July 7, 2009

Mr. David A. Heacock
President and Chief Nuclear Officer
Dominion Energy Kewaunee, Inc.
Innsbrook Technical Center – 2SW
5000 Dominion Blvd.
Glen Allen, VA 23060-6711

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR THE REVIEW OF THE KEWAUNEE POWER STATION LICENSE RENEWAL APPLICATION – LEAK BEFORE BREAK/BORAL (TAC NO. MD9408)

Dear Mr. Heacock:

By letter dated August 12, 2008, Dominion Energy Kewaunee, Inc. (Dominion), submitted an application for renewal of Operating License DPR-43 for the Kewaunee Power Station (KPS). The staff of the U.S. Nuclear Regulatory Commission (NRC or the staff) is reviewing this application in accordance with the guidance in NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants." During its review, the staff has identified areas where additional information is needed to complete the review. The staff's requests for additional information are included in the Enclosure. Further requests for additional information may be issued in the future.

Items in the enclosure were discussed with Paul Aitken, of your staff, and a mutually agreeable date for the response is within 30 days from the date of this letter. If you have any questions, please contact me by telephone at 301-415-4049 or by e-mail at samuel.hernandez@nrc.gov.

Sincerely,

/RA/

Samuel Hernández, Project Manager
Projects Branch 1
Division of License Renewal
Office of Nuclear Reactor Regulation

Docket No. 50-305

Enclosure:
As stated

cc w/encl: See next page

July 7, 2009

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Innsbrook Technical Center – 2SW
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Projects Branch 1
Division of License Renewal
Office of Nuclear Reactor Regulation

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DATE	06/18/09	07/7/09	07/07/09	07/ /09

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Letter to David A. Christian from Samuel Hernandez dated July 07, 2009

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR THE REVIEW OF THE KEWAUNEE POWER STATION LICENSE RENEWAL APPLICATION – LEAK BEFORE BREAK/BORAL (TAC NO. MD9408)

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Kewaunee Power Station

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KEWAUNEE POWER STATION
LICENSE RENEWAL APPLICATION
REQUEST FOR ADDITIONAL INFORMATION
LEAK BEFORE BREAK/BORAL

Request for Additional Information (RAI) 4.7.3-1

Background:
Section 4.7.3, page 4-36 of the Kewaunee Power Station License Renewal Application (LRA), cites NUREG-1031, Volume 3 as a source of procedures and guidance for the application of the Leak-Before-Break (LBB) methodology.

Issue:
It is the staff understanding that the procedures for LBB methodology are contained in NUREG-1061, Volume 3.

Request:
Please indicate if there is a typographical error in the description of the document referenced in the LRA.

Request for Additional Information (RAI) 4.7.3-2

Background:
Pressurized water reactors plants have experienced primary water stress corrosion cracking (PWSCC) in Alloy 82/182 dissimilar metal welds in the American Society of Mechanical Engineers (ASME) Class 1 piping.

Issue:
The PWSCC has an aggressive crack growth rate and is an active degradation mechanism. The LBB application prohibits active degradation mechanisms. Industry and the U.S. Nuclear Regulatory Commission (NRC) are currently working to resolve primary water stress corrosion cracking (PWSCC) in Alloy 82/182 welds with respect to the LBB analysis assumptions. It is not clear whether PWSCC is an issue for the LBB piping at Kewaunee.

Request:
- Identify all Alloy 82/182 dissimilar metal welds in the LBB piping.
- If Alloy 82/812 welds exist in the LBB piping, discuss the actions that will be taken to mitigate and/or inspect the Alloy 82/182 welds to ensure that PWSCC will not affect the structural integrity of the LBB piping.

Request for Additional Information (RAI) 4.7.3-3

Background:
Section 4.7.3, *Leak-Before-Break,* discusses the fatigue flaw growth and fracture toughness of cast austenitic stainless steel material as part of the Time-Limited Aging Analysis (TLAA).

Issue:
It is not clear whether there are flaws in the LBB piping. Also, it is not clear as to the current status of the LBB piping structural integrity.

Request:
- Discuss the inspection history and results of the LBB piping.
- If indications or flaws are remaining in service in the LBB piping, discuss how the indications and flaws are monitored to the end of the period of extended operation.
- Discuss future inspection schedules for each of the LBB pipes (other than indications and flaws).

Request for Additional Information (RAI) 4.7.3.1-01

Background:
Section 4.7.3.1, *LBB-Reactor Coolant Loop Piping,* states that the LBB evaluations have been updated to support the power uprate program and steam generator replacement.

Issue:
The LRA did not discuss the impact of the power uprate and steam generator replacement on the LBB piping and fatigue flaw growth analysis, other than fracture toughness values.

Request:
Discuss the impact of the operating conditions of power uprate and steam generator replacement on all the LBB piping (including branch lines and surge line) and fatigue flaw growth analysis at the end of 60 years. The staff requests the applicant to submit the analyses (i.e., WCAP-16738-P) that supports its conclusions regarding the impact of power uprate on the reactor coolant loop piping during the period of extended operation.

Request for Additional Information (RAI) 4.7.3.1-02

Background:
Section 4.7.3.1, *LBB-Reactor Coolant Loop Piping*, states that Westinghouse has updated the LBB analysis to support the steam generator replacement project in WCAP-15311 and the power uprate program in WCAP-16040-P.

Issue:
The LRA states that a review of the above documents identified that the fracture toughness values for the cast austenitic stainless steel loop piping were based on a 40-year plant service life. The LRA states that the fracture toughness for the fully aged condition was used and that mechanical properties were determined at operating temperatures. However, the LRA did not discuss whether the fracture toughness values at the 60 years were used.

Request:
- Discuss whether the fracture toughness values used in the LBB evaluations were the values at the end of the 60-year plant life.
- Explain why the mechanical properties were determined at operating temperatures, not at the temperature at faulted conditions.

Request for Additional Information (RAI) 4.7.3.1-03

Background:
Section 4.7.3.1, *LBB-Reactor Coolant Loop Piping*, states that the LBB analysis for the period of extended operation is discussed in WCAP-16738. The applicant states that the report documents the plant specific geometry, operating parameters, loading, and material properties used in the fracture mechanics evaluation.

Issue:
It is not clear as to the impact of 60-year operation on the above parameters in the original LBB analysis. Also, it is not clear whether WCAP-16738 considered the effect of power uprate and steam generator replacement.

Request:
- Discuss the impact of 60-year operation on the material properties, operating parameters, and loading of reactor coolant loop, surge line, and branch piping.

Request for Additional Information (RAI) 4.7.3.1-04

Background:
Section 4.7.3.1, *LBB-Reactor Coolant Loop Piping*, references WCAP-11411 (Reference 4.8-15).

Request:
Reference 4.8-15 cites WCAP-14111 instead of WCAP-11411. Please indicate if there is a typographical error in the description of the document referenced in the LRA.

Request for Additional Information (RAI) 4.7.3.2-01

Background:
Section 4.7.3.2, *LBB-Pressurizer Surge Line Piping,* discusses the applicant's evaluation of pressurizer surge line.

Issue:
It is not clear whether thermal stratification events have occurred in the surge line in the past.

Request:
- Discuss operating procedures implemented to prevent or mitigate future thermal stratification events.

Request for Additional Information (RAI) 4.7.3.3-01

Background:
Section 4.7.3.3, *LBB – Reactor Coolant Loop Branch Piping,* pages 4-39, states that the fatigue growth evaluation for the 8-inch residual heat removal (RHR) lines and the 12-inch safety injection (SI) accumulator lines show that only a limited number of RHR initiation transients could be tolerated. The applicant states further that growth of a postulated crack would remain well within critical crack size limits for a period of 10 years.

Issue:
It appears that the above LBB lines cannot tolerate transients other than a limited number of RHR initiation transients. Also, it is not clear how many years before the postulated crack would reach to half of the critical crack size in order to satisfy the margin of 2 which is recommended in SPR 3.6.3 "Leak-Before-Break Evaluation Procedures" of the Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (NUREG-0800). The staff reviewed SIR-00-045, Revision 1, which contains the LBB analysis of the subject branch lines. It is not evident that SIR-00-045, Revision 1, provides detailed information regarding the crack growth analysis that is discussed on page 4-39 of the LRA. It seems that the crack growth analysis of the subject branch lines discussed on page 4-39 is contained in SIR-00-045, Revision 2, which has not been submitted to the NRC and is identified as Reference 4.8-23.

Request:
- Clarify why the above LBB piping can tolerated only a limited number of RHR initiation transients, but the analysis still concludes that growth of a postulated crack would remain well within the critical crack size as stated on pages 4-39 of the LRA. It seems that if the postulated crack size remains well within the critical crack size, the subject piping should be able to tolerate all RHR initiation transients.
- Given that all RHR initiation transients were not used in the crack growth calculation, discuss whether the subject piping is outside of the design basis.
- Discuss the number of years for the postulated fatigue flaw to reach half of critical crack size or the allowable flaw size, whichever is applicable, in the 8-inch RHR lines and 12-inch safety injection (SI) accumulator lines. This is to determine whether the 10-year inspection frequency is adequate to monitor the potential fatigue crack growth.
- Submit report SIR-00-045, Revision 2, for staff review because this report is referenced on pages 4-38 and is related to the crack growth evaluation of the 8-inch and 12-inch branch lines.

Request for Additional Information (RAI) 4.7.3.3-02

Background:
Section 4.7.3.3, *LBB – Reactor Coolant Loop Branch Piping,* page 4-39, states that "…Since the time-based input for the crack growth analysis for these lines is less than 40 years, the crack growth analysis associated with these branch lines does not constitute a TLAA per 10CFR 54.3(a)(3)…"

Issue:
In general, a crack growth analysis assumes an initial flaw size. The flaw is assumed to grow based on a certain growth rate for 40 years (or for X number of years) to determine whether the final flaw size will be within the allowable flaw size. In Section 4.7.3.3, the crack growth is based on the fatigue mechanism. For the fatigue mechanism, transient cycles for 40 years should be used in combination with the fatigue crack growth rate to derive the final flaw size. Therefore it is not clear why a crack growth analysis uses time-based input that is less than 40 years unless the postulated flaw would grow to exceed the allowable flaw size.

10 CFR 54.3(a)(3) states that TLAA is applicable if it "…Involve[s] time-limited assumptions defined by the current operating term for example 40 years…". The applicant contends that because the crack growth analysis of the subject 8-inch and 12-inch piping did not use time – based input for 40 years; therefore, the crack growth analysis would not be considered as a TLAA. The staff believes that time-limited assumptions, not time-based input (that is less than 40 years), should be the criterion to satisfy the condition that the crack growth analysis is not a TLAA. It seems that the original crack growth analysis used transient cycles less than 40 years so that the final flaw size would satisfy the allowable flaw size. The less-than-40 year transient cycles are not an assumption but an input to the analysis. Therefore, the staff is not clear as to the technical basis to support the conclusion that the crack growth analysis of the subject lines is not a TLAA.

Request:
- In light of the above, clarify what is the time-based input that is less than 40 years and why input that is less than 40 years is used in the crack growth analysis.
- Clarify how 10 CFR 54.3(a)(3) is applicable to the crack growth analysis of the 8-inch RHR lines and the 12-inch safety injection accumulator lines.

Request for Additional Information (RAI) 4.7.3.3-03

Background:
Section 4.7.3.3, *LBB – Reactor Coolant Loop Branch Piping,* page 4-39, states that "…The fatigue crack growth conclusions are not affected by the extended plant service life since the original design basis transient have been shown to be bounding for the period of extended operation in Section 4.3.1.1, Component Design Transient Cycles…".

Issue:
It is not clear how the applicant can assure that the actual operating transients at the end of 60 years are bounded by the design transient cycles.

Request:
Discuss how the actual transient cycles can be monitored to verify that the design transient cycles used in the LBB evaluations bound the actual operating transients. This question applies to all LBB piping and associated LBB evaluations.

Request for Additional Information (RAI) 4.7.3.3-04

Background:
Section 4.7.3.3, *LBB – Reactor Coolant Loop Branch Piping,* page 4-39, states that "…for the 8-inch RHR lines and the 12-inch SI accumulator lines…It was further concluded that the American Society of Mechanical Engineers Boiler & Pressure Vessel code, Section XI – required inspections every 10 years would effectively manage cracking in this piping such that a crack greater in size than that postulated would not be present at the start of the ten year interval…" The applicant stated further that the crack growth analysis associated with the 8-inch RHR line and 12-inchs SI accumulator lines does not constitute a TLAA

Issue:
It appears that the 10-year inservice inspection is a part of the applicant's technical basis for not considering the crack growth analysis as a TLAA. However, it is not clear how these two piping systems will be inspected during the license renewal period to ensure their structural integrity to the end of 60 years.

Request:
- Identify exactly the number of 8-inch RHR lines and 12-inch safety injection accumulator lines that will be inspected during the period of extended operation.
- Specify the total number of the welds in each of the RHR and safety injection accumulator lines that will be inspected in each 10-year inspection interval during the period of extended operation.
- Specify the total number of welds that are in the subject lines. This information is used to determine the percentage of the welds that will be inspected.
- Discuss which nondestructive examination method will be used (e.g., penetrant testing, ultrasonic testing).
- Discuss the criteria for weld selection for examination (e.g., high stress locations, or fatigue crack growth calculation of the subject piping).
- If the above information has been submitted to the NRC, provide the references.

Request for Additional Information (RAI) 2.3-01(a)

Background:
In RAI 2.3-01, LRA Section 2.3.4.2, dated April 03, 2009, the staff noted that the license renewal drawing LRM-211 locations B-6 and B-7 show continuations of 10 CFR 54.4(a)(2) pipe sections from cylinder heating steam supply system without drawing numbers or grid locations. The applicant was requested to submit additional information to identify the license renewal boundaries.

Issue:
In its response, dated April 27, 2009, the applicant stated that the drain lines shown on drawing LRM-211, locations B-6 and B-7, continue on drawing LRXK-101-17A at locations C-3 and C-7. Based on its review, the staff finds the applicant's response to this RAI 2.3.4.2-02 acceptable because the staff located the continuations. However, staff noted on LRXK-101-17A, location C-3, a piping section continued to the GLD STM LEAKOFF TO GLAND CONDENSER that was not included in-scope. Similar piping at location C-7 was included in-scope for 10 CFR 54.4 (a)(2).

Request:
The applicant is requested to provide a basis for not including the piping continuing to the GLD STM LEAKOFF TO GLAND CONDENSER in the scope of license renewal for 10 CFR 54.4(a)(2).

Request for Additional Information (RAI) 2.3.3.26-01(a)

Background:
Follow-up RAI 2: In RAI 2.3.3.26-01, dated April 3, 2009, the staff noted drawing LRM-350, locations D-5, D-6, and D-10, show non-safety related piping connected to safety-related piping components at valves MD(R)-250A&B, MD(R)-251A&B, MD(R)-260, MD(R)-261, MD(R)-270, MD(R)-271, MD(R)-272, MD(R)-273 and MD(R)-262. The applicant was requested to provide the location of the seismic restraint for the non safety-related 1" lines connected to the safety-related heat exchangers #1A and #1B, the letdown exchanger and seal water heat exchanger piping.

Issue:
In its response dated April 27, 2009, the applicant clarified that the bounding scoping methodology was applied wherein the sludge interceptor tank was used as an equivalent anchor. Based on its review, the staff finds the applicant's response to RAI 2.3.3.26-01 acceptable for the piping to the sludge interceptor tank, however the response was incomplete because it did not identify the seismic anchor for the branch piping continued to the waste area sump pumps. Therefore, the staff's concern described in RAI 2.3.3.26-01 is not resolved.

Request:
The applicant is requested to provide the location of the seismic anchor for the non safety-related for the branch piping continued to the waste area sump pumps.

Request for Additional Information (RAI) 3.3.2.2.6-1

Background/Issue:
Boron carbide plates have been used at KPS for over twenty five years with no evidence of bulging, reduction in neutron absorption or loss of material; however this justification is not sufficient in stating that there will not be any bulging, reduction in neutron absorption of loss of material in the period of license extension. The staff requires additional information in order to determine if aging management would be required:

Request:

- Please provide the operating experience of the boron carbide plates at KPS, including the following:
  - What was the location of coupons relative to the spent fuel racks? What was the neutron flux of the coupons relative to that for the rods?
  - How were the coupons mounted and were they fully exposed to the spent fuel pool water (both sides exposed or bolted to a wall)?
  - What specific testing procedures were used for determining areal density, verifying surface corrosion (if any) and examining for blister formation?
  - To demonstrate that the boron carbide plate integrity has been maintained, the staff requests the applicant to provide the test results for the coupons, including areal density measurements.
  - What are the acceptance criteria for these results?
  - After removal from the pool for inspection were the coupons inserted back at the same locations in the pool?
  - What was the subcritical margin used in the criticality analysis? In order to prevent excess degradation, the potential degradation should be accounted for in the subcritical margin. How is the potential degradation during the time in between surveillance periods accounted for in the subcritical margin?
  - Please describe the corrective actions that would be implemented if coupon test results are not acceptable.
- Please describe how the neutron-absorbing capacity will be monitored in the period of extended operation. Please include a description of the parameters, calculations, and acceptance criteria. If coupon testing will still be used:
  - Discuss the schedule for coupon removal and testing during the period of extended operation to demonstrate continued boron carbide performance.
- Please discuss any other industry operating experience of boron carbide, and discuss how that experience is applicable to KPS and any potential safety concerns identified in the boron carbide operating experience.

Request for Additional Information (RAI) 3.3.2.2.6-2

Background/Issue:
The Generic Aging Lessons Learned (GALL) report recognizes the possibility of the existence of aging effects in the Boral used in the spent fuel storage racks and the need for having a plant specific aging management program. However, the applicant has indicated in the KPS submittal that degradation of the Boral is insignificant and no aging management program is required. The applicant provided several justifications for not having management program. In order to determine if aging management is required the staff requires the following additional information:

Request:

- It is unclear to the staff which Holtec and industry testing is referenced in section 3.3.2.2.5 of the submittal. Please describe the testing performed and how that relates to a Boral period of performance of over thirty years. Also please provide a copy of the reference/report.
- The staff requests the applicant to provide the installation date of the Boral currently in the spent fuel pool. In addition, to demonstrate that Boral integrity has been maintained, the

staff requests the applicant to provide the test results for the coupons, including areal density measurements.

- Please provide the following specifications of the Boral panels in the spent fuel pool racks:
  - Geometry of the Boral panels
  - Areal density of boron
- Please describe how the neutron-absorbing capacity will be monitored. Please include a description of the parameters, calculations, and acceptance criteria.

Request for Additional Information (RAI) 3.3.2.2.6-3

Request:

- In the submittal, it is unclear whether a surveillance program will still be used in the period of extended operation. Please confirm the existence of a surveillance program in period of extended operation. If a surveillance program will be in use please address the following:
  - Please confirm that KPS has sufficient Boral coupon samples to maintain the sampling frequency through the period of extended operation.
  - Please provide a detailed description of the Boral coupons and the tests performed on them during their examination:
    - What was the location of coupons relative to the spent fuel racks?
    - How were the coupons mounted and were they fully exposed to the spent fuel pool water?
    - What specific testing procedures were used for determining Boral-10 areal density, verifying surface corrosion (if any) and examining for blister formation?
    - After removal from the pool for inspection were the coupons inserted back at the same locations in the pool?
  - What are the acceptance criteria for these results?
  - Please discuss the correlation between measurements of the physical properties of Boral coupons and the integrity of the Boral panels in the storage racks.
  - What was the subcritical margin used in the criticality analysis? In order to prevent excess degradation, the potential degradation should be accounted for in the subcritical margin. How is the potential degradation during the time in between surveillance periods accounted for in the subcritical margin?
  - Please describe the corrective actions that will be implemented if coupon test results are not acceptable.
  - Discuss the schedule for coupon removal and testing during period of extended operation to demonstrate continued Boral performance.
- In September 2003, inspection of Boral test coupons at Seabrook Nuclear Station revealed bulging and blistering of the aluminum cladding. Please discuss the impact, if any, that this event is considered to have on the Boral surveillance program at KPS. Industry experience has indicated that during long-term exposure such blisters may form. Since formation of blisters may affect the efficiency of the Boral panels to attenuate neutrons (through flux trap formation) and may cause deformation of the fuel cells, the applicant should explain why in its plant blistering will not be a safety concern.
- Please discuss any other industry operating experience of Boral, and discuss how that experience is applicable to KPS and any potential safety concerns identified in the boron carbide operating experience.