



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

June 21, 2010

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

SUBJECT: KEWAUNEE POWER STATION, MILLSTONE POWER STATION UNITS 2 AND 3, NORTH ANNA POWER STATION UNITS 1 AND 2, AND SURRY POWER STATION UNITS 1 AND 2 - REMOVAL OF MIXING VANE GRID SPACING RESTRICTION IN APPENDIX B TO FLEET REPORT DOM-NAF-2-A (TAC NOS. ME2321 – ME2327)

Dear Mr. Heacock:

By letter dated August 28, 2009, Mr. J. Alan Price of Dominion Resource Services, requested Nuclear Regulatory Commission (NRC) approval of a change to the NRC-approved Topical Report DOM-NAF-2-A, "Reactor Core Thermal-Hydraulics Using the VIPRE-D Computer Code." The change involves removing the mixing vane grid spacing restriction in Appendix B to DOM-NAF-2-A. Mr. Price supplemented the August 28, 2009, letter with letters dated November 20, 2009, and April 16, 2010.

The NRC staff has reviewed the proposed change conveyed by the cited submittals and found the proposed change acceptable. Details of the NRC staff's review are set forth in the enclosed Supplemental Safety Evaluation for DOM-NAF-2-A.

Sincerely,

A handwritten signature in black ink, reading "Peter S. Tam". The signature is stylized with a large, sweeping "P" and "T".

Peter S. Tam, Senior Project Manager
Plant Licensing Branch III-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-305, 50-336, 50-423,
50-338, 50-339, 50-280, and 50-281

Enclosure: As stated

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SUPPLEMENTAL SAFETY EVALUATION

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

DOMINION RESOURCE SERVICES, INC., TOPICAL REPORT DOM-NAF-2-A

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

DOCKET NOS. 50-305, 50-336, 50-423, 50-338, 50-339, 50-280, AND 50-281

1.0 INTRODUCTION

By letter dated August 28, 2009 (Reference 1), as supplemented by letters dated November 20, 2019, and April 16, 2010 (References 8 and 9), Dominion Resources Services, Inc. requested the Nuclear Regulatory Commission (NRC) staff to approve a change to the NRC-approved Fleet Topical Report DOM-NAF-2-A, "Reactor Core Thermal-Hydraulics Using the VIPRE-D Computer Code." This topical report, and its Appendices A, B, and C were approved by NRC via Safety Evaluations dated April 4, 2006 (ADAMS Accession No. ML060790496), June 23, 2006 (ADAMS Accession No. ML061740212), and April 22, 2009 (ADAMS Accession No. ML091030639). The approved version of Fleet Report DOM-NAF-2-A, Rev. O.O-A (Reference 3), including Appendices A and B, was submitted by Dominion by letter dated September 13, 2006 (ADAMS Accession No. ML062650184).

Dominion requested approval to remove the mixing vane grid spacing restriction in Appendix B, "Qualification of the Westinghouse WRB-1 CHF Correlation in the Dominion VIPRE-D Computer Code," of Fleet Topical Report DOM-NAF-2-A.

Dominion provided the above-cited submittals to justify the removal of the restriction from Appendix B of DOM-NAF-2-A. Appendix B to 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 (IFM) vane grids fuel types. The restriction was originally placed on WRB-1 in the safety evaluation for the COBRA/WRB1 Topical Report VEP-NE-3-A, "Qualification of the WRB-1 CHF Correlation in the Virginia Power COBRA Code," July 1990 (Reference 5). When the VIPRE-D fleet report was developed, the restriction from the COBRA safety evaluation 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

Enclosure

to be able to use VIPRE-D/WRB-1 to perform departures from nucleate boiling (DNB) calculations for these fuel types, the grid spacing restriction must be rescinded.

2.0 REGULATORY EVALUATION

Title 10 of the *Code of Federal Regulations* Part 50, Section 34, "Contents of applications; technical information," requires that safety analysis reports be submitted that analyze the design and performance of structures, systems, and components provided for the prevention of accidents and the mitigation of the consequences of accidents. As part of the core reload design process, licensees (or vendors) perform reload safety evaluations to ensure that their safety analyses remain bounding for the design cycle. To confirm that the analyses remain bounding, licensees confirm those key inputs to the safety analyses such as the critical heat flux (CHF) are conservative with respect to the current design cycle. If key safety analysis parameters are not bounded, a re-analysis or a re-evaluation of the affected transients or accidents is performed to ensure that the applicable acceptance criteria are satisfied.

Appendix B to DOM-NAF-2-A describes Dominion's methodology for implementing the WRB-1 CHF correlation in its sub-channel code, VIPRE-D. The NRC staff has previously reviewed and approved this correlation (see Reference 3). The NRC staff's review will be based on the evaluation of technical merit and compliance with any applicable regulations of the revisions.

3.0 TECHNICAL EVALUATION

3.1 Background Information

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 IFM vane grids fuel types. The restriction was originally placed on WRB-1 in the issuance of the safety evaluation for the COBRA/WRB-1 topical report, VEP-NE-3-A. When the VIPRE-D fleet topical report was developed, the restriction from the COBRA safety evaluation was included in the WRB-1 Qualification in Appendix B of DOM-NAF-2-A (Reference 3). 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.

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

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 4). 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 5). Appendix B summarizes the data evaluations that were performed to qualify the VIPRE-D/WRB-1 code/correlation pair and to develop the corresponding departure from nucleate boiling ratio (DNBR) design limits for the correlation. In addition, Appendix B provides the range of application for operating conditions.

Westinghouse conducted confirmatory CHF testing in the time period December 1998 to January 1999 to revalidate the WRB-1 applicability to the 15x15 Vantage+ fuel designs which included IFM grids. The CHF test section consisted of a 4x4 typical cell with geometry prototypical of 15x15 Vantage+ fuel design. Details of the test section, axial layout of the grids, assembly instrumentation, and axial and radial power distributions, are provided in Reference 2. Westinghouse demonstrated in Reference 6 that the quantity of test data was comparable with other Westinghouse test bundles and that the test conditions were representative of the WRB-1 database. Westinghouse evaluated the test data for normality, and compared the test data to the WRB-1 database using the F- and T-statistical tests. The results indicated that the test data produced a 95/95 DNBR limit less than 1.17 (the accepted WRB-1 design limit) and a mean M/P (measured to predicted CHF) greater than 1.0, which shows that these results are conservative. Westinghouse showed similar results using VIPRE and THING computer codes. Westinghouse concluded that the CHF test data can be conservatively considered as part of the WRB-1 database and the WRB-1 DNBR design limit of 1.17 can be conservatively applied to 15X15, Vantage+ fuel. The 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 6). Further, the NRC staff reviewed data and documentation of the tests performed by Westinghouse, leading to approval of an amendment for Indian Point Unit 3 (Reference 7).

Dominion replicated the Westinghouse evaluation of the CHF test data using the VIPRE-D Code with the WRB-1 correlation to develop a 95/95 DNBR limit for the test data. One-sided tolerance theory (Reference 8) was used by Dominion for the calculation of the test data DNBR design limit. This theory allows the calculation of a DNBR limit so that, for a DNBR equal to the design limit, DNB will be avoided with 95 percent probability at a 95 percent confidence level. A comparison of the WRB-1 M/P results between the Westinghouse VIPRE-W and Dominion VIPRE-D Code indicated excellent agreement.

Because all the statistical techniques used in Table 1 of Dominion's November 20, 2009, submittal (Reference 8) assume that the original data distribution is normal, it is necessary to verify that the overall distribution for the M/P ratio is a normal distribution. To evaluate whether the distribution is normal, the D' normality test was applied. This D' value is within the range of acceptability for the number of data points for conducting a 95/95DNBR limit. Thus, Dominion concluded that the M/P distribution for the test data is indeed normal. Based on the results listed in Table 1, the 95/95 DNBR limit for the test data can be calculated using the typical DNBR relation which is presented in Reference 1.

In addition, Dominion also performed an F-Test and a T-Test. The F-Test is performed to determine if the variances of two variables, the WRB-1 variance and the variance of the test data, are equal. Thus, the NRC staff agrees that the result of this analysis showed that the two variances were indeed equal, and the additional IFM data collected for the 15x15 and 17x17 fuel designs can be included in the WRB-1 data base (Reference 8).

The T-test was used to compare the means of populations with equal variances. The NRC staff requested the licensee to provide additional information in order to complete the review. The questions, conveyed in an e-mail dated March 9, 2010 (ADAMS Accession No. ML100700236), requested Dominion to clarify statistical calculations and define the expected operational range of the correlation. Dominion responded by Reference 9, providing a sample calculation of its

statistical method and providing a specific table of ranges for the correlation. The NRC staff found Dominion's response in Reference 9 acceptable.

4.0 CONCLUSION

The NRC staff has reviewed the request by Dominion to remove a mixing vane grid spacing restriction contained in Appendix B of Fleet Topical Report DOM-NAF-2-A. Based on its review, the NRC staff concludes that the removal of the restriction is acceptable.

5.0 REFERENCES

1. Letter from J. Alan Price (Dominion Resources Services, Inc.) to NRC, proposing to revise Appendix B to Fleet Report DOM-NAF-2-A to remove a restriction associated with mixing vane grid spacing, August 28, 2009 (ADAMS Accession No. ML092430338).
2. Letter from E. S. Grecheck (Dominion) to NRC, requesting clarification of the NRC safety evaluation for Dominion Fleet Report DOM-NAF-2, June 1, 2006 (ADAMS Accession No. ML061530114).
3. Dominion Fleet Report, DOM-NAF-2-A, "Reactor Core Thermal-Hydraulics Using the VIPRE-D Computer Code," R. M. Bilbao y Leon, September 2006 (ADAMS Accession No. ML062650184).
4. 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.
5. Topical Report, VEP-NE-3-A, "Qualification of the WRB-1 CHF Correlation in the Virginia Power COBRA Code," R. C. Anderson, July 1990 (ADAMS Legacy Library Accession No. 9009260097).
6. Letter from H. A. Sepp (Westinghouse) to NRC. "Notification of FCEP Application for DNB Testing and Revalidation of WRB1- Application to the 15x15 Vantage+ Fuel Design (Proprietary)," March 29, 1999 (ADAMS Legacy Library Accession No. 9904050141)
7. Letter from G. F. Wunder (NRC) to J. Knubel (NYPA), "Indian Point Nuclear Generation Unit No. 3 – Issuance of Amendment No. 191," September 2, 1999 (ADAMS Accession No. ML003780850).
8. Letter from J. Alan Rice (Dominion Resources Services, Inc.) to NRC, supplementing the August 20, 2009 letter regarding revising Fleet Topical Report DOM-NAF-2-A, November 20, 2009 (ADAMS Accession No. ML093310330).
9. Letter from J. Alan Price (Dominion Resources Services, Inc.) to NRC, providing addition information in response to an NRC Request for Additional Information, April 16, 2010 (ADAMS Accession No. ML101100608).

Principal Contributor: Anthony Attard, NRR

Date: June 21, 2010

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/RA/

Peter S. Tam, Senior Project Manager
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