalition Contention 3 (Dec. 22, 2005). Nothing in Dr. Hopenfeld's Testimony shows additional relevant credentials.[5]

The rebuttal testimony of Entergy's witnesses is intended to refute the following claims made by Dr. Hopenfeld: that (1) there is no evidence that the ODYN code that is used for transient analyses at VY has been benchmarked for the type of transients that have been analyzed at

[5] Dr. Hopenfeld asserts that "thermal hydraulic issues are common to many components both in PWRs and BWRs. For example both PWRs and BWRs use dryers to separate moisture from steam. Differences in geometry and the operating conditions would require different modeling; nevertheless the concepts of the governing equations are similar. My broad experience in various areas of thermal hydraulics qualifies me as an expert in evaluating thermal hydraulic issues in BWRs." Hopenfeld Testimony at A5. However, as discussed in this Rebuttal Statement, issues involving steam dryers and component thermal hydraulic performance are irrelevant to NEC Contention 3.

EPU conditions, or of how the ODYN code was benchmarked for steady state operations (Hopenfeld Testimony at A8 and A9; Hopenfeld Declaration at 3, ¶ 9c); (2) computer codes and analyses cannot be used as a substitute for testing (Hopenfeld Declaration at 5, ¶ 14); (3) the operational experience at other plants cannot be relied upon to substitute for LTT because plant design and operating and maintenance history are plant-specific and influence plant response to transients (id. at 4, ¶ 11); (4) VY operational experience at a 100% (pre-EPU) power level cannot be relied on to predict that the plant will operate safely under transients occurring at the EPU (120%) power level (id. at 5, ¶ 12); and (5) the VY steam dryer's structural integrity could be affected by EPU operation and LTT is needed to establish whether this is the case (Hopenfeld Testimony at A8, A10; Hopenfeld Declaration at 2-3, ¶ 9a).

In addition, the rebuttal testimony of Messrs. Nichols and Casillas responds to NEC's assertion, unsupported by Dr. Hopenfeld's testimony or otherwise, that "component testing, piecemeal ascension testing, and inappropriately applied predictive computer codes" may not be substituted for "integral Large Transient Testing." NEC's Statement at 13.

B. Benchmarking of ODYN Code

1. The behavior of the VY plant during a large transient can be bounded analytically. Entergy Reb. at A11.
2. The large transient analyses for VY, which were performed using the NRC-approved code ODYN, predict the behavior of the safety- and non-safety-related systems in the plant during operational transients. These large transient analyses model both the performance of the secondary side of the plant and any relevant potential interactions between primary and secondary systems in a transient to evaluate the parameters of interest. Id.

3. ODYN is a proprietary code developed by GE and approved by the NRC in 1981 for use in the analysis of GE BWR plant response to pressurization transients. A description of the ODYN model and the qualification turbine trip tests as well as the NRC Safety Evaluation Report can be found in the four-volume report NEDO 24154-A. Id. at A12 and Entergy Reb. Exhibit 1.
4. The ODYN code models BWR vessel physical components, mechanical equipment functions, control systems and nuclear/thermal-hydraulic phenomena. The simulation involves describing the physical plant in the model (i.e., volumes, flow paths, resistances), establishing the desired operating conditions (i.e., water level, power, pressure) and introducing a disturbance (i.e., valve closure, pump trip, control action). The ODYN model predicts the plant response behavior based on its physical model correlations. Entergy Reb. at A13.
5. The ODYN analyses assume operational configurations and component/system failures that bound (i.e., represent more severe conditions than) the transients that would occur during normal plant operations or design basis events, including large transients. Id.
6. Dr. Hopenfeld asserts in A8 of his Testimony that "Entergy does not state that the ODYN code was benchmarked for pressurized transients nor does it discuss how the ODYN code was benchmarked for steady state operations." Contrary to Dr. Hopenfeld's claims, the ODYN code has been benchmarked against turbine trips (equivalent in their effects to generator load rejection trips) and main steam valve isolation events. The turbine trip data were obtained from the Peach Bottom and KKM plants; the MSIV closure data were obtained from the Hatch plant. The Peach Bottom turbine trip tests used to benchmark the ODYN code represented more severe condi-

tions than those observed in actual plant transient events, in that the reactor trip was purposefully delayed to increase the severity of the transient. The ODYN model is based on physical correlations that are applicable over wide range of parameters that are even beyond the acceptable licensing ranges. Therefore, the ODYN code is fully qualified for the VY pressurization transients. Entergy Reb. at A14 and Exhibit 1 to Entergy Reb.

7. ODYN has not been benchmarked against steady state conditions because it does not need to be. The purpose of the ODYN code is to predict the transient behavior of key vessel parameters, such as dome pressure and core power, not to evaluate the plant's initial, pre-transient conditions. Id. at A15.

8. The operating parameters assumed by ODYN at the start of the transient reflect the plant steady state conditions calculated by appropriate, and more detailed, steady state modeling codes. For example, the axial power distribution in ODYN at the start of the transient is based on that calculated by the 3-Dimensional Nuclear Reactor code. Likewise, the flow inside the fuel assemblies is based on that calculated by the multi-channel detailed thermal hydraulic model. Therefore, the steady state conditions utilized by ODYN reflect the best representation of the status of the reactor before the transient and provide a consistent basis for the transient solution. Id.

9. Dr. Hopenfeld states that "ENVY failed to state whether the ODYN code was specifically designed and verified (benchmarked) for the type of transients they have analyzed at EPU conditions. ENVY has not referenced any prototypic separate effects, or system transient tests that were conducted at EPU conditions" (Hopenfeld Declaration at ¶ 9.c). Contrary to these statements, the ODYN code is fully qualified (and bench-

marked against plant data) for the type of pressurization events that result from plant transients. Furthermore, the ODYN code physical correlations, such as hydraulic losses, flow characteristic, and fluid, material and nuclear properties are applicable for ranges beyond the bounds of the VY licensing analyses. Id. at A16.

10. The key plant equipment performance features from the viewpoint of pressurization transient considerations, such as valve stroke characteristics, control rod insertion and relief valve actuation are not affected by implementation of the EPU. Component and system testing validate that these parameters remain within analysis input assumptions. Id.

11. Dr. Hopenfeld alleges that "closure of the MSIVs, due to operator error or LOCA redirects the flow of steam into the containment suppression pool. The uncertainties in predicting loads under these conditions must be quantified at EPU flow rates" (Hopenfeld Testimony at A9). This allegation is irrelevant to NEC Contention 3 because the ODYN code is applied to pressurization events to demonstrate compliance to both the vessel overpressure and overpower criteria including appropriate margin for uncertainties. However, the ODYN code analyses do not apply to other plant conditions, such as a LOCA, which are subject to different analyses. Id. at A17.

C. Use of Computer Codes and Analyses as a Substitute for Testing

12. The ODYN model is qualified for the analysis of large transients and the resulting parameters are within the applicable physical correlations of the model for the bounding licensing analysis. Also, a VY LTT at the increased power condition at constant pressure would be significantly milder than those assumed in the ODYN analyses. Several VY transients have been compared against ODYN predictions over the years to assess

the specific BWR licensing basis. All of these comparisons have determined that the ODYN predictions are bounding and that the plant equipment response is consistent with its design basis. Id. at A18.

13. GE has simulated in detail some of the transients for the purpose of revising the equipment response or setpoints in order to improve the plant response. None of these simulations has shown any ODYN model deficiency with respect to its licensing and qualification basis. Therefore, GE would not expect any model qualification benefit if the LTTs were performed at VY. Id. and Exhibit 2 to Entergy Reb.
14. Dr. Hopenfeld misleadingly asserts that Entergy has made "the erroneous assumption that computer codes and analysis can be used as a substitute for testing. We strongly disagree with this approach; one of the main purposes of the transient testing is to discover unforeseen component behavior or operator actions" (Hopenfeld Declaration, ¶ 14). While the results of LTT at EPU in VY would differ from those of tests that have been conducted at VY in the past, the LTT from EPU would not result in new conditions or phenomena that are beyond the equipment (valve stroke characteristic, rod insertion and relief valve actuation) qualification. All the LTT would accomplish is further validate the ODYN model predictions, which is unnecessary because, as discussed earlier, the ODYN model has been benchmarked and qualified for conditions that exceed those that would be experienced at VY during transients. Entergy Reb. at A19.
15. There are no operator actions required in the LTT, thus performance of the tests would shed no light on "operator actions." Id.

D. Reliance on operational experience at other plants as a substitute for LTT

16. Of the thirteen BWR plants that have implemented EPUs without increased reactor operating pressure, four (Hatch 1 and 2, Brunswick 2, and Dresden 3) have experienced one or more unplanned large transients from uprated power levels. Id. at A20.

17. Contrary to Dr. Hopenfeld's assertion that Entergy must demonstrate "that the design and operating histories of the cited plants are the same as the design and operating history of the Vermont Yankee plant" before it can take credit for other plant's response to plant events as a substitute for LTT (Hopenfeld Declaration ¶ 11), having identical "design and operating histories" is not necessary in order to draw valid inferences from plant operating experience. Entergy Reb. at A21.

18. Also, while specific equipment performance can vary depending of several factors, the safety analyses apply the limiting performance bounds consistent with design specifications, thus assuring conservative results. Id.

E. Reliance on VY operational experience at a pre-EPU 100% power level

19. VY has previously experienced several unplanned transients, most recently in 2004 and 2005. No significant anomalies were seen in the plant's response to these transients. The performance of VY in the transients it experienced at pre-EPU power levels was well within the bounds of the ODYN analyses. Id. at A22.

20. The VY transients in 2004 and 2005 occurred after most of the modifications associated with EPU were already implemented, including the new HP turbine rotor, Main Generator Stator rewind, the new high pressure feedwater heaters, condenser tube staking, an upgraded isophase bus duct cooling system, and condensate demineralizer fil-

tered bypass. In each instance, the modified or added equipment functioned normally during the transient. The plant's performance during these recent transients, including that of the modified components, demonstrates that the EPU modifications do not significantly affect the plant's response during transient conditions. Id. at A23.

21. Dr. Hopenfeld's assertion (Hopenfeld Declaration at ¶¶ 12-13) that Entergy "has not provided any relevant data showing that the plant will operate safely and efficiently when the transients are initiated at the relatively high EPU flow rates where high dynamic loads could be created during the transient adversely affecting its mitigation" is irrelevant because determination of dynamic loadings on components is not the purpose of either the large transient analyses performed by ODYN or the LTT themselves. The purposes of both the analyses and the LTT are to determine 1) the peak pressure transient in the case of the MSIV closure, or 2) the greatest transient challenge to the reactor thermal limits in the case of the generator load rejection. Dynamic loadings of components under normal, upset, or faulted conditions (including transients) are covered in separate analyses and acceptance criteria. Entergy Reb. at A24.

F. Effect of the VY Uprate on Steam Dryer's Structural Integrity

22. Dr. Hopenfeld states that "increase in flow velocity at EPU conditions, steady state temperature and pressure fluctuations will increase the fatigue usage factor of the steam dryer. This increase in fatigue together with the increase in fatigue during transients must be taken into account to show that the cumulative fatigue factor at EPU conditions will remain below A.S.M.E. allowable limits" (Hopenfeld Testimony at A10). These statements are irrelevant to LTT because the MSIV closure and the generator

load rejection tests provide no information on steam dryer fatigue usage factor. Entergy Reb. at A25.

23. LTT provides information on the peak reactor vessel pressure and power level (i.e., temperature increase) resulting from the pressurization caused by the large transients. Performance of LTT would not provide information for use in deriving either fatigue factors on the steam dryer or the loadings to which the dryer will be subjected. Id.

24. The four-point prescription set forth by Dr. Hopenfeld in his Testimony at A11 for things that Entergy should do to "demonstrate that the fatigue usage factor of critical components will remain below the relevant A.S.M.E. code limits" has been fully satisfied in that Entergy has already performed precisely each of the actions that Dr. Hopenfeld would require in order to resolve his concerns. Entergy Reb. at A27. At any rate, the concerns expressed by Dr. Hopenfeld underlying his call for this four-point prescription are irrelevant to LTT. Id. at A28.

G. Reliance on System and Component Testing

25. System and component testing during normal operations provide an adequate basis for an exception to LTT. Id. at A29.

26. Technical Specification-required surveillance testing (e.g., component testing, trip logic system testing, simulated actuation testing) is routinely performed during plant operations. Such testing demonstrates that the structures, systems and components ("SSCs") required for appropriate transient performance will perform their functions, including integrated performance for transient mitigation as assumed in the transient analysis. Id.

27. Because the characteristics and functions of SSCs are tested periodically during plant operations, they do not need to be demonstrated further in a large transient test. In ad-

dition, limiting transient analyses (i.e., those that affect core operating and safety limits) are re-performed for each operating cycle and are included as part of the reload licensing analysis. Id. at A30.

28. NEC quotes at length from discussions at meetings of the Advisory Committee on Reactor Safeguards ("ACRS") to assert that "component testing, piecemeal ascension testing, and inappropriately applied predictive computer codes" may not be substituted for "integral Large Transient Testing." NEC's Statement at 13. However, the discussions at the ACRS meetings cited by NEC are inapplicable, since they refer to a different type of plant (PWR) rather than BWRs such as VY. Entergy Reb. at A31.

29. In addition, the excerpts quoted seem to reflect the view of a single ACRS member (Mr. Rosen) and not the view of the ACRS as a whole. In fact, the ACRS specifically concluded that LTT was not needed at VY, and wrote: "Load rejection and main steam isolation valve closure transient tests are not warranted. The planned transient testing program adequately addresses the performance of the modified systems." Id.

30. The experience of the BWR fleet demonstrates that the transient events of concern here are well understood, and the key equipment has been observed to perform as designed. Furthermore, the qualification of the ODYN code against more challenging pressurization events than those that would occur during plant operations (or during LTT) assures that its application to EPU conditions is sound. Id.

IV. CONCLUSION

Nothing in NEC's Statement or the testimony of Dr. Hopenfeld undercuts the validity of Entergy's position and its testimony that the extensive and conservative engineering analyses, historical test and actual transient data, individual component testing, and observed performance at other plants experiencing large transients provide assurance and confidence that VY systems will function as designed in mitigation of large transients from EPU conditions. Therefore, Entergy's request for an exception to LTT at VY is reasonable and poses no threat to public health and safety. Id. at A33.

Consequently, the test program implemented by Entergy for the EPU, which excludes the performance of LTT, complies with Criterion XI of Appendix B to 10 C.F.R. Part 50 by demonstrating that structures, systems, and components will perform satisfactorily in service at the proposed EPU power level.

Respectfully submitted,

Matias F Travieso-Diaz

Jay E. Silberg
Matias F. Travieso-Diaz
PILLSBURY WINTHROP SHAW PITTMAN LLP
2300 N Street, N.W.
Washington, DC 20037-1128
Tel. (202) 663-8063

Counsel for Entergy Nuclear Vermont Yankee, LLC and Entergy Nuclear Operations, Inc.

Dated: June 14, 2006

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	Docket No. 50-271
ENTERGY NUCLEAR VERMONT YANKEE, LLC and ENTERGY NUCLEAR OPERATIONS, INC.	)	ASLBP No. 04-832-02-OLA (Operating License Amendment)
(Vermont Yankee Nuclear Power Station)	)	

CERTIFICATE OF SERVICE

I hereby certify that copies of "Entergy's Rebuttal Statement of Position on New England Coalition Contention 3," Rebuttal Testimony of Craig J. Nichols and Jose L. Casillas On NEC Contention 3 – Large Transient Testing," "Affidavit of Craig J. Nichols," and "Affidavit of Jose L. Casillas" were served on the persons listed below by deposit in the U.S. mail, first class, postage prepaid, and where indicated by an asterisk by electronic mail, this 14th day of June, 2006.

*Administrative Judge
Alex S. Karlin, Chair
Atomic Safety and Licensing Board Panel
Mail Stop T-3 F23
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001
ask2@nrc.gov

*Administrative Judge
Lester S. Rubenstein
4760 East Country Villa Drive
Tucson AZ 85718
lesrrr@comcast.net

*Administrative Judge
Dr. Anthony J. Baratta
Atomic Safety and Licensing Board Panel
Mail Stop T-3 F23
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001
ajb5@nrc.gov

Atomic Safety and Licensing Board
Mail Stop T-3 F23
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

*Secretary
Att'n: Rulemakings and Adjudications Staff
Mail Stop O-16 C1
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001
secy@nrc.gov, hearingdocket@nrc.gov

Office of Commission Appellate Adjudication
Mail Stop O-16 C1
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

*Raymond Shadis
New England Coalition
P.O. Box 98
Shadis Road
Edgecomb ME 04556
shadis@prexar.com

*Sherwin E. Turk, Esq.
*Steven C. Hamrick, Esq.
Office of the General Counsel
Mail Stop O-15 D21
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001
set@nrc.gov, sch1@nrc.gov

*Marcia Carpentier
Atomic Safety and Licensing Board Panel
Mail Stop T-3 F23
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001
mxc7@nrc.gov

*Jonathan Rund
Atomic Safety and Licensing Board Panel
Mail Stop T-3 F23
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001
jmr3@nrc.gov

Matias F. Travieso-Diaz

Matias F. Travieso-Diaz

June 14, 2006

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	Docket No. 50-271
ENTERGY NUCLEAR VERMONT YANKEE, LLC and ENTERGY NUCLEAR OPERATIONS, INC. (Vermont Yankee Nuclear Power Station)	)	ASLBP No. 04-832-02-OLA (Operating License Amendment)

REBUTTAL TESTIMONY OF CRAIG J. NICHOLS AND JOSE L. CASILLAS ON NEC CONTENTION 3 – LARGE TRANSIENT TESTING

June 14, 2006

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of ENTERGY NUCLEAR VERMONT YANKEE, LLC and ENTERGY NUCLEAR OPERATIONS, INC. (Vermont Yankee Nuclear Power Station)	))))))))	Docket No. 50-271 ASLBP No. 04-832-02-OLA (Operating License Amendment)

REBUTTAL TESTIMONY OF CRAIG J. NICHOLS AND JOSE L. CASILLAS ON NEC CONTENTION 3 – LARGE TRANSIENT TESTING

I. INTRODUCTION

Craig J. Nichols ("CJN")

Q1. Please state your full name.

A1. (CJN) My name is Craig J. Nichols.

Q2. By whom are you employed and what is your position?

A2. (CJN) I am the Extended Power Uprate Project Manager for Entergy Nuclear Operations, Inc. ("Entergy"). In that capacity, I am the manager for the implementation of the extended power uprate ("EPU") at the Vermont Yankee Nuclear Power Station ("VY").

Q3. Have you previously provided written testimony in this proceeding?

A3. (CJN) Yes. I was co-sponsor with Mr. Jose L. Casillas of direct testimony dated May 17, 2006 entitled "Testimony of Craig J. Nichols and Jose L. Casillas on NEC Contention 3 – Large Transient Testing." "Entergy's Direct Testimony."

Jose L. Casillas ("JLC")

Q4. Please state your full name.

A4. (JLC) My name is Jose L. Casillas.

Q5. By whom are you employed and what is your position?

A5. (JLC) I am the Plant Performance Consulting Engineer in the Nuclear Analysis group of the Engineering organization of General Electric Nuclear Energy ("GE"). In that capacity, I am responsible for boiling water reactor ("BWR") plant performance design and analyses, including evaluations in support of EPU applications and the development and application of computer codes used to predict BWR plant performance.

Q6. Have you previously provided written testimony in this proceeding?

A6. (CJN) Yes. I was co-sponsor, with Mr. Craig J. Nichols, of Entergy's Direct Testimony.

Q7. What is the purpose of your testimony?

A7. (CJN, JLC) The purpose of our testimony is to respond, on behalf of Entergy Nuclear Vermont Yankee, LLC and Entergy Nuclear Operations, Inc. (collectively "Entergy"), to certain materials submitted by the New England Coalition ("NEC") on May 17, 2006 regarding NEC Contention 3 in this proceeding. As admitted by the Atomic Safety and Licensing Board ("Board"), NEC Contention 3 reads:

> The license amendment should not be approved unless Large Transient Testing is a condition of the Extended Power Uprate.

Memorandum and Order, LBP-04-28, 60 NRC 548, 580, App. 1 (Nov. 22, 2004).

In addition, the scope of NEC Contention 3 has been clarified by the Board, which has ruled that "the 'Large Transient Testing' ["LTT"] at issue in NEC Contention 3, and the testimony and other evidence to be submitted concerning it, are limited to the main steam isolation valve ["MSIV"] closure test and the turbine generator load rejection test." Memorandum and Order (Clarifying the Scope of NEC Contention 3) (April 17, 2006), slip op. at 3.

Q8. To what materials submitted by NEC regarding NEC Contention 3 are you responding?

A8. (CJN, JLC) Our response is directed at (a) "New England Coalition's Statement of Position" ("NEC Statement") dated May 17, 2006; (b) the "Prefiled Direct Testimony of Dr. Joram Hopenfeld Regarding Contention 3" ("Hopenfeld Testimony") dated May 17, 2006, and (c) the "Declaration of Dr. Joram Hopenfeld Supporting New England Coalition's Response to ENVY's Motion for Summary Disposition" ("Hopenfeld Declaration") dated December 21, 2005. The Hopenfeld Declaration is incorporated by reference into the Hopenfeld Testimony at A13.

II. DISCUSSION

A. Issues Raised By NEC Direct Case Filing

Q9. What issues are raised by Dr. Hopenfeld in his Testimony and his Declaration?

A9. (CJN, JLC) Dr. Hopenfeld asserts: that (1) there is no evidence that the ODYN code that is used for transient analyses at VY has been benchmarked for the type of transients that have been analyzed at EPU conditions, or of how the ODYN code was benchmarked for steady state operations (Hopenfeld Testimony at A8 and A9; Hopenfeld Declaration at 3, ¶ 9c); (2) computer codes and analyses cannot be used as a substitute for testing (Hopenfeld Declaration at 5, ¶ 14); (3) the operational experience at other plants cannot be relied upon to substitute for LTT because plant design and operating and maintenance history are plant-specific and influence plant response to transients (id. at 4, ¶ 11); (4) VY operational experience at a 100% (pre-EPU) power level cannot be relied on to predict that the plant will operate safely under transients occurring at the EPU (120%) power level (id. at 5, ¶ 12); and (5) the VY steam dryer's structural integrity could be affected by EPU operation and LTT is needed to establish whether this is the case (Hopenfeld Testimony at A8, A10; Hopenfeld Declaration at 2-3, ¶ 9a).

Q10. What issues does NEC raise in its Statement?

A10. (CJN, JLC) NEC's Statement asserts that "component testing, piecemeal ascension testing, and inappropriately applied predictive computer codes" may not be substituted for "integral Large Transient Testing." Statement of Position at 13. In support of its assertion, NEC quotes extensively from statements made at meetings of the Advisory Committee on Reactor Safeguards ("ACRS"), none relating to Entergy's EPU Application at VY but to that at another plant (the Waterford plant, a pressurized water reactor quite different from VY). NEC Statement at 9-13.

B. Benchmarking of ODYN Code

Q11. Can the behavior of the VY plant during a large transient be bounded analytically?

A11. (CJN) Yes. The large transient analyses for VY, which were performed using the NRC-approved code ODYN, predict the behavior of the safety- and non-safety-related systems in the plant during operational transients. These large transient analyses model both the performance of the secondary side of the plant and any relevant potential interactions between primary and secondary systems in a transient to evaluate the parameters of interest.

Q12. Please provide a summary description of the ODYN code.

A12. (JLC) ODYN is a proprietary code developed by GE and approved by the NRC in 1981 for use in the analysis of GE BWR plant response to pressurization transients. A description of the ODYN model and the qualification turbine trip tests as well as the USNRC Safety Evaluation Report can be found in NEDO 24154-A, Volumes 1 and 2 respectively, dated August 1986. (A copy of the NEDO 24154-A, report, vols. 1 and 2 will be provided on June 19, 2006 pursuant to the Board's June 5, 2006 Order Regarding Submission of Supplemental Documents). Volume 3 of this report (proprietary) contains the procedure for licensing applications to pressurization transient analyses. A more recent (1998) Volume 4 of this report (proprietary) contains the qualification and application of ODYN to the complete range of core wide transients. I prepared a summary of the key information contained in each of the four volumes, as it pertains to the qualification of the model and its application to BWR safety analyses. The summary is included as Exhibit 1 hereto.

The ODYN model has been upgraded over the last 20 years to include greater modeling detail such as increased nodes, advanced physics correlations, and more representative control systems. These changes have consistently improved the accuracy of the ODYN code and reduced the uncertainty in its predictions compared against the qualification tests.

Q13. How does the ODYN code model the behavior of BWRs such as VY during large transients?

A13. (JLC) The ODYN code models BWR vessel physical components, mechanical equipment functions, control systems and nuclear/thermal-hydraulic phenomena. The simulation involves describing the physical plant in the model (i.e., volumes, flow paths, resistances), establishing the desired operating conditions (i.e., water level, power, pressure) and introducing a disturbance (i.e., valve closure, pump trip, control action). The ODYN model predicts the plant response behavior based on its physical model correlations.

The ODYN analyses assume operational configurations and component/system failures that bound (i.e., represent more severe conditions than) the transients that would occur during normal plant operations or design basis events, including large transients.

Q14. Dr. Hopenfeld asserts in A8 of his Direct Testimony that "Entergy does not state that the ODYN code was benchmarked for pressurized transients nor does it discuss how the ODYN code was benchmarked for steady state operations." What are pressurized transients and has the ODYN code been benchmarked for such transients?

A14. (JLC) Pressurized transients (or "pressurization transients") involve fast pressure increases caused by closure of valves in the vessel steam piping. Both the MSIV closure and the generator load rejection are pressurization transients.

As stated in Entergy's Direct Testimony at A36, the ODYN code has been benchmarked against turbine trips (equivalent in their effects to generator load rejection trips) and main steam valve isolation events. The turbine trip data were obtained from the Peach Bottom and KKM plants; the MSIV closure data were obtained from the Hatch plant. See Exhibit 1. The Peach Bottom turbine trip tests used to benchmark the ODYN code represented more severe conditions than those observed in actual plant transient events, in that the reactor trip was purposefully delayed to increase the severity of the transient. The ODYN model is based on physical correlations that are applicable over wide range of parameters that are even beyond the acceptable licensing ranges. Therefore, the ODYN code is fully qualified for the VY pressurization transients. Performance of LTT at VY would not challenge the facility nearly as much as the Peach Bottom tests used in the ODYN qualification.

Q15. Has ODYN been benchmarked for steady state operations?

A15. (JLC) No, because it did not need to be. The purpose of the ODYN code is to predict the transient behavior of key vessel parameters, such as dome pressure and core power, not to evaluate the plant's initial, pre-transient conditions.

The operating parameters assumed by ODYN at the start of the transient reflect the plant steady state conditions calculated by appropriate, and more detailed, steady state modeling codes. For example, the axial power distribution in ODYN at the start of the transient is based on that calculated by the 3-Dimensional Nuclear Reactor code. Likewise, the flow inside the fuel assemblies is based on that calculated by the multi-channel detailed thermal hydraulic model. Therefore, the steady state conditions utilized by ODYN reflect the best representation of the status of the reactor before the transient and provide a consistent basis for the transient solution.

Q16. Dr. Hopenfeld states in his Declaration at ¶ 9.c that "ENVY failed to state whether the ODYN code was specifically designed and verified (benchmarked) for the type of transients they have analyzed at EPU conditions. ENVY has not referenced any prototypic separate effects, or system transient tests that were conducted at EPU conditions." Has ODYN been benchmarked against the specific conditions that will be encountered during MSIV closure and generator load rejection transients at VY?

A16. (JLC) As has been stated before, the ODYN code is fully qualified (and benchmarked against plant data) for the type of pressurization events that result from plant transients. Furthermore, the ODYN code physical correlations, such as hydraulic losses, flow characteristic, and fluid, material and nuclear properties are applicable for ranges beyond the bounds of the VY licensing analyses. The key plant equipment performance from pressurization transient considerations, such as valve stroke characteristics, control rod insertion and relief valve actuation are not affected by implementation of the EPU. Component and system testing validate that these parameters remain within analysis input assumptions.

Q17. Dr. Hopenfeld further states in A9 of his direct testimony that "if the ODYN computer code employs inaccurate models, the predicted behavior of the VY reactor during transients will include large uncertainties. For example, closure of the MSIVs, due to operator error or LOCA redirects the flow of steam into the containment suppression pool. The uncertainties in predicting loads under these conditions must be quantified at EPU flow rates." How do you respond to Dr. Hopenfeld's concerns?

A17. (JLC) The ODYN code is applied to pressurization events to demonstrate compliance to both the vessel overpressure and overpower criteria including appropriate margin for uncertainties. The ODYN code analyses do not apply to other plant conditions, such as a LOCA, which are subject to different analyses. Therefore, the alleged modeling errors and uncertainties in predicted loads that are of concern to Dr. Hopenfeld are irrelevant to the issues raised in NEC Contention 3.

C. Use of Computer Codes and Analyses as a Substitute for Testing

Q18. Why is it reasonable to conclude that the ODYN simulations of VY's behavior in large transients during EPU operation accurately predict the actual plant response to those transients?

A18. (JLC) The ODYN model is qualified for the analysis of large transients and the resulting parameters are within the applicable physical correlations of the model for the bounding licensing analysis. Also, a VY LTT at the increased power condition at constant pressure would be significantly milder than those assumed in the ODYN analyses. Several VY transients have been compared against ODYN predictions over the years to assess the specific BWR licensing basis. All of these comparisons have determined that the ODYN predictions are bounding and that the plant equipment response is consistent with its design basis. See Exhibits 9-16 to the Direct Testimony. Furthermore, GE has simulated in detail some of the transients for the purpose of revising the equipment response or setpoints in order to improve the plant response. See Exhibit 2. None of these simulations has shown any ODYN model deficiency with respect to its licensing and qualification basis. Therefore, GE would not expect any model qualification benefit if the LTTs were performed at VY.

Q19. In ¶ 14 of his Declaration, Dr. Hopenfeld asserts that Entergy has made "the erroneous assumption that computer codes and analysis can be used as a substitute for testing. We strongly disagree with this approach; one of the main purposes of the transient testing is to discover unforeseen component behavior or operator actions." How do you respond to these assertions?

A19. (JLC) Dr. Hopenfeld's argument is misleading. While the results of LTT at EPU in VY would differ from those of tests that have been conducted at VY in the past, the LTT from EPU would not result in new conditions or phenomena that are beyond the equipment (valve stroke characteristic, rod insertion and relief valve actuation) qualification. All the LTT would accomplish is further validate the ODYN model predictions, which is unnecessary because, as discussed earlier, the ODYN model has been benchmarked and qualified for conditions that exceed those that would be experienced at VY during transients.

With respect to "operator actions," there are no operator actions required in the LTT, thus performance of the tests would shed no light on "operator actions."

D. Reliance on operational experience at other plants as a substitute for LTT

Q20. What industry experience confirms the basic transient analysis methodology used by Entergy at VY?

A20. (JLC) Of the thirteen BWR plants that have implemented EPUs without increased reactor operating pressure, four (Hatch 1 and 2, Brunswick 2, and Dresden 3) have experienced one or more unplanned large transients from uprated power levels. These transients are discussed in Entergy's Direct Testimony at A44.

Q21. Dr. Hopenfeld states on ¶ 11 of his Declaration that plant operating experience shows that plant events depend on plant design, plant operating and maintenance history, and quality assurance during construction and that, because these are plant specific variables, Entergy must demonstrate "that the design and operating histories of the cited plants are the same as the design and operating history of the Vermont Yankee plant" before it can take credit for other plant's response to plant events as a substitute for LTT. Do you agree with that position?

A21. (JLC) Not entirely. The plants have to be analogous in the relevant aspects of the design that one wishes to compare; thus, operational experience with steam generator issues in pressurized water reactors is inapplicable to BWRs. However, having identical "design and operating histories" is not necessary in order to draw valid inferences from plant operating experience. For example, the Entergy Direct Testimony at A16 shows the significant similarities between VY and the Brunswick units, so that it is reasonable to predict that the performance of both plants in the event of a large transient would be substantially the same with respect to transients experienced under EPU operations. Also, while specific equipment performance can vary depending of several factors, the safety analyses apply the limiting performance bounds consistent with design specifications, thus assuring conservative results.

E. Reliance on VY operational experience at a pre-EPU 100% power level

Q22. Has VY experienced large transients during its operating lifetime?

A22. (CJN) Yes. VY has previously experienced several unplanned transients, most recently in 2004 and 2005. Those are discussed in Entergy's Direct Testimony at A49 – A50. As described there, no significant anomalies were seen in the plant's response to these transients. The performance of VY in the transients it experienced at pre-EPU power levels was well within the bounds of the ODYN analyses.

Q23. Does VY's historical response to large transients provide a basis for an exception to LTT?

A23. (CJN) Yes. In particular, the transients in 2004 and 2005 occurred after most of the modifications associated with EPU were already implemented, including the new HP turbine rotor, Main Generator Stator rewind, the new high pressure feedwater heaters, condenser tube staking, an upgraded isophase bus duct cooling system, and condensate demineralizer filtered bypass. In each instance, the modified or added equipment functioned normally during the transient. The plant's performance during these recent transients, including that of the modified components, demonstrates that the EPU modifications do not significantly affect the plant's response during transient conditions.

Q24. Dr. Hopenfeld's Declaration at ¶¶ 12-13 charges that Entergy's reliance on its operational experience is based on speculation, not hard data, and asserts that "ENVY has not provided any relevant data showing that the plant will operate safely and efficiently when the transients are initiated at the relatively high EPU flow rates where high dynamic loads could be created during the transient adversely affecting its mitigation." What is your response to his objections?

A24. (CJN) Determination of dynamic loadings on components is not the purpose of either the large transient analyses performed by ODYN or the LTT themselves. The purposes of both the analyses and the LTT are to determine 1.) the peak pressure transient in the case of the MSIV closure, or 2.) the greatest transient challenge to the reactor thermal limits in the case of the generator load rejection. Dynamic loadings of components under normal, upset, or faulted conditions (including transients) are covered in separate analyses and acceptance criteria. Determination of such loadings has no relation to large transient analysis, LTT, or this contention.

F. Effect of the VY Uprate on Steam Dryer's Structural Integrity

Q25. Dr. Hopenfeld states in his Testimony at A10 that "increase in flow velocity at EPU conditions, steady state temperature and pressure fluctuations will increase the fatigue usage factor of the steam dryer. This increase in fatigue together with the increase in fatigue during transients must be taken into account to show that the cumulative fatigue factor at EPU conditions will remain below A.S.M.E. allowable limits." What information do the MSIV closure and the generator load rejection tests provide relevant to steam dryer fatigue usage factor?

A25. (JLC) None. LTT provides information on the peak reactor vessel pressure and power level (i.e., temperature increase) resulting from the pressurization caused by the large transients. Performance of LTT would not provide information for use in deriving either fatigue factors on the steam dryer or the loadings to which the dryer will be subjected.

Q26. Dr. Hopenfeld also claims that "[i]t is preposterous for ENVY to claim that transient testing at the 120% power level is not required in the light of the Quad Cities dryer failure. Load variations and insufficient full scale testing resulted in the unexpected failure of the dryer." Would LTT provide and information that would determine loads on the steam dryer?

A26. (JLC) No. LTT does not provide information that could be used to determine steam dryer loadings.

Q27. In his Testimony at A11 Dr. Hopenfeld provides the following prescription for things that Entergy should do to "demonstrate that the fatigue usage factor of critical components will remain below the relevant A.S.M.E. code limits:

1. Walk around the plant and identify those components that are most susceptible to failure by flow-induced vibrations.

2. Identify the parameters (pressure, neutronic response) that can be used to compare plant behavior during MSIVs closure and load rejections to ODYN predictions under VY- EPU conditions.

3. Compare ODYN predictions with Peach Bottom data

4. If a good agreement is not obtained in 3 above, show that transient tests are not required in spite of the differences between Peach Bottom and VY."

What is your response to Dr. Hopenfeld's prescription?

A27. (JLC, CJN) In response to Dr. Hopenfeld's four point prescription:

1. VY performed extensive plant-specific flow induce vibration (FIV) analyses and then as part of the Power Ascension Test Program used monitoring and observation (by walking around the plant follow-

ing power level changes) of systems and components to determine if there were any FIV issues.

2. As discussed earlier, the parameters of interest predicted by ODYN are peak reactor vessel pressure and power level.

3. As also discussed earlier, ODYN has been successfully qualified against the Peach Bottom tests and these represent a significant degree of pressurization beyond what would be experienced in a VY LTT.

4. ODYN's predictions matched closely the Peach Bottom test data used to benchmark the program.

In short, Entergy has performed precisely each of the actions that Dr. Hopenfeld would require in order to resolve his concerns.

Q28. Do Dr. Hopenfeld's concerns relate to LTT?

A28. (JLC) Not at all.

G. Reliance on System and Component Testing

Q29. Does system and component testing during normal operations provide an adequate basis for an exception to LTT?

A29. (CJN) Yes. Technical Specification-required surveillance testing (e.g., component testing, trip logic system testing, simulated actuation testing) is routinely performed during plant operations. Such testing demonstrates that the structures, systems and components ("SSCs") required for appropriate transient performance will perform their functions, including integrated performance for transient mitigation as assumed in the transient analysis.

Q30. What is the significance of the system and component testing program?

A30. (CJN) Because the characteristics and functions of SSCs are tested periodically during plant operations, they do not need to be demonstrated further in a large transient test. In addition, limiting transient analyses (i.e., those that affect core operating and safety limits) are re-performed for each operating cycle and are included as part of the reload licensing analysis.

Q31. NEC quotes at length from discussions at meetings of the Advisory Committee on Reactor Safeguards to assert that "component testing, piecemeal ascension testing, and inappropriately applied predictive computer codes" may not be substituted for "integral Large Transient Testing." Statement of Position at 13. How do you respond to NEC's allegations?

A31. (JLC) The discussions at the ACRS meetings cited by NEC are inapplicable, since they refer to a different type of plant (PWR) rather than BWRs such as VY. In addition, the excerpts quoted seem to reflect the view of a single ACRS member (Mr. Rosen) and not the prevailing view of the ACRS. In fact, as noted in the Direct Testimony at A59, the ACRS specifically concluded that LTT was not needed at VY, and wrote: "Load rejection and main steam isolation valve closure transient tests are not warranted. The planned transient testing program adequately addresses the performance of the modified systems."

In any case, the experience of the BWR fleet is that the transient events of concern here are well understood, and the key equipment has been observed to perform as designed. Furthermore, the qualification of the ODYN code against more challenging pressurization events than those that would occur during plant operations (or during LTT) assures that its application to EPU conditions is sound.

III. SUMMARY AND CONCLUSIONS

Q32. Please summarize your rebuttal testimony.

A32. (CJN, JLC) Our rebuttal testimony can be summarized as follows:

- The ODYN Code has been benchmarked against pressurization transients representing more severe conditions than those that would be experienced at VY in large transients from EPU conditions.

- Performance of LTT from EPU would not result in a new condition or phenomena that is beyond the equipment (valve stroke characteristic, rod insertion and relief valve actuation) qualification.

- Having identical "design and operating histories" is not necessary in order to draw valid inferences from operating experience at other plants similar to VY.

- Performance of LTT from EPU would not result in new conditions or phenomena beyond the equipment qualification.

- VY's performance during the 2004 and 2005 pre-EPU transients, including that of the components modified for the uprate, demonstrates that the EPU modifications do not significantly affect the plant's response during transient conditions.

- Dynamic loadings of components under normal, upset, or faulted conditions (including transients) are determined in separate analyses and acceptance criteria. Determination of those loadings has no relation to large transient analyses or LTT.

- Performance of LTT would not provide information for use in deriving either fatigue factors on the steam dryer or the loadings to which the dryer will be subjected.

- Because the characteristics and functions of SSCs are tested periodically during plant operations, they do not need to be demonstrated further in a large transient test.

- The experience of the BWR fleet is that large transient events are well understood, and the key equipment has been observed to perform as designed during them.

- The qualification of the ODYN code against more challenging pressurization events than those that would occur during plant operations (or during LTT) assures that its application to EPU conditions is sound.

Q33. What overall conclusions do you draw after reviewing NEC's Statement of Position and the Testimony and Declaration of Dr. Hopenfeld?

A33. (CJN, JLC) Nothing in NEC's Statement or the testimony of Dr. Hopenfeld undercuts our earlier conclusion that the extensive and conservative engineering analyses, historical test and actual transient data, individual component testing, and observed performance at other plants experiencing large transients provide assurance and confidence that VY systems will function as designed in mitigation of large transients from EPU conditions. Therefore, Entergy's request for an exception to LTT at VY is reasonable and poses no threat to public health and safety.

Q34. Does that conclude your rebuttal testimony?

A34. (CJN, JLC) Yes, it does.

Exhibit 1

REBUTTAL TESTIMONY OF CRAIG J. NICHOLS AND JOSE L. CASILLAS ON NEC CONTENTION 3 – LARGE TRANSIENT TESTING – EXHIBIT 1

ODYN Model Reports

NEDO-24154 Vol 1 'Qualification of the One Dimensional Core Transient Model for BWRs' (Non- Proprietary):
This report provides the technical detail of the ODYN model. The report includes question and answer information during the approval process in Appendices and the NRC approval. With respect to the application to BWR transients, Section 2 of the report documents the major simplifications of the model and the fact that the model includes essential phenomena to simulate transient events, though qualification is limited to pressurization events as given in Volume 2. The ODYN model review by the NRC includes an assessment of the effect of the various correlations' uncertainties used by the model on the predictions as shown below (NRC review page xlviii). These uncertainties are based on the application of the correlation capability over the range of parameters to be used, and includes operating conditions of EPU by VY. The review by the NRC also includes comparison against separate effects tests, comparison against plant tests and comparison against other independent models (NRC evaluation page xv). Therefore, it is concluded that the ODYN model has been reviewed and approved for predicting pressurization events without limitation including EPU conditions, because its individual correlations remain applicable.

TABLE-I

COMPARISON OF CODE UNCERTAINTIES AND CORRESPONDING BOUNDING VALUES AS ESTIMATED BY GENERAL ELECTRIC AND THE STAFF

	GE		STAFF	
	Bounding Values of Parameters	$\pm\Delta CPR/ICPR$	Bounding Values of Parameters	$\pm\Delta CPR/ICPR$
I. Reactor Core Model				
(1) Nuclear Model				
(a) Void Coefficient	$\alpha_v \pm 13\%$	0.020	$\alpha_v \pm 11\%$	0.018
(b) Doppler Coefficient	$\alpha_d \pm 6\%$	0.002	$\alpha_d \pm 10\%$	0.002
(c) Scram Reactivity	$\alpha_s \pm 4\%$	0.010	$\alpha_s \pm 10\%$	0.020
(d) Prompt Neutron Heating		0.006		0.006
(2) Thermal Hydraulic Model				
(a) Drift Flux Parameters	$C_o \pm 3\%$		$C_o = 1.00$	
	$V_{gj} \pm 20\%$	0.008	$V_{gj} = \pm 30\%$	0.011
(b) Subcooled Void Model	$n = 1.25$	0.009	$n = 0.5$ 2.0	0.023
(3) Fuel Heat Transfer Model				
(a) Pellet Heat Distribution	(Conservative)		-	-
(b) Pellet Heat Transfer Parameters	(Conservative)		-	-
II. Recirculation System Model				
(1) System Inertia	$(L/A) + 200\%$	0.002	$L/A + 200\%$	0.002
(2) Jet Pump losses	$K - 20\%$	0.010	$K - 20\%$	0.010
(3) Core Pressure Drop	$\Delta + 1.5$ psi	0.005	$\Delta p + 1.5$ psi	0.005
(4) Separator (L/A)	-30%	0.002	-200%	0.015
(5) Separator ΔP	(Conservative)		-	-
III. Steam Line Model				
(1) Pressure Loss Coefficients	$K - 20\%$	0.010	$K - 20\%$	0.010
(2) Specific Heat Ratio	$\gamma + .10$	0.010	$\gamma + .10$	0.010
Total:		0.031		0.044

NEDO-24154 Vol 2 'Qualification of the One Dimensional Core Transient Model for BWRs' (Non- Proprietary):

This report provides the qualification of the ODYN model. The report repeats the NRC approval statement found in Volume 1. With respect to the application to BWR transients, Section 2 includes qualification of the simplified single channel representation in ODYN by comparison against detail 3 dimensional nuclear and thermal hydraulic core properties, such as axial reactivity and void distributions, and Section 3 includes qualification of the transient predictions by ODYN against the Peach Bottom and KKM Turbine Trip tests. It is important to note that the comparison of ODYN against the tests is limited to both the core over-power and the vessel over-pressure, as these are the safety limits that apply to pressurization events. With respect to peak pressure, the ODYN model predictions are sufficiently conservative that safety analyses would be bounding to actual plant behavior (NRC conclusion in page cxix). With respect to peak power, the ODYN predictions are also conservative, but not to a sufficiently large degree that no additional margin for uncertainties would be applied (NRC conclusion in page xc). Shown below are the pressure and power comparison tables from the report (page 3-17, Tables 3-3 and 3-4) illustrating the higher pressure predicted by ODYN, and the larger change in CPR (indicative of the over-power) predicted by ODYN compared against the data. It is important to note that the PB tests included a delay of the time to scram and shut down the reactor (NRC conclusion in page lvi) such that a severe test was obtained, the resulting tests were such that they exceed the severity of actual plant events and are comparable to those in safety analyses (NRC introduction in page xi). Therefore, from a model qualification point of view, the ODYN model is qualified to as severe an over-power event as possible in a BWR.

NEDO-24154-A

Table 3-3

PEAK VESSEL PRESSURE

	Data*	Model Calculation
Turbine Trip 1	1042	1070
Turbine Trip 2	1052	1072
Turbine Trip 3	1069	1100

*Data value is biased to the same initial value as calculation.

Table 3-4

MAXIMUM ΔCPR VALUES FOR PEACH BOTTOM TURBINE TRIP TESTS

	Initial CPR	ΔCPR/ICPR (Data)	ΔCPR/ICPR (Model)
Turbine Trip 1	2.536	0.170	0.173
Turbine Trip 2	2.115	0.136	0.129
Turbine Trip 3	2.048	0.132	0.141

NEDO-24154P Vol 3 'Qualification of the One Dimensional Core Transient Model for BWRs' (Proprietary):

This report provides the procedure for performing safety analyses with the ODYN model. While no model qualification information is included in this report, GE demonstrates the conservative nature of the application safety analyses through several calculation sensitivities. Thus, in addition to accounting for the model uncertainties in the ODYN over-power analyses required by the NRC approval (NRC summary of code qualification page xc), the analysis also includes the plant equipment performance representing the most limiting conditions as noted in the NRC approval (NRC review page cvii Table IV) and copied below. Therefore, the application of ODYN to safety analyses at EPU includes accounting for both model uncertainties and worst equipment performance guaranteeing a conservative analysis.

TABLE IV

INPUT PARAMETERS SENSITIVE FOR THE ANALYSES

1. CRD scram speed - at tehcnical specification limit.
2. Scram setpoints - at technical specification limits.
3. Protection system logic delays - at equipment specification limits.
4. Relief valve capacities - minimum specified.
5. Relief valve setpoints and response - all valves at specified upper limits of setpoints and slowest specified response.
6. Pressure drop from vessel to relief valves - maximum value.
7. Steamline and vessel geometry - plant-unique values.
8. Initial power and steam flow - maximum plant capability.
9. Initial pressure and core flow - design values at maximum plant capability.
10. Core exposure/power distribution - consistent with Haling mode of operation.
11. Feedwater conditions - maximum temperature (maximum core average void content).

NEDE-24154P Vol 4 'Qualification of the One Dimensional Core Transient Model for BWRs' (Proprietary):
This report provides the qualification and procedure for the ODYN model for non-pressurization events. The purpose of this application extension of the ODYN model is to eliminate the older REDY model used for these non-limiting event applications. The report includes additional technical detail pertaining to core flow and feedwater flow transient disturbances to complete the approval application of the ODYN model to all BWR transients. The qualification includes comparisons to additional plant parameters, such as water level and core flow, which are key aspects of these events. This application extension of the ODYN model demonstrates the wide best estimate nature of the model to simulate BWRs. Therefore, with respect to the question of ODYN application to EPU conditions, the review by the NRC establishing ODYN as a best estimate code for transient application (NRC conclusion in page xc) as noted below applies also to EPU.

5. <u>Summary of Code Qualification</u>

In summary, we find that the ODYN is a best estimate code containing models developed from first principles and provides good predictions of existing experimental data. The experimental data were obtained from separate effects and integral plant tests. The separate effects tests include core power measurements from various plants and heated tube tests to verify the void fraction model. Integral plant tests were performed at Peach Bottom Unit 2 and KKM. Comparison of the test data and calculations indicates that the agreement is within the uncertainties calculated in Section A. We find that the ΔCPR predictions from the ODYN and SCAT codes are neither conservative nor nonconservative. They predict the available data well.

ODYN Benchmark at EPU

GE-NE-A13-00413-01-04, 'Engineering Evaluation of KKL Revision 99 Turbine Trip Test 109% Power of 11 September 1999', December 1999:

This report presents the evaluation of the turbine trip test results in KKL at 109% uprate power, corresponding to 102% over VY EPU power density, against the ODYN pre-test predictions. The purpose of the turbine trip test is to perform control system adjustments to mitigate the transient event. This plant is similar to VY in that it includes a large turbine steam bypass capacity, not typical of most BWRs. The result of the bypass capacity is that the transient becomes very mild, and in the case of KKL, the plant remains on-line with partial power reduction due to automatic core flow runback and partial control rod insertion actuations. A similarly mild transient is expected in VY at EPU conditions. With respect to the ODYN power and pressure predictions, the comparison against the KKL test data shows that ODYN power and pressure are conservatively predicted. This conclusion is consistent with other observations; this was particularly true in this KKL test because of the presence of partially inserted rods, which have a stronger effect on the single channel model used in ODYN. Therefore, the EPU high steam conditions do not impact the prediction capability of the ODYN model.

NEDE-30253 'Qualification of the ODYNM05 and ODYNV05 Computer Programs' (Proprietary), September 1983:

This report presents the predictions of a later version of ODYN against several plant test data, discussed in this summary is the MSIV closure test comparison. The MSIV test was conducted at plant Hatch Unit 2 during the initial plant startup program on June 27, 1979. The MSIV test conditions are 95% power and 96.5% flow, the power density of Hatch Unit 2 is the same design as for VY. The ODYN benchmark calculation applied the equipment response corresponding to the test and compared the dome pressure predicted by the ODYN model to the test data. The test recorded a lower peak pressure than the ODYN model prediction, consistent with previous observations. The MSIV test does not record a power increase because the automatic pre-emptive scram signal from the valve closure position inserts the control rods before the pressure increase takes effect in the vessel. A similarly mild MSIV closure test is expected in VY at EPU conditions. Therefore, the MSIV closure test does not challenge the ODYN model beyond its qualification basis corresponding to the Peach Bottom turbine trip tests.

GE-NE-0000-0041-1254, 'ODYN Benchmark of the Dresden 3 January 30, 2004 Turbine Trip Event', July 2005:

This report presents a comparison of ODYN model predictions of a Dresden 3 unplanned turbine trip event on January 30, 2004. The turbine trip event occurred at 95% of EPU power, which corresponds to an approximate power density of 75% of VY EPU power level. The event was evaluated using the ODYN model as committed by the utility to the NRC as part of their EPU requirements. The purpose of the evaluation is to confirm that the ODYN model predictions of significant transient events are consistent with past experience. This event represents a more severe pressurization than would be expected in VY at EPU conditions because the Dresden plant has a turbine steam bypass capacity of only a third compared against VY and thus a pressure transient bounds that expected for VY at EPU power. The comparison of the event data against the ODYN model prediction was consistent with past experience by over-predicting the peak vessel dome pressure and peak power. While this event was initiated at lower power than VY EPU, the results reflect a more severe condition than expected for VY EPU and therefore are indicative of the ODYN capability for VY at EPU. Therefore, the ODYN model capability for predicting a turbine trip for VY at EPU is defensible.

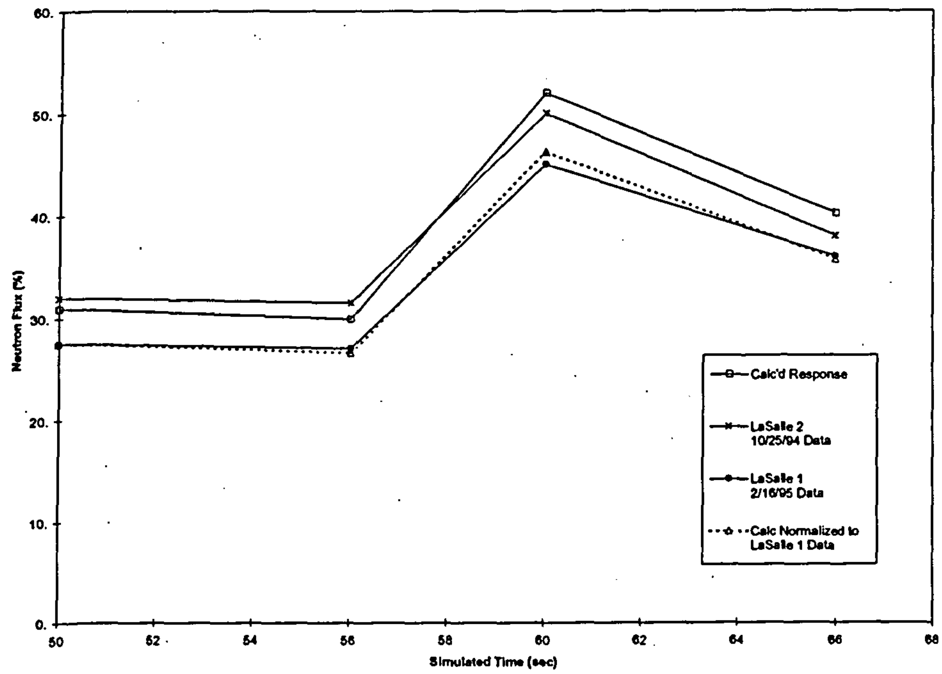
Exhibit 2

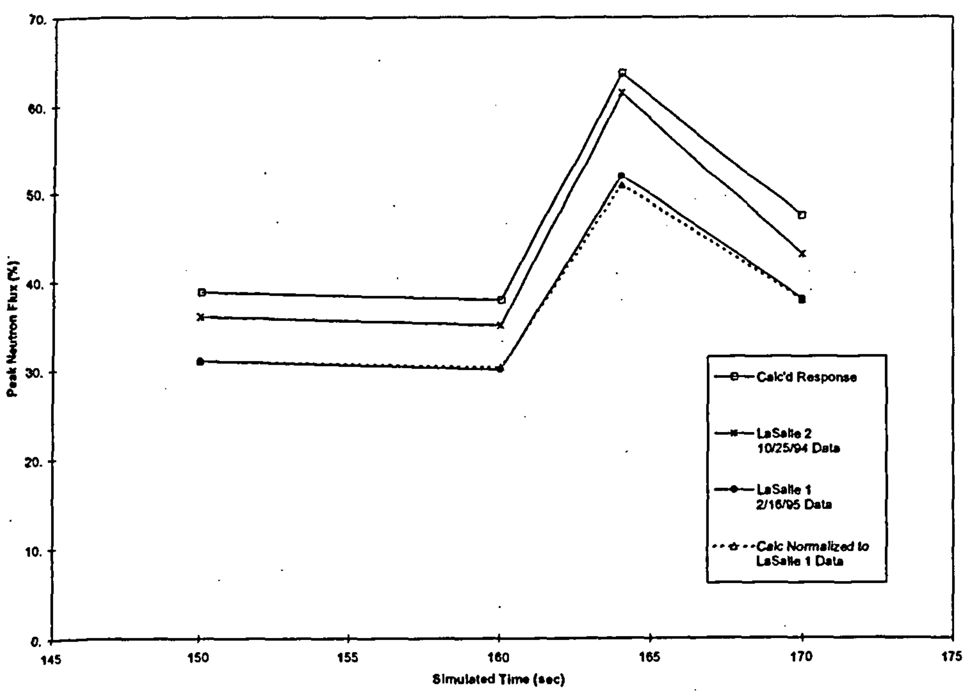
REBUTTAL TESTIMONY OF CRAIG J. NICHOLS AND JOSE L. CASILLAS
ON NEC CONTENTION 3 – LARGE TRANSIENT TESTING – EXHIBIT 2

ODYN Studies Reports

GE-NE-B13-00296-02P 'Recirculation Flow Control Valve Maximum Pump Up-Shift Position for LaSalle County Nuclear Station Units 1 and 2' (Proprietary), March 1998:
This report includes an evaluation to increase the flow control valve position setpoint that allows the BWR to change the recirculation pump from low to high speed. The increased valve position setpoint will result in a larger power spike from the increased valve flow and therefore a high degree of confidence is required that the power spike will not result in a reactor high power scram. The ODYN model is used to predict the magnitude of the power spike during the recirculation pump speed up-shift maneuver. In order to determine the accuracy of the ODYN model to predict the power spike, a benchmark against past maneuvers at the current valve setpoint are made. The figures below illustrate the agreement of the ODYN model prediction of the power spike for two past cases (LaSalle Unit 1 and 2). The top figure compares the power spike of the first pump speed up-shift and the lower figure compares the power spike of the second pump speed up-shift. The agreement of the ODYN model predictions to the actual data demonstrates the capability of the model for this problem.

ODYN Model Pump Speed Up-Shift Power Spike Benchmark Figures





GE-NE-B31-00265-01P 'Duane Arnold Energy Center Recirculation Runback Setpoint Evaluation' (Proprietary), April 1998:
This report includes an evaluation to decrease the speed setpoint of the recirculation pump following a loss of feedwater flow event. The partial loss of feedwater from a pump leads to a decrease in water level and may result in a scram if the remaining pumps are not able to increase their flow sufficiently fast and to the level of the steam flow being produced by the reactor. Therefore, if coincident with the loss of feedwater flow the plant initiates a recirculation flow speed decrease, that will lower the steam flow production, the magnitude of the water level decrease will be mitigated and avoid the scram. The pump speed setpoint to be selected needs to be sufficiently low to accommodate the dynamic response of both the feedwater and recirculation systems. The ODYN model is used to predict the water level transient to establish the optimum pump speed setpoint. In order to determine the accuracy of the ODYN model to predict the water level, a benchmark against past loss of feedwater events are made. The figures below illustrate the agreement of the ODYN model prediction of both the recirculation flow and the water level following the trip of a feedwater pump in the Duane Arnold plant. The top figure compares the pump speed reduction to the current setpoint of 45% and the lower figure compares the resulting water level. This event results in a scram at approximately 30 seconds, and is predicted consistently. The agreement of the ODYN model predictions to the actual data demonstrates the capability of the model for this problem.

ODYN Model Flow Runback Water Level Benchmark Figures

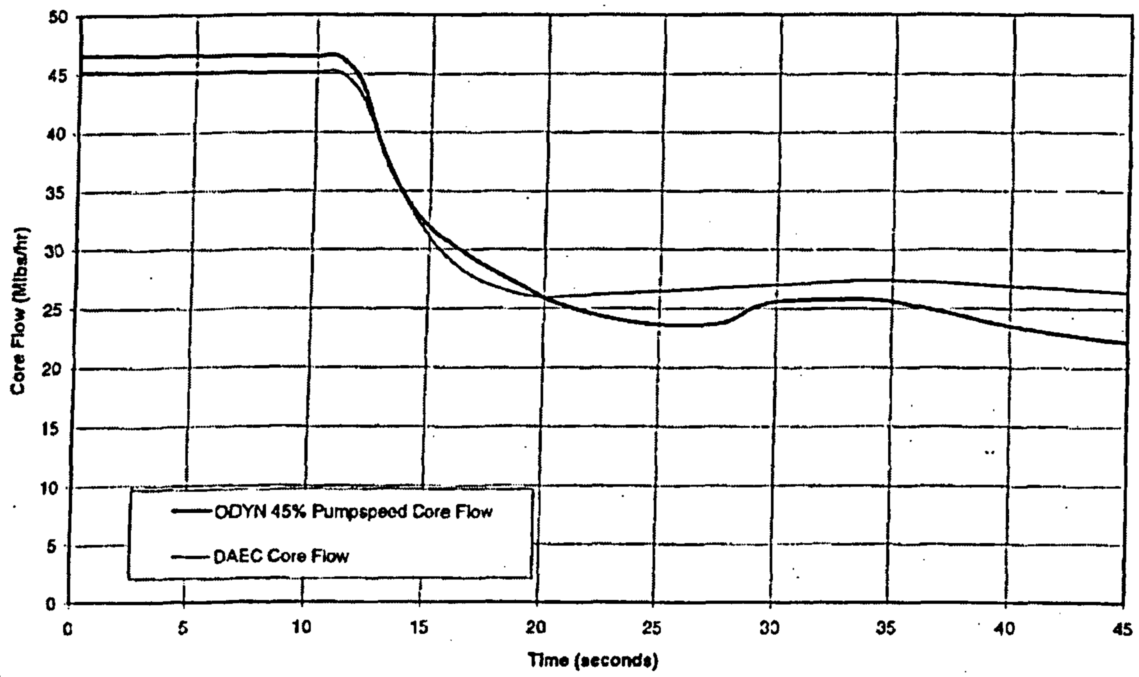


Figure 2. Single Feedwater Pump Trip Event with 45% Runback, Simulation and Test Data Comparison: Core Flow.

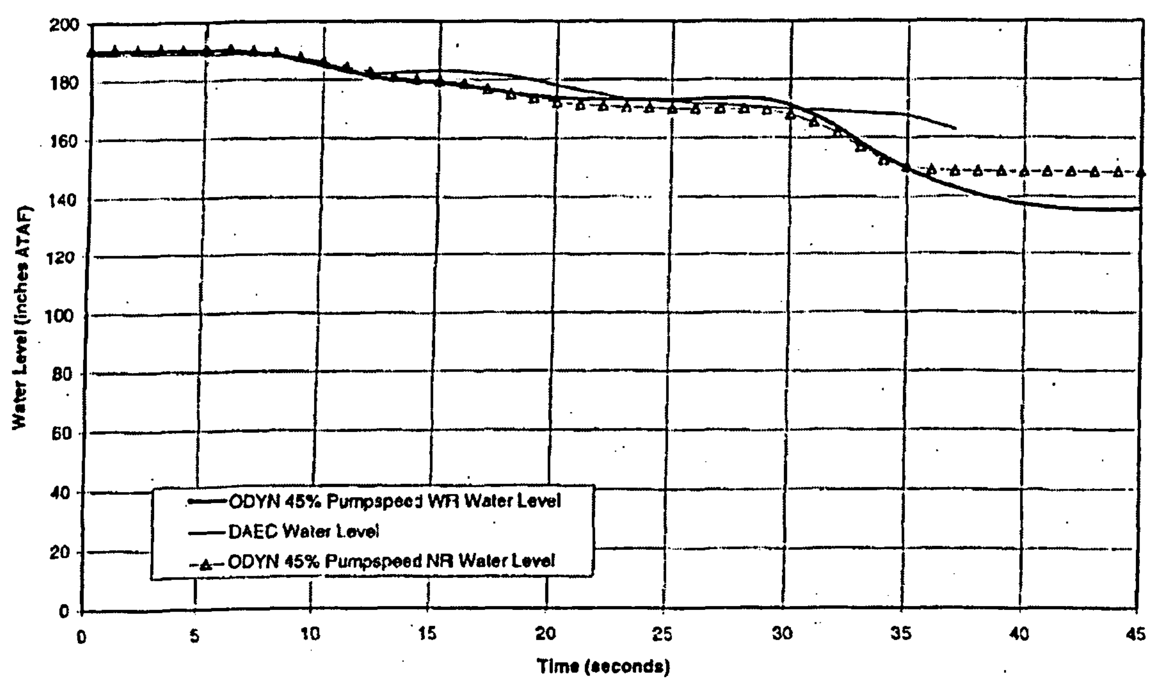


Figure 4. Single Feedwater Pump Trip Event with 45% Runback, Simulation and Test Data Comparison: Water Level.

NEDO-24154P Vol 3 'Qualification of the One Dimensional Core Transient Model for BWRs' (Proprietary):
This report provides.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	Docket No. 50-271
ENTERGY NUCLEAR VERMONT YANKEE, LLC and ENTERGY NUCLEAR OPERATIONS, INC.	)	ASLBP No. 04-832-02-OLA (Operating License Amendment)
(Vermont Yankee Nuclear Power Station)	)	

AFFIDAVIT OF CRAIG J. NICHOLS RE NEC CONTENTION 3
REBUTTAL TESTIMONY

County of Windham)
)
State of Vermont)

I, Craig J. Nichols, being duly sworn according to law, depose and state the following:

1. I am the Extended Power Uprate Project Manager for Entergy Nuclear Operations, Inc. My business address is 320 Governor Hunt Road, P.O. Box 250, Vernon, VT 05354.

2. I am providing testimony, dated June 14, 2006, on behalf of Entergy Nuclear Vermont Yankee, LLC and Entergy Nuclear Operations, Inc. in the above captioned proceeding, entitled "Rebuttal Testimony of Craig J. Nichols and Jose L. Casillas on NEC Contention 3 – Large Transient Testing."

3. The factual statements and opinions I express in the cited testimony are true and correct to the best of my personal knowledge and belief.

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

Further, the affiant sayeth not.

Craig J. Nichols

Subscribed and sworn to before me
this 10 Th day of June, 2006

Notary Public

My commission expires 2/10/2007

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of ENTERGY NUCLEAR VERMONT YANKEE, LLC and ENTERGY NUCLEAR OPERATIONS, INC. (Vermont Yankee Nuclear Power Station)	)	Docket No. 50-271 ASLBP No. 04-832-02-OLA (Operating License Amendment)

AFFIDAVIT OF JOSE L. CASILLAS RE NEC CONTENTION 3 REBUTTAL TESTIMONY

County of Santa Clara)
)
State of California)

I, Jose L. Casillas, being duly sworn according to law, depose and state the following:

1. I am the Plant Performance Consulting Engineer in the Nuclear Analysis group of the Engineering organization of GE Nuclear Energy. My business address is 1989 Little Orchard Street, San Jose, California 95125.

2. I am providing testimony, dated June 14, 2006, on behalf of Entergy Nuclear Vermont Yankee, LLC and Entergy Nuclear Operations, Inc. in the above captioned proceeding, entitled "Rebuttal Testimony of Craig J. Nichols and Jose L. Casillas on NEC Contention 3 – Large Transient Testing."

3. The factual statements and opinions I express in the cited testimony are true and correct to the best of my personal knowledge and belief.

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

Further, the affiant sayeth not.

Jose L. Casillas

Jose L. Casillas

NR01
RINKOO R.
COMM. #
Notary Public
Santa Clara
My Comm. Expires Feb.

Subscribed and sworn to before me
this 12 day of June, 2006

Notary Public

My commission expires 02-13-2009.

NR01
RINKOO R. NAT
COMM. #1552543
Notary Public - California
Santa Clara County
My Comm. Expires Feb. 13, 2009
NR01