Dominion Energy Kewaunee, Inc.
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Dominion

July 23, 2007

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

Serial No. 06-578E
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Docket No. 50-305
License No. DPR-43

DOMINION ENERGY KEWAUNEE, INC.
KEWAUNEE POWER STATION
RESPONSE TO NRC QUESTIONS REGARDING KEWAUNEE REQUEST FOR APPROVAL OF TOPICAL REPORT DOM-NAF-5, "APPLICATION OF DOMINION NUCLEAR CORE DESIGN AND SAFETY ANALYSIS METHODS TO THE KEWAUNEE POWER STATION (KPS)"

On January 31, 2006, a public meeting was held with the Nuclear Regulatory Commission (NRC) and Dominion Energy Kewaunee, Inc. (DEK) staff. During this meeting, DEK presented an approach and implementation strategy for application of existing NRC-approved nuclear core design and safety analysis methods to Kewaunee Power Station (KPS) (reference 1). These design and analysis methods are already in use within the remainder of the Dominion fleet. Fundamental to the proposed approach was creation of a composite topical report (DOM-NAF-5) that would document the application of the relevant methodologies to KPS.

On August 16, 2006, DEK submitted Dominion Topical Report DOM-NAF-5 without Attachments A and B (reference 2). On December 6, 2006, Attachment A to DOM-NAF-5 was submitted, which contained Core Management Systems benchmark analysis results (reference 3). On April 16, 2007, DEK submitted Attachment B to DOM-NAF-5, containing RETRAN benchmark analysis results (reference 4). This submittal, in conjunction with References 2 and 3, provided the complete contents of DOM-NAF-5.

On May 4, 2007, DEK submitted the KPS plant specific application of the NRC approved Dominion Topical Report VEP-NE-2-A, "Statistical DNBR Evaluation Methodology," for KPS cores containing Westinghouse 422V+ fuel assemblies with the VIPRE-D/WRB-1 code correlation (reference 5).

Subsequently, on June 27, 2007 the (NRC) staff communicated four questions regarding the April 16, 2007 letter (reference 4). On June 28, 2007 a telephone discussion was held between members of the NRC and Dominion staff to discuss each question. The DEK responses to the four questions are provided in Attachment 1.

Should you have any questions, please contact Mr. Craig D. Sly at 804-273-2784.

Very truly yours,

W R Matthews

William R. Matthews
Senior Vice President – Nuclear Operations

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by William R. Matthews, who is Senior Vice President – Nuclear Operations of Dominion Energy Kewaunee, Inc. He has affirmed before me that he 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 his knowledge and belief.

Acknowledged before me this 23RD day of July, 2007.

My Commission Expires: August 31, 2008.

Margaret B. Bennett
Notary Public

MARGARET B. BENNETT
Notary Public 354302
Commonwealth of Virginia
My Commission Expires Aug 31, 2008

References:

1. Summary of Meeting on January 31, 2006, "To Discuss the Applicability of Dominion Safety and Core Design Methods to Kewaunee Power Station (TAC No. MC 9566)," (ADAMS Accession Number ML 060400098).
2. Letter from G. T. Bischof (DEK) to NRC, "Request for Approval of Topical Report DOM-NAF-5, 'Application of Dominion Nuclear Core Design and Safety Analysis Methods to the Kewaunee Power Station (KPS),'" dated August 16, 2006 (ADAMS Accession Number ML 062370351).
3. Letter from G. T. Bischof (DEK) to NRC, "Attachment A to Topical Report DOM-NAF-5, 'Application of Dominion Nuclear Core Design and Safety Analysis Methods to the Kewaunee Power Station (KPS),'" dated December 6, 2006 (ADAMS Accession Number ML 0063410177).
4. Letter from G. T. Bischof (DEK) to NRC, "Request for Approval of Topical Report DOM-NAF-5, 'Application of Dominion Nuclear Design and Safety Analysis Methods to the Kewaunee Power Station (KPS),'" dated April 16, 2007.
5. Letter from G. T. Bischof (DEK) to NRC, "Implementation of the Dominion Statistical DNBR Methodology with VIPRE–D/WRB–1 at Kewaunee Power Station," dated May 4, 2007.

Attachment:

1. Response to NRC Request for Additional Information Regarding Kewaunee Request for Approval of Topical Report DOM-NAF-5, "Application of Dominion Nuclear Core Design and Safety Analysis Methods to the Kewaunee Power Station (KPS)."

Commitments made in this letter: None

cc: Regional Administrator
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NRC Senior Resident Inspector
Kewaunee Power Station

ATTACHMENT 1

Response to NRC Questions Regarding Kewaunee Request for Approval of Topical Report DOM-NAF-5, "Application of Dominion Nuclear Core Design and Safety Analysis Methods to the Kewaunee Power Station (KPS)"

KEWAUNEE POWER STATION

DOMINION ENERGY KEWAUNEE, INC.

Response to NRC Questions Regarding Kewaunee Request for Approval of Topical Report DOM-NAF-5, "Application of Dominion Nuclear Core Design and Safety Analysis Methods to the Kewaunee Power Station (KPS)"

On August 16, 2006, Dominion Energy Kewaunee (DEK) submitted Dominion Topical Report DOM-NAF-5 without Attachments A and B (reference 2) to the NRC. On December 6, 2006, Attachment A to DOM-NAF-5 was submitted, which contained Core Management Systems benchmark analysis results (reference 3). On April 16, 2007, DEK submitted Attachment B to DOM-NAF-5, containing RETRAN benchmark analysis results (reference 4). This submittal, in conjunction with references 2 and 3, provided the complete contents of DOM-NAF-5.

On May 4, 2007, DEK submitted the KPS plant specific application of the NRC approved Dominion Topical Report VEP-NE-2-A, "Statistical DNBR Evaluation Methodology," for KPS cores containing Westinghouse 422V+ fuel assemblies with the VIPRE-D/WRB-1 code correlation (reference 5).

Subsequently, on June 27, 2007, the (NRC) staff communicated four questions regarding the April 16, 2007 letter (reference 4). On June 28, 2007, a telephone discussion was held between members of the NRC and Dominion staff to discuss each question and clarify the scope and detail of the information being requested by the NRC staff. Consistent with the results of these communications, the DEK responses to the four questions are provided below.

Note: For the purposes of consistency and clarity in the following responses, the most recently adopted analytical models will be referred to as "Dominion KPS" models. The presently used and proposed-to-be-changed models will be referred to as "current USAR" models.

NRC Question 1

In Appendix B, of the April 16, 2007, submittal, DEK provided their RETRAN calculations as they are applied to Kewaunee. Table 2-1 on page 5 of 49, provides a comparison of the Dominion-USAR models. It appears to the staff that the USAR model is more detailed than the more recently adopted RETRAN model. Please be prepared to discuss each section of Table 2-1 with the intent of demonstrating the reasons for the preferred use of a less detailed DOM model over the USAR model.

Response

The differences between the Dominion KPS and current USAR RETRAN models, as summarized in Table 2-1 of DOM-NAF-5 Attachment B, are the result of certain model noding differences. The base model noding used in the Dominion KPS model was selected to ensure consistency with the Dominion RETRAN Topical Report (VEP-FRD-41) for non-LOCA licensing analyses. Wherever practical, it is a Dominion objective to maintain consistency within the models used among Dominion plants. As such, the Dominion KPS model noding was chosen to be the same as the Surry and North Anna models with the exception of some minor differences that have been described in DOM-NAF-5 Section 3.4.1.4 and Attachment B. The Dominion KPS model is applied consistent with the conditions and limitations described in the NRC Safety Evaluation Report (SER) for VEP-FRD-41.

Dominion uses special modeling methods to address those transients where the base model noding may not be adequate for detailed phenomena prediction. For example, an overlay deck is used to create a split reactor vessel model to use when analyzing Main Steam Line Break (MSLB) events. This overlay adds volumes to create a second, parallel flow path through the active core from the lower plenum to the upper plenum such that RCS loop temperature asymmetries can be represented. In addition, this overlay maximizes the steam generator (SG) tube heat transfer coefficients to ensure conservative SG heat transfer from the primary to secondary. Again, these special modeling methods are consistent with VEP-FRD-41.

It should be noted that the differences in the transient results for the current USAR and Dominion KPS models are generally attributable to differences in modeling and/or initial condition assumptions rather than noding differences. Responses to Questions 2 through 4 provide some specific examples of such differences.

NRC Question 2

On page 20 of 49, the Locked Rotor analysis (Figure 4.2-6) indicates that the core heat flux drops in the first second of the transient. Please explain.

Response

The core heat flux drops in the first second of the transient because the core conductor heat transfer coefficients in the Dominion KPS model change during the transient as a result of the decreasing core flow rate. In comparison, the current USAR model incorporates a different core heat transfer treatment that does not involve calculation of time-dependent values of heat transfer coefficients during the transient.

For the Dominion KPS model, the heat transfer coefficients for the core conductors decrease during the first 0.5 seconds of the Locked Rotor transient. This is a result of the decreasing RCS flow rate. The Dominion KPS model initially predicts a single-phase, subcooled forced convection heat transfer regime in the core regions. As core flow decreases, so does the single-phase forced convection heat transfer coefficient.

This causes a corresponding decrease in heat flux. At approximately 0.5 seconds, the heat transfer mode begins to transition from single-phase forced convection to nucleate boiling, based on local fluid conditions. This causes an increase in the magnitude of the heat transfer coefficient in the affected core volumes. As a result, the core heat flux begins to increase in the time frame between approximately 0.5 to 1.0 second. At approximately one second, the Dominion KPS model closely matches the current USAR heat flux response.

This modeling difference between static (current USAR) and dynamic (Dominion KPS) heat transfer coefficients has little impact on the Locked Rotor analysis acceptance criterion of peak RCS pressure. The Dominion KPS model agrees very well with the current USAR RCS pressure response, as shown in DOM-NAF-5, Attachment B, Figure 4.2-2 (page 18).

NRC Question 3

On page 28 of 49, Figure 4.3-4, LONF pressurizer pressure, requires additional explanation.

Response

Pressurizer pressure response demonstrates wider pressure swings (higher initial peak and more pronounced post-reactor trip pressure decrease) for the Dominion KPS model when compared to the current USAR model response. One reason for this difference is the current USAR model dampens pressurizer pressure response by assuming an artificially high pressurizer spray flow value. By suppressing pressurizer pressure, pressurizer PORV actuation is minimized or precluded, reducing the initial pressure increase and the subsequent pressure decrease.

A second factor driving pressurizer pressure is the pressurizer volume insurge, which in turn, is influenced by reactor vessel temperature increase. This initial temperature increase is more pronounced for the Dominion KPS model case due to an approximately 10 second delay in reactor trip, causing increased energy input into the reactor coolant system. The SG low-low level reactor trip is delayed because the Dominion KPS model is initialized at a higher initial SG water mass when compared to the current USAR model. The current USAR model has less SG water mass due, in part, to the zero-slip assumption for the current USAR multi-node steam generator (MNSG). It is noted that when the Dominion KPS initial SG water mass is established at the current USAR value, the reactor trip occurs at the same time as the current USAR model.

The benchmark criteria for this event are satisfied and the benchmark results are acceptable. The difference in pressurizer pressure response between the Dominion

KPS model and the current USAR model are understood as being the result of differences in initial conditions and assumed control system response.

NRC Question 4

On page 34 of 49, Figures 4.4-3 and 4.4-4, MSLB reactivity and core power indicate significant differences between the USAR and DOM calculations both of which are done with RETRAN-02. Please explain the different reactivity curves in light of the fact that both are done with the same kinetics model, i.e., point kinetics.

Response

The difference in core reactivity response between the Dominion KPS and current USAR models is due to the difference in boron injection from the emergency core cooling system (ECCS) safety injection and accumulator injection. ECCS flow rate and timing are different between the two models causing core boron concentration and core reactivity differences during the transient. The boron concentration difference can be seen in DOM-NAF-5, Attachment B, Figure 4.4-5 (page 35).

The significant difference in core reactivity response is observed after approximately 130 seconds into the Main Steam Line Break (MSLB) transient. For the first 130 seconds or so, the core reactivity response predicted by the Dominion KPS model matches the current USAR model fairly well. The primary driver for the observed difference in core reactivity after 130 seconds is the core boron concentration, as shown in Figure 4.4-5. In the Dominion KPS model, boron injection from the refueling water storage tank (RWST) by way of the safety injection (SI) system is delayed until all of the fluid from the SI piping is purged. The initial fluid in the SI piping volumes is assumed to be at zero parts per million (ppm) boron concentration. For the Dominion KPS model, significant boron concentrations do not reach the core until approximately 130 seconds after the start of the transient. The current USAR model predicts a sharper increase in boron concentration in the 55 to 70 second time frame, as the accumulators discharge borated water into the RCS. The current USAR model predicts higher flow rates from the accumulators than the Dominion KPS model.

The model differences in ECCS flow rate and core boron concentration affect the core power and heat flux response. The Dominion KPS model shows a slightly higher core heat flux during the transient as shown on DOM-NAF-5, Attachment B, Figure 4.4-3 (page 34). Higher core heat fluxes are conservative for the MSLB core response transient, as they lead to lower Departure from Nucleate Boiling Ratios (DNBR).

References:

1. Summary of Meeting on January 31, 2006, "To Discuss the Applicability of Dominion Safety and Core Design Methods to Kewaunee Power Station," (TAC No. MC 9566), (ADAMS Accession Number ML 060400098).
2. Letter from G. T. Bischof (DEK) to NRC, "Request for Approval of Topical Report DOM-NAF-5, 'Application of Dominion Nuclear Core Design and Safety Analysis Methods to the Kewaunee Power Station (KPS),'" dated August 16, 2006 (ADAMS Accession Number ML 062370351).
3. Letter from G. T. Bischof (DEK) to NRC, "Attachment A to Topical Report DOM-NAF-5, 'Application of Dominion Nuclear Core Design and Safety Analysis Methods to the Kewaunee Power Station (KPS),'" dated December 6, 2006 (ADAMS Accession Number ML 0063410177).
4. Letter from G. T. Bischof (DEK) to NRC, "Request for Approval of Topical Report DOM-NAF-5, 'Application of Dominion Nuclear Design and Safety Analysis Methods to the Kewaunee Power Station (KPS),'" dated April 16, 2007.
5. Letter from G. T. Bischof (DEK) to NRC, "Implementation of the Dominion Statistical DNBR Methodology with VIPRE–D/WRB–1 at Kewaunee Power Station," dated May 4, 2007.
6. Dominion Fleet Report DOM-NAF-2-A, "Reactor Core Thermal-Hydraulics Using the VIPRE-D Computer Code," August 2006.
7. WCAP-10216-P-A, Revision 1A, "Relaxation of Constant Axial Offset Control FQ Surveillance Technical Specification," February 1994.