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Dominion®

July 22, 2010

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Serial No.: 10-366
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Docket No.: 50-305
License No.: DPR-43

DOMINION ENERGY KEWAUNEE, INC.
KEWAUNEE POWER STATION
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION FOR THE REVIEW OF THE KEWAUNEE POWER STATION LICENSE RENEWAL APPLICATION

By letter dated May 27, 2010 (reference 1), the NRC transmitted a request for additional information regarding the review of the license renewal application (LRA) for Kewaunee Power Station (KPS) (reference 2). The NRC staff indicated that a response to this request for additional information (RAI) is needed to complete the review of the KPS LRA. Attachment 1 to this letter provides the Dominion Energy Kewaunee, Inc. (DEK) response to the RAI.

In a letter dated May 13, 2010 (reference 3), DEK committed to provide a response to KPS LRA RAI 3.1.2.2.13-01 after further industry review of the NRC concern identified in the RAI. Attachment.2 provides the DEK response to RAI 3.1.2.2.13-01.

Should you have any questions regarding this submittal, please contact Mr. Paul C. Aitken at (804) 273-2818.

Very truly yours,

Leslie N. Hartz
Vice President – Nuclear Support Services

VICKI L. HULL
Notary Public
Commonwealth of Virginia
140542
My Commission Expires May 31, 2014

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and State aforesaid, today by Leslie N. Hartz, who is Vice President – Nuclear Support Services of Dominion Energy Kewaunee, Inc. 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 22nd day of July, 2010.

My Commission Expires: May 31, 2014

Vicki L. Hull
Notary Public

A135
NRR

Attachment:

1. Response to RAI B2.1.7-3
2. Response to RAI 3.1.2.2.13-01

References:

1. Letter from John Daily (NRC) to David A. Heacock (DEK), "Request for Additional Information for the Review of the Kewaunee Power Station License Renewal Application (TAC No. MD9408)," dated May 27, 2010. [ADAMS Accession No. ML101410322]
2. Letter from D. A. Christian (DEK) to NRC, "Kewaunee Power Station Application for Renewed Operating License," dated August 12, 2008. [ADAMS Accession No. ML082341020]
3. Letter from L. N. Hartz (DEK) to NRC, "Response to Request for Additional Information Related to the Review of the Kewaunee Power Station License Renewal Application," dated May 13, 2010. [ADAMS Accession No. ML101340182]

Commitments made in this letter:

License Renewal Commitment 4 will be revised in LRA Table A6.0-1 consistent with the response to RAI B2.1.7-3. The revised commitment is proposed to support approval of the renewed operating license, and may change during the NRC review period.

cc: U.S. Nuclear Regulatory Commission
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ATTACHMENT 1

RESPONSE TO RAI B2.1.7-3

KEWAUNEE POWER STATION
DOMINION ENERGY KEWAUNEE, INC.

RAI B2.1.7-3

Background

The license renewal application (LRA) states that Aging Management Program (AMP) B2.1.7, Buried Piping and Tanks Inspection Program, is an existing program with one enhancement and is consistent with the program elements in GALL AMP XI.M34. This AMP addresses buried piping, (i.e., piping in direct contact with soil). The LRA also states that AMP B2.1.10, External Surfaces Monitoring Program, is an existing program with enhancement. This AMP addresses aging management of the external surfaces of piping exposed to air, which would normally include underground inaccessible piping (i.e., piping not in direct contact with soil, but located below grade in a vault, pipe chase, or other structure where it is exposed to air and where access is limited).

There have been a number of recent industry events involving leakage from buried and underground piping and tanks.

Issue

In light of this recent industry Operating Experience (OE), the staff is concerned about the continued susceptibility to failure of buried and/or underground piping that are within the scope of 10 CFR 54.4 and subject to aging management for license renewal. In reviewing the AMPs cited above along with the applicable aging management review (AMR) items associated with them, the staff is not clear whether: (1) the components addressed by these AMPs clearly include both buried and underground piping (piping which is below grade and contained in a vault or other structure where it is exposed to air and where access is limited); and (2) whether such programs are being updated to incorporate lessons learned from these recent events as well as any OE from the applicant's own history.

Request

1. *Provide a list and brief summary of any leaks or adverse conditions discovered during inspections (e.g., coating damage that directly exposes the piping or tank to the environment, presence of any coarse material in backfill within 6 inches of the pipe or tank, unexpected corrosion or damage to piping walls or component pressure boundaries) which have occurred in buried or underground piping or tanks at the station in the past five years that were entered in your corrective action program but are not included in your LRA. Describe how your current AMPs or proposed changes to the AMPs address these issues.*

2. *Provide a discussion of how the AMPs used in managing the aging of buried, underground, and limited access piping and tanks within the scope of license renewal will address recent industry OE as well as any OE from the applicant's own history.*

DEK Response

The scope of buried piping and tanks for which aging effects are managed by the *Buried Piping and Tanks Inspection* program is limited to portions of the Circulating Water System piping, Fire Protection System piping, and Diesel Generator System fuel oil piping and fuel oil storage tanks. As identified in LRA Appendix B2.1.7, *Buried Piping and Tanks Inspection*, the following materials and associated protective measures are utilized in buried applications:

- Steel (including cast iron)/coated,
- Steel/coated and wrapped,
- Steel/uncoated, and
- Stainless steel/coated and wrapped

There are also piping and components located below grade in a vault and exposed to air that are within the scope of license renewal. These components are periodically accessed and aging effects will be managed as described in LRA Appendix B2.1.10, *External Surfaces Monitoring*.

1. There have been no leaks discovered during inspections performed on buried or underground piping and tanks within the scope of license renewal within the past five years that were not previously described in the LRA. However, degradation due to corrosion was identified on a portion of buried Diesel Generator System fuel oil piping as described below. The following is a description of buried piping inspections performed on in-scope piping within the past five years:

   In 2007, an approximately 11' section of coated, ductile cast iron, buried Fire Protection System piping was excavated for inspection to determine the condition of the protective coating and piping material. The inspection was conducted on a portion of the system piping that was installed in 1967, where the likelihood for material degradation was considered to be highest based on the installation date. As part of the excavation, soil samples were taken to determine the corrosivity of the environment to ductile iron. The inspection results noted limited areas of pitting on the pipe surface. The pitting was evaluated and the depth did not challenge minimum pipe wall thickness requirements. The piping and protective coating were noted to be in good condition. The evaluation of the surrounding soil conditions concluded that proper bedding of sand and gravel backfill was present, which is generally not corrosive to iron pipe. The soil analysis for material surrounding the pipe backfill showed some corrosion potential for unprotected piping. Based on the as-found condition of the piping and its coating, the Fire Protection System piping was determined to be adequate for continued use.

   In 2009, during modifications to the Diesel Generator System fuel oil tanks vent piping, an opportunity was presented to inspect buried portions of the vent piping. Approximately 70' of fuel oil storage tank and fuel oil day tank vent piping was excavated. The piping was inspected to determine the condition of the protective coating and wrapping, and the piping material. The backfill around the piping consisted of sand and gravel, as specified. The coating and wrapping on the piping was installed as specified on all of the inspected piping except for a portion of two day tank vent pipes where the piping transitions from buried to above-ground. There was no coating or wrapping installed on an approximately 2' length of pipe for each of these vents. With the exception of the uncoated day tanks vent piping, there was no identified degradation of the inspected piping. The uncoated portion of the piping exhibited surface degradation and irregularities due to corrosion. This portion of the piping was properly prepared, coated and wrapped per specifications prior to its return to service. Two additional vent lines were inspected where the piping transitioned from buried to above-ground. The coating and wrapping were installed as specified and no degradation was identified for these lines. The buried fuel oil storage tank and day tank vent piping had been installed over 35 years ago.

2. Industry Operating Experience

In response to industry operating experience with buried and underground piping, the Nuclear Energy Institute (NEI) promulgated an industry initiative on buried piping integrity adopted by the NEI Nuclear Strategic Issues Advisory Committee on November 18, 2009. Buried piping and piping components at Kewaunee are included within the scope of the industry initiative, a subset of which were also subject to aging management review for license renewal. DEK is committed to the implementation of the elements of the industry initiative. Under the timeline established for the NEI initiative, DEK intends to complete the development of the inspection plan by June 30, 2011, and commence inspections under the inspection plan by June 30, 2012.

Kewaunee evaluates industry operating experience in accordance with the established Operating Experience Review program as described in LRA Appendix B1.4, *Operating Experience*. The implementing procedures for the review of operating experience provide for incorporating additional plant-specific and industry operating experience into the aging management programs to ensure continued program effectiveness. Industry operating experience relevant to the *Buried Piping and Tanks Inspection* program is evaluated on a fleet-wide basis, and specific applicability is determined for each of the nuclear stations within the Dominion fleet. Where applicable, enhancements are made to both fleet and station-specific programs, as well as implementing procedures, to enhance program effectiveness.

A Site Program Owner is assigned responsibility for the implementation of the buried piping program at each of the nuclear stations in the Dominion fleet. A corporate engineering Fleet Lead is assigned responsibility for coordination and oversight activities related to the buried piping programs for all Dominion nuclear stations. The Fleet Lead facilitates periodic meetings among the site program owners to discuss lessons learned, operating experience, and best practices. Recent industry operating experience is discussed and evaluated for incorporation into the program.

Dominion also actively participates as a member of the EPRI Buried Piping Integrity Group (BPIG). This working group conducts periodic meetings and workshops with industry peers to identify lessons learned, best practices, and operating experience. Vendors also participate in the meetings to present the latest innovations and methods for dealing with buried piping issues.

Cathodic Protection

Cathodic protection is provided for the in-scope Circulating Water System buried piping and the Diesel Generator System fuel oil storage tanks and piping, except for an approximately 100 ft. portion of the fuel oil supply piping to 'A' EDG. The cathodic protection for portions of the in-scope Circulating Water System piping was out-of-service for a period of approximately 12 years, but full repairs were made in 1992. The cathodic protection system has been completely refurbished and upgraded over the past ten years, with many items being replaced including anodes. Cathodic protection currents and component-to-soil potential measurements are routinely performed in accordance with National Association of Corrosion Engineers (NACE) standards to ensure proper function of the system and protection of buried components.

Buried Piping and Tank Inspections

The *Buried Piping and Tanks Inspection* program will perform inspections of a representative sample of the in-scope buried component material/protective measure combinations prior to the period of extended operation and again within the first ten years of the period of extended operation. The *Buried Piping and Tanks Inspection* program requires visual inspections of the external surfaces of in-scope buried piping and tanks. The program requires inspection for evidence of damaged wrapping, coating defects or damage, and evidence of loss of material on the external surface of the piping or component. The inspections also confirm that the component protective measures (coatings, wrappings) are installed as specified. These inspections will be performed on an opportunistic basis (i.e., as conditions that allow inspection are otherwise made available). If no opportunity is presented to inspect a representative sample of buried components for each of the material types/protective measures combinations, directed inspections will be performed. Each inspection will include a minimum of ten linear feet of piping. Inspections are conducted where the likelihood for material degradation is highest considering the buried environment and expected condition of the coating. The fuel oil storage tanks are represented by the inspection of one of the three in-scope buried tanks.

The following inspections will be performed under the *Buried Piping and Tanks Inspection* program:

- The Circulating Water System 30" diameter recirculation line (consisting of approximately 200' of coated and wrapped carbon steel piping) will receive one inspection prior to the period of extended operation and an additional inspection within the first ten years of the period of extended operation.

- The Circulating Water System recirculation line vent piping (consisting of approximately 15' of coated and wrapped stainless steel piping) will receive one inspection prior to the period of extended operation and an additional inspection within the first ten years of the period of extended operation.

- The Diesel Generator System fuel oil piping, which includes fuel oil supply and return piping, fuel oil storage tank vent piping, and day tank vent piping (consisting of approximately 500' of coated and wrapped carbon steel piping), will receive one inspection prior to the period of extended operation and an additional inspection within the first ten years of the period of extended operation.

- The Diesel Generator System fuel oil storage tanks (consisting of 3 coated carbon steel tanks) will receive one inspection of one tank prior to the period of extended operation. An additional tank inspection will be performed within the first ten years of the period of extended operation.

- The Diesel Generator System fuel oil storage tanks hold down straps (consisting of two straps for each of two tanks - uncoated carbon steel) will be inspected (in conjunction with the associated fuel oil storage tank inspection). One set will be inspected prior to the period of extended operation and one set will be inspected within the first ten years of the period of extended operation.

- The Fire Protection System piping (consisting of approximately 2350' of coated ductile iron piping) was inspected in 2007 as described above, and will receive two additional inspections prior to the period of extended operation. Three additional inspections of Fire Protection System piping will be performed within the first ten years of the period of extended operation.

Degraded conditions identified during inspections are entered into the Corrective Action Program and receive an engineering evaluation. Degraded conditions include damage to the wrapping and/or coating, and signs of loss of material due to corrosion. Cause evaluations for damaged wrapping and/or coating include determining the potential for backfill contribution to the observed degradation. The evaluation of any identified degraded conditions will determine whether additional buried components require inspection to ensure that the extent of the condition is identified and whether a more comprehensive examination is necessary to characterize the degraded condition of the buried component.

The inspections performed by the *Buried Piping and Tanks Inspection* program ensure that the effects of aging associated with the in-scope buried components will be adequately managed so that there is reasonable assurance that their intended functions will be maintained consistent with the current licensing basis throughout the period of extended operation.

Commitment #4 in LRA Appendix A, USAR Supplement, Table A6.0-1 is replaced as a result of this RAI response with the following:

Item	Commitment	Source	Schedule
4	The *Buried Piping and Tanks Inspection* program will be enhanced to perform visual inspections of a representative sample of material/protective measure combinations for in-scope buried piping and tanks. The following materials are utilized in buried applications with the associated protective measures: • Steel (including cast iron)/coated, • Steel/coated and wrapped, • Steel/uncoated, and • Stainless steel/coated and wrapped Visual inspections of the external surface of the components will be performed to identify damaged wrapping (if present), degraded or damaged coating (if present), and evidence of loss of material. Each piping inspection will include a minimum of ten linear feet of piping. The following inspections will be performed: The Circulating Water System 30" diameter recirculation line, which is coated and wrapped carbon steel, will receive one inspection prior to the period of extended operation and an additional inspection within the first ten years of the period of extended operation. The Circulating Water System recirculation line vent piping, which is coated and wrapped stainless steel, will receive one inspection prior to the period of extended operation and an additional inspection within the first ten years of the period of extended operation. The Diesel Generator System fuel oil piping, which includes coated and wrapped carbon steel fuel oil supply and return piping, storage tank vent piping, and day tank vent piping, will receive one inspection prior to the period of extended operation and an additional inspection within the first ten years of the period of extended operation. The Diesel Generator System fuel oil storage tanks, which are coated carbon steel, will receive one inspection of one tank prior to the period of extended operation. An additional tank inspection will be performed within the first ten years of the period of extended operation. The Diesel Generator System fuel oil storage tanks hold down straps, which are uncoated carbon steel, will be inspected in conjunction with the associated fuel oil storage tank inspection. One set will be inspected prior to the period of extended operation and one set will be inspected within the first ten years of the period of extended operation. The Fire Protection System piping, which is coated ductile iron, will receive three inspections prior to the period of extended operation and three additional inspections within the first ten years of the period of extended operation.	Letter 10-366 Response to RAI B2.1.7-3.	Prior to the Period of Extended Operation, and During the first ten (10) years of the Period of Extended Operation

ATTACHMENT 2

RESPONSE TO RAI 3.1.2.2.13-01

KEWAUNEE POWER STATION
DOMINION ENERGY KEWAUNEE, INC.

RAI 3.1.2.2.13-01, Cracking due to PWSCC

Background

SRP-LR Section 3.1.2.2.13 identifies that cracking due to primary water stress corrosion cracking (PWSCC) could occur in PWR components made of nickel alloy and steel with nickel alloy cladding, including reactor coolant pressure boundary components and penetrations inside the RCS such as pressurizer heater sheathes and sleeves, nozzles, and other internal components. GALL Report Volume 2 Item IV.D1-06 recommends Chapter XI.M2, "Water Chemistry," for PWR primary water for managing the aging effect of cracking in the nickel alloy steam generator divider plate exposed to reactor coolant.

In LRA Table 3.1.1, Item 81, the applicant credits its Primary Water Chemistry Program to manage the aging effect of cracking due to primary water stress corrosion cracking in nickel alloy or nickel-alloy clad steam generator (SG) divider plate exposed to reactor coolant, and indicates in Item 82 of this same table that Kewaunee's installed steam generator divider plate is fabricated from nickel alloy.

Issue

From recent foreign operating experience in steam generators with a similar design to that of Kewaunee, extensive cracking due to PWSCC has been identified in SG divider plates, even with proper primary water chemistry. Specifically, cracks have been detected in the stub runner, very close to the tubesheet/stub runner weld and with depths of almost a third of the divider plate thickness (OECD/NEA/CSNI/IAGE April 2007 EDF presentation). Therefore, the staff notes that the water chemistry program alone does not appear to be effective in managing the aging effect of cracking due to PWSCC in SG divider plate.

Although these SG divider plate cracks may not have a significant safety impact in of themselves, such cracks could impact adjacent items, such as the tubesheet and the channel head, if they propagate to the boundary with these items. For the tubesheet, PWSCC cracks in the divider plate could propagate to the tubesheet cladding with possible consequences to the integrity of the tube/tubesheet welds. For the channel head, the PWSCC cracks in the divider plate could propagate to the SG triple point and potentially affect the pressure boundary of the SG channel head.

Request

Please discuss the materials of construction of your SG divider plate assembly. If these materials are susceptible to cracking (e.g., Alloy 600 or the associated Alloy 600 weld materials), please discuss the potential for cracking in the divider plate to propagate into other components (e.g., .tubesheet cladding).

If propagation into these other components cannot be ruled out, please describe an inspection program (examination technique and frequency) for ensuring that there are no cracks propagating into other items (e.g., tube sheet and channel head) that could challenge the integrity of these other items.

DEK Response

As identified in LRA Table 3.2.1-4, the Divider Plate is fabricated from nickel-based alloy material. The steam generator divider plate assembly was replaced in 2001 along with the tubes, tubesheet, channel head, and a portion of the secondary shell of the steam generators as part of the steam generator replacement project. The divider plate assembly consists of the divider plate, a stub runner, and associated welds. The divider plate is nominally 2-inch thick Alloy 600 plate that is welded to the channel head around its perimeter and to the stub runner along its top edge. The stub runner is 2-inch thick Alloy 600 plate material and is welded to the tubesheet along its top edge and to the channel head along the sides. The full penetration welds between the divider plate and stub runner, and between the stub runner and tubesheet, are Alloy 52/152 material.

The aging management review determined that the nickel-based alloy material of these components is potentially susceptible to primary water stress corrosion cracking (PWSCC) in the reactor coolant environment. Cracking of the divider plate assembly is managed by the *Primary Water Chemistry* program, as indicated in LRA Table 3.2.1-4, consistent with NUREG-1801, *Generic Aging Lessons Learned (GALL) Report*, Volume II, Item IV.D1-06.

Foreign operating experience has been reviewed regarding steam generator divider plate region cracking. The Kewaunee steam generator configuration is similar to the French plant steam generators that experienced divider plate cracking in that both designs are inverted U-tube type with a partition or divider plate to direct reactor coolant flow through the tubes. However, there are distinct differences in steam generator construction details. The Kewaunee steam generator divider plate is approximately 47% thicker than the French design (~2" versus ~1.3"), and the French tubesheet is 30% thinner. In addition, the French plants are operated in a load-following manner, whereas Kewaunee is a base-loaded plant resulting in fewer anticipated thermal fatigue cycles for the divider plate assembly. One French plant steam generator divider plate was indicated to be subject to significant impingement effects due to plant operation with loose parts inside the steam generator channel head. There is no operating history with loose parts in the Kewaunee steam generator primary-side. Also, as noted above, the Kewaunee divider plate-to-stub runner and stub runner-to-tubesheet welds are Alloy 52/152 material which has demonstrated resistance to PWSCC, whereas the corresponding welds in the French design steam generators are Alloy 182 material, with known susceptibility to PWSCC.

The foreign operating experience has been extensively evaluated by the Electric Power Research Institute (EPRI) and the results of the studies have been published for industry reference in the following reports:

- EPRI Report No. 1014982, "Divider Plate Cracking in Steam Generators, Results of Phase I: Analysis of Primary Water Stress Corrosion Cracking and Mechanical Fatigue in the Alloy 600 Stub Runner to Divider Plate Weld Material", Final Report, June 2007

- EPRI Report No. 1016552, "Divider Plate Cracking in Steam Generators, Results of Phase II: Evaluation of Impact of a Cracked Divider Plate on LOCA and Non-LOCA Analyses", Final Report, November 2008
- EPRI Report No. 1019040, "Steam Generator Divider Plate Cracking Engineering Study", Technical Update, December 2009

The studies conservatively considered the existence of significant divider plate assembly cracking, including cracks extending along the entire length of the divider plate completely through wall, even though there has been no reported U.S. nuclear industry operating experience with divider plate cracking. Analyses were completed for the Steam Line Break, Large LOCA, and Small LOCA, and both qualitative and quantitative non-LOCA transients. In each of these cases, the cracked divider plate was found to have either a negligible impact on the steam generator response to the transient, or to be less limiting than an un-cracked divider plate. Therefore it was concluded that a cracked divider plate is not a safety concern.

Based on information available to EPRI related to the foreign operating experience, there has been no reported incidence of divider plate region cracks propagating into channel head or tubesheet base materials, or into the tubesheet cladding, similar to that postulated in the RAI. In addition, crack propagation into these regions is not expected based on the following:

- Crack propagation in the direction of base materials or cladding would require the crack to grow contrary to the influence of the primary stress field, which is not consistent with fracture mechanics principles.
- Based on service experience, PWSCC cracking stops when a non-susceptible material is encountered, such as stainless steel cladding, Alloy 52/152 welds, or low-alloy steel base materials.
- Cracking initiated in the Alloy 600 divider plate or stub runner is not expected to extend significantly into the adjacent welds due to the low crack growth rates observed in Alloy 52/152 weld metal in primary water.
- Data from the EPRI studies of divider plate cracking suggests that the stresses in the divider plate materials become compressive within a short distance of the face of the divider plate if a crack were to propagate into the thickness of the weld. Similarly, the stress field in the triple point connection of the channel head, divider plate, tubesheet, and stub runner is also compressive. The implication of this data is that a crack in any postulated PWSCC sensitized divider plate material is forced to remain in its original plane.

Therefore, it is not considered feasible for divider plate cracks to grow in such a manner as to propagate through the divider plate material and adjoining welds to the channel head and tubesheet cladding or base materials. Based on the EPRI evaluation of the effects of steam generator divider plate cracking and the information available from foreign plants operating experience, an inspection program is not considered necessary to ensure that potential steam generator divider plate region cracking does not challenge the integrity of other steam generator components.

Kewaunee monitors and evaluates industry operating experience related to the design and operation of the plant, including the steam generators, in accordance with the Operating Experience Program. In the event that relevant operating experience is identified within the industry, whether from domestic or foreign plants, the information will be evaluated and necessary corrective actions will be implemented to provide reasonable assurance that the intended functions of steam generators are maintained consistent with the current licensing basis.