VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

September 5, 2003

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

Serial No. 03-313C
NLOS/ETS
Docket Nos. 50-338/339
License Nos. NPF-4/7

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)
NORTH ANNA POWER STATION UNITS 1 AND 2
PROPOSED TECHNICAL SPECIFICATIONS CHANGES AND EXEMPTION REQUEST FOR USE OF FRAMATOME ANP ADVANCED MARK-BW FUEL
SUPPLEMENTAL INFORMATION FOR REALISTIC LARGE BREAK LOSS OF COOLANT ACCIDENT (RLBLOCA) ANALYSIS RESULTS

In a May 6, 2003 letter (Serial No. 03-313), Dominion submitted the Realistic Large Break LOCA (RLBLOCA) results for Advanced Mark-BW fuel in North Anna Unit 2 to support the NRC's review of a proposed amendment and exemptions that will permit North Anna Units 1 and 2 to use Framatome ANP Advanced Mark-BW fuel. On August 20, 2003 (Serial No. 03-313A) Dominion provided a response to an August 6, 2003 NRC request for additional information regarding the RLBLOCA results. In an August 28, 2003 meeting to discuss the RLBLOCA analysis results, the NRC staff requested further clarification of Dominion's August 20, 2003 responses. Supplemental information for Questions 1, 5, 9, and 10b is included in Attachment 1 to this letter. The requested clarification for Questions 2, 3, 4, 6, and 11a will be provided by separate correspondence. It is our understanding that Dominion's responses to Questions 7, 8, 10a, 11b, and 12 require no further clarification. As noted in our August 20, 2003 letter, this information is applicable to both North Anna Units 1 and 2 even though the RAIs received were only directed at Unit 2.

To support the use of Framatome Advanced Mark-BW fuel in North Anna Unit 2, Cycle 17, we respectfully request the NRC to complete their review and approval of the license amendment and associated exemptions by September 30, 2003. We appreciate your consideration of our technical and schedular requests. If you have any questions or require additional information, please contact us.

Very truly yours,

Leslie N. Hartz
Vice President – Nuclear Engineering

Commitments made in this letter: None

Attachment

A001

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

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, VA 23218

Mr. S. R. Monarque
NRC Project Manager
U. S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Mail Stop 8-H12
Rockville, MD 20852

Mr. M. J. Morgan
NRC Senior Resident Inspector
North Anna Power Station

SN: 03-313C
Docket Nos.: 50-338/339
Subject: Supplemental Information – Proposed TS Change
And Exemption
Use of Framatome Fuel – RLBLOCA Analysis Results

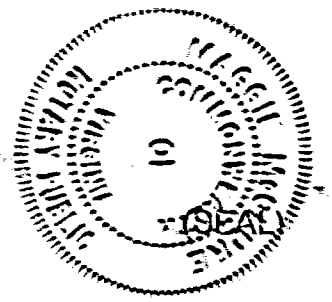
COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

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 5th day of September, 2003.

My Commission Expires: March 31, 2004.

Maggie McClure
Notary Public



Attachment 1

Supplemental Responses to Request for Additional Information
Questions 1, 5, 9 and 10b of August 20, 2003 letter (Serial No. 03-313A)

Realistic Large Break LOCA Analysis Results – North Anna

Framatome Fuel Transition Program
Technical Specification Change

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

Dominion Supplemental Responses to NRC Request for Additional Information
North Anna Realistic LBLOCA Analysis
Questions 1, 5, 9 and 10b of August 20, 2003 letter (Serial No. 03-313A)

In an August 28, 2003 meeting, the NRC staff requested additional information to supplement the responses provided in Dominion's August 20, 2003 letter (Reference 1). The original questions and supplemental responses requested by NRC staff are provided below. Items which the NRC staff has deemed acceptable as originally provided in the August 20, 2003 letter are noted. The responses provided below are applicable to both North Anna Units 1 and 2, even though the RAIs received were specific to Unit 2.

A. OVERALL APPLICABILITY TO NORTH ANNA 2

Section 7.2.1 of the North Anna Unit 2 (NAPS-2) submittal provides a plant description and a summary of analysis parameters. This section also refers to Tables 7.2-1, 7.2-2, and 7.2-3, which provide information specific to the LBLOCA analyses performed to define the licensing basis for NAPS-2 LBLOCA. The submittal also provides Figures 7.2-1 and 7.2-3, which show the NAPS-2 Realistic LBLOCA methodology (RLBLOCA using the S-RELAP5 computer code) Loop and Reactor Vessel Noding diagrams used for the analyses. The staff requests further information to address the programmatic requirements of 10 CFR 50.46 (c).

Q1. To show that the referenced generically approved LOCA analysis methodologies apply specifically to the NAPS-2 plant, provide a statement that VEPCO and its vendor have ongoing processes which assure that the ranges and values of input parameters for the NAPS-2 LOCA analysis bound the ranges and values of the as-operated plant values for those parameters. Furthermore, if the NAPS-2 plant-specific analyses are based on the model and or analyses of any other plant (i.e., NAPS-1), then justify that the model or analyses apply to NAPS-2. (e.g., if the other design has a different vessel internals design the model wouldn't apply to NAPS-2.)

Supplemental Response:

Dominion and its fuel vendor have ongoing processes which assure that the ranges and values of input parameters for the North Anna Units 1 and 2 analyses bound the ranges and values of the as-operated plant values for those parameters. Dominion's reload core design process is an example of one such process.

B. APPLICABILITY OF ANALYTICAL MODELS

Many of the analytical models in the NAPS-2 best estimate LBLOCA methodology are supported by empirical data taken at temperatures less than 1700°F, and by sensitivity studies performed at temperatures less than 1700°F.

The RLBLOCA peak cladding temperature spectrum calculated for NAPS-2 using this methodology extends above 2000°F. At temperatures above 1700°F many of the principal phenomena which influence peak cladding temperature (PCT) change or increase in their influence (e.g., cladding oxidation rate), such that the data and sensitivity studies identified for cladding temperatures lower than 1700°F may not apply.

Q2. Prominent among the phenomena of concern is heat transfer from the rod to the coolant during the dispersed flow film-boiling regime. S-RELAP5 uses the Forslund-Rohsenow model, which was developed using data from a test with geometry and thermal hydraulic conditions that are non-prototypic of the NAPS-2 core. While this model was shown to have only a small effect below 1700°F, this has not been demonstrated for the higher temperatures predicted for the NAPS-2 calculation, which exceed 2000°F. Justify the applicability of the Forslund-Rohsenow model as it is used in the proposed NAPS-2 plant licensing basis methodology. (The S-RELAP5 topical report presented a sensitivity study of the Forslund-Rohsenow model to PCT and quench time to address this concern. However, the analyses for this study were at low temperatures, which are not prototypic of NAPS-2.)

Supplemental Response:

Results of the sensitivity case(s) agreed upon at the August 28, 2003 public meeting will be provided by separate correspondence.

Q3. The S-RELAP5 approval was based, in part, on assessment against separate and integral effects data. This assessment focused on those phenomena that would govern the PCT response during a LBLOCA transient. The correlations in the S-RELAP5 methodology that predict the evolution of these phenomena depend on a variety of thermal hydraulic parameters, such as temperature, pressure, mass flux, etc. Demonstrate that the range of these parameters covered by the assessment data bounds the range encountered in the NAPS-2 LBLOCA analyses.

Supplemental Response:

Augmented versions of Tables 7.2-4 and 7.2-5 originally submitted in Reference 2 will be provided by separate correspondence.

Q4. The convective heat transfer coefficient used in the Framatome ANP RLBLOCA methodology does not extract the effect of radiation heat transfer. Experimental test cases exist for which it can be shown that inclusion of radiation heat transfer in the convective heat transfer coefficient results in non-conservative reflood heat transfer. Confirm that the NAPS-2 fuel and core configuration will not result in reflood heat transfer that takes undue credit for the inclusion of radiation heat transfer in the convective heat transfer coefficient.

Supplemental Response:

Results of the sensitivity case(s) agreed upon at the August 28, 2003 public meeting will be provided by separate correspondence.

Q5. The methodology does not consider pellet fragmentation and relocation (including relocation to the ruptured zone). By ignoring both of these effects and using a fixed value of gap conductance at the higher PCTs calculated in the NAPS-2 analyses, the NAPS-2 model may underestimate the LBLOCA limiting PCT and oxidation values. Sensitivity studies supporting the absence of these phenomena from the S-RELAP5 methodology were performed at PCTs not prototypic of the NAPS-2 analyses. Address this NAPS-2 LBLOCA methodology concern.

Supplemental Response:

The NRC staff indicated at the August 28, 2003 public meeting that the response to Question 5 was acceptable if the peak linear heat generation rate (LHGR) used in sensitivity studies (presented in the RLBLOCA topical report EMF-2103) was greater than or equal to that used in the North Anna RLBLOCA analyses.

The peak LHGR used in the sensitivity studies was 15.7 kw/ft; the value used in the North Anna Unit 1 and 2 RLBLOCA analyses was 13.5 kw/ft.

Q6. The NAPS-2 LBLOCA calculations were ranged down to 0.1 ft^2 which is below the minimum range in the current NAPS-2 LBLOCA. This size for NAPS-2 falls in the current SBLOCA range. The supporting demonstration plant analyses for the Framatome ANP RLBLOCA were accepted to this small size because for the demonstration plant the phenomena that were predicted to occur were indicative of a LBLOCA rather than a SBLOCA. NAPS-2 must justify that the ranging of break size for application of the Framatome ANP RLBLOCA methodology does not result in phenomena occurring that are typical of a SBLOCA.

Supplemental Response:

The proposed clarification discussed at the August 28, 2003 public meeting will be provided in separate correspondence.

Q7. Supplemental Response: *none requested; question is resolved.*

Q8. Supplemental Response: *none requested; question is resolved.*

Q9. The qualitative discussion in the NAPS-2 submittal is not sufficient to demonstrate that a mixed core has been fully assessed. The NAPS-2 licensing basis LBLOCA methodology must be shown to be able to analyze all fuel in the NAPS-2 core, not just the hot assembly. Provide values for PCT and total oxidation (including pre-LOCA, LOCA cladding outside, and cladding post-rupture inside oxidation) for the non-Framatome fuel in the core, and indicate how these values were determined.

Supplemental Response:

Dominion has reviewed Westinghouse proprietary calculation results of pre-existing cladding oxidation for limiting fuel rods that are representative of current

North Anna reload cores. These data confirm that the sum of pre-existing oxidation and transient oxidation is less than the 17% local oxidation limit specified in 10CFR50.46(b).

Q10. Table 7.2-2, 3.0 "Accident Boundary Conditions" lists the refueling water storage tank (RWST) temperature as less than/equal to 60°F. The NAPS-2 Technical Specification Surveillance Requirement 3.5.4.1 assures this value is not exceeded by requiring the RWST temperature to be greater than/equal to 40°F and less than/equal to 50°F.

Q10a. Supplemental response: *none requested; question is resolved.*

Q10b. Describe how the effect of water at this low temperature has been considered in boron precipitation analyses.

Supplemental Response:

The requirement to prevent boric acid buildup and potential precipitation in the core and fuel is an aspect of ensuring long term cooling as required by 10CFR50.46(b)(5). The need to establish procedural actions during the recirculation mode to switch from the initial cold leg injection to a hot leg injection pathway was documented in the North Anna Units 1 and 2 Safety Evaluation Report (Reference 3). The analysis methodology is based on that documented in support of the generic Westinghouse Emergency Response Guidelines (ES-1.4, Transfer to Hot Leg Recirculation). The calculational methodology to establish a conservative time for switching to hot leg recirculation was developed by Westinghouse in Reference 4. The requirement to switch to hot leg injection was based upon the NRC limit of 23.5 weight percent boric acid solution, which is 4 percent below the solubility limit at 212°F. This limit incorporates the NRC requirement that 4 weight percent safety margin should be maintained because the concentration of boric acid in the reactor vessel cannot be predicted with a sufficiently high degree of accuracy. The North Anna analysis assumes the contents of the RCS, Accumulators, RWST, ECCS piping, Boron Injection Tank and Casing Cooling Tank are injected to the sump, mixed uniformly and recirculated through the core. The initial tank boric acid concentrations are assumed to be at their maximum Technical Specifications values. This calculation defines the time after the LBLOCA at which the ECCS should be realigned to recirculate sump fluid to the core via hot leg injection, to maintain the boric acid solution concentration in the core below the 23.5 weight percent limit. The analysis produces predicted values of boric acid concentration (in weight percent) versus time after LBLOCA initiation. The Emergency Operating Procedures provide direction to initiate hot leg recirculation at a time that is earlier than the time calculated for the core boric acid concentration to reach 23.5 weight percent. The North Anna analysis assumptions concerning vessel fluid conditions and mass evaporation from the core are appropriately conservative to accommodate the effects of initial tank temperatures and sump temperature during the timeframe simulated by the calculation.

Q11. Downcomer Boiling - The containment pressure in Figure 7.2-33 indicates that the containment pressure is at about 30 psia and continues to decline at 200 seconds into the limiting LBLOCA. Figures 7.2-23, 7.2-30, and 7.2-32 seem to indicate that downcomer boiling occurs at about 375 seconds into the transient. The containment plot ends at 200 seconds and it appears from Figures 7.2-23 and 7.2-32 that the calculation was terminated at ~460 seconds. At ~460 seconds, the PCT drops to ~450°F. At this time, the (extrapolated) containment pressure is 30 psia or less. The saturation temperature at 30 psia is ~250°F or less, but the drop in PCT stops at ~450°F. 10 CFR 50.46 requires that analyses to be run until the core is quenched.

a. Extend the analysis results tables and graphs, particularly Table 7.2-11 and Figure 7.2-33, to beyond the time that stable and sustained quench is established.

Supplemental Response:

The proposed results agreed upon at the August 28, 2003 meeting will be provided by separate correspondence.

Q11b. Supplemental Response: *none requested; question is resolved.*

Q12. Supplemental Response: *none requested; question is resolved.*

REFERENCES

1. Letter, Leslie N. Hartz (Dominion) to USNRC, "Virginia Electric and Power Company, North Anna Power Station Units 1 and 2, Request For Additional Information Regarding Realistic Large Break Loss Of Coolant Accident (RLBLOCA) Analysis Results For The Proposed Technical Specifications Changes And Exemption Request For Use Of Framatome Anp Advanced Mark-Bw Fuel," Serial No. 03-313A, August 20, 2003.

2. Letter, Leslie N. Hartz (Dominion) to USNRC, "Virginia Electric and Power Company, North Anna Power Station Units 1 and 2, Realistic Large Break Loss of Coolant Accident (RLBLOCA) Analysis Results for the Proposed Technical Specifications Changes and Exemption Request for Use of Framatome ANP Advanced Mark-BW Fuel," Serial No. 03-313, May 6, 2003.

3. NUREG-0053, Revision 0, Addendum 0, "Safety Evaluation Report Related to Operation of North Anna Power Station Units 1 and 2, Virginia Electric and Power Company," June 1976.

4. Letter, C. L. Caso (Westinghouse) to T. M. Novak (NRC), "Long Term Core Cooling – Boron Considerations," April 1, 1975.