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August 28, 2009

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

Serial No.	09-528
NL&OS/GDM	R1
Docket Nos.	50-305
	50-336/423
	50-338/339
	50-280/281
License Nos.	DPR-43
	DPR-65/NPF-49
	NPF-4/7
	DPR-32/37

DOMINION ENERGY KEWAUNEE, INC.
DOMINION NUCLEAR CONNECTICUT, INC.
VIRGINIA ELECTRIC AND POWER COMPANY
KEWAUNEE POWER STATION
MILLSTONE POWER STATION UNITS 2 AND 3
NORTH ANNA POWER STATION UNITS 1 AND 2
SURRY POWER STATION UNITS 1 AND 2
REMOVAL OF MIXING VANE GRID SPACING RESTRICTION IN APPENDIX B TO FLEET REPORT DOM-NAF-2 - EVALUATION OF 4X4 DNB TEST OF 15X15 VANTAGE+ WITH IFMS USING VIPRE-D/WRB-1

In a September 30, 2004 letter (ADAMS Accession No. ML042800118), Dominion submitted Fleet Report DOM-NAF-2, "Reactor Core Thermal-Hydraulics Using the VIPRE-D Computer Code," and Appendix A to DOM-NAF-2, "Qualification of the F-ANP BWU CHF Correlations in the Dominion VIPRE-D Computer Code," for NRC review and approval. Pursuant to discussions with the NRC during an August 4, 2004 public meeting (ADAMS Accession No. ML042520317), Dominion submitted Appendix B to the Fleet Report, "Qualification of the Westinghouse WRB-1 CHF Correlation in the Dominion VIPRE-D Computer Code," by letter dated January 13, 2005 (ADAMS Accession No. ML050180257) for NRC review and approval. Appendix B documented the qualification of the Westinghouse WRB-1 CHF Correlation with the VIPRE-D code and the code/correlation departure from nucleate boiling ratio (DNBR) design limits. The NRC approved Fleet Report DOM-NAF-2, including Appendices A and B, in the Safety Evaluation Report (SER) included in their letter dated April 4, 2006 (ADAMS Accession No. ML060790496). Dominion provided comments on the NRC SER in a letter dated June 1, 2006 (ADAMS Accession No. ML061530114), and the NRC issued a revised SER that addressed Dominion's comments in a letter dated June 23, 2006 (ADAMS Accession No. ML061740212). The approved version of Fleet Report DOM-NAF-2-A, Rev. 0.0-A, was submitted to the NRC for information in a letter

dated September 13, 2006 (ADAMS Accession No. ML062650184). Appendix C to Fleet Report DOM-NAF-2, "Qualification of the Westinghouse WRB-2M CHF Correlation in the Dominion VIPRE-D Computer Code," was submitted to the NRC in letter dated April 4, 2008 (Serial No. 08-0174), and subsequently approved by the NRC in letter dated April 22, 2009. The approved version of Fleet Report DOM-NAF-2, Rev. 0.1-A, with the inclusion of Appendix C was submitted to the NRC for information in a letter dated August 4, 2009 (Serial No. 09-479).

Appendix B to Fleet Report DOM-NAF-2-A currently includes a restriction associated with mixing vane grid spacing. Specifically, the subject restriction states that "VIPRE-D/WRB-1 will not be used for fuel with less than 13" mixing vane grid spacing." The purpose of this restriction was to exclude the use of the VIPRE-D/WRB-1 code/correlation with Westinghouse Intermediate Flow Mixing Vane grids (IFM) fuel types. The restriction was originally placed on WRB-1 in the SER for the COBRA/WRB-1 topical report, VEP-NE-3-A, "Qualification of the WRB-1 CHF Correlation in the Virginia Power COBRA Code," July 1990. When the VIPRE-D fleet report was developed, the restriction from the COBRA SER was included in the WRB-1 Qualification in Appendix B of DOM-NAF-2-A. However, Westinghouse has developed several fuel products that incorporate IFMs (e.g. 15x15 VANTAGE+ and 15x15 Upgrade fuel products); consequently, for Dominion to be able to use VIPRE-D/WRB-1 to perform DNB calculations for these fuel types the grid spacing restriction must be rescinded.

Therefore, Dominion hereby requests NRC approval to remove the mixing vane grid spacing restriction contained in Appendix B of Fleet Report DOM-NAF-2-A. The technical justification for this request is provided in the attachment.

If you have any further questions or require additional information, please contact Mr. Gary D. Miller at (804) 273-2771.

Sincerely,

J. Alan Price
Vice President – Nuclear Engineering
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Attachment

Commitments made in this letter: None

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ATTACHMENT

Technical Justification for the Removal of the Grid Spacing Restriction in Appendix B to Fleet Report DOM-NAF-2-A

DOMINION ENERGY KEWAUNEE, INC.
DOMINION NUCLEAR CONNECTICUT, INC.
VIRGINIA ELECTRIC AND POWER COMPANY
KEWAUNEE POWER STATION
MILLSTONE POWER STATION UNITS 2 AND 3
NORTH ANNA POWER STATION UNITS 1 AND 2
SURRY POWER STATION UNITS 1 AND 2

Technical Justification for the Removal of the Grid Spacing Restriction in Appendix B to Fleet Report DOM-NAF-2-A

Introduction

In a September 30, 2004 letter (Reference 1), Virginia Electric and Power Company (Dominion) submitted Fleet Report DOM-NAF-2, "Reactor Core Thermal-Hydraulics Using the VIPRE-D Computer Code," and Appendix A to the Fleet Report DOM-NAF-2, "Qualification of the F-ANP BWU CHF Correlations in the Dominion VIPRE-D Computer Code," for NRC review and approval. Pursuant to discussions with the NRC during an August 4, 2004 public meeting (Reference 2), Dominion submitted Appendix B to the Fleet Report, "Qualification of the Westinghouse WRB-1 CHF Correlation in the Dominion VIPRE-D Computer Code," by letter dated January 13, 2005 (Reference 3) for NRC review and approval. Appendix B documented the qualification of the Westinghouse WRB-1 CHF Correlation with the VIPRE-D code and the code/correlation departure from nucleate boiling ratio (DNBR) design limits. The NRC approved DOM-NAF-2 including Appendices A and B and provided their associated Safety Evaluation Report (SER) in Reference 4. Dominion provided comments on the NRC SER in Reference 5, and the NRC issued a revised SER that addressed Dominion's comments in Reference 6. The approved version of Fleet Report DOM-NAF-2-A, Rev. 0.0-A was submitted to the NRC for information in a letter dated September 13, 2006 (Reference 7). Appendix C to Fleet Report DOM-NAF-2, "Qualification of the Westinghouse WRB-2M CHF Correlation in the Dominion VIPRE-D Computer Code," was submitted to the NRC in letter dated April 4, 2008 (Reference 17) and subsequently approved by the NRC in letter dated April 22, 2009 (Reference 15). The approved version of Fleet Report DOM-NAF-2, Rev. 0.1-A, with the inclusion of Appendix C was submitted to the NRC for information in a letter dated August 4, 2009 (Reference 16).

Dominion herein requests the removal of the mixing vane grid spacing restriction contained in Appendix B of Fleet Report DOM-NAF-2-A. The restriction requested for removal is as follows: *"VIPRE-D/WRB-1 will not be used for fuel with less than 13" mixing vane grid spacing."* The basis for this request is provided below.

Background

The basic objective of core thermal-hydraulic analysis is the accurate calculation of reactor coolant conditions to verify that the fuel assemblies constituting the reactor core can safely meet the limitations imposed by departure from nucleate boiling (DNB) considerations. DNB, which could occur on the heating surface of the fuel rod, is characterized by a sudden decrease in the heat transfer coefficient with a corresponding increase in the surface temperature. DNB is a concern in reactor design because of the possibility of fuel rod failure resulting from the increased rod surface temperature.

To preclude potential DNB related fuel damage, a design basis is established and is expressed in terms of a minimum departure from nucleate boiling ratio (MDNBR). The

DNBR is the ratio of the predicted heat flux at which DNB occurs (i.e. the critical heat flux, CHF) and the local heat flux of the fuel rod. By imposing a DNBR design limit, adequate heat transfer between the fuel cladding and the reactor coolant is assured. DNBRs greater than the design limit indicate the existence of thermal margin within the reactor core. Thus, the purpose of core thermal-hydraulic DNB analysis is the accurate calculation of DNBR to assess and quantify core thermal margin.

The computer code VIPRE (Versatile Internals and Components Program for Reactors - EPRI) was developed for the Electric Power Research Institute (EPRI) by Battelle Pacific Northwest Laboratories to perform detailed thermal-hydraulic analyses to predict CHF and DNBR of reactor cores. Topical Report VIPRE-01 was approved by the U.S. Nuclear Regulatory Commission (USNRC) in References 8 and 9 for referencing in licensing applications. VIPRE-D is the Dominion version of the VIPRE computer code based upon VIPRE-01, MOD-02.1. VIPRE-D was developed to fit the specific needs of Dominion's nuclear plants and fuel products by adding vendor specific CHF correlations and customizing its input and output. However, Dominion has not made any modifications to the NRC-approved constitutive models and algorithms contained in VIPRE-01.

Dominion Fleet Report DOM-NAF-2-A describes Dominion's use of the VIPRE-D code, including modeling and qualification for Pressurized Water Reactors (PWR) thermal-hydraulic design. The Fleet Report demonstrates that the VIPRE-D methodology is appropriate for PWR licensing applications.

Appendix B of DOM-NAF-2-A documents Dominion's qualification of the WRB-1 correlation with the VIPRE-D code. This qualification was performed against a subset of the data from the Columbia-EPRI CHF database for Westinghouse "R" grid 17x17 and 15x15 fuel (Reference 10). This is the same subset of the Columbia-EPRI CHF database used by Dominion in the qualification of the WRB-1 correlation with the COBRA code (Reference 11). Appendix B summarizes the data evaluations that were performed to qualify the VIPRE-D/WRB-1 code/correlation pair and to develop the corresponding DNBR design limits for the correlation. In addition, Appendix B provides the range of application for operating conditions:

$$1440 \leq \text{Pressure} \leq 2490 \text{ psia}$$
$$0.9 \leq \text{Mass Flux} \leq 3.7 \text{ Mlbm/hr-ft}^2$$
$$\text{Local Quality} \leq 0.30$$

and imposed two additional restrictions on the intended range of application as follows:

- VIPRE-D/WRB-1 will not be used when the local heat flux exceeds 1.0 Mbtu/hr-ft^2, and
- VIPRE-D/WRB-1 will not be used for fuel with less than 13" mixing vane grid spacing.

Discussion

Dominion is requesting the removal of the grid spacing restriction note above imposed by Appendix B of the VIPRE-D Fleet Report DOM-NAF-2-A. The purpose of this restriction was to exclude the use of the VIPRE-D/WRB-1 code/correlation with Westinghouse Intermediate Flow Mixing Vane grids (IFM) fuel types. The restriction was originally placed on WRB-1 in the issuance of the SER for the COBRA/WRB-1 topical report, VEP-NE-3-A (Reference 11). When the VIPRE-D fleet report was developed, the restriction from the COBRA SER was included in the WRB-1 Qualification in Appendix B of DOM-NAF-2-A (Reference 12). However, Westinghouse has developed several fuel products that incorporate IFMs (e.g. 15x15 VANTAGE+ and 15x15 Upgrade). Consequently, for Dominion to be able to use VIPRE-D/WRB-1 to perform DNB calculations for these fuel types the grid spacing restriction must be rescinded.

Westinghouse conducted confirmatory DNB testing on the 15x15 fuel design (with Intermediate Flow Mixers) in December 1998 / January 1999. The measured and predicted critical heat flux for the range of the experimental data were used to statistically determine the 95/95% DNBR limit. The test data yielded a limiting DNBR value of 1.114. The results of this testing demonstrated that the use of the WRB-1 correlation for the 15x15 VANTAGE+ fuel is conservative and confirmed its applicability for this fuel type. It was therefore concluded that the DNB tests verified that application of the WRB-1 correlation to the 15X15 VANTAGE+ fuel was appropriate. The DNB test results were discussed during a March 17, 1999 meeting between the NRC, Westinghouse, and New York Power Authority (NYPA). Westinghouse documented this meeting in a letter to the NRC dated March 29, 1999 (Reference 13). Further, the NRC staff reviewed data and documentation of the DNB tests performed by Westinghouse in an amendment request for Indian Point Unit 3 (Reference 14) and determined that, because the new test data yielded a DNBR lower than the bounding limit of 1.17, the WRB-1 correlation is applicable to the 15X15 VANTAGE+ fuel.

Dominion has performed a similar evaluation of the Westinghouse CHF test data. The approved VIPRE-D methods with WRB-1 (Reference 12) were used to yield a limiting DNBR value of 1.112. Additionally, Dominion's evaluations obtained essentially identical results to those Westinghouse provided to the NRC in Reference 13. The standard deviation determined using VIPRE-D/WRB-1 was within 0.004 of the Westinghouse results with THINC and VIPRE-W. (It is noted that the Westinghouse data and results transmitted in Reference 13 are proprietary to Westinghouse and are referred to herein by reference only.)

With essentially identical results, Dominion concludes, as did Westinghouse, that the DNB test data can be conservatively considered part of the WRB-1 database population. Therefore, the existing VIPRE-D/WRB-1 qualification in Reference 12 can be conservatively applied for IFM fuel types with respect to the VIPRE-D/WRB-1 limit DNBR of 1.17 (Appendix B, Reference 12).

Conclusion

Dominion requests NRC review and approval to remove the following restriction from Fleet Report DOM-NAF-2-A, Appendix B (Reference 12):

> *"VIPRE-D/WRB-1 will not be used for fuel with less than 13" mixing vane grid spacing." (page B-8 of Appendix B)*

and the mixing vane grid spacing row from the range of validity table for VIPRE-D/WRB-1 as follows:

Range of Validity for VIPRE-D/WRB-1 *(page B-28 of Appendix B)*

Pressure [psia]	**1,440 to 2,490**
Mass Velocity [Mlbm/hr-ft^2]	**0.9 to 3.7**
Thermodynamic Quality at CHF	**≤ 0.30**
Local Heat Flux [Mbtu/hr- ft^2]	**≤ 1.0**
~~**Mixing Vane Grid Spacing [in]**~~	~~**> 13.0**~~

With the removal of the grid spacing restriction, Dominion will have approval to use the VIPRE-D/WRB-1 code/correlation pair to analyze Westinghouse fuel products with IFMs (e.g., 15x15 VANTAGE+ and 15x15 Upgrade). Test data provided by Westinghouse demonstrates that WRB-1 can be conservatively used for IFM fuel types (Reference 13). Dominion has evaluated the same test data and has come to the same conclusions using its approved in-house DNB methods, i.e., VIPRE-D. Thus, Dominion has concluded that the VIPRE-D/WRB-1 limit of 1.17 and associated statistics can be conservatively applied to the analysis of Westinghouse fuel products with IFMs.

References

1. Letter from L. N. Hartz (Dominion) to Document Control Desk (USNRC), "Virginia Electric and Power Company (Dominion), Dominion Nuclear Connecticut, Inc. (DNC), North Anna and Surry Power Stations Units 1 and 2, Millstone Power Station Units 2 and 3, Request for Approval of Topical Report DOM-NAF-2, Reactor Core Thermal-Hydraulics Using the VIPRE-D Computer Code Including Appendix A, Qualification of the F-ANP BWU CHF Correlations in the Dominion VIPRE-D Computer Code," Serial No. 04-606, dated September 30, 2004, ADAMS Accession No. ML042800118.

2. Meeting Notes (S. R. Monarque, USNRC), "Summary of August 4, 2004, Meeting with VEPCO on Topical Report DOM-NAF-2 (TAC NOS. MC3904, MC3905, MC3906, AND MC3907)," September 3, 2004, ADAMS Accession No. ML042520317.

3. Letter from E. S. Grecheck (Dominion) to Document Control Desk (NRC), 'Virginia Electric and Power Company (Dominion), Dominion Nuclear Connecticut, Inc. (DNC), North Anna and Surry Power Stations Units 1 and 2, Millstone Power Station Units 2 and 3, Request for Approval of Appendix B of Topical Report DOM-NAF-2, Qualification of the Westinghouse WRB-1 CHF Correlation in the Dominion VIPRE-D Computer Code," Serial No. 05-020, dated January 13,2005, ADAMS Accession No. ML050180257.

4. Letter from C. I. Grimes (USNRC) to D. A. Christian (Dominion), "Millstone Power Station Unit Nos. 2 and 3 (Millstone 2 and 3), North Anna Power Station Unit Nos. 1 and 2 (North Anna 1 and 2) and Surry Power Station Unit Nos. 1 and 2 (Surry 1 and 2) - Approval of Dominion's Fleet Report DOM-NAF-2, 'Reactor Core Thermal-Hydraulics Using the VIPRE-D Computer Code, (TAC Nos. MC4571, MC4572, MC4573, MC4574, MC4575 and MC4576)", Serial No. 06-319, April 4, 2006, ADAMS Accession No. ML060790496.

5. Letter from E.S. Grecheck (Dominion) to NRC Document Control Desk, "Dominion Nuclear Connecticut, Inc. (DNC), Virginia Electric and Power Company (Dominion), Millstone Power Station Unit Nos. 2 and 3, North Anna Power Station Unit Nos. 1 and 2, and Surry Power Station Unit Nos. 1 and 2, Requested Clarification of the NRC SER for Dominion Fleet Report DOM-NAF-2, (TAC Nos. MC4571, MC4572, MC4573, MC4574, MC4575 and MC4576)", Serial No. 06-319, June 1, 2006, ADAMS Accession No. ML061530114.

6. Letter from S. R. Monarque (USNRC) to D. A. Christian (Dominion), "Millstone Power Station Unit Nos. 2 and 3, North Anna Power Station Unit Nos. 1 and 2, and Surry Power Station Unit Nos. 1 and 2 – Correction to Dominion's Fleet Report DOM-NAF-2, 'Reactor Core Thermal-Hydraulics Using the VIPRE-D Computer Code'," Serial No. 06-560, June 23, 2006, ADAMS Accession No. ML061740212.

7. Letter from G. T. Bischof (Dominion) to NRC Document Control Desk (USNRC), "Virginia Electric and Power Company (Dominion), Dominion Nuclear Connecticut, Inc. (DNC), North Anna and Surry Power Stations Units 1 and 2, Millstone Power Station Units 2 and 3, Approved Topical Report DOM-NAF-2, Rev. 0.0-A, 'Reactor Core Thermal-Hydraulics using the VIPRE-D Computer Code including Appendixes A and B'," Serial No. 06-773, September 13, 2006, ADAMS Accession No. ML062650184.

8. Letter from C. E. Rossi (USNRC) to J. A. Blaisdell (UGRA Executive Committee), "Acceptance for Referencing of Licensing Topical Report, EPRI NP-2511-CCM, 'VIPRE-01: A Thermal-Hydraulic Analysis Code for Reactor Cores,' Volumes 1, 2, 3 and 4," May 1, 1986.

9. Letter from A. C. Thadani (USNRC) to Y. Y. Yung (VIPRE-01 Maintenance Group), "Acceptance for Referencing of the Modified Licensing Topical Report, EPRI NP-2511-CCM, Revision 3, 'VIPRE-01: A Thermal Hydraulic Analysis Code for Reactor Cores,' (TAC No. M79498)," October 30, 1993.

10. Technical Report, EPRI NP-2609, "Parametric Study of CHF Data, Volume 3, Part 1; Critical Heat Flux Data," C. F. Fighetti, & D.G. Reddy, September 1982.

11. Topical Report, VEP-NE-3-A, "Qualification of the WRB-1 CHF Correlation in the Virginia Power COBRA Code," R. C. Anderson, July 1990.

12. Fleet Report, DOM-NAF-2-A, "Reactor Core Thermal-Hydraulics using the VIPRE-D Computer Code,' R. M. Bilbao y León, August 2006.

13. Letter from H. A. Sepp (Westinghouse) to Document Control Desk (USNRC) (NSD-NRC-99-5828), "Notification of FCEP Application for DNB Testing and Revalidation of WRB-1 Applicability to the 15x15 VANTAGE+ Fuel Design, (Proprietary)," March 29, 1999.

14. Letter from G. F. Wunder (USNRC/NRR) to J. Knubel (NYPA), "Indian Point Nuclear Generation Unit No. 3 – Issuance of Amendment RE: Removal of Footnote from Technical Specifications (TAC NO. MA5193)," September 2, 1999, ADAMS Accession No. ML003780850.

15. Letter from D. N. Wright (NRC) to D. A. Christian (Dominion), "Kewaunee Power Station, Millstone Power Station Units 2 and 3, North Anna Power Station Unit Nos. 1 and 2, and Surry Power Station Unit Nos. 1 and 2 – Appendix C to Dominion Fleet Report DOM-NAF-2, „Qualification of the Westinghouse WRB-2M CHF Correlation in the Dominion VIPRE-D Computer Code" (TAC Nos. MD8703, MD8704, MD8705, MD8706, MD8707, MD8708, MD8709)," Serial No. 09-290, April 22, 2009.

16. Letter from J. A. Price (Dominion) to NRC Document Control Desk (USNRC), "Virginia Electric and Power Company (Dominion), Dominion Nuclear Connecticut, Inc. (DNC), Dominion Energy Kewaunee, Inc. (DEK), Surry and North Anna Power Stations Units 1 and 2, Millstone Power Station Units 2 and 3, Kewaunee Power Station, Approved Topical Report DOM-NAF-2, Rev. 0.1-A," Serial No. 09-479, August 4, 2009.

17. Letter from G. T. Bischof (Dominion) to Document Control Desk (NRC), "Dominion Energy Kewaunee, Inc. (DEK), Dominion Nuclear Connecticut, Inc. (DNC), Virginia Electric and Power Company (Dominion), Kewaunee Power Station, Millstone Power Station Units 2 and 3, North Anna and Surry Power Stations Units 1 and 2, Request for Approval of Appendix C of Fleet Report DOMNAF-2, Qualification of the Westinghouse WRB-2M CHF Correlation in the Dominion VIPRE-D Computer Code," Serial No. 08-0174, dated April 4, 2008.