September 23, 2005

Mr. Michael G. Gaffney
Site Vice President
Kewaunee Nuclear Power Plant
Nuclear Management Company, LLC
N490 Highway 42
Kewaunee, WI 54216-9511

SUBJECT: KEWAUNEE NUCLEAR POWER PLANT - FOURTH 10-YEAR INSERVICE INSPECTION INTERVAL PROGRAM REQUESTS FOR RELIEF (TAC NOS. MC2502, MC2508 AND MC2537)

Dear Mr. Gaffney:

By letter to the Nuclear Regulatory Commission (NRC) dated December 16, 2003, as supplemented by letters dated September 17, 2004, September 30, 2004, February 18, 2005, June 17, 2005, August 4, 2005, and August 31, 2005, Dominion Energy Kewaunee, Inc., submitted requests for relief RR-1-1, RR-1-2, RR-1-3, RR-1-4, RR-1-5, RR-1-6, RR-1-7, RR-1-8, RR-1-9, RR-2-1, RR-G-1 and RR-G-2, from certain requirements of the American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code* (Code), Section XI, for the fourth 10-year interval inservice inspection (ISI) program at Kewaunee Nuclear Power Plant (KNPP). The code of record for KNPP for the fourth 10-year ISI interval is the 1998 Edition with 2000 Addenda.

By letter dated February 18, 2005, the NRC granted relief for requests RR-1-1, RR-1-2, RR-1-3, RR-1-4, RR-1-5, RR-1-7, RR-1-8, RR-2-1, and RR-G-2. By letter dated September 17, 2004, you withdrew relief request RR-1-9. By letter dated August 31, 2005, you withdrew relief request RR-1-6.

The NRC staff has completed its review of the final relief request RR-G-1. The results are provided in the enclosed safety evaluation.

The final relief request RR-G-1 requested approval of a risk-informed inservice inspection (RI-ISI) alternative to the ASME Code, Section XI, requirements. The RI-ISI program for the KNPP was developed in accordance with the NRC-approved Electric Power Research Institute Topical Report TR-112657, Revision B-A. The NRC staff review found that the proposed RI-ISI program for the KNPP is an acceptable alternative to the requirements of the ASME Code, Section XI, for inservice inspection (ISI).

The proposed alternative provides reasonable assurance of structural integrity. Pursuant to Title 10 of the *Code of Federal Regulations*, Section 50.55a(a)(3)(i), the alternative in relief request RR-G-1 provides an acceptable level of quality and safety and is authorized for the fourth 10-year ISI interval at the KNPP, which ends on June 16, 2014.

Sincerely,

/RA/

L. Raghavan, Chief, Section 1
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-305

Enclosure: Safety Evaluation

cc w/encl: See next page

The proposed alternative provides reasonable assurance of structural integrity. Pursuant to Title 10 of the *Code of Federal Regulations*, Section 50.55a(a)(3)(i), the alternative in relief request RR-G-1 provides an acceptable level of quality and safety and is authorized for the fourth 10-year ISI interval at the KNPP, which ends on June 16, 2014.

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L. Raghavan, Chief, Section 1
Project Directorate III
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Office of Nuclear Reactor Regulation

Docket No. 50-305

Enclosure: Safety Evaluation

cc w/encl: See next page

<u>DISTRIBUTION</u>:

PUBLIC	PDIII-1 R/F	HNeih	LRaghavan
JStang	THarris	AKeim	TChan
DWeaver	ACRS	OGC	TKozak, RIII
DLPM DPR	MMelnicoff	MRubin	

ADAMS Accession Number: ML052660057 No major changes to SE dated 07/25/2005

OFFICE	PDIII-1/PM	PDIII-1/LA	SPSB/SC *	EMCB/SC *	OGC	PDIII-1/SC
NAME	JStang	DClarke for THarris	MRubin	TChan	MZobler	LRaghavan
DATE	9/23/05	9/9/05	07/25/05	07/25/05	9/19/05	9/23/05

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

FOURTH 10-YEAR INTERVAL INSERVICE INSPECTION PROGRAM

REQUESTS FOR RELIEF

KEWAUNEE NUCLEAR POWER PLANT

DOMINION ENERGY KEWAUNEE, INC

DOCKET NO. 50-305

1.0 INTRODUCTION

By letter to the Nuclear Regulatory Commission (NRC, the Commission) dated December 16, 2003 (Agencywide Documents Access and Management System (ADAMS Accession No. ML033580734), as supplemented by letters dated September 17, 2004 (ADAMS Accession No. ML042720366), September 30, 2004 (ADAMS Accession No. ML042890373), February 18, 2005 (ADAMS Accession No. ML050610018), June 17, 2005 (ADAMS Accession No. ML051790216), August 4, 2005 (ADAMS Accession No. ML052240254), and August 31, 2005 (ADAMS Accession No. ML052510387), Dominion Energy Kewaunee, Inc. (the licensee), submitted requests for relief RR-1-1, RR-1-2, RR-1-3, RR-1-4, RR-1-5, RR-1-6, RR-1-7, RR-1-8, RR-1-9, RR-2-1, RR-G-1 and RR-G-2, from certain requirements of the American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code* (Code), Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," for the fourth 10-year interval inservice inspection (ISI) program at Kewaunee Nuclear Power Plant (KNPP). The code of record for KNPP for the fourth 10-year ISI interval is the 1998 Edition with 2000 Addenda.

By letter dated February 18, 2005 (ADAMS Accession No. ML050350225), the NRC granted relief for requests RR-1-1, RR-1-2, RR-1-3, RR-1-4, RR-1-5, RR-1-7, RR-1-8, RR-2-1, and RR-G-2. By letter dated September 17, 2004, the licensee withdrew relief request RR-1-9. By letter dated August 31, 2005, the licensee withdrew relief request RR-1-6.

The final relief request, RR-G-1, requested approval of a risk-informed inservice inspection (RI-ISI) alternative to ASME Code, Section XI, requirements. The RI-ISI program for KNPP was developed in accordance with the NRC-approved Electric Power Research Institute (EPRI) Topical Report TR-112657, Revision B-A, "Revised Risk-Informed Inservice Inspection Evaluation Procedure," December 1999. The licensee proposed the RI-ISI program as an alternative to the requirements in the ASME Code, Section XI, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(a)(3)(i). The licensee requested implementation of this alternative beginning with the first period of the fourth 10-year ISI interval at KNPP.

2.0 REGULATORY EVALUATION

Pursuant to 10 CFR 50.55a(g), ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements set forth in the Code to the extent practical within the limitations of design, geometry, and materials of construction of the components. Section 50.55a(g) also states that ISI of the ASME Code, Class 1, 2, and 3 components is to be performed in accordance with Section XI of the ASME Code and applicable addenda, except where specific written relief has been granted by the NRC. The objective of the ISI program as described in Section XI of the ASME Code and applicable addenda is to identify conditions (i.e., flaw indications) that are precursors to leaks and ruptures in the pressure boundary of these components that may impact plant safety. The regulation also requires that, during the first 10-year ISI interval and during subsequent intervals, the licensee's ISI program complies with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference into 10 CFR 50.55a(b) 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. KNPP began its fourth interval on June 16, 2004. The applicable edition of Section XI of the ASME Code for KNPP for this 10-year ISI interval is the 1998 Edition with the 2000 Addenda.

According to 10 CFR 50.55a(a)(3)(i), the NRC may authorize alternatives to the requirements of 10 CFR 50.55a(g), and by extension, ASME Code, Section XI, 1998 Edition with the 2000 Addenda (as amended by prior relief authorized by the NRC), if an applicant demonstrates that the proposed alternatives would provide an acceptable level of quality and safety.

Regulatory Guide (RG) 1.174, "An Approach for Using Probabilistic Risk Assessment In Risk-Informed Decisions On Plant-Specific Changes to the Licensing Basis," Revision 1, November 2002, defines the following safety principles that should be met in an acceptable RI-ISI program:

1) The proposed change meets current regulations unless it is explicitly related to a requested exemption.

2) The proposed change is consistent with the defense-in-depth philosophy.

3) The proposed change maintains sufficient safety margins.

4) When proposed changes result in an increase in risk, the increases should be small and consistent with the intent of the Commission's Safety Goal Policy Statement.

5) The impact of the proposed change should be monitored using performance measurement strategies.

RG 1.178, "An Approach For Plant-Specific Risk-Informed Decisionmaking - Inservice Inspection of Piping," Revision 1, September 2003, describes methods acceptable to the NRC staff for integrating insights from probabilistic risk assessment (PRA) techniques with traditional engineering analyses into ISI programs for piping, and addresses risk-informed approaches that are consistent with the basic elements identified in RG 1.174.

The licensee has proposed to use a RI-ISI program for ASME Class 1 and Class 2 piping (Examination Categories B-F, B-J, C-F-1, and C-F-2 welds), as an alternative to the ASME

Code, Section XI, requirements. The licensee states that this proposed program was developed using RI-ISI methodology described in EPRI TR-112657. The NRC staff's safety evaluation report (SER) of October 28, 1999, approving the methodology described in EPRI TR-112657, concluded that this methodology conforms to the guidance provided in RGs 1.174 and 1.178, and that no significant risk increase should be expected from the changes to the ISI program resulting from applying the methodology. The transmittal letter for the October 28, 1999, SER, of the same date, stated that an RI-ISI program as described in EPRI TR-112657 utilizes a sound technical approach and will provide an acceptable level of quality and safety. It also stated that, pursuant to 10 CFR 50.55a, any RI-ISI program meeting the requirements of EPRI TR-112657 provides an acceptable alternative to the piping ISI requirements with regard to (1) the number of locations, (2) the locations of inspections, and (3) the methods of inspection.

The NRC staff concludes that the regulatory approach taken by the licensee is acceptable.

3.0 TECHNICAL EVALUATION

Pursuant to 10 CFR 50.55a(a)(3)(i), the NRC staff has reviewed and evaluated the licensee's proposed RI-ISI program based on guidance and acceptance criteria provided in the following documents:

- RGs 1.174 and 1.178
- NRC NUREG-0800, Chapter 3.9.8, "Standard Review Plan for the Review of Risk-Informed Inservice Inspection of Piping," Revision 1, September 2003.
- EPRI TR-112657
- NRC SER for EPRI TR-112657

3.1 Request for Relief RR-G-1 Class 1 and Class 2 Piping

Code Requirement: Volumetric and Surface Examination of Class 1 and Class 2 Piping per the 1998 Edition 2000 Addenda of Section XI, Table IWB-2500-1, Examination Category B-J, Table IWC-2500-1, Examination Category C-F-1 and C-F-2

Licensee's Code Relief Request: In accordance with 10CFR 50.55a(a)(3)(i) the licensee requested the RI-ISI program as an alternative to the existing ISI requirements of the ASME Code, Section XI. The end result of the program changes is that the number and locations of non-destructive examination (NDE) inspections based on ASME Code, Section XI requirements will be replaced by the number and locations of these inspections based on the RI-ISI guidelines. The Code requires, in part, that for each successive 10-year ISI interval, 100 percent of Category B-F welds and 25 percent of Category B-J welds for the ASME Code, Class 1 non-exempt piping be selected for volumetric and/or surface examination based on existing stress analyses and cumulative usage factors. For Category C-F welds in Class 2 piping, 7.5 percent of non-exempt welds are selected for volumetric and/or surface examination. The proposed RI-ISI program for KNPP selects 65 of 648 Class 1 piping welds, and 51 of 1131 Class 2 piping welds for NDE. The surface examinations required by ASME Code, Section XI, will be discontinued while system pressure tests and VT-2 visual examinations shall continue. These results are consistent with the concept that, by focusing inspections on the most safety significant welds, the number of inspections can be reduced while at the same time maintaining protection of public health and safety.

Licensee's Basis for Relief Requested (as stated):

The ASME Code, Section XI requirements for Inservice Inspection of Class 1, 2 and 3 pressure retaining welds in piping have been in effect since 1978. Since that time, the industry has expended significant cost and man-Rem exposure performing required examinations which have detected few service-induced flaws. Service experience has shown little correlation between the current ASME Code, Section XI Inservice Inspection (ISI) requirements and actual field failures or degradation mechanisms. Where field failures have been observed in piping, they have generally been due to either material concerns (e.g., Intergranular Stress Corrosion Cracking) or stress/cycling mechanisms not identified in the original design basis document (e.g. thermal stratification), and therefore would not be selected for inspection under current Section XI requirements.

Licensee's Proposed Alternative Examination (as stated):

Perform Volumetric and Surface examinations on Class 1 and Class 2 Piping at the Kewaunee Nuclear Power Plant per the requirements of Electric Power Research Institute (EPRI) Topical Report TR-112657 Rev. B-A "Revised Risk-Informed Inservice Inspection Evaluation Procedure" which is conducted in a manner consistent with ASME Boiler and Pressure Vessel Code Section XI Code Case -578 Risk-Informed Requirements for Class 1, 2, and 3 Piping Method B Section XI, Division 1. TR-112657 Rev. B-A as a Risk-Informed application meets the intent and principles of Nuclear Regulatory Commission [Regulatory] Guide 1.174 "An Approach For Using Probabilistic Risk Assessment in Risk-Informed Decisions On Plant-Specific Changes to the Licensing Basis" and Nuclear Regulatory [Commission Regulatory] Guide 1.178, "An Approach for Plant-Specific Risk-Informed Decision Making Inservice Inspection of Piping".

The licensee states that other augmented piping inspection programs are affected by the proposal as follows:

Source Document	Subject	Status of Incorporation into Licensee RI-ISI Program[1]
IEB 79-13 (supplemented by IEN 93-020)	Cracking in Feedwater System Piping	In Enclosure 1 of its June 17, 2005, submittal, the licensee indicates that this augmented inspection program was subsumed into the RI-ISI program.
IEB 79-17	Pipe Cracks in Stagnant Borated Water Systems in Pressurized Water Reactor Plants	In Enclosure 1 of its June 17, 2005, submittal, the licensee indicates that this augmented inspection program was subsumed into the RI-ISI program. In a subsequent discussion in this same document, the licensee indicates that there is some piping related to IEB 79-17, but is outside the scope of the RI-ISI program (i.e., - not ASME Class 1 or 2).
IEB 88-08	Thermal Stresses in Piping Connected to the RCS	In Enclosure 1 of its June 17, 2005, submittal, the licensee indicates that this

Source Document	Subject	Status of Incorporation into Licensee RI-ISI Program[1]
		augmented inspection program was subsumed into the RI-ISI program.
GL 89-08	Flow Accelerated Corrosion (FAC)	In Section 2.2 of its December 16, 2003, submittal, the licensee states that the augmented inspection program for FAC per Generic Letter (GL) 89-08 is relied upon to manage this damage mechanism but is not otherwise affected or changed by the RI-ISI Program. Discussion about the impact of this program on the RI-ISI program (i.e., risk-ranking and element selection) is provided in Section 3.2.4.1 and 3.2.4.2 of this SE.

[1] Table 6-2 of EPRI TR-112657 states that all of these programs, with the exception of GL 89-08, may be subsumed into the RI-ISI program.

Evaluation: The licensee has elected to subsume the first three augmented inspection programs listed above into the RI-ISI program. This treatment is permitted in Table 6-2 of EPRI TR-112657. In its August 4, 2005, submittal, the licensee states that none of the additional examinations to be performed in connection with the augmented inspection programs listed in Enclosure 2 of its February 18, 2005, submittal, during the fourth 10-year ISI interval will be credited to the NDE count of the RI-ISI program. Furthermore, the licensee has committed to maintaining a separate GL 89-08 program, which is consistent with the requirements of EPRI TR-112657. The NRC staff finds the licensee's disposition of the aforementioned augmented inspection programs to be consistent with EPRI TR-112657 and acceptable.

3.2 Engineering Analysis

In accordance with the guidance provided in RGs 1.174 and 1.178, the licensee provided the results of an engineering analysis of the proposed changes, using a combination of traditional engineering analysis and supporting insights from the PRA. The licensee performed an

evaluation to determine susceptibility of components (i.e., a piping weld) to a particular degradation mechanism that may be a precursor to leak or rupture, and then performed an independent assessment of the consequence of a failure at that location.

The results of this analysis assure that the proposed changes are consistent with the principles of defense-in-depth because EPRI TR-112657 methodology requires that the population of welds with high consequences following failure will always have some weld locations inspected regardless of the failure potential. No changes to the evaluation of design-basis accidents in the final safety analysis report are being made by the RI-ISI process. Therefore, sufficient safety margins will be maintained.

3.2.1 Failure Potential

Piping systems within the scope of the RI-ISI program were divided into piping segments. Pipe segments are defined as lengths of pipe whose failure (anywhere within the pipe segment) would lead to the same consequence and which are exposed to the same degradation mechanisms. That is, some lengths of pipe whose failure would lead to the same consequence may be split into two or more segments when two or more regions are exposed to different degradation mechanisms. The licensee’s December 16, 2003, submittal states that failure potential assessment, summarized in Table 3.3 of the submittal, was accomplished utilizing industry failure history, plant-specific failure history, and other relevant information using the guidance provided in EPRI TR-112657.

Section 3 of the licensee’s December 16, 2003, submittal describes a proposed deviation to the EPRI RI-ISI methodology for assessing the potential for the thermal stratification, cycling, and striping (TASCS) degradation mechanism. This proposed methodology for assessing TASCS at KNPP conforms to criteria which have previously been submitted by EPRI for generic approval (letters dated February 28, 2001, and March 28, 2001, from P.J. O'Regan (EPRI) to Dr. B. Sheron (USNRC), "Extension of Risk-Informed Inservice Inspection Methodology”). In Enclosure 1 of the June 17, 2005, submittal, the licensee confirmed that this methodology is identical to that in EPRI TR-1000701, “Interim Thermal Fatigue Management Guideline (MRP-24),” January 2001. While this guideline applies this methodology to specific types of piping, the licensee used the methodology for assessing TASCS with other in-scope piping.

In the proposed deviation, the licensee provides additional considerations for determining the potential for TASCS, including piping configuration and potential turbulence, low flow conditions, valve leakage, and heat transfer due to convection. The NRC staff finds that these considerations are appropriate for determining the potential for TASCS. The licensee further states in Enclosure 1 of its June 17, 2005, submittal, that it would incorporate applicable NRC-approved final guidance of MRP-24 into its RI-ISI program for assessing TASCS or seek relief in accordance with 10 CFR 50.55a(g)(5)(iii). The NRC staff finds this acceptable.

The NRC staff concludes that the licensee has met the NUREG-0800, Chapter 3.9.8 guidelines to confirm that a systematic process was used to identify the component’s (i.e., pipe segments) susceptibility to common degradation mechanisms, and to categorize these degradation mechanisms into the appropriate degradation categories with respect to their potential to result in a postulated leak or rupture.

3.2.2 Consequence Analysis

The licensee states that the consequences of pressure boundary failures were evaluated and ranked based on their impact on core damage and containment performance (i.e., isolation, bypass and large early release). The licensee notes that the consequence evaluation included an assessment of shutdown and external events. Also, the licensee indicates that impact on the above measures due to both direct and indirect effects was considered. Results of the consequence analysis are tabulated for each in-scope piping segment in a table entitled, “Kewaunee Risk Ranking Report,” provided as an enclosure to the December 16, 2003, submittal, and appear to be within expected norms. The licensee reports no deviations from the approved consequence evaluation guidance provided in EPRI TR-112657. Therefore, the NRC staff considers the consequence analysis performed by the licensee for this application to be acceptable.

3.2.3 Probabilistic Risk Assessment

As stated in December 16, 2003, the licensee used an updated version of its original PRA to evaluate the consequences of pipe rupture for the RI-ISI assessment. This version of the risk model, Revision 0101, reflecting the as-built and operated plant as of December 2001, is comprised of both Level 1 and Level 2 PRA analyses. It addresses accidents initiated by internal events at full power, including internal flooding, and containment response to these accidents. For Revision 0101, the licensee states that the baseline core damage frequency (CDF) estimated from this PRA model is 4.1E-05/yr and the baseline large early release frequency (LERF) estimated is 4.8E-06/yr.

3.2.3.1 Staff/Industry Review of the PRA

The KNPP individual plant examination (IPE) was submitted to the NRC on December 1, 1992. The original IPE estimated a CDF of 6.7E-05/year, which was revised upward to 1E-4/year following the performance of an updated human reliability analysis. As an enclosure to the December 16, 2003, submittal, Structural Integrity Calculation/File No. NMC-01-343, “Risk Impact Analysis for the Kewaunee Nuclear Power Plant,” Revision 0, July 29, 2003, concluded that the “IPE process is capable of identifying the most likely severe accidents and severe accident vulnerabilities, and therefore, that the Kewaunee IPE has met the intent of GL 88-20."

In Enclosure 1 of its June 17, 2005, submittal, the licensee states that there were six weaknesses identified during the NRC staff’s review of the IPE. Of these, three of the weaknesses pertained only to documentation, and did not need any model changes to resolve them. One pertained to a lack of completeness in the scope of the flooding analysis. However, the licensee states in the submittal that flooding impact was considered separately during the consequence analysis, rather than relying on the existing flooding analysis in the PRA (which is derived from the IPE).

The two remaining weaknesses pertain to human interactions (HIs). One weakness was the inadequate treatment of dependency between HIs. The licensee indicates that this weakness was addressed subsequently and the corrected treatment was found to be acceptable by the aforementioned peer review. The model used for this application does not have this weakness. The other weakness pertained to the time windows used to develop human error probabilities (HEPs). This issue was not addressed prior to the peer review, and was also identified by the peer review as an issue that needed to be resolved. Its impact on the consequence analysis is discussed in the peer review results, below.

An industry peer review of the KNPP PRA model used for this application was completed in June 2002, and concluded that the KNPP PRA could be effectively used to support applications involving risk significance determinations supported by deterministic analyses, once the Facts and Observations (F&Os) noted in the report are addressed. The review produced 5 Category A F&Os, and 49 Category B F&Os. The five Category A F&Os, with the licensee's and NRC staff's assessment of their impact on this application are listed below.

- "Long-term condensate storage tank (CST) inventory is not appropriately modeled for the loss of service water scenario. The resolution of this issue showed that it did not have a major effect on results." In Enclosure 1 of its June 17, 2005, submittal, the licensee supports this contention by providing the following additional information: "For auxiliary feedwater to be successful in a loss of service water event, the condensate storage tanks must be cross-tied to the reactor makeup water storage tanks. Since this is a relatively simple action and uses passive components, it adds minimal additional risk. As a result of this model change, the CDF for a loss of service water increased by 19%. This is not sufficient to change any consequence ranking." While this point alone does not speak directly to the consequence ranking (i.e., conditional core damage probability (CCDP) as defined in EPRI TR-112657) of piping that transports the contents of the CST, the NRC staff notes that the issue is restricted to just a loss of service water initiating event, and to piping for which the CST may be a surrogate in the PRA model, such as auxiliary feedwater suction piping. ASME piping class information provided in the submittal indicates that this issue involves only ASME Code, Class 3 piping which is out-of-scope for this application. The increase in the failure probability associated with the CST due to the need to cross-tie the CST and the reactor makeup water storage tanks will have no effect on any pipe segments within the scope of this application.

- "Time-phasing of diesel generator [DG] run failures and different types of losses of offsite power [LOOP] (weather-related, plant-centered, etc.) are not modeled. The resolution of this issue showed that it did not have a major effect on results." The NRC staff agrees in that, if anything, DG run failure probabilities and LOOP frequencies will drop (because of their separation into smaller compartments), which will reduce the CDF of cutsets containing both DG run failures/LOOP initiators and surrogate basic events for pipe segments being evaluated for CCDP. Reduced CDFs will result in reduced CCDPs. It is unlikely that a given pipe segment's importance will increase to a higher risk category.

- "The bases for the time windows for human actions are not well defined. Work is in progress on resolving this F&O. Preliminary results show that the human error probabilities (HEPs) in the model tend not to be greatly affected by the new time windows." In Enclosure 1 of its June 17, 2005, submittal, the licensee provides a listing of eleven HEPs which did significantly increase in probability, relative to the values in the model used for this application. The listing is followed with a statement that none of these revised, increased HEPs changed that consequence ranking of any consequence (i.e., - pipe segment) in the submittal.

- "The flooding analysis is deficient in a number of areas. Flooding was examined separately in the consequence analysis rather than relying on the PRA flooding analysis." The NRC staff agrees that this F&O requires special treatment by the licensee. This issue was dispositioned in the above discussion on IPE weaknesses.

- "Operator action to close valve SI-101A or SI-101B after accumulator refill is overly conservative and perhaps should not be modeled. The resolution of this issue showed that it did not have a major effect on results. The sequences involved were unrelated to piping failures." The NRC staff finds that correcting this F&O will not result in the increase of any pipe segment CCDPs, since it will result in the removal of cutsets containing the above pre-initiators.

With regard to the 49 Category B F&Os, the licensee states that it reviewed them for impact on this application, and concluded that correcting them would not result in a significant increase in pipe segment failure rates and/or consequences. The 49 Category B F&Os were also considered for severe global impacts that could affect this application. None were identified.

The licensee explained that, of all 49 Category B F&Os, only eight have not yet been incorporated into a revised model. Of these eight, four of them relate to the previously identified Category A F&O concerning the flooding analysis. These were also dispositioned similarly to Category A F&Os, in that flooding impact was considered separately during the consequence analysis.

Of the four remaining currently unresolved Category B F&Os, two of them involve the modeling of heating, ventilation, and air conditioning (HVAC) systems. The licensee notes that calculations for 1) crediting HVAC in the model, and 2) for screening out HVAC initiators are either lacking or are overly conservative. This indicates that the fault tree logic in the current model is based on air flow requirements that are greater than what may actually be needed. For cutsets which contain both HVAC components (either as an initiator or as a mitigating basic event) and one or more pipe segment surrogates, refined HVAC requirement calculations should reduce the frequency and/or numbers of these cutsets, and the CCDP of the pipe segment surrogates.

For the remaining two currently unresolved Category B F&Os, one involves the lack of basic events to represent the transferring closed of normally open motor-operated valves (MOVs). While adding these basic events to the model will cause the generation of new cutsets, these are expected to be very low frequency cutsets, as the probability of a normally open MOV transferring closed is extremely low. The CCDP of any pipe segment surrogates in these new cutsets is expected to be very low. The other currently unresolved Category B F&O is simply a documentation issue, with no impact on the PRA model.

Of the 41 Category B F&Os that have been incorporated into a revised model, the licensee states that the consequence analysis was re-performed with this model (0403A, October 2004). Also, all of the Category A F&Os, with exception of a new flooding analysis, have also been incorporated into this model. The only significant result of the re-performed consequence

analysis is that the consequence of a small break loss of coolant accident (SBLOCA) changed from high to medium. The licensee has opted to conservatively continue to treat all pipe segments whose rupture would result in an SBLOCA as high consequence segments.

The NRC staff concludes that all significant comments from the IPE review and from the industry review of the model used for this application have been adequately dispositioned. The NRC staff did not review this PRA model to assess the accuracy of the quantitative estimates. The NRC staff recognizes that the quantitative results of this PRA model are used as order of magnitude estimates to support the assignment of segments into three broad consequence categories. Inaccuracies in the models or in assumptions large enough to invalidate the broad categorizations developed to support the RI-ISI have been identified during the NRC staff's review of the IPE, and by the licensee's model update control program that included peer review/certification of the PRA model. Minor errors or inappropriate assumptions will affect only the consequence categorization of a few segments and will not invalidate the general results or conclusions.

3.2.3.2 Change in Risk

As required by Section 3.7 of EPRI TR-112657, the licensee evaluated the expected change in risk resulting from replacing the current ISI program with the RI-ISI program. The calculations estimated the change in risk due to removing locations and adding locations to the inspection program.

The expected change in risk was quantitatively evaluated using the "Simplified Risk Quantification Method" described in Section 3.7 of EPRI TR-112657. For high consequence category segments, the licensee used the conditional core damage probability (CCDP) and conditional large early release probability (CLERP) based on the highest estimated CCDP and CLERP. For medium consequence category segments, bounding estimates of CCDP and CLERP were used. The licensee estimated the change in risk using bounding pipe failure rates from the EPRI methodology.

The licensee performed its bounding analysis with and without taking credit for an increased probability of detection (POD). The NRC staff has not reviewed the acceptability of the increased POD values, and bases its review and acceptance of the proposed program on the without enhanced POD evaluations for changes in CDF and LERF. The licensee has estimated the system and plant level changes in CDF and LERF.

The plant level changes in risk estimates are provided in the following table:

Change in CDF		Change in LERF	
With Increased POD	Without Increased POD	With Increased POD	Without Increased POD
-3.19E-08/yr	-1.58E-08/yr	-3.19E-09/yr	-1.58E-09/yr

The NRC staff finds the licensee's process to evaluate and bound the potential change in risk reasonable based on the following: 1) the process accounts for the change in the number and

location of elements inspected, 2) recognizes the differences in degradation mechanisms related to failure likelihood, and 3) considers the synergistic effects of multiple degradation mechanisms within the same piping segment. System level and aggregate estimates of the changes in CDF and LERF are less than the corresponding guideline values in EPRI TR-112657. The NRC staff finds that re-distributing the welds to be inspected with consideration of the safety significance of the segments provides assurance that segments whose failure have a significant impact on plant risk receive an acceptable and often improved level of inspection. Therefore, the NRC staff concludes that the implementation of the RI-ISI program at KNPP will have a small and possibly a beneficial impact on risk consistent with RG1.174 guidelines.

3.2.4 Integrated Decisionmaking

The licensee used an integrated approach in defining the proposed RI-ISI program by considering in concert the traditional engineering analysis, the risk evaluation, the implementation of the RI-ISI program, and performance monitoring of piping degradation. This is consistent with the guidelines given in RG 1.178 and is, therefore, acceptable.

3.2.4.1 Risk Characterization

The licensee states that pipe segments (and ultimately the elements within, which are defined as all having the same degradation susceptibility) are ranked in accordance with definitions given in EPRI TR-112657. The licensee has excluded the impact of the FAC on the risk-ranking of pipe segments. The licensee states that FAC is a degradation mechanism that is managed by an independent augmented inspection program. This treatment is consistent with previous RI-ISI program submittals that have been approved. Based on this, the NRC staff finds the licensee’s risk-ranking of pipe segments to be acceptable.

3.2.4.2 Selection of Element Population for Inspection

The licensee states that the selection of elements to be examined was determined using the guidance provided in EPRI TR-112657, specifically taking note of Section 3.6.4.2 “ASME Code Case -578.”

For elements containing the FAC degradation mechanism, the licensee indicates in its August 4, 2005, submittal that no FAC examinations will be credited to satisfy RI-ISI selection requirements. Rather, inspection locations selected for RI-ISI purposes that are in the FAC Program will be subject to an independent examination to satisfy the RI-ISI Program requirements. The only in-scope pipe segment at KNPP susceptible to FAC is of medium consequence with no other degradation mechanism (i.e., Risk Category 6). The elements in this segment are not subject to any RI-ISI NDE requirements.

As noted previously, ASME Class 1 and 2 elements within the scope of the IEB 79-13, 79-17, and 88-08 augmented inspection programs have been subsumed into the RI-ISI program and are subject to selection for NDE similarly to all other elements in the RI-ISI scope.

The NRC staff concludes that the EPRI TR-112657 guidance of at least 25 percent of the locations in each high-risk category, and that at least 10 percent of the locations in each medium-risk category must be selected for NDE, has been met.

The licensee noted that the percentage of Class 1 piping welds selected strictly for RI-ISI purposes was 10 percent. This meets the guidelines from Section 3.6.4.2 of EPRI TR-112657, which states that if the percentage of Class 1 piping locations selected for examination falls substantially below 10 percent, then the basis for selection needs to be investigated. The licensee has met this expectation of EPRI TR-112657, and no investigation is required.

The NRC staff concludes that the element selection results are consistent with the described process, and with EPRI TR-112657 guidelines. The licensee's selection of element locations, which includes consideration of degradation mechanisms in addition to those covered by augmented inspection programs, is acceptable.

3.2.4.3 Examination Methods

The objective of ISI is to identify conditions (i.e., flaw indications) that are precursors to leaks and ruptures in the pressure boundary that may impact plant safety. To meet this objective, the risk-informed location selection process, per EPRI TR-112657, employs an "inspection for cause" approach. To address this approach, Section 4 of EPRI TR-112657 provides guidelines for the areas and/or volumes to be inspected, as well as the examination method, acceptance standard, and evaluation standard for each degradation mechanism. The NRC staff concludes that these examination methods are appropriate since they are selected based on specific degradation mechanisms, pipe sizes, and materials of concern. The licensee states that Section 4 of EPRI TR-112657 was used as guidance in determining the examination methods and requirements for these locations.

Based on these considerations, the NRC staff concludes that the licensee's determination of examination methods is acceptable.

3.2.4.4 Relief Requests for Examination Locations and Methods

As required by Section 6.4 of EPRI TR-112657, the licensee has completed an evaluation of existing relief requests to determine if any should be withdrawn or modified due to changes that occur from implementing the RI-ISI program. The licensee concluded that none of its existing relief requests should be withdrawn as a result of the RI-ISI application.

The licensee states that any examination location where greater than 90 percent volumetric coverage cannot be obtained, the process outlined in EPRI TR-112657 will be followed. The NRC staff finds that the licensee's proposed treatment of existing relief requests to be acceptable.

3.2.5 Implementation and Monitoring

Implementation and performance monitoring strategies require careful consideration by the licensee and are addressed in Element 3 of RG 1.178 and the SRP 3.9.8. The objective of Element 3 is to assess performance of the affected piping systems under the proposed RI-ISI program by utilizing monitoring strategies that confirm the assumptions and analyses used in the development of the RI-ISI program. Pursuant to 10 CFR 50.55a(a)(3)(i), a proposed

alternative-in this case the implementation of the RI-ISI program, including inspection scope, examination methods, and methods of evaluation of examination results - must provide an acceptable level of quality and safety.

The licensee states in the submittal that upon approval of the RI-ISI program, procedures that comply with EPRI TR-112657 guidelines will be prepared to implement and monitor the RI-ISI program. The licensee also states that the applicable aspects of the ASME Code not affected by the proposed RI-ISI program would be retained.

The licensee states that the RI-ISI program is a living program and its implementation will require feedback of new relevant information to ensure the appropriate identification of safety significant piping locations. The licensee also states that, as a minimum, risk ranking of piping segments will be reviewed and adjusted on an ASME period basis and that significant changes may require more frequent adjustment as directed by NRC Bulletin or Generic Letter requirements, or by industry and plant-specific feedback. The proposed periodic reporting requirements meet existing ASME Code requirements and applicable regulations, and therefore, are considered acceptable.

The licensee states that additional examinations would be performed when examinations reveal flaws or relevant conditions exceeding the applicable acceptance standards. These additional examinations shall include piping structural elements with the same postulated failure mode and the same or higher failure potential. Additional examinations will be performed on these elements up to a number equivalent to the number of elements initially required to be inspected. If the additional required examinations reveal flaws or relevant conditions exceeding the acceptance standards, the examinations shall be further extended to include all elements subject to the same failure mechanism, throughout the scope of the program, during the outage.

The NRC staff finds the licensee's approach acceptable since the additional examinations, if required, will be performed during the outage during which the indications or relevant conditions are identified.

KNPP has completed the third 10-year ISI inspection interval, and will begin the RI-ISI program at the beginning of the first period of the fourth interval. The licensee states that 100 percent of the required RI-ISI program inspections will be completed in the fourth interval, and that examinations will be performed during the interval such that the period examination percentage requirements of ASME Code, Section XI, paragraphs IWB-2412 and IWC-2412 are met.

The NRC staff finds this acceptable because it is consistent with the guidance provided in the NRC staff's SE, dated October 28, 1999, related to EPRI RI-ISI evaluation procedure (EPRI TR-112657, Revision B-A, December 1999).

The NRC staff finds that the proposed process for RI-ISI program implementation, monitoring, feedback, and update meets the guidelines of RG 1.174 which states that risk-informed applications should include performance monitoring and feedback provisions. The NRC staff finds the licensee's proposed process for program implementation, monitoring, feedback, and update is acceptable.

4.0 CONCLUSIONS

Pursuant to 10 CFR 50.55a(a)(3)(i), alternatives to the requirements of 10 CFR 50.55a(g) may be used, when authorized by the NRC, if the licensee demonstrates that the proposed alternative will provide an acceptable level of quality and safety. In this case, the licensee has proposed an alternative to use the risk-informed process described in NRC-approved EPRI TR-112657.

RG 1.174 establishes requirements for risk-informed decisions involving a change to a plant's licensing basis. RG 1.178 establishes requirements for risk-informed decisions involving alternatives to the requirements of 10 CFR 50.55a(g) (ISI program requirements), and its directive to follow the requirements of the ASME Code, Section XI. These two RGs, taken together, define the elements of an integrated decisionmaking process that assesses the level of quality and safety embodied in a proposed change to the ISI program. EPRI TR-112567 RI-ISI methodology contains the necessary details for implementing this process.

This methodology provides for a systematic identification of safety-significant pipe segments, for a determination of where inspections should occur within these segments (i.e., identification of locations), and for a determination how these locations will be inspected.

Such segments/locations are characterized as having active degradation mechanisms, and/or whose failure would be expected to result in a significant challenge to safety (either immediately by initiating an event or later on in response to an unrelated event).

The EPRI TR-112657 methodology also provides for implementation and performance monitoring strategies, to ensure a proper transition from the current ISI program, and to assure that changes in plant performance, and new information from the industry and/or from the NRC, is incorporated into the licensee's ISI program as needed.

Other aspects of the licensee's ISI program, such as system pressure tests and visual examination of piping structural elements will continue to be performed on all Class 1, 2, and 3 systems in accordance with ASME Code, Section XI. This provides a measure of continued monitoring of areas that are being eliminated from the NDE portion of the ISI program.
As required by the EPRI TR-112657 methodology, the existing ASME Code performance measurement strategies will remain in place. In addition, the EPRI TR-112657 methodology provides for increased inspection volumes for those locations that are included in the NDE portion of the program.

The licensee proposed one deviation from this methodology, in that it will assess susceptibility of piping segments and elements at KNPP to TASCS in accordance with the Materials Reliability Project (MRP) methodology in EPRI TR-1000701, "Interim Thermal Fatigue Management Guideline (MRP-24)," January 2001. The NRC staff finds that the considerations in this guideline are appropriate for determining the potential for TASCS. The NRC staff also finds the licensee's commitment to incorporate final MRP guidance (with any NRC limitations on its use) into its RI-ISI application, or to otherwise seek relief in accordance with 10 CFR 50.55a(g)(5)(iii), acceptable.

The NRC staff concludes that the licensee's proposed program which is consistent with the methodology as described in EPRI TR-112657, will provide an acceptable level of quality and safety pursuant to 10 CFR 50.55a(a)(3)(i) for the proposed alternative to the piping ISI requirements with regard to (1) the number of locations, (2) the locations of inspections, and (3) the methods of inspection.

The NRC staff concludes that the licensee's proposed RI-ISI program is an acceptable alternative to the current ISI program for Class 1 and Class 2 piping welds at KNPP. Therefore, the proposed RI-ISI program is authorized for the fourth 10-year ISI interval pursuant to 10 CFR 50.55a(a)(3)(i) on the basis that this alternative will provide an acceptable level of quality and safety.

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Date: September 23, 2005