VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

July 9, 2002

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

Serial No. 02-167A
Docket Nos. 50-338
50-339
License Nos. NPF-4
NPF-7

Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION UNITS 1 AND 2
MINIMUM CONTAINMENT PRESSURE ANALYSIS TO SUPPORT
PROPOSED TECHNICAL SPECIFICATIONS CHANGES AND EXEMPTION REQUEST
USE OF FRAMATOME ANP ADVANCED MARK-BW FUEL

In a March 28, 2002 letter (Serial No. 02-167), Virginia Electric and Power Company (Dominion) requested: 1) an amendment to Facility Operating License Numbers NPF-4 and NPF-7 for North Anna Power Station Units 1 and 2, and 2) associated exemptions from 10 CFR 50.44 and 10 CFR 50.46. The amendments and exemptions will permit North Anna Units 1 and 2 to use Framatome ANP Advanced Mark-BW fuel. This fuel design has been evaluated by Framatome and Dominion for compatibility with the resident Westinghouse fuel and for compliance with fuel design limits. The attachment to this letter forwards the minimum containment backpressure analysis. This analysis was performed in support of the large break LOCA evaluation for the Advanced Mark-BW fuel and is provided in response to the NRC Staff request in a May 28, 2002 conference call. The remainder of the documentation required to establish compliance with the emergency core cooling system (ECCS) requirements of 10 CFR 50.46 for the transition to Advanced Mark-BW fuel is being developed for submittal as soon as possible, but no later than September 30, 2002.

The attached analysis employs the guidance of Standard Review Plan Section 6.2.1.5 and Containment Systems Branch Technical Position CSB 6-1, in calculations performed with the CONTEMPT code (Reference 1). The model and its application have been previously approved for use as part of the Framatome ANP BWNT LOCA evaluation model for B&W-designed plants (Reference 2). The application of this model for North Anna is justified since the North Anna containment features and predicted conditions have been confirmed to be fully within its range of applicability. The analysis has been performed using the detailed containment design input description employed in the existing minimum backpressure analysis. The assumed initial containment pressure is consistent with operation within the proposed Technical Specifications

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conditions submitted in Dominion letter, Serial No. 01-684, dated November 29, 2001 (Reference 3).

As noted in previous correspondence, the initial reload batch of Advanced Mark-BW fuel is currently planned for North Anna Unit 1 Cycle 17, which is scheduled to begin operation in April 2003. Consistent with our previous correspondence, we continue to request your timely review and approval to achieve this reload schedule.

If you have any questions or require additional information on this, please contact us.

Very truly yours,

L. N. Hartz
Vice President - Nuclear Engineering

Attachment

Commitments made in this letter: None

References:

1. BAW-10095A, Revision 1, "CONTEMPT – Computer Program for Predicting Containment Pressure-Temperature Response to LOCA," April 1978.

2. BAW-10192P-A, "BWNT LOCA – BWNT Loss-of-Coolant Accident Evaluation Model for Once-Through Steam Generator Plants," Revision 0, June 1998.

3. Letter, Leslie N. Hartz to USNRC, "Virginia Electric and Power Company North Anna Power Station Unit 1 and 2 – Proposed Technical Specifications Changes, Revised Containment Analysis, " Serial No. 01-684, November 29, 2001.

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SN: 02-167A
Docket Nos.: 50-338/339
Subject: Proposed TS Changes & Exemption Request
Use of Framatome ANP Advanced Mark-BW Fuel

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Leslie N. Hartz, who is Vice President - Nuclear Engineering, of Virginia Electric and Power Company. She has affirmed before me that she 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 her knowledge and belief.

Acknowledged before me this 9th day of July, 2002.

My Commission Expires: March 31, 2004.

Notary Public

(SEAL)

ATTACHMENT

Containment Minimum Pressure Analysis
Framatome Fuel Transition Program

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

MINIMUM CONTAINMENT BACKPRESSURE CALCULATION METHODOLOGY FOR APPLICATION AT NORTH ANNA POWER STATION UNITS 1 and 2

Framatome ANP will be delivering Advanced Mark-BW reload fuel to the North Anna Power Station (NAPS) Units 1 and 2 starting in the first quarter of 2003. These units are Westinghouse-designed, three-loop plants operating at a rated thermal power of 2,893 MWt. The plants have conventional ECCS systems and dry, sub-atmospheric containment designs. In accordance with 10CFR50.46 and 10CFR50, Appendix K, an evaluation of ECCS performance is being performed for the Framatome ANP reload fuel.

One component of the overall LOCA evaluation is the determination of the minimum containment backpressure. The governing LOCA evaluation model—topical report BAW-10168P-A, Revision 3 (Reference 1) - specifies that the minimum containment backpressure, generally reported in the FSAR, is taken with proper validation from the prior vendor's fuel reload licensing calculations. In the instance of North Anna, the UFSAR backpressure time histories were of insufficient duration (and unsuitable for conservative extrapolation) for use in the LOCA calculations. The Framatome ANP analysis required approximately 400-second backpressure time histories; the NAPS UFSAR (Chapter 15) backpressure curves ended at 240 seconds. Therefore, Framatome ANP has performed an independent minimum containment backpressure analysis.

The calculation methodology used in the LOCA analysis of the NAPS units is described below. The minimum containment backpressure methodology is formulated to follow that set forth in the NRC-approved LOCA evaluation model for B&W-designed plants (Section 4.3.6.1[1] in Reference 2). The methodology in Reference 2 employs the NRC-approved CONTEMPT containment pressure computer code (Reference 3) and it adheres to the guidelines of Branch Technical Position CSB 6-1.

The containment designs for the NAPS units are comparable to those for B&W-designed plants with dry containment having domed and cylindrical steel liner, conventional pressure reduction systems (no ice condenser), and a normal mix of heat sinks and heat sink materials. Hence, the application of the Reference 2 minimum containment backpressure methodology to the NAPS units is appropriate.

Containment Pressure Computer Code

The minimum containment backpressure is determined by using the CONTEMPT computer code (Reference 3). CONTEMPT is a NRC-approved containment pressure prediction tool for use within the Framatome ANP LOCA evaluation model for B&W-designed plants (Reference 2). The containment designs for the NAPS units are comparable to those for B&W plants. Two general, but inconsequential, differences exist between the containment types. First, the NAPS units have a sub-atmospheric containment design; the B&W plants do not. The range of the 'water property tables' in CONTEMPT is sufficiently large to accommodate the sub-atmospheric containment design and is applicable to the North Anna design. Second, the NAPS units use three spray

[1] Equation 4-3 contains a typographical error. The term $Q^{0.62}/(V \times t_P)$ should be $[Q/(V \times t_P)]^{0.62}$.

systems (with water capacity sufficient to return the containment to a sub-atmospheric state within one hour following a LOCA) for containment pressure suppression; the B&W plants use both spray and fan cooler pressure suppression devices. CONTEMPT is capable of modeling containment spray systems and can accommodate this design feature. Although these design differences will affect the value of containment model input parameters, the methodology is equally applicable. Therefore, CONTEMPT, as approved in the Framatome ANP LOCA evaluation model for B&W-designed plants (Reference 2), is also valid for use in determining the minimum containment backpressure for the NAPS units.

Minimum Containment Backpressure Model

Branch Technical Position CSB 6-1, attached to Standard Review Plan 6.2.1.5, provides guidance for determining values of important model input parameters. The following discussion addresses the modeling of the parameters highlighted in Branch Technical Position CSB 6-1.

Initial Containment Internal Conditions

The initial containment conditions (9.92 psia, 100° F, and 100% humidity) are consistent with the requirements of Branch Technical Position CSB 6-1 and reflect minimum containment pressure and gas temperature, and maximum humidity encountered under limiting normal operating conditions. The assumed containment pressure reflects operation within the proposed Technical Specifications conditions submitted in Dominion letter, Serial No. 01-684, dated November 29, 2001 (Reference 4).

Initial Outside Containment Ambient Conditions

A conservatively low outside temperature of –10° F is used. This temperature is identical to that used in the current licensing base as stated in the UFSAR. The value is consistent with the requirement of Branch Technical Position CSB 6-1.

Containment Volume

The containment volume used is 5% larger than the volume used for the containment integrity calculations from the NAPS UFSAR. The volume is the same as that used in the current licensing base as stated in the UFSAR Chapter 15 minimum containment backpressure analysis (UFSAR Table 15.4-2). It is consistent with the requirements of Branch Technical Position CSB 6-1.

Purge Supply and Exhaust Systems

The NAPS LOCA analysis precludes purge system operation during normal plant operation.

Spray and Fan Cooling Systems

The NAPS containments do not have fan coolers; they only have spray pressure suppression systems. Three spray systems, a quench system and two re-circulating spray systems, are available for use in the NAPS containments. The Quench Spray system takes suction from the RWST with a nominal water temperature of 45° F, a temperature consistent with that used in the 10CFR50.46 LOCA calculations. The other two spray systems are Recirculation Spray systems that take suction from the containment sump and cool the water via external heat exchangers before spraying the water into the containment atmosphere. All spray systems are assumed available with no single failures. The systems are conservatively modeled at or near run-out capacities. Appropriate time delays are incorporated. The modeling is consistent with the requirements of Branch Technical Position CSB 6-1.

Containment Steam Mixing With Spilled ECCS Water

Consistent with Branch Technical Position CSB 6-1, spilled ECCS water is combined with discharge from the postulated break for direct addition to the containment atmosphere. The effect of steam-water mixing in the containment atmosphere is considered.

Containment Steam Mixing With Water from Ice Melt

The water of ice melt is not applicable to the dry containment design of the NAPS units.

Passive Heat Sinks

The passive heat sinks are the same as used in the current NAPS licensing base 10CFR50.46 LOCA analysis as stated in UFSAR Chapter 15. The surface areas of the heat sinks are increased by 3% above the areas used in the containment integrity calculations, UFSAR Chapter 6. Where appropriate, paint is included in the heat sink description. The heat sink thermophysical properties are consistent with those in Branch Technical Position CSB 6-1.

Heat Transfer Coefficients

This containment model uses the condensing heat transfer coefficients for heat transfer to exposed passive heat sinks prescribed by Branch Technical Position CSB 6-1. For the blowdown phase, a linear increase from 8 Btu/hr-ft^2-°F to 4 times the maximum value calculated using the Tagami correlation is used. For the long-term post blowdown phase, 1.2 times the Uchida data is used. The transition between these two phases uses an exponential decay. The approach is the same used in the containment calculation under the Framatome ANP LOCA evaluation model for B&W-designed plants (Reference 2) and it is consistent with the requirements of Branch Technical Position CSB 6-1.

Model Application

As approved for the Framatome ANP LOCA evaluation model for B&W-designed plants (Reference 2), the transient masses and energies generated using approved 10 CFR Part 50, Appendix K blowdown and reflood models are introduced as a non-coupled input to the containment atmosphere for the transient pressure prediction. The mass and energy additions include break effluent as well as spilled ECCS liquid. In an iterative process, the predicted containment pressure is applied to the blowdown and reflood models as a boundary condition to ensure that the containment pressure is a lower bound of that resulting from a fully coupled evaluation.

Representative Results

Application of Framatome ANP LOCA evaluation models provides individual limiting transient calculations for core axial power distributions peaked toward the core inlet, the center of the core, and the core outlet. Each case may result in a slightly different minimum containment backpressure time history. The approved Framatome ANP minimum containment backpressure methodology in Reference 2, however, allows the use of the same minimum containment backpressure evolution irrespective of the core axial peak location. The minimum containment backpressure selected for the North Anna large break LOCA limit calculations results from a centrally peaked core and is shown in Figure 1.

References

1. RSG LOCA – BWNT Loss-of-Coolant Accident Evaluation Model for Recirculating Steam Generator Plants, Topical Report BAW-10168P-A, Revision 3, December 1996.

2. BWNT LOCA – BWNT Loss-of-Coolant Accident Evaluation Model for Once-Through Steam Generator Plants, Topical Report BAW-10192P-A, Revision 0, June 1998.

3. CONTEMPT – Computer Program for Predicting Containment Pressure-Temperature Response to LOCA, Topical Report BAW-10095A, Revision 1, April 1978.

4. Letter, Leslie N. Hartz to USNRC, "Virginia Electric and Power Company North Anna Power Station Unit 1 and 2 – Proposed Technical Specifications Changes, Revised Containment Analysis," Serial No. 01-684, November 29, 2001.

Figure 1 - NAPS Minimum Containment Backpressure, $C_D = 0.6$, MAX ECC