VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

May 11, 2006

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Serial No. 06-142B
NL&OS/ETS R0
Docket Nos. 50-338/339
License Nos. NPF-4/7

**VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)
NORTH ANNA POWER STATION UNIT NOS. 1 AND 2
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION ON PROPOSED TECHNICAL SPECIFICATION CHANGES ON ADDITION OF ANALYTICAL METHODOLOGY TO THE CORE OPERATING LIMITS REPORT (TAC NOS. MC7526 AND MC7527)**

By letter dated July 5, 2005 (Serial No. 05-419), Dominion submitted proposed license amendments for North Anna Unit Nos. 1 and 2. The proposed changes would add a reference in Technical Specification 5.6.5.b, "Core Operating Limits Report (COLR)," to allow the use of an alternate methodology to perform a thermal-hydraulics analysis to predict the critical heat flux and departure from nucleate boiling ratio (DNBR) for the Advanced Mark-BW fuel. In addition, Dominion requested the Nuclear Regulatory Commission (NRC) staff's approval of the site/fuel type/code specific Statistical Design Limits obtained by the plant specific implementation of the NRC-approved methodology documented in Topical Report VEP-NE-2-A, "Statistical DNBR Evaluation Methodology." In a facsimile dated April 25, 2006, the NRC staff requested further additional information to complete the review. The attachment to this letter provides the requested information.

Dominion continues to request approval of this license amendment request by September 1, 2006. This requested schedule permits in-house performance of DNB analyses with DOM-NAF-2 and the VIPRE-D/BWU code/correlation set in support of the use of AREVA AMBW fuel at North Anna Power Station Units 1 and 2 for operating cycles 20 and 19, respectively. This change will be implemented within 60 days of NRC approval.

If you have any questions or require additional information, please contact Mr. Thomas Shaub at (804) 273-2763.

Very truly yours,

Eugene S. Grecheck
Vice President – Nuclear Support Services

Attachment

Commitments made in this letter: None

cc: U.S. Nuclear Regulatory Commission
Region II
Sam Nunn Atlanta Federal Center
61 Forsyth Street, SW
Suite 23T85
Atlanta, Georgia 30303

Mr. J. T. Reece
NRC Senior Resident Inspector
North Anna Power Station

Mr. Stephen R. Monarque
NRC Project Manager – Surry and North Anna
U. S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, Maryland 20852

Mr. J. E. Reasor, Jr.
Old Dominion Electric Cooperative
Innsbrook Corporate Center
4201 Dominion Blvd.
Suite 300
Glen Allen, Virginia 23060

Commissioner
Bureau of Radiological Health
1500 East Main Street
Suite 240
Richmond, Virginia 23218

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Eugene S. Grecheck, who is Vice President – Nuclear Support Services, of Virginia Electric and Power Company. He has affirmed before me that he is duly authorized to execute and file the foregoing document in behalf of that Company, and that the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 11TH day of May, 2006.

My Commission Expires: May 31, 2006.

Vicki L. Hull
Notary Public

(SEAL)

ATTACHMENT

Serial No. 06-142B

Response to Request for Additional Information on Proposed Technical Specification Changes on Addition of Analytical Methodology to the Core Operating Limits Report
(Tac Nos. MC7526 and MC7527)

Virginia Electric and Power Company
(Dominion)
North Anna Power Station Units 1 and 2

Virginia Electric and Power Company (Dominion) North Anna Power Station Unit Nos. 1 and 2 Response to Request for Additional Information on Proposed Technical Specification Changes on Addition of Analytical Methodology to the Core Operating Limits Report (Tac Nos. MC7526 And MC7527)

Background

By letter dated July 5, 2005, Virginia Electric and Power Company (Dominion) submitted proposed license amendments to add a reference in Technical Specification 5.6.5.b, "Core Operating Limits Report (COLR)," to permit the use of an alternate methodology to perform a thermal-hydraulic analysis to predict the critical heat flux (CHF) and departure from nucleate boiling (DNB) ratio (DNBR) for the Advanced Mark-BW (AMBW) fuel at North Anna Power Station, Unit Nos. 1 and 2 (North Anna 1 and 2).

In a letter dated February 14, 2006, the NRC staff requested additional information to complete the review of the proposed Technical Specification and statistical design limit. This information was provided in a letter dated March 30, 2006. In a subsequent facsimile, dated April 25, 2006, the NRC requested further information to clarify information provided in the original July 5, 2005 submittal.

NRC Question 1

Table 3.2.1-1 lists the DNBR limits to be 1.20 (above 700 psia) for the BWU-Z correlation and 1.18 (above 594 psia) for the BWU-ZM. Appendix A to topical report DOM-NAF-2 lists the corrected standard deviations to be 0.0919 (Table A.4.1-2) and 0.0875 (Table A.4.2-2) for BWU-Z and BWU-Z/ZM, respectively. In combining the two correlations into BWU-Z/ZM, Section 3.1.3 states that "because additional experimental code/correlations uncertainty.... In this implementation, BWU-ZM code/correlation uncertainties were used to obtain the BWU-Z/ZM SDL, because they are slightly more conservative."

Clarify the apparent inconsistency in stating that the BWU-ZM uncertainty is slightly larger and more conservative.

Dominion Response

The randomized DNBR distribution is obtained from the unrandomized MDNBR results by correcting for the code/correlation uncertainty using equation 1.

$$\text{Randomized\_DNBR} = \frac{\text{Unrandomized\_MDNBR}}{[1.0 + s(M/P) \times K \times \text{NormalRandomNumber}]} \quad \text{[equation 1]}$$

where:

- *s(M/P)* is the standard deviation of the code/correlation M/P database for the CHF correlation under study (see Table 1-1 below).

- K is a sample correction factor that depends on the size of the experimental database used to obtain the code/correlation deterministic DNB limit, which is calculated as:

$$K = \sqrt{\frac{2 \cdot (n-1)}{\left(\sqrt{2n-3} - 1.645\right)^2}}$$ [equation 2] (Reference 2, Page 37, equation 2.4.5)

Table 1-1: CHF Code/Correlation Data

	BWU-Z	BWU-ZM
Average M/P	0.9950	1.0138
S(M/P)	0.0907	0.0875
N	528	148
K	1.05390	1.10820
K * S(M/P)	0.09559	0.09697

To randomize the MDNBR results obtained for the BWU-Z/ZM correlation, the BWU-ZM code/correlation uncertainties were used, as they happen to be slightly more conservative than the code/correlation uncertainties for BWU-Z. This is because the Equation 1 accounts not only for the standard deviation of the CHF experimental database, but also for the size of the database. When taking both into account BWU-ZM is slightly more conservative, i.e. the product K * S(M/P) is larger.

Equation 1 differs slightly from Equation 2.4.1 in Reference 2 because its original assumption of a normally distributed qualification DNBR database was found to be incorrect. Typically the M/P distribution is found to be normal, but not the reciprocal DNBR distribution itself. As a consequence, the randomizing factor was re-written to reflect the normality of the M/P distribution, and it was defined in Equation 7 in the request for additional information (RAI) for Reference 2. This equation has been used in previous implementations of the Statistical DNBR Evaluation Methodology, such as Reference 3 (see Equation 3.2.2-1) and Reference 4.

NRC Question 2

Explain how the numbers in Columns 2 and 3 (randomized DNB s_{DNBR} and Total DNB s_{Total}) in Tables 3.1.6-3 and 3.1.6-4 are obtained.

Dominion Response

The Randomized DNBR distribution is obtained for each statepoint using Equation 1 as described in detail in the response to Question #1. The Randomized DNBR distribution is then evaluated to determine the Randomized DNBR s_{DNBR}, which is shown in Column 2 of Tables 3.1.6-3 and 3.1.6-4.

Column 3, the Total s_{Total}, is obtained using the Root-Sum-Square method according to equation 3:

$$s_{TOTAL} = \sqrt{s_{DNBR}^2 \cdot \left(1.0 + \sqrt{\left\{\sqrt{\frac{n-1}{\chi^2}} - 1.0\right\}^2 + \left\{\frac{1}{\sqrt{N}}\right\}^2}\right)^2 + F_c^2 + F_M^2} \qquad \text{[equation 3]}$$

where:

- s_{DNBR} is the standard deviation for the Randomized DNBR distribution.
- The factor $\left\{\sqrt{\frac{n-1}{\chi^2}} - 1.0\right\}$ is the uncertainty in the standard deviation of the 2,000 Monte Carlo simulations, and provides a 95% upper confidence limit on the standard deviation.
- $1/\sqrt{N}$ is the uncertainty in the mean of the correlation. N is the number of experimental datapoints in the original correlation database.
- F_c is the code uncertainty, that has been defined as 5% (2σ value), i.e. 5.0%/1.645 =3.04% (1σ value). See Section 3.1.5 in Reference 1.
- F_M is the model uncertainty, which is 0.0 in our case as we are running the Monte Carlo simulation with the production model (see Section 3.1.4 in Reference 1).

Note that this equation differs slightly from the equation listed in Reference 2. It has a new factor applied to the Randomized DNBR s_{DNBR}, the $1/\sqrt{N}$ factor to correct for the uncertainty in the mean of the correlation. This factor has been used in previous implementations of the Statistical DNBR Evaluation Methodology, such as Reference 3 and Reference 4.

NRC Question 3

In Section 3.1.7, it is stated that the SDLs for the BWU-Z/ZM and BWU-N correlations are increased to 1.34 and 1.38, respectively, so that 99.9% of fuel rods in the core would not experience DNB. However, Statepoint B in Table 3.1.7-1 and Statepoint A in Table 3.7.1-2 show the rods in DNB are 0.092% and 0.091%, respectively, for the chosen SDL for BWU-Z/ZM and BWU-N.

Clarify why it is not necessary to increase the SDLs further so that 0.1% of the rods core-wide would experience DNB.

Dominion Response

The Pin Peak $SDL_{95/95}$ values in Tables 3.1.6-3 and 3.1.6-4 result in less than 0.1% of the rods in DNB on a core-wide basis. According to page 52 of Reference 2, the application of a higher SDL for a fixed DNBR standard deviation will yield a lower number of rods in DNB.

Statepoint B in Table 3.1.7-1 shows the rods in DNB is 0.092% with the applied SDL of 1.34. The SDL that would result in 0.1% of the rods in DNB on a core-wide basis for Statepoint B in Table 3.1.7-1 would be less than 1.34, but greater than 1.33.

Statepoint A in Table 3.1.7-2 shows the rods in DNB is 0.091% with the applied SDL of 1.38. The SDL that would result in 0.1% of the rods in DNB on a core-wide basis for Statepoint A in Table 3.1.7-2 would be less than 1.38, but greater than 1.37.

It is conservative to use the largest Full Core $SDL_{99.9}$ from all the evaluated statepoints for application to safety analysis. Thus, the SDLs for the BWU-Z/ZM and BWU-N correlations were appropriately selected as 1.34 and 1.38, respectively.

References

1. Letter from E. S. Grecheck (Dominion) to US NRC Document Control Desk, "Virginia Electric and Power Company North Anna Power Station Units 1 and 2 - Proposed Technical Specification Changes - Addition of Analytical Methodology to COLR," Serial No. 05-419, July 5, 2005.

2. Topical Report, VEP-NE-2-A, "Statistical DNBR Evaluation Methodology," June 1987.

3. Letter from W. L. Stewart (VEPCO) to US NRC Document Control Desk, "Virginia Electric and Power Company North Anna Power Station Units 1 and 2 - Proposed Technical Specification Changes," Serial No. 87-231, June 17, 1987.

4. Letter from W. L. Stewart (VEPCO) to US NRC Document Control Desk, "Virginia Electric and Power Company Surry Power Station Units 1 and 2 - Proposed Technical Specification Changes - FΔh Increase/Statistical DNBR Methodology," Serial No. 91-374, July 8, 1991.