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**Christopher J. Wamser**
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BVY 12-008

February 1, 2012

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

SUBJECT: Response to Request for Additional Information Regarding Core Plate Hold-down Bolt Inspection Plan and Analysis
Vermont Yankee Nuclear Power Station
Docket No. 50-271
License No. DPR-28

REFERENCES:
1. Letter, Entergy to USNRC, "Response to Request for Additional Information for Core Plate Hold Down Bolt Inspection Plan and Analysis," BVY 11-078, dated December 9, 2011
2. Letter, Entergy to USNRC, "Core Plate Hold Down Bolt Inspection Plan and Analysis," BVY 11-021, dated March 18, 2011
3. Letter, Entergy to USNRC, "Deviation from BWRVIP-25 Inspection Requirements," BVY 11-024, dated March 18, 2011

Dear Sir or Madam:

In Reference 1, Vermont Yankee Nuclear Power Station (VYNPS) submitted a response to a Request for Additional Information regarding the core plate hold-down bolt inspection plan and analysis submitted in Reference 2. The Reference 2 submittal was made to satisfy VYNPS License Renewal Commitment 29.

A teleconference was held on January 17, 2012 to discuss additional NRC staff questions on the inspection plan and analysis. Attachment 1 of this letter contains the responses to these questions.

Attachment 2 contains a revision to the regulatory commitment made in Reference 3.

Should you have any questions or require additional information concerning this submittal, please contact Mr. Robert Wanczyk at 802-451-3166.

Sincerely,

[CJW/PLC]

Attachments: 1. Response to Request for Additional Information
2. List of Regulatory Commitments

cc: Mr. William M. Dean, Regional Administrator
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Mr. James S. Kim, Project Manager
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Ms. Elizabeth Miller, Commissioner
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# Attachment 1

Vermont Yankee Nuclear Power Station
License No. DPR-28 (Docket No. 50-271)

Response to Request for Additional Information

Background

**In its response to Request for Additional Information (RAI) 3, Items 3 and 4, by letter dated December 9, 2011 (Reference 1), Entergy stated that the core plate stress analysis (Reference 2) did not account any portion of the bolts being either completely or partially cracked due to intergranular stress corrosion cracking (IGSCC) or irradiation-assisted stress corrosion cracking (IASCC). In the response to Item 4, Entergy provided a justification for not considering any bolts to be partially or completely cracked. The justification relies on the fact that the bolts are not sensitized and on the operating experience with inspections of these bolts, in which no instances of cracking have been observed. However, BWRVIP-25, Section 2.1.1 indicates that radiolysis model calculations, validated by electrochemical corrosion potential (ECP) readings at several locations, predict that the environment in contact with the core plate assembly location has relatively high levels of hydrogen peroxide which leads to high ECP, which is one of the key factors in promoting IGSCC in combination with adverse material microstructures and imposed residual and fit-up stresses.**

**In addition, the staff is not convinced that the inspection method being used would be effective in detecting either partially or completely cracked bolts since the inspection method is a VT-3 visual examination conducted from above the core plate.**

**BWRVIP-25, in the discussion of visual examination (VT) as an inspection option in Section 3.2.2.2, states:**

> **"The critical number of bolts is plant-specific (dependent on plant geometry, number of bolts, location of bolts intact, loading conditions). The conservative example analysis in Appendix A shows that about 80% of the bolts at the allowable stress would react the applied load. A distributed inspection sample of 50% of the bolts with none cracked assures the integrity of 80% of the bolts with very high confidence. Therefore, inspection of 50% of the bolts is recommended. If cracking is detected in any of these first 50%, the remaining 50% should be inspected."**

**The staff therefore requests the following information:**

1. **Provide a justification that the VT-3 visual examinations would be effective at detecting failed core-plate hold-down bolts.**

Response

The effectiveness of a VT-3 visual examination at detecting a failed core plate hold-down bolt is discussed in General Electric Services Information Letter (SIL) No. 588R1 (Reference 4):

> *In the older BWRs* [including Vermont Yankee Nuclear Power Station (VYNPS)] *without core plate wedges, the core plate is retained in place by the friction caused by the bolt preload. These bolts were procured to a specification that prohibited cold forming operations following solution heat treatment. Further, the preload was limited (10-15 Ksi) depending on BWR type. Thus, they are resistant to stress corrosion cracking; breakage or excessive relaxation of the bolts is unlikely. Consequently, the recommended inspection is only that necessary to show that the bolts have not loosened and rotated due to a combination of vibration and failure of the welds on the*

*locking device (keeper). If this were to occur, it should be obvious by visual inspection(VT3).*

VYNPS acknowledges the limitations of using the VT-3 method from above the core plate in detecting partially or completely cracked bolts. VYNPS also acknowledges that BWRVIP-25 recommends that plants without core plate wedges perform enhanced visual examination (EVT-1) of the bolts from below the core plate (or ultrasonic (UT) inspections from above the core plate once the technique is developed). In the Electric Power Research Institute (EPRI) letter which transmitted the draft deviation dispositions (DD) for core plate bolt inspections (Reference 5) the BWRVIP noted that:

*BWRVIP-25 requires that plants without core plate wedges perform EVT-1 or UT inspections of the core plate bolts. Currently, it is not possible to perform meaningful inspections by those methods and, consequently, many plants are not in compliance with the BWRVIP guidelines. The NRC has become aware of this fact and has indicated that it is appropriate for all plants that are not in compliance to prepare DDs to address this situation.*

*In order to promote standardization, the BWRVIP has developed two generic forms of the DDs: an "Analysis Template" that is based on results of a crack growth evaluation and an "Inspection Template" based on a commitment to perform VT-3 inspections. Both DDs justify postponing core plate bolt inspections (as required by BWRVIP-25) until 2015 or until such time as the BWRVIP publishes revised guidance.*

In response to this, VYNPS submitted a BWRVIP-25 deviation notification in Reference 6. It should be noted that although both forms of the DDs justified postponing inspections until 2015, VYNPS committed in Reference 6 to continue performing inspections every other refueling outage until BWRVIP-25 is revised and approved by the NRC staff.

Use of the VT-3 inspection method from above the core plate, rather than dismantling or removing internal components in order to perform an EVT-1 examination from below the core plate, is further supported by Section 3.2.5 of BWRVIP-47-A (Reference 7) which states:

***3.2.5 Other Inspections***

*The BWRVIP has determined that removing or dismantling of internal components for the purpose of performing inspections is not warranted to assure safe operation. However, on occasion, utilities may have access to the lower plenum due to maintenance activities not part of normal refueling outage activities. In such cases, utilities will perform a visual inspection to the extent practical. Results of the inspection will be reported to the BWRVIP and will be forwarded by the BWRVIP to the NRC.*

The VYNPS Reactor Vessel Internals (RVI) Program contains a provision for performing inspections when access to the lower plenum is available due to maintenance activities.

2. **What percentage of core plate bolts for VYNPS must be intact to avoid exceeding the allowable stresses on the bolts as given by Table 8-1 of the analysis (Reference 2)?**

Response

Consistent with the methodology used in BWRVIP-25 Appendix A, the Reference 2 core plate hold-down bolt stress analysis was performed with the assumption that 100% of the bolts were intact. It did not assume an initial number of failed or cracked bolts. None of the three BWRVIP-25 analytical scenarios involved a determination of the minimum number of intact bolts required to avoid exceeding ASME allowable stresses.

As discussed in BWRVIP-25, Section A.1.2, the purpose of the analysis was to assess the loading of the core plate hold-down bolts in order to determine a strategy for bolt inspection. As reported in Sections 3.0 and 8.1 of Reference 2, the analysis shows that the core plate hold-down bolt stresses meet the ASME allowable stresses for the loading conditions and assumptions made for all three scenarios analyzed. Two of the scenarios introduced conservatism into the analysis by not taking credit for the core plate aligner pins (i.e. the bolts take all of the horizontal and vertical loads). See also the response to RAI 4 in VYNPS letter BVY 11-082, dated January 5, 2012.

This analysis was performed in order to satisfy the requirements of VYNPS License Renewal Commitment 29. By performing the analysis in accordance with BWRVIP-25, VYNPS believes it has met this portion of the commitment.

A plant-specific analysis using the BWRVIP-25 Appendix A methodology was also performed in support of the license renewal application for Monticello Nuclear Generating Plant. NRC review and evaluation of the methodology is documented in Section 4.8 of NUREG-1865 (Reference 8).

3. **Considering the effectiveness of the VT-3 examination at detecting cracked or broken bolts, does the percentage of the bolts being sampled support demonstration that the required number of bolts is intact, assuming no failed bolts are found in the sample? Provide a statistical argument or analysis similar to that provided in BWRVIP-25, Section 3.2.2.2. Include the details of the statistical calculation.**

Response

VYNPS has 30 core plate hold-down bolts. ANSI-ASQ Standard Z1.4 Table 1 specifies that for a population of 26-50, the user enters Table II-A with Code Letter C, D, or E. Table II-A provides the following sample sizes: Code Letter C gives a sample size of 5 for a non-conformance value of 2.5%; Code Letter D gives a sample size of 8 for a non-conformance value of 1.5%; Code Letter E gives the most conservative sample size of 13 for a non-conformance value of 1.0%. Therefore, a sample size of 13 provides reasonable assurance that if no non-conforming items are found in the sample, the remainder of the population is also acceptable.

In Reference 6, VYNPS committed to continue to inspect 25% of the core plate hold down bolts every other refueling outage (RFO) using the VT-3 method in accordance with the Reactor Vessel Internals (RVI) Program until the inspection guidance of BWRVIP-25 is revised by the Electric Power Research Institute and approved by the NRC.

Based on the statistical argument provided above, and not withstanding the previous core plate hold-down bolt inspection history at VYNPS which supported the 25% sample size, VYNPS will inspect 50% of the core plate hold-down bolts

every RFO, commencing in RFO 31, using the VT-3 method in accordance with the RVI Program until the inspection guidance of BWRVIP-25 is revised by the Electric Power Research Institute. Fifty percent of the VYNPS core plate hold-down bolt population is 15 core plate hold-down bolts, which exceeds the ANSI-ASQ Z1.4 sample size. The 50% sample size is consistent with the BWRVIP-25 Table 3-2 inspection strategy. The revised regulatory commitment is provided in Attachment 2 of this letter.

4. **If a statistical argument cannot be made, provide a more detailed basis supporting a very low probability of significant loss of load bearing capability due to IGSCC of the bolts, and/or revise the analysis to account for the possibility of some bolt failures due to SCC. The basis for the low probability of IGSCC should consider the historical and current water chemistry conditions (i.e. ECP) for the core plate bolt locations for VYNPS, operating stresses, material processing, and any other relevant factors.**

Response

Because the response to RAI 3 was based on a statistical argument, no response to this RAI is required.

References


1. Letter from Christopher J. Wamser to NRC dated December 9, 2011, Subject: "Response to Request for Additional Information for Core Plate Hold Down Bolt Inspection Plan and Analysis," Vermont Yankee Nuclear Power Station Docket No. 50-271, License No. DPR-28 (BVY 11-078) (ADAMS Accession No. ML11353A407)
2. NEDC-33618P – Revision 0, Vermont Yankee Core Plate Bolt Stress Analysis, March 2011, (ADAMS Accession No. ML110840070 - Proprietary Version, ML110840069 – Non-Proprietary Version)
3. Letter from Michael J. Colomb to NRC dated March 18, 2011, Subject: "Core Plate Hold Down Bolt Inspection Plan and Analysis," Vermont Yankee Nuclear Power Station Docket No. 50-271 License No. DPR-28 (BVY 11-021) (ADAMS Accession No. ML110840068)
4. General Electric Nuclear Services Information Letter, SIL No. 588R1, "Top Guide and Core Plate Cracking," dated May 18, 1995
5. Letter from Randy Schmidt and Bob Carter to BWRVIP Assessment Committee and BWRVIP Integration Committee, Subject: "Transmittal of Draft Deviation Dispositions for Core Plate Bolt Inspections," Electric Power Research Institute, dated July 13, 2010
6. Letter from Michael J. Colomb to NRC dated March 18, 2011, Subject: "Deviation from BWRVIP-25 Inspection Requirements," Vermont Yankee Nuclear Power Station Docket No. 50-271 License No. DPR-28 (BVY 11-024)
7. BWRVIP-47-A: BWR Vessel and Internals Project, "BWR Lower Plenum Inspection and Flaw Evaluation Guidelines," final report dated June 2004
8. NUREG-1865, "Safety Evaluation Report Related to the License Renewal of the Monticello Nuclear Generating Plant," dated October 2006

# Attachment 2

Vermont Yankee Nuclear Power Station
License No. DPR-28 (Docket No. 50-271)

List of Regulatory Commitments

## List of Regulatory Commitments

This table identifies actions discussed in this letter for which Entergy commits to perform. Any other actions discussed in this submittal are described for the NRC's information and are **not** commitments.

| COMMITMENT | TYPE (Check one) | | SCHEDULED COMPLETION DATE (If Required) |
|---|---|---|---|
| | ONE-TIME ACTION | CONTINUING COMPLIANCE | |
| VYNPS will inspect 50% of the core plate hold down bolts every other refueling outage, commencing with RFO 31, using the VT-3 method in accordance with the VYNPS Reactor Vessel Internals Inspection Program until BWRVIP-25 is revised.<br><br>VYNPS will implement the revised BWRVIP-25 inspection guidance for the core plate bolts. | | X | Following revision of BWRVIP-25 guidance in accordance with BWRVIP-94 Rev 1 guidelines. |