UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

June 21, 2011

Mr. David A. Heacock
President and Chief Nuclear Officer
Virginia Electric and Power Company
Innsbrook Technical Center
5000 Dominion Boulevard
Glen Allen, VA 23060-6711

SUBJECT: NORTH ANNA POWER STATION, UNIT NOS. 1 AND 2, REQUEST FOR ADDITIONAL INFORMATION (TAC NOS. ME4933 AND ME4934)

Dear Mr. Heacock:

By license amendment request (LAR) dated October 21, 2010 (Reference 1), Virginia Electric and Power Company (the licensee), proposed modifications to the Technical Specifications (TSs) for the North Anna Power Station, Unit Nos. 1 and 2 to add the the Westinghouse best-estimate large break loss-of-coolant accident analysis methodology using the Automated Statistical Treatment of Uncertainty Method to the list of methodologies approved for reference in the Core Operating Limits Report (COLR) in TS 5.6.5.b. This LAR also removes four obsolete COLR references.

The U.S. Nuclear Regulatory Commission staff is reviewing the submittal listed above and has determined that additional information as identified in the enclosure is needed in order to continue its review. We request that a response be provided within 60 days of the date of this letter.

Sincerely,

Robert Martin

Robert E. Martin, Senior Project Manager
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-338 and 50-339

Enclosure:
Request for Additional Information

cc w/encl: Distribution via Listserv

REQUEST FOR ADDITIONAL INFORMATION REGARDING THE ADDITION OF

ANALYTICAL METHODOLOGY TO THE TECHNICAL SPECIFICATIONS FOR

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)

NORTH ANNA POWER STATION, UNIT NOS. 1 AND 2 (NAPS)

DOCKET NOS. 50-338 AND 50-339

The Nuclear Regulatory Commission (NRC) staff has reviewed North Anna Power Station Unit Nos. 1 and 2 (NAPS) License Amendment Request regarding addition of analytical methodology to the core operating limits report for the best-estimate large break loss-of-coolant accident (LBLOCA) and has identified requests for additional information (RAI) as discussed below.

1. Provide a description and the results of the evaluation done against the conditions and limitations stated in the staff's safety evaluation (SE) on the Automated Statistical Treatment of Uncertainty Method (ASTRUM) in Westinghouse report WCAP-16009-P-A (Reference 2) with respect to the NAPS plant-specific adaptation of the ASTRUM methodology. Also, identify any deviations and their safety impact on the plant operations.

2. With respect to the analysis employing a plant-specific adaptation of the ASTRUM evaluation model, please provide the following:

   (a) A clarification that a plant-specific adaption of the ASTRUM evaluation model is still within the approved limitations and conditions stated in the staff SE;

   (b) The reason for increasing the number of circumferential noding stacks in the downcomer region from three to nine;

   (c) The plant nodalization scheme for NAPS; and

   (d) The results from the three circumferential node analyses.

3. RAI number not used.

4. Please describe the reason why higher peak cladding temperatures (PCTs) fall in the range of CD * Abreak/ACL values between 1.0 and 2.0 on Figure 1 for Unit 1 and between 0.9 and 2.3 on Figure 16 for Unit 2. Also, clarify that the lower break size (around 0.8) for the split break case and the higher break size (around 2.2) for the double-ended guillotine break case yield a similar high PCT for Unit 2, while the high PCTs are dominated by double-ended guillotine break at an effective break size of 1.9 for Unit 1.

5. Please describe the physical meaning and cause with respect to a negative hot assembly vapor flow rate as shown in Figure 7 for Unit 1 and Figure 22 for Unit 2 between 7 and 30 seconds after the break.

Enclosure

6. Provide the date of approval for the proposed Technical Specification (TS) 5.6.5.b.4 and identify which parameter listed in TS 5.6.5.a is supported by TS 5.6.5.b.4. Also, provide similar information for the rest of the methodologies listed in TS 5.6.5.b, such as its approval date and cycle-specific parameter it supported.

7. Provide the results of the boric acid precipitation analysis (i.e., the analysis report) that supports the NAPS power level of 2951 megawatts thermal. The analysis should show the boric acid concentration versus time assuming no switch to simultaneous injection. The analysis should also list all of the key parameter inputs and assumptions applicable to the model used to identify the emergency operating procedure timing for switching to hot-leg injection.

8. Provide the following information regarding the NAPS nuclear steam supply system:

   (a) Volume of the lower plenum, core and upper plenum below the bottom elevation of the hot leg, each identified separately. Also provide heights of these regions.

   (b) Loop friction and geometry pressure losses from the core exit through the steam generators (SGs) to the inlet nozzle of the reactor vessel. Also, provide the locked rotor reactor coolant pump (RCP) k-factor. Provide the mass flow rates, flow areas, k-factors, and coolant temperatures for the pressure losses (upper plenum, hot legs, SGs, suction legs, RCPs, and discharge legs). Include the reduced SG flow areas due to plugged tubes. Provide the loss from each of the intact cold legs through the annulus to a single broken cold leg. Also, provide the equivalent loop resistance for the broken loop and separately for the intact loop.

   (c) Capacity and boron concentration of the refueling water storage pool

   (d) Capacity of the condensate storage tank

   (e) Flushing flow rate at the time of the switch to simultaneous injection

   (f) High pressure safety injection runout flow rate

   (g) Capacities and boron concentrations for boron injection tank (BIT) storage tanks

   (h) Flow rate into the reactor coolant system from the BIT

9. Provide the following elevation data.

   (a) Bottom elevation of the suction leg horizontal leg piping and cold leg diameter

   (b) Top elevation of the cold leg at the RCP discharge

   (b) Top elevation of the core (also height of core)

   (d) Bottom elevation of the downcomer

10. Provide the limiting bottom and top skewed axial power shapes.

11. Discuss whether the Idlechik Handbook recommended expression for pressure loss coefficients along a curved channel was used. If so, explain why it was not used in the calculation for the k-factor. Also, provide the values of the lateral k-factors used for the downcomer lateral flow paths for the plant.

12. Provide the method used to compute the azimuthal lateral k-factors and the values used in the plant calculations. The staff notes that the "Idlechik" reference for calculating k-factors presents a method to compute k-factors in annuli of various radii. Please provide the results of a k-factor study for the lateral flow paths in the downcomer if it was performed.

13. Describe the azimuthal nodalization and results from the approved best estimate WCOBRA/TRAC model. Provide the results of other nodalization studies applied to the azimuthal detail in the downcomer (other than the three and nine azimuthal node studies). Also show the impact of time step on the PCT for the worst case downcomer boiling calculation.

14. The NRC staff completed its sensitivity study on downcomer boiling and the effect of lateral k-factor on this phenomenon. The case with zero lateral k-factor in the downcomer cross flow paths joining the azimuthal cells resulted in a 400 degrees F reduction in PCT. This was due to the maximization of mixing between the downcomer azimuthal cells, which severely limited downcomer boiling. The cold water entering the downcomer during the long term readily mixed into the adjacent downcomer volumes and reduced boiling and the resulting core uncovery and clad temperature. Emergency core coolant bypass and liquid sweep-out that dominate the very early portion of the event (the first 100-200 seconds) does not prevail during the longer term when the downcomer fills with liquid and vapor velocities are no longer high enough to entrain and sweep out the injected liquid. Provide a detailed analysis of impact of the lateral k-factor values on PCT during downcomer boiling following an LBLOCA.

15. Note that the staff will review the results of the applicable small break LOCA (SBLOCA) break spectrum analysis for NAPS in a forthcoming audit activity. This will include the analysis supporting RCP trip timing, which supports the emergency operating procedure for tripping these pumps following a SBLOCA and a description of the methods and identification of the break sizes and limiting location and other pertinent assumptions supporting the RCP trip timing for North Anna.

16. Provide the decay heat multiplier of the limiting LBLOCA and a detailed description of how decay heat is sampled for each LBLOCA that was analyzed.

References:

1. License Amendment Application from Virginia Electric and Power Company, October 21, 2010, to U.S. NRC Document Control Desk, Agencywide Documents Access and Management System (ADAMS) Accession No. ML102980447.

2. NRC Safety Evaluation on the ASTRUM methodology in WCAP-16009-P-A, November 5, 2004, ADAMS Accession No. ML043100073

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/RA/

Robert E. Martin, Senior Project Manager
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
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Docket Nos. 50-338 and 50-339

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Request for Additional Information

cc w/encl: Distribution via Listserv

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ADAMS Accession No. ML11166A253 *by memo dated 5/06/2011

OFFICE	NRR/LPL2-1/PM	NRR/LPL2-1/LA	NRR/DSS/SRXB	NRR/LPL2-1/BC	NRR/LPL2-1/PM
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DATE	06/16/11	06/16/11	05/06/11	06/21/11	06/21/11

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