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Dominion

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United States Nuclear Regulatory Commission
Attention: Document Control Desk
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DOMINION ENERGY KEWAUNEE, INC.
KEWAUNEE POWER STATION
RESPONSE TO REQUEST FOR SUPPLEMENTAL INFORMATION REGARDING THE WORK CONTROL PROCESS AGING MANAGEMENT PROGRAM

By letter dated March 23, 2009 (Reference 1), and through recent discussions related to review of the Kewaunee Work Control Process aging management program, the NRC requested additional information regarding the license renewal application (LRA) for Kewaunee Power Station. The attachments to this letter contain the requested supplemental information related to the Kewaunee Work Control Process aging management program.

Attachment 1 provides additional descriptive information related to the Work Control Process program and addresses the methods of aging management, inspection opportunities, and selection of the Work Control Process program as the optimal aging management program. Attachment 2 provides the results of the study performed to determine the number of inspection opportunities afforded by the Work Control Process program based on a historical review of maintenance activities. Attachment 3 provides responses to the requests for additional information provided in the March 23, 2009 NRC letter.

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

GINGER L. ALLIGOOD
Notary Public
Commonwealth of Virginia
316847
My Commission Expires Apr 30, 2013

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Leslie N. Hartz, who is Vice President – Nuclear 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 13th day of April, 2009.

My Commission Expires: 4/30/13

Notary Public

Reference:

1. Letter from David L. Pelton (NRC) to David A. Christian (DEK), "Request to Supplement the Kewaunee Power Station License Renewal Application in Regards to the Use of the Work Control Process as an Aging Management Program (TAC No. MD9408)," dated March 23, 2009. [ADAMS Accession No. ML090530003]

Attachments:

1. Supplemental Description of the Work Control Process Aging Management Program
2. Work Control Process Inspection Opportunities Study
3. Work Control Process Program – Program Elements Supplemental Information

Commitments made in this letter:

None.

cc:

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ATTACHMENT 1

SUPPLEMENTAL DESCRIPTION OF THE KEWAUNEE WORK CONTROL PROCESS AGING MANAGEMENT PROGRAM

KEWAUNEE POWER STATION
DOMINION ENERGY KEWAUNEE, INC.

SUPPLEMENTAL DESCRIPTION OF THE KEWAUNEE WORK CONTROL PROCESS AGING MANAGEMENT PROGRAM

Introduction

The Kewaunee Work Control Process program is a plant-specific aging management program (AMP) and is described in the Kewaunee License Renewal Application (LRA) in Appendix B, Section B2.1.32. The program description addresses the ten program elements included in NUREG-1800, 'Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants,' Appendix A, Section A.1.2.3, "Aging Management Program Elements." Additional details of the Work Control Process program are provided herein to aid in the NRC review of the applicability and effectiveness of the program for managing the effects of aging.

The Work Control Process program provides opportunities for aging management inspections of structures and components (SCs) on a routine and as-needed basis over the lifetime of the plant. The program manages the effects of aging for various in-scope SCs through visual inspections completed during the performance of preventive and corrective maintenance, surveillance testing, condition monitoring activities, and other routinely scheduled tasks. Inspections and testing performed through the Work Control Process program are controlled in accordance with approved plant procedures as part of the Kewaunee work management process.

The Work Control Process program is a common, fleet-wide program implemented at all of the Dominion nuclear stations. This program was also credited for management of aging effects in the Surry, North Anna, and Millstone Units 2 and 3 License Renewal Applications and was determined to be an effective program in the NRC Safety Evaluation Reports that were issued in support of the renewed operating licenses for these stations (NUREG-1766, Safety Evaluation Report Related to the License Renewal of North Anna Power Station, Units 1 and 2, and Surry Power Station, Units 1 and 2 {ML030160853} and NUREG-1838, Final Safety Evaluation Report Related to the License Renewal of the Millstone Power Station, Units 2 and 3 {ML053270483 and ML053290180}).

The Work Control Process program is credited in the Kewaunee LRA aging management review results tables (LRA Section 3) for confirmation of the effectiveness of plant system fluid chemistry control programs and for management of aging effects as a stand-alone aging management program or in combination with other Kewaunee aging management programs. The number of line items from LRA Section 3 aging management review results tables (Table 2's) that credit the Work Control Process program are tallied in the following table according to whether the program is credited as a chemistry program effectiveness confirmation or as an aging management program, sorted by LRA section, for each managed aging effect.

LRA Table 2 Line Items Crediting Work Control Process Program

Aging Effect	LRA Section						Total
	3.1	3.2	3.3	3.4	3.5	3.6	
Work Control Process Program Credited for Chemistry Control Program Effectiveness Confirmation							
Change in Material Properties	0	0	0	0	0	0	0
Cracking	2	14	69	62	0	0	147
Hardening and Loss of Strength	0	0	0	0	0	0	0
Loss of Material	18	61	280	221	0	0	580
Loss of Sealing	0	0	0	0	0	0	0
Loss of Strength	0	0	0	0	0	0	0
Reduction of Heat Transfer	0	5	7	4	0	0	16
Total	20	80	356	287	0	0	743
Work Control Process Program Credited as Aging Management Program							
Change in Material Properties	0	0	2	0	0	0	2
Cracking	0	0	4	0	0	0	4
Hardening and Loss of Strength	0	0	12	0	0	0	12
Loss of Material	0	4	357	80	0	0	441
Loss of Sealing	0	0	0	0	3	0	3
Loss of Strength	0	0	1	0	0	0	1
Reduction of Heat Transfer	0	0	15	0	0	0	15
Total	0	4	391	80	3	0	478
Total LRA Line Items Crediting Work Control Process Program =							**1221**

Supplemental information related to the Work Control Process program methods of aging management, historical Work Control Process program inspection opportunities, and some additional information related to the selection of the Work Control Process program to augment or in lieu of the generic aging management programs determined to be acceptable by NUREG-1801 is provided below.

Methods of Aging Management

The Work Control Process program manages the effects of aging through inspection opportunities afforded by the performance of maintenance and surveillance activities. Visual inspections are performed for various structures and components during the normal operation of the plant. Adjacent components (e.g., piping) are frequently made accessible by in-progress maintenance activities and these opportunities are used to further identify the presence of aging.

In accordance with the Work Control Process program, inspections are performed by trained and qualified plant personnel and inspection results are documented in accordance with procedural requirements. Work Control Process program inspection activities will monitor SCs for abnormal surface conditions; loss of material; presence of corrosion products; excessive deposits on surfaces due to silting and macrofouling; cracking/crazing, discoloration, swelling, reduced resilience of elastomers; and signs of cracking in steel materials. The results of the inspection activities are documented in

the work package and reviewed for identification of adverse aging effects or trends. Adverse conditions are documented in the Corrective Action Program and evaluated to determine necessary corrective measures, including initiation of repairs, performance of extent of condition reviews, and implementation of revisions to plant programs and practices to prevent recurrence of the condition. The evaluation of the adverse condition, and the extent of condition reviews, may require more detailed inspections, including the use of NDE techniques, and the inspection of additional components that may be susceptible to similar aging effects. The Corrective Action Program is described in LRA Appendix B, Section B1.3.

Chemistry Control Program Effectiveness Confirmation

The Work Control Process program is credited in the LRA for the confirmation of the effectiveness of plant chemistry control programs in mitigating corrosion-related aging effects. Chemistry control programs are in place to provide an optimal environment for plant equipment operation and the prevention of equipment degradation due to the effects of corrosion. Chemistry control programs are based on industry guidance and best practices, and are evaluated for improvement considering industry and plant-specific operational experience. (Further description of the applicable chemistry control programs is provided in LRA Appendix B as indicated in the list below.)

Based on plant operating experience over the significant operating history of the nuclear industry, chemistry control measures have been effective in minimizing significant degradation of plant equipment due to corrosion such that component functions are maintained. Issues involving the localized effects of water chemistry-related corrosion, such as steam generator tube degradation, have been resolved through chemistry control program improvements and plant design modifications. Overall, chemistry control measures are expected to continue to provide an effective means of preventing significant corrosion-related aging effects that could affect the ability of plant components to perform their intended functions. Although not anticipated based on plant operating history, the possibility of off-normal chemistry conditions in stagnant or low-flow areas could create the potential for unexpected aging of components. Therefore, the effectiveness of chemistry control programs is confirmed by visual inspections of a sampling of SCs through the Work Control Process program. These inspections occur during the normal course of ongoing maintenance and surveillance activities at Kewaunee. As described above, adverse conditions identified during the Work Control Process program inspections are documented in the Corrective Action Program and actions are taken to resolve the condition, including trending of abnormal conditions and implementation of chemistry control program enhancements, as necessary.

As identified in the LRA, the Work Control Process program will provide confirmation of the effectiveness of the following chemistry control programs during the period of extended operation:

- Primary Water Chemistry (LRA Appendix B, Section B2.1.24)
- Secondary Water Chemistry (LRA Appendix B, Section B2.1.28)

- Fuel Oil Chemistry (LRA Appendix B, Section B2.1.14)
- Lubricating Oil Analysis (LRA Appendix B, Section B2.1.17)
- Closed-Cycle Cooling Water System (LRA Appendix B, Section B2.1.8)

In certain instances, NUREG-1801 specifies that chemistry control programs are to be augmented to provide a verification of the effectiveness of chemistry control in preventing or minimizing aging effects. NUREG-1801 recommends using a plant-specific program or a program similar to the One-Time Inspection AMP described in NUREG-1801, Section XI.M32, for the verification. As discussed above, the plant-specific Work Control Process program provides the opportunity for verification of the effectiveness of chemistry control through visual inspections during maintenance and surveillance activities. The use of the Work Control Process program in this manner is consistent with NUREG-1801, Section XI.M32, One-Time Inspection, which states that an alternative acceptable program may include routine maintenance or a review of repair or inspection records to confirm that these components have been inspected for aging degradation and significant aging degradation has not occurred. The review of plant maintenance history is discussed later in this submittal.

The Work Control Process program provides a continuing validation of the effectiveness of the plant chemistry control programs through maintenance activities that occur considerably more frequently than the one-time inspections identified in NUREG-1801, "Generic Aging Lessons Learned (GALL) Report."

Management of the Effects of Aging Using the Work Control Process Program

The Work Control Process program is also credited in the LRA for the management of aging effects for selected SCs. The use of the Work Control Process program as an aging management program is based on the SC material and environment. The process applied for determining applicability of the Work Control Process program included consideration of the specific aging effects determined to be significant by the aging management review and the opportunity for inspection of the component, or components similar in material and environment, afforded by the Work Control Process program. A review was also performed to determine whether a component or aging effect-specific aging management program would be applicable, or required, to effectively manage the identified aging effect(s). For SCs for which the Work Control Process program was determined to be the optimal aging management program, the Kewaunee maintenance and surveillance activity history was reviewed to ensure that adequate opportunities for inspection of a sampling of similar components with the same material, environment, and aging effects were identified.

The aging management review results tables in LRA Section 3 credit the Work Control Process program for managing aging effects as summarized below.

The majority of applications of the Work Control Process program in the LRA as an aging management program involve management of the loss of material aging effect. Aging-related loss of material can be caused by processes such as general corrosion,

crevice corrosion, pitting, and erosion. The loss of material that is significant to performance of intended functions would be identifiable during visual inspections as irregular surface conditions or loss of wall thickness.

Change in material properties, hardening, and cracking of elastomeric materials are also managed by the Work Control Process program. Maintenance activities performed in accordance with the Work Control Process program provide opportunities to visually inspect the internal surfaces of these components. Aging effects are visually observable for these elastomeric components by such conditions as evidence of cracking and crazing, discoloration, distortion, evidence of swelling, tackiness, evaluation of resiliency and indentation recovery.

For selected heat exchangers, the Work Control Process program manages reduction of heat transfer due to fouling of heat transfer surfaces that could affect their ability to perform the intended function. Fouling due to marine growth or silt affecting heat transfer surfaces is readily observable during visual inspections.

Cracking of a limited number of stainless steel components is managed by the Work Control Process program where chemistry control measures are not applicable or not effective in preventing the aging effect. Adverse conditions identified through visual inspections performed by the Work Control Process program will be entered into the corrective action program. The corrective action program will require an engineering evaluation to determine the cause and the extent of condition. The cause evaluation may require additional inspections, including the use of NDE techniques, which are effective for detecting cracking.

Loss of sealing due to deterioration of reactor cavity seal ring and spent fuel pool gate elastomeric seals, and of electrical junction and terminal box gaskets, is managed by the Work Control Process program. Current visual inspections performed during maintenance and surveillance activities can effectively identify degradation of these components that could affect the component function.

The loss of strength of Station and Instrument Air System filter regulator paper elements is managed through maintenance of compressed air system components by the Work Control Process program. Visible degradation of the paper element is recognizable during maintenance activities prior to affecting the paper element filtration intended function.

Inspection Opportunities

The Work Control Process program performs visual inspections on a representative sample of various component types and structural commodities during scheduled maintenance and surveillance activities. The inspections are implemented in accordance with the Kewaunee work management process, which includes surveillance testing, preventive and corrective maintenance, conditioning monitoring activities, and other routinely scheduled tasks.

Opportunities to visually inspect the internal surfaces of components constructed of typical system materials and exposed to typical system environments, including stagnant locations, are provided on an ongoing basis due to the comprehensive scope of the work management process. In order to verify that the inspection opportunities provide a representative sample, a review of more than ten years of historical maintenance and surveillance activity records was performed.

The maintenance history review identified the number of inspection opportunities for each of the in-scope systems and structures, for each of the material and environment combinations, and for each of the component types for which the Work Control Process program is credited in the LRA. For component material and environment combinations for which sufficient opportunity for inspection could not be identified from the historical review, specific visual inspections will be added to the scope of the Work Control Process program. The detailed methodology and results of this review are provided in Attachment 2, Work Control Process Program Inspection Opportunities Study, to this letter.

The results of the inspection opportunities review indicated that only a limited number of component material and environment combinations were not sufficiently represented in the maintenance and surveillance history. Additionally, the review determined that three component types were subject to component-specific aging effects, but were not sufficiently represented in the maintenance and surveillance history. LRA Appendix B, Section B2.1.32, Enhancement 2, provides the commitment to include supplemental Work Control Process program visual inspections in the scope of the program in order to effectively manage the applicable aging effects in the event that sufficient inspection opportunities are not presented prior to the period of extended operation.

Specifically, the following items will be included in the enhanced program:

- Material/Environment Combination: Elastomeric material in raw water environment
- Component Types: Accumulators, Flame Arrestors, Hoses

With the implementation of the Work Control Process program enhancement described above, the number of inspection opportunities expected to be available through the performance of surveillance and maintenance activities, based on the historical review, provide for the frequent and comprehensive assessment of plant component aging. The Work Control Process program provides significantly more opportunity to assess aging effects than a one-time inspection approach, and will continue to provide inspections through the period of extended operation.

The review of inspection opportunities provided by the Work Control Process program, including the supplemental inspections enhancement, concludes that adequate inspection opportunities are available to inspect and manage component aging in order to provide reasonable assurance that intended functions will be maintained for the period of extended operation.

Additional Information Related to the Application of the Work Control Process Program In Lieu of NUREG-1801 Recommended Aging Management Programs

The aging management review results in the LRA credit the Work Control Process program for management of aging effects for certain SCs that are identified in NUREG-1801 as being managed by one of the following seven NUREG-1801 AMPs:

- XI.M2, Water Chemistry
- XI.M20, Open-Cycle Cooling Water System
- XI.M21, Closed-Cycle Cooling Water System
- XI.M24, Compressed Air Monitoring
- XI.M27, Fire Water System
- XI.M38, Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components
- XI.S6, Structures Monitoring Program

As described below, each of these applications of the Work Control Process program has been reviewed in order to provide the rationale for the determination that the Work Control Process program is the optimal aging management program in these instances.

XI.M2, Water Chemistry

NUREG-1801, XI.M2, "Water Chemistry," states in Scope of Program that the "program includes periodic monitoring and control of known detrimental contaminants such as chlorides, fluorides (PWRs only), dissolved oxygen, and sulfate concentrations below the levels known to result in loss of material or cracking." The Primary Water Chemistry program described in LRA Appendix B, Section B2.1.24, is consistent with the NUREG-1801, XI.M2 AMP and manages the effects of aging for components that are exposed to a primary treated water environment.

For the component type "Pumps" in the Chemical Volume and Control System listed in LRA Table 3.3.2-9, cracking is not managed by the Primary Water Chemistry program since the operating environment for these components is below the threshold temperature for susceptibility to stress corrosion cracking of 140°F. Cracking due to cyclic loading is an applicable aging effect for these pumps. However, this aging effect is not mitigated by control of water chemistry. Therefore, an alternate aging management program was required to be identified to manage cracking for these components. The aging management review determined that the plant-specific Work Control Process program was an effective program for managing the aging effects of cracking for these components. An industry standard footnote "E" was applied to indicate the aging management program difference from NUREG-1801.

XI.M20, Open-Cycle Cooling Water System

NUREG-1801, XI.M20, "Open-Cycle Cooling Water System," states, in part, in reference to the scope of the program that "... the OCCW system is defined as a

system or systems that transfer heat from safety-related systems, structures, and components (SSC) to the ultimate heat sink (UHS)." The intent of the AMP is to ensure that the guidelines of NRC Generic Letter (GL) 89-13 are satisfied. The Open-Cycle Cooling Water System program described in LRA Appendix B, Section B2.1.23, which is consistent with the NUREG-1801, XI.M20 AMP (with exceptions), manages the effects of aging for components included within the scope of the GL 89-13 requirements.

The Kewaunee open-cycle cooling water systems also contain components outside the scope of GL 89-13, but with similar materials, operating environment (open cycle cooling water), and aging effects. Because of this similarity, the aging management review results for these components were compared to NUREG-1801, Section VII.C1, Open-Cycle Cooling Water System. However, the Open-Cycle Cooling Water System program was not credited for managing the aging effects for these components since this program is only applicable to SSCs within the scope of GL 89-13. Therefore, an alternate aging management program was required to be identified to manage the effects of aging for these components. The aging management review determined that the plant-specific Work Control Process program was an effective program for managing the aging effects of loss of material and reduction of heat transfer for OCCW system components outside the scope of the Open-Cycle Cooling Water System program. An industry standard footnote "E" was applied to indicate the aging management program difference from NUREG-1801.

XI.M21, Closed-Cycle Cooling Water System

NUREG-1801, XI.M21, "Closed-Cycle Cooling Water System," defines a closed-cycle cooling water (CCCW) system as a system "... that is not subject to significant sources of contamination, in which water chemistry is controlled and in which heat is not directly rejected to a heat sink." The Closed-Cycle Cooling Water System program described in LRA Appendix B, Section B2.1.8, which is consistent with the NUREG-1801, XI.M21 AMP (with exceptions), manages the effects of aging for components that are in CCCW systems meeting the NUREG-1801 definition.

Two systems (the Diesel Generator System and the Gaseous Waste Processing and Discharge System) include closed-cycle cooling water loops, but do not meet the NUREG-1801 definition of a CCCW system. One additional system (the Secondary Sampling System) includes a closed cooling water loop, but is non-safety related and only included in scope due to the spatial orientation of some of its components near safety-related components. These systems contain components with similar materials, operating environment, and aging effects as components in the CCCW systems. Because of this similarity, the aging management review results for these components were compared to NUREG-1801, Section VII.C2, Closed-Cycle Cooling Water System. However, the Closed-Cycle Cooling Water System program was not credited for managing the aging effects for these components since this program is only applicable to systems that meet the NUREG-1801 definition of a CCCW system. Therefore, an alternate aging management program was required to be identified to manage the effects of aging for these components. The aging management review determined that the plant-specific Work Control Process program was an effective program for

managing the aging effect of loss of material and reduction of heat transfer for these components. An industry standard footnote "E" was applied to indicate the aging management program difference from NUREG-1801.

XI.M24, Compressed Air Monitoring

NUREG-1801, XI.M24, "Compressed Air Monitoring," states in Scope of Program that the "program manages the effects of corrosion and the presence of unacceptable levels of contaminants on the intended function of the compressed air system. The AMP includes frequent leak testing of valves, piping, and other system components, especially those made of carbon steel and stainless steel, and a preventive maintenance program to check air quality at several locations in the system." The Compressed Air Monitoring program described in LRA Appendix B, Section B2.1.9, which is consistent with the NUREG-1801, XI.M24 AMP (with exception), manages the effects of aging for components that are in the compressed air systems.

There are additional non-compressed air systems at Kewaunee that contain components with similar materials, operating environment (moist air, which is the Kewaunee LRA equivalent of the NUREG-1801 condensation (internal) environment), and aging effects as compressed air systems components, but with no comparable system results included in NUREG-1801. Therefore, the aging management review results for these components were compared to NUREG-1801, Section VII.D, Compressed Air System. However, the Compressed Air Monitoring program was not credited for managing the aging effects for these components since this program scope is limited to the compressed air systems. Therefore, an alternate aging management program was required to be identified to manage the effects of aging for these components. The aging management review determined that the plant-specific Work Control Process program was an effective program for managing the aging effects of loss of material for these components. An industry standard footnote "E" was applied to indicate the aging management program difference from NUREG-1801.

XI.M27, Fire Water System

NUREG-1801, XI.M27, "Fire Water System,' states that the AMP "applies to water-based fire protection systems that consist of sprinklers, nozzles, fittings, valves, hydrants, hose stations, standpipes, water storage tanks, and aboveground and underground piping and components...". The Fire Protection program described in LRA Appendix B, Section B2.1.1, which is consistent with the NUREG-1801, XI.M27 AMP (with exceptions), manages the effects of aging for components that are in the water-based Fire Protection System.

There are additional non-fire protection systems at Kewaunee that contain components with similar materials, operating environment (raw water), and aging effects as the water-based fire protection components, but with no comparable system results included in NUREG-1801. Therefore, the aging management review results for these components were compared to NUREG-1801, Section VII.G, Fire Protection. However, the Fire Protection program was not credited for managing the aging effects for these

components since these components are not within the scope of the Fire Protection program. Therefore, an alternate aging management program was required to be identified to manage the effects of aging for these components. The aging management review determined that the plant-specific Work Control Process program was an effective program for managing the aging effects of loss of material for these components. An industry standard footnote "E" was applied to indicate the aging management program difference from NUREG-1801.

XI.M38, Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components

NUREG-1801, XI.M38, "Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components," provides the following description of the program:

The program consists of inspections of the internal surfaces of steel piping, piping components, ducting, and other components that are not covered by other aging management programs. These internal inspections are performed during the periodic system and component surveillances or during the performance of maintenance activities when the surfaces are made accessible for visual inspection. The program includes visual inspections to assure that existing environmental conditions are not causing material degradation that could result in a loss of component intended functions. If visual inspection of internal surfaces is not possible, then the applicant needs to provide a plant-specific program.

The Work Control Process program is a plant-specific program and is described in LRA Appendix B, Section B2.1.32. Although the Work Control Process program is not specifically compared to the XI.M38 AMP in the LRA, the programs are based on the same premise of visual inspections performed during the opportunities made available during routine maintenance and surveillance activities. In order to demonstrate similarities between the Work Control Process program and the XI.M38 AMP, the following program element comparison is provided for the NUREG-1800, Appendix A.1.2.3, Elements 1 through 6.

Element 1 – Scope of Program

NUREG-1801, XI.M38 states:

The program visual inspections include internal surfaces of steel piping, piping elements, ducting, and components in an internal environment (such as indoor uncontrolled air, condensation, and steam) that are not included in other aging management programs for loss of material. Inspections are performed when the internal surfaces are accessible during the performance of periodic surveillances, during maintenance activities or during scheduled outages. This program includes indication of borated water leakage on internal surfaces.

From LRA Appendix B2.1.32:

The Work Control Process program performs visual inspections of a representative sample of various component types and structural elements fabricated of aluminum, copper alloys, elastomers, nickel alloys, non-metallics, stainless steel, and steel, as applicable, during maintenance or surveillance activities. The program inspections are performed on components such as accumulators, air handling units, housings, chillers, compressors, coolers, heat exchangers, expansion joints, filters, flexible connections, regulators, pipe, strainers, tanks, traps, pumps, tubing, and valves. Additionally, the program inspects the fuel transfer equipment, electrical box gaskets, the Spent Fuel Pool gate seals, and the reactor cavity seal ring elastomeric seal.

The Work Control Process program inspections are implemented in accordance with the work management process. The work management process includes all surveillance procedures, preventive and corrective maintenance procedures, or other routinely scheduled tasks.

Although the scope of the Work Control Process program is broader than the XI.M38 AMP in terms of component materials of fabrication, the program includes inspections of internal surfaces of steel components and encompasses the scope of the XI.M38 AMP.

Element 2 – Preventive Actions

NUREG-1801, XI.M38 states:

This program is an inspection activity independent of methods to mitigate or prevent degradation.

From LRA Appendix B2.1.32:

The Work Control Process program verifies the effectiveness of the Fuel Oil Chemistry, Lubricating Oil Analysis, Primary Water Chemistry, and Secondary Water Chemistry programs. The program inspections also verify the effectiveness of the Closed-Cycle Cooling Water System program, in conjunction with the inspections performed by the Closed-Cycle Cooling Water System program.

Consistent with the XI.M38 AMP, the Work Control Process program does not include specific preventive actions for mitigation of aging effects.

Element 3 – Parameters Monitored/Inspected

NUREG-1801, XI.M38 states:

Visual inspections of internal surfaces of plant components are performed during maintenance or surveillance activities. Parameters monitored or inspected include visible evidence of corrosion to indicate possible loss of materials.

From LRA Appendix B2.1.32:

The aging effects monitored by the Work Control Process are consistent with the materials of fabrication as listed below:

- *Aluminum - Loss of material and reduction of heat transfer*
- *Copper Alloys - Cracking, loss of material, and reduction of heat transfer*
- *Elastomers - Change in material properties, cracking, hardening and loss of strength, loss of material, and loss of sealing*
- *Nickel Alloys - Loss of material*
- *Non-Metallic - Loss of strength·*
- *Stainless steel - Cracking, loss of material, and reduction of heat transfer·*
- *Steel - Loss of material and reduction of heat transfer*

As discussed previously in this attachment, the Work Control Process program manages aging effects through visual inspections of internal surfaces during maintenance and surveillance activities. Although the scope of materials of fabrication is broader than the XI.M38 AMP, the parameters monitored/inspected are encompassed by the Work Control Process program.

Element 4 – Detection of Aging Effects

NUREG-1801, XI.M38 states:

Periodic inspections provide for detection of aging effects prior to the loss of component function. For painted or coated surfaces, degradation of steel surfaces cannot occur without the degradation of the paint or coating. Confirmation of the integrity of the paint or coating is an effective method for managing the effects of corrosion on the steel surface. The applicant should identify and justify the inspection technique used for detecting the aging effects of concern. Locations should be chosen to include conditions likely to exhibit these aging effects. Inspection intervals are established such that they provide timely detection of degradation.

From LRA Appendix B2.1.32:

The Work Control Process program performs visual inspections on a representative sample of various component types and structural elements during scheduled maintenance or surveillance activities. The inspections are implemented in accordance with the work management process, which includes all surveillance procedures, preventive and corrective maintenance procedures, or other routinely scheduled tasks.

Due to the comprehensive scope of the work management process, the process provides the opportunity to visually inspect the internal surfaces of components constructed of typical system materials and exposed to typical system environments,

including stagnant locations, during preventive and corrective maintenance activities on an ongoing basis.

To verify that the inspection opportunities provide a representative sample of the material and environment combinations found in the plant, a review of the inspection opportunities afforded by the Work Control Process program for the systems in the scope of license renewal has been performed. The review identified the number of inspection opportunities for the systems, material/environment combinations, and component types in the scope of the program. The results of the review documented that the Work Control Process program provides the opportunity to inspect a representative sample of the systems, material/environment combinations, and component types.

Personnel performing maintenance activities on a component inspect the internal surfaces of the component and adjacent components and piping to identify component and commodity aging. The maintenance procedures require that these "As Found" conditions be documented. The "As Found" descriptions detail the inspection extent and results even when no signs of aging degradation are found in order to allow meaningful trending of aging effects.

The Work Control Process program provides the opportunity for visual inspections that, as discussed previously in this attachment, are broadly applied and of sufficient frequency to be effective for managing aging effects. Coatings are not credited for preventing aging effects; however, if coatings degradation is identified during Work Control Process program visual inspections, the condition would be documented in the Corrective Action Program.

Element 5 – Monitoring and Trending

NUREG-1801, XI.M38 states:

Visual inspection activities are performed and associated personnel are qualified in accordance with site controlled procedures and processes. Maintenance and surveillance activities provide for monitoring and trending of aging degradation. Inspection intervals are dependent on component material and environment, and take into consideration industry and plant-specific operating experience. Results of the periodic inspections are monitored for indications of various corrosion mechanisms and fouling. The extent and schedule of inspections and testing assure detection of component degradation prior to loss of intended functions.

From LRA Appendix B2.1.32:

The frequencies of maintenance activities vary based on the preventive maintenance determinations made in accordance with the implementing procedures. These procedures establish the requirements and guidelines for development, implementation, and maintenance of the preventive maintenance program to ensure plant equipment is

maintained at a quality level to perform its intended function and provide guidance for performing reviews and evaluations of the preventive maintenance activities.

The "As Found" descriptions detail the inspection extent and results even when no signs of aging degradation are found in order to allow meaningful trending of aging effects.

If the Work Control Process program inspections identify degradation of the components, a Corrective Action Program condition report will be initiated to determine the cause of the degradation, including aging, and to identify the appropriate corrective actions. Additional monitoring of the system, structure, or component during the Period of Extended Operation is a possible corrective action and would be performed by the Work Control Process program. This additional condition monitoring would be implemented with the work management process.

The Systems Engineers monitor the performance of their systems including reviewing the Corrective Action Program items, maintaining overall cognizance of long term effects on their systems, monitoring the effects of continued use of aging equipment for system performance degradation, monitoring the availability of parts on aging and obsolete plant equipment and changes in technology.

The Work Control Process program provides monitoring and trending of signs of aging effects consistent with the monitoring and trending recommendations of the XI.M38 AMP. In addition, as discussed previously in this attachment, visual inspections are performed by trained and qualified personnel.

Element 6 – Acceptance Criteria

NUREG-1801, XI.M38 states:

Indications of various corrosion mechanisms or fouling that would impact component intended function are reported and will require further evaluation. The acceptance criteria are established in the maintenance and surveillance procedures or other established plant procedures. If the results are not acceptable, the Corrective Action Program is implemented to assess the material condition and determine whether the component intended function is affected.

From LRA Appendix B2.1.32:

The Work Control Process program inspections are implemented in accordance with the work management process. The work management process includes all surveillance procedures, preventive and corrective maintenance procedures, or other routinely scheduled tasks. The program inspections provide the opportunity to detect the effect of aging prior to the loss of component intended function. The implementing procedures have established the acceptance criteria and require that the "As Found" condition descriptions should detail the extent of the inspection and results to allow meaningful

trending of aging effects. The personnel performing the inspections will be trained to perform these activities in accordance with the qualification program.

The Work Control Process program implementing procedures establish acceptance criteria for visual inspections and, as described previously in this attachment, unacceptable conditions are documented in the Corrective Action Program for resolution and to determine the effect on the component function. The Work Control Process program acceptance criteria element is consistent with the XI.M38 AMP.

XI.S6, Structures Monitoring Program

NUREG-1801, XI.S6, "Structures Monitoring Program," states in Scope of Program that "The applicant specifies the structure/aging effect combinations that are managed by its structures monitoring program." The Structures Monitoring program described in LRA Appendix B, Section B2.1.31, which is consistent with the NUREG-1801, XI.S6 AMP, manages the effects of aging for structures that are in the scope of the Kewaunee Structures Monitoring Program.

There are a limited number of components at Kewaunee with similar materials (elastomers), operating environment, and aging effects as structural components listed in NUREG-1801, Section III.A6, Group 6 Structures (Water-Control Structures). Therefore, the aging management review results for these components were compared to NUREG-1801, Section III.A6. However, the Structures Monitoring program was not credited for managing the aging effects for these components since these components are not included within the scope of the program. Therefore, an alternate aging management program was required to be identified to manage the effects of aging for these components. The aging management review determined that these components are inspected using maintenance procedures, and that the plant-specific Work Control Process program was an effective program for managing the aging effects of loss of sealing for these components. An industry standard footnote "E" was applied to indicate the aging management program difference from NUREG-1801.

Conclusion

The on-going periodic inspections and testing performed in accordance with the Work Control Process program provide inspection opportunities to monitor the material condition of systems and components throughout the entire plant. Operating history indicates that the Work Control Process program has been effective in monitoring aging effects and that the sample population provided by the Work Control Process program has been representative of the total population of components. The excellent physical condition and operation of Kewaunee indicates the successful experiences with implementing the Work Control Process program and the Corrective Action Program. Therefore, it is concluded that the Work Control Process program ensures that the effects of aging associated with the in-scope components will be adequately managed so that there is reasonable assurance that their intended functions will be maintained consistent with the current licensing basis during the period of extended operation.

ATTACHMENT 2

WORK CONTROL PROCESS INSPECTION OPPORTUNITIES STUDY

KEWAUNEE POWER STATION
DOMINION ENERGY KEWAUNEE, INC.

1.0 WORK CONTROL PROCESS PROGRAM INSPECTION OPPORTUNITIES STUDY

The Kewaunee Work Control Process program performs visual inspections of the internal surfaces of components during maintenance and surveillance activities. The Work Control Process program inspections are implemented in accordance with the work management process. The work management process includes all surveillance procedures, preventive and corrective maintenance procedures, and other routinely scheduled tasks. The Work Control Process program, as it applies to aging, uses a number of different types of maintenance activities. Due to the comprehensive scope of the work management process, the opportunity to visually inspect the internal surfaces of components constructed of typical system materials and exposed to typical system environments, including stagnant locations, during planned maintenance (e.g. preventive maintenance) and corrective maintenance activities is provided on an ongoing basis.

Planned activities can be categorized into three programmatic categories:

1. Preventive maintenance activities
2. Predictive analysis maintenance activities
3. Periodic surveillance testing

These planned activities are typically performed on a frequency ranging from 2 weeks to 120 months.

Work Control Process program inspections are also performed during corrective maintenance activities. Although corrective maintenance activities are not performed at planned frequencies, the Work Control Process program requires inspections to be performed at every opportunity to verify that the effects of aging are managed.

A maintenance history review[1] verified that preventive and corrective maintenance has provided many opportunities to periodically inspect numerous systems, component types, and structural commodities that are representative of the different material-environment combinations within the plant. The review of these individual maintenance activities indicated that out of 18,293 work orders, over 2475 inspection opportunities were identified. Of these total work orders, over 7800 were preventative maintenance work orders (with 907 inspection opportunities). Preventive maintenance activities provide multiple opportunities for inspections due to their recurring nature; however, for determining the number of inspection opportunities discussed in Section 1.2, each preventative maintenance activity was counted only as a single inspection opportunity.

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[1] Review included preventative maintenance activities from February 1991 through June 2007 and corrective/elective maintenance activities from March 1997 to July 2007.

As discussed in the following sections, these inspection opportunities provided the opportunity to inspect a cross-section of in-scope plant systems, component groups, and material-environment combinations located throughout the plant.

1.1 WORK CONTROL PROCESS INSPECTION OPPORTUNITY CRITERIA AND REVIEW

A search of the Enterprise Maintenance Planning and Control System (EMPAC) work order history was performed using the following parameters for each system that utilizes the Work Control Process program for aging management:

- Timeframe – As stated in Section 1.0.
- Work order types– certain work order types were chosen to define the work order population used for searching the inspection opportunities. The following work order types were determined to best represent the recurring and corrective type work activities that can be credited as an inspection opportunity. The work management process definition is also provided for each.
    - Elective Maintenance – Maintenance performed to fix failed or degraded power block equipment that does not affect system operability, impair plant operations, or create significant exposure/contamination concerns due to release of fluids.
    - Corrective Maintenance – Maintenance performed to fix failed or degraded power block equipment that affects system operability, impairs plant operations, or creates significant exposure/contamination concerns due to release of fluids.
    - Preventive Maintenance (Recurring Work) - Maintenance performed prior to known failure or degradation of equipment to maintain equipment reliability.

Preventative maintenance procedures and elective/corrective maintenance work orders were evaluated as part of this review.

Each work order was reviewed to determine if it provided an inspection opportunity. Typically, an inspection opportunity consists of disassembly or removal of a system component such that adjacent surfaces (e.g. piping) would be available for visual inspection. For example, if a valve were disassembled such that the disc was removed, this would be considered an inspection opportunity since the adjacent piping could be visually inspected. For structural commodities, specific searches were limited to the spent fuel pool gate seals and gaskets on Environmentally Qualified (EQ) electrical boxes. If the number of inspection opportunities exceeded fifty for any system, group of systems, material and environment combination, or component type, the review was truncated because the sample size was adequate to show that there are sufficient opportunities to manage aging. The number of fifty inspection opportunities is consistent with the methodology employed for similar inspection opportunity review efforts that were used to support the LRAs for Surry, North Anna, and Millstone Power Stations. If less than fifty inspection opportunities for the particular system, group of systems, material and environment combination, or component type was identified, then

the actual number of inspection opportunities is listed in the inspection opportunities tables in Section 1.2. Less than fifty inspection opportunities for a particular system, group of systems, material and environment combination, or component type may be adequate to show that there are sufficient opportunities to manage aging when a particular component type includes a limited number of components or the number of components with a particular material/environment combination is limited.

1.2 KEWAUNEE INSPECTION OPPORTUNITIES

1.2.1 System Inspection Opportunities

Forty-five mechanical systems use the Work Control Process program for managing aging at Kewaunee. As outlined in Section 1.1, searches of historical work orders were performed and the work orders were reviewed for inspection opportunities. The results of the review are provided in Table 1.2-1.

Table 1.2-1
System Inspection Opportunities
In-Scope Systems

System	System Number	Total
Air Removal	09	15[(1)]
Chemical and Volume Control	35	>50
Chemical Injection	28	>50
Component Cooling	31	>50
Condensate	03	>50
Containment Vessel Internal Spray	23	22[(2)]
Control Room Air Conditioning	25	>50
Diesel Generator, Mechanical	10	>50
Feedwater Systems • Auxiliary Feedwater • Feedwater	 05B 05A	>50
Gaseous Waste Processing and Discharge	32B	48[(2)]

Table 1.2-1
System Inspection Opportunities
In-Scope Systems

System	System Number	Total
General Ventilation Systems • Auxiliary Building Special Ventilation and Steam Exclusion • Auxiliary Building Air Conditioning • Turbine Building and Screenhouse Ventilation • Auxiliary Building Ventilation • Shield Building Vent System • Technical Support Center Ventilation	 14 15 16 17 24 67	>50
Heating System	22	>50
Liquid Waste Processing and Discharge	32A	28[2]
Main Generator (Mechanical) and Auxiliaries	84	4[1]
Makeup Water Systems • Makeup and Demineralized Water • Makeup Water-SWPT	 27A 27B	>50
Miscellaneous Drains and Sumps	30	24[2]
Miscellaneous Gas	51	33[1]
Primary Sampling	37	>50
Radiation Monitoring	45	2[1]
Raw Water Systems • Circulating Water • Fire Protection • Potable Water • Service Water	 04 08 26 02	>50
Reactor Building Ventilation • Containment Hydrogen Analyzers	18 56C	15[1]
Reactor Coolant	36	>50

Table 1.2-1
System Inspection Opportunities
In-Scope Systems

System	System Number	Total
Residual Heat Removal	34	20[2]
Safety Injection	33	>50
Secondary Sampling	29	29[2]
Secondary System Drains • Heater and Moisture Separator Drains • Steam Generator Blowdown Treatment • Turbine Room Traps and Drains	 11 07 13	>50
Spent Fuel Pool Cooling	21	27[2]
Station and Instrument Air	01	>50
Steam Systems • Bleed Steam • Main Steam and Steam Dump	 12 06	>50
Turbine	54	>50
Turbine Oil Purification	20	11[1]

Notes:

(1) System contains a limited number of components and has the same material and environment combination as other systems that afford sufficient leading indicator inspection opportunities, as indicated in Table 1.2-2, Materials and Environments Inspection Opportunities.

(2) System has the same material and environment combination as other systems that afford sufficient leading indicator inspection opportunities, as indicated in Table 1.2-2, Materials and Environments Inspection Opportunities.

1.2.2 Materials and Environments Inspection Opportunities

The inspection opportunities identified in Table 1.2-1 for each system provide results that are specifically based on the maintenance history for that system. Identifying the inspection opportunities by material and environment combinations, regardless of the system, shows that numerous opportunities exist for all the identified combinations, except the elastomer/raw water combination. Inspections of this material/environment combination will be performed as supplemental inspections in accordance with the Work Control Process program. The results of this review are provided in Table 1.2-2.

Table 1.2-2

Materials and Environments Inspection Opportunities

Internal Environment	Stainless Steel	Carbon Steel	Nickel based alloys	Copper based alloys	Aluminum	Elastomers	Glass	Non-metallic
Air - moist	29[1]	>50	N/A[2]	44[3]	22[4]	N/A[2]	N/A[2]	N/A[2]
Air - dried	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	>50
Air - indoor controlled	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]
Air - indoor uncontrolled	N/A[2]	>50	N/A[2]	N/A[2]	N/A[2]	>50	N/A[2]	N/A[2]
Air - outdoor	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]
Diesel Exhaust	2[5]	4[6]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]
Fuel Oil	2[7]	22[8]	N/A[2]	8[9]	N/A[2]	N/A[2]	N/A[2]	N/A[2]
Gas - Inert	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]
Hydraulic oil	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]
Lube Oil	6[10]	38[11]	N/A[2]	25[12]	12[13]	N/A[2]	N/A[2]	N/A[2]
Raw Water	>50	>50	N/A[2]	>50	N/A[2]	0[14]	N/A[2]	N/A[2]
Treated Water Primary	>50	5[15]	>50	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]
Treated Water Closed cycle	33[16]	>50	N/A[2]	17[17]	N/A[2]	N/A[2]	N/A[2]	N/A[2]
Treated Water and/or Steam - secondary	>50	>50	N/A[2]	7[18]	N/A[2]	N/A[2]	N/A[2]	N/A[2]

Table 1.2-2

Materials and Environments Inspection Opportunities

Notes:

(1) Population of 25 components, a limited number of valves, and limited amount of piping and tubing.

(2) Material & environment combination does not exist or the material/environment combination does not have any aging effects that require management as determined by the aging management review(s).

(3) Population of 23 components and a limited amount of tubing.

(4) Population of 12 components.

(5) Population of 4 components.

(6) Population of 6 components.

(7) Population of 4 components, a limited number of valves, and a limited amount of tubing.

(8) Population of 20 components.

(9) Population of 3 components, a limited number of valves, and limited amount of piping and tubing.

(10) Population of 4 components, a limited number of valves, and limited amount of piping and tubing.

(11) The number of components in the population is approximately equal to the number of inspection opportunities. This provides a representative sample.

(12) Population of 45 components, a limited number of valves, and a limited amount of tubing.

(13) Population of 4 components.

(14) Population of 4 components. Supplemental inspections will be performed in accordance with the Work Control Process program.

(15) Population of 5 components.

(16) Population of 69 components.

(17) Population of 17 components, a limited number of valves, and a limited amount of tubing.

(18) Population of 9 components, a limited number of valves, and a limited amount of tubing.

1.2.3 Component Type Inspection Opportunities

The inspection opportunities identified for each component type provide results that are specifically based on the maintenance history for the specific component(s) included in the component type. Identifying the inspection opportunities by component type, regardless of the system, shows that numerous opportunities exist for each component type, except accumulators, flame arrestors, and hoses. Inspections of these component types will be performed as supplemental inspections in accordance with the Work Control Process program. The results of this review are provided in Table 1.2-3.

Table 1.2-3
Component Type Inspection Opportunities

Component Type	Total
Accumulators	2[1]
Air Ejectors	5[2]
Air Handling Units • Fan/Blower Housings • Damper Housings • Expansion Joints • Flexible Connections • Ductwork	>50[3]
Compressor	>50[4]
Demineralizers / Ion Exchangers	12[5]
Drip Pans	2[6]
Eductors	0[7]
Evaporators	8[8]
Filters • Filter Housings • Filter Assembly	>50[9]
Flame Arrestors	1[10]
Flow Elements	18[11]

Table 1.2-3
Component Type Inspection Opportunities

Component Type	Total
• Orifices	
Fuel Handling Fuel Transfer Equipment	1[12]
Heat Exchangers	>50[13]
Hoses	10[14]
Instruments	0[15]
Moisture Separators	18[16]
Oil Coolers	>50
Oil Reservoirs • Oil Sumps	4[17]
Pipe	>50[18]
Pulsation Dampeners	3[19]
Pumps • Oil Pumps • Sump Pumps • Hydraulic Pumps • Cooling Water Pumps • Fire Pumps	>50
Radiation Detectors	2[20]
Receiver	7[21]
Resistance Temperature Detectors	0[22]
Rupture Disks	5[23]
Strainers	>50
Stripping Column	1[24]
Suction Stabilizers	3[25]

Table 1.2-3

Component Type Inspection Opportunities

Component Type	Total
Tanks	39[26]
Traps	>50
Turbine Casings	16[27]
Turbocharger Casings	2[28]
Valves	>50

Notes:

(1) Population of 43 components. Supplemental inspections will be performed in accordance with the Work Control Process program.

(2) Population of 3 components. For the purposes of Inspection Opportunities, "ejector" and "hogging jet" are considered to be air ejectors.

(3) For the purposes of Inspection Opportunities, the component types "Fan Coil Unit and Vent" are both considered to be subcomponents of Air Handling Units. Also, the component type "smoke detector" located in ductwork, is considered to be part of the ductwork since it performs a ductwork pressure boundary function.

(4) Compressor types included in this component group are:

- Instrument Air Compressors
- Air Conditioning Unit Compressors
- Waste Gas Compressors
- Diesel Generator Startup Air Compressors
- CO_2 Compressor

(5) Population of 25 components.

(6) Population of 2 components.

(7) Population of 1 component. The single eductor is fabricated of stainless steel and has an internal environment of treated water–primary. As noted in Table 1.2-2, this material/environment has >50 inspection opportunities that would provide indication of degradation of components with this combination. Therefore, inspection is this particular component is not required.

(8) Population of 11 components. For the purposes of Inspection Opportunities, absorption tower is considered to be a subcomponent of evaporators.

(9) For the purposes of Inspection Opportunities, Oilers are considered to be filters since they are actually filter assemblies with oil in them.

(10) Population of 8 components. Supplemental inspections will be performed in accordance with the Work Control Process program.

Table 1.2-3

Component Type Inspection Opportunities

Component Type	Total

(11) Population of 120 components. Flow elements and orifices are part of the piping system and are typically made of the same materials. Though the inspection opportunities for this specific component type is limited, the inspections of the specific component type plus the inspections for the piping provide adequate inspection opportunities.

(12) Population includes the wetted portions of the fuel transfer equipment consisting of the carriage, lifting frame, support frame, rails and fasteners. Inspections are performed prior to each refueling operation in accordance with a refueling procedure.

(13) For the purposes of Inspection Opportunities, the following component types are considered to be heat exchangers:

- Chillers, i.e., Evaporators and Condensers as part of Air Conditioning Units
- Air Handling Unit heating coils
- CO_2 Vaporizer
- Heater (electric)
- Steam Boiler
- Tank Heater
- Turbo Charger After-cooler

(14) There is a large population of hoses in numerous systems. Supplemental inspections will be performed in accordance with the Work Control Process program.

(15) Internal inspection of instruments is not possible due to their design. The instrument tubing providing the process fluid to the indicator is inspected in the tubing component type which rolls up under the component type "Pipe." The following is a list of component types considered to be "Instruments":

- Conductivity Probes
- Indicators
- Flow Transmitters
- Level Gauges
- Level Switches
- pH Electrodes
- Radiation Detectors
- Resistance Temperature Detectors
- Sight Glass
- Sodium Analyzer
- Temperature Elements

Table 1.2-3

Component Type Inspection Opportunities

Component Type	Total

(16) Population of 14 components.

(17) Population includes 1 lube oil reservoir and pump oil sumps. The identified inspection opportunities are for the lube oil reservoir. The pump oil sumps are inspected as part of the pump inspections.

(18) For the purposes of Inspection Opportunities, the following component types are considered to be "Pipe":

- Blender
- Condensing Chambers
- Constant Head Chamber
- Exhaust Manifold
- Exhaust Muffler and Silencer
- Float Chamber
- Humidifier
- Mixer
- Nozzles
- Sample Pressure Vessel
- Steam Humidifier Sparger
- Tubing

(19) Population of 3 components.

(20) Population of 11 process monitors.

(21) Population of 14 components.

(22) Internal inspection of resistance temperature detectors is not possible. The wells in which the detectors are installed are made of the same material as the piping system and are inspected as part of the piping.

(23) Population of 11 components.

(24) Population of 1 component.

(25) Population of 3 components.

(26) Population of 84 components.

(27) Population of 4 components. For the purposes of Inspection Opportunities, the component type "Turbine Exhaust Hood" is considered to be "Turbine Casing".

(28) Population of 3 components.

1.2.4 Structural Inspection Opportunities

The Work Control Process program is used to manage aging of certain structural members and commodities at Kewaunee. Searches were performed as outlined in Section 1.1 and the work orders were reviewed for inspection opportunities where a specific structural member or commodity was inspected. Plant procedures were also reviewed to determine if the members or commodities were inspected during the performance of the procedure. The results of the review are provided in Table 1.2-4.

Table 1.2-4
Structural Members and Commodities Inspection Opportunities

Commodity	Total
Spent Fuel Pool Gate Seals	2(1)
Reactor Cavity Seal Ring Elastomer Seals	1(2)
Gaskets in junction, terminal, and pull boxes	0(3)
Spent Fuel Storage Racks	5(4)

(1) The spent fuel pool gate seals are inspected prior to each use in accordance with an existing maintenance procedure.

(2) The reactor cavity seal ring elastomer seals are inspected prior to each use in accordance with an existing refueling procedure.

(3) No work orders directing the inspection of these gaskets were identified. However, a general maintenance procedure directs that the gaskets on EQ qualified boxes be inspected each time the box is opened.

(4) The Spent Fuel Storage Racks are inspected once every 3 years in accordance with surveillance procedure.

1.2.5 Stagnant Water Condition Inspection Opportunities

The Work Control Process program is used to verify the effectiveness of chemistry programs credited for managing the effects of aging for primary and secondary system components. As outlined in Section 1.1, searches of historical work orders were performed and the work orders were reviewed for inspection opportunities. System drawings were also reviewed to determine stagnant flow areas (typically, a branch line for a vent or drain) and components in those areas were reviewed for inspection opportunities.

The results of the review are provided in Table 1.2-5. The totals provided represent the actual number of times a relief, vent or drain valve, or pipe was open for inspection for the system(s) indicated.

Stagnant water conditions typically exist in only a small portion of a system so fewer inspection opportunities are needed to provide a representative sample of the materials with stagnant water conditions. As a result, the totals that provide less than 50 inspection opportunities are considered adequate for verification of the effectiveness of the chemistry program for these stagnant areas.

Table 1.2-5

Stagnant Water Condition Inspection Opportunities in Support of Chemistry Aging Management Programs

System/Groups	System Number	Total
Closed-Cycle Cooling Water Systems		24
• Component Cooling Water	31	
• Emergency Diesel Generator Cooling Water Subsystem	10	
• Control Room Air Conditioning	25	
Engineered Safety Features Systems		43
• Containment Vessel Internal Spray	23	
• Residual Heat Removal	34	
• Safety Injection	33	
Liquid Waste Systems		15
• Liquid Waste Processing and Discharge	32A	
• Steam Generator Blowdown Treatment	07	
Miscellaneous Drains and Sumps	30	2
Primary Process Systems		>50
• Chemical and Volume Control	35	
• Primary Make-up Water		
◦ Makeup and Demineralized Water	27A	
◦ Makeup Water-SWPT	27B	
• Primary Sampling	37	
• Spent Fuel Pool Cooling	21	

Table 1.2-5

Stagnant Water Condition Inspection Opportunities in Support of Chemistry Aging Management Programs

System/Groups	System Number	Total
Raw Water Systems • Chlorination System • Circulating Water • Fire Protection • Potable Water • Service Water	 04 08 26 02	>50
Reactor Coolant System	36	26
Secondary System Drains • Heater and Moisture Separator Drains • Turbine Room Traps and Drains	 11 13	15
Steam & Power Conversion Systems • Auxiliary Feedwater • Bleed Steam • Feedwater • Heating Steam • Main Steam and Steam Dump • Steam Generator Blowdown • Secondary Sampling	 05B 12 05A 22 06 07 29	>50

1.2.6 Fuel Oil System Inspection Opportunities

The Work Control Process program is used to verify the effectiveness of the Fuel Oil Chemistry program to manage aging for diesel fuel oil system components for the Emergency Diesel Generators and Technical Support Center Diesel Generator. As outlined in Section 1.1, searches of historical work orders were performed and the work orders were reviewed for inspection opportunities where the specific fuel oil system components were inspected. Plant procedures were also reviewed to determine the occurrence of fuel oil quality checks and checks of the storage tank condition, all of

which provide an indication of the effectiveness of the program. The results of the review are provided in Table 1.2-6.

Table 1.2-6
Inspection Opportunities for Kewaunee
Fuel Oil Systems in Support of Chemistry Aging Management Program

System	Total
Fuel Oil Systems	>50

1.2.7 Non-Closed Cooling System Inspection Opportunities

The Work Control Process program is credited for managing aging of jacket cooling water subsystem components of the Technical Support Center Diesel Generator. This subsystem is not considered a Closed-Cycle Cooling Water System as described in NUREG-1801, Chapter XI, Section M21, Closed-Cycle Cooling Water System, because the system does not reject heat to the Service Water System.

The routine chemistry monitoring, maintenance, and periodic testing relied upon to monitor the aging of the components in this system are identified in Table 1.2-7.

An inhibited ethylene glycol solution is used for general corrosion control and for anti-freeze protection. Operating experience has shown that the boron nitrite based corrosion inhibitor used, Corrshield NT-403, is very effective in reducing corrosion rates of carbon steel.

Inspection opportunities to perform visual inspection of the system internals are provided when maintenance personnel change out the thermostat and replace the flexible hoses.

Periodic testing is performed to verify the performance of the jacket cooling water subsystem for the Technical Support Center Diesel Generator.

Table 1.2-7 Surveillance Testing for TSC Diesel Generator Jacket Water System	
Parameter	**Frequency**
Chemistry Parameters • PH • Freeze Point • Ethylene Glycol • Nitrite • Conductivity • Silica • Total Iron • Total Copper	 Quarterly Quarterly Quarterly Quarterly Quarterly Annually Annually Annually
Annual Coolant Analysis	Annually
Maintenance • Change Jacket Water Thermostat • Replace Flexible Hoses – Jacket Water Cooling	 72 Months 144 Months
Availability Testing	Monthly Annually

2.0 CONCLUSION

The number of inspection opportunities realized through the combination of corrective maintenance activities, preventive maintenance activities, and surveillances provide for adequate aging management of the structures and components that credit the Work Control Process program. Although corrective maintenance activities are performed at random locations with no scheduled frequency, it is reasonable to assume that the maintenance history is representative with respect to numbers and diverse locations of anticipated maintenance for future years.

Additionally, the Work Control Process program supplements the planned and corrective maintenance activities through its corrective action elements. If ongoing aging is identified in a system with a certain material and environment combination, the Corrective Action Program will require a broader evaluation of other areas of the system

with the same material and environment conditions and other applicable systems with similar material and environmental conditions.

Based on the above information, the Work Control Process program, including the supplemental inspections, ensure that adequate inspection opportunities are afforded to inspect and monitor the material condition of a cross-section of plant systems, components, and material-environment combinations across numerous inspection locations. This provides reasonable assurance that age-related degradation of these SCs will be adequately managed for the period of extended operation.

ATTACHMENT 3

WORK CONTROL PROCESS PROGRAM – PROGRAM ELEMENTS SUPPLEMENTAL INFORMATION

KEWAUNEE POWER STATION
DOMINION ENERGY KEWAUNEE, INC.

In a letter dated March 23, 2009, the NRC identified that additional information related to the Work Control Process program would be required to support the review of the Kewaunee LRA. The attachment to the March 23, 2009 letter identified examples of program element descriptions where supplemental information was required. The following information related to the Work Control Process program provides additional evaluation of the program element information for NUREG-1800, Appendix A.1.2.3, Elements 1, 3, 4, 5, 6, and 10 to supplement LRA Appendix B, Section B2.1.32.

Element 1 – Scope of Program

NRC Request for Additional Information

The element does not include a listing of the specific structures and components of which the program manages the aging.

Dominion Response

The Kewaunee LRA includes the following information for Element 1:

The Work Control Process program performs visual inspections of a representative sample of various component types and structural elements fabricated of aluminum, copper alloys, elastomers, nickel alloys, non-metallics, stainless steel, and steel, as applicable, during maintenance or surveillance activities. The program inspections are performed on components such as accumulators, air handling units, housings, chillers, compressors, coolers, heat exchangers, expansion joints, filters, flexible connections, regulators, pipe, strainers, tanks, traps, pumps, tubing, and valves. Additionally, the program inspects the fuel transfer equipment, electrical box gaskets, the Spent Fuel Pool gate seals, and the reactor cavity seal ring elastomer seal.

The Work Control Process program inspections are implemented in accordance with the work management process. The work management process includes all surveillance procedures, preventive and corrective maintenance procedures, or other routinely scheduled tasks.

The following supplemental information is provided for Element 1:

A listing of structures and components with aging effects managed by the Work Control Process program is provided below:

Structures and Components with Aging Effects Managed by the Work Control Process Program	
System/Structure Name	**Component Group/Commodity**
Air Removal	Air Ejector After Condensers, Air Ejector Inter Condensers, Air Ejectors, Damper Housings, Gland Steam Condenser Air Exhauster, Hogging Jet, Pipe, Sight Glass, Strainer Housing, Traps, Tubing, Valves
Auxiliary Building	Spent fuel pool gate seal
Auxiliary Building Air Conditioning	Damper Housings, Ductwork, Fan/Blower Housings, Flexible Connections
Auxiliary Building Special Ventilation and Steam Exclusion	Damper Housings, Ductwork, Fan/blower Housings, Flexible Connections, Tubing, Zone SV Exhaust Filter Assemblies
Auxiliary Building Ventilation	Auxiliary Building Vent, Damper Housings, Ductwork, Fan Coil Units, Fan/blower Housings, Filter Assemblies, Flexible Connections, Heating Coils, Temperature Elements, Tubing
Auxiliary Feedwater	AFW Pump Oil Coolers, AFW Pump Oil Pumps, AFW Pump Oil Reservoir, Breakdown Orifices, Filter Housings, Flow Elements, Level Glass, Motor Driven Auxiliary Feedwater Pumps, Pipe, Tubing, Turbine Driven AFW Pump Turbine Bearing Coolers, Turbine Driven Auxiliary Feedwater Pump, Valves
Bleed Steam	Expansion Joints, Flow Elements, Moisture Separators/Reheaters, Pipe, Restricting Orifices, Tubing, Valves
Chemical and Volume Control	Absorption Tower, Batching Tank, Boric Acid Blender, Boric Acid, Evaporator Distillate Sample Cooler, Boric Acid Tanks, Chemical Mixing Tank, Concentrates Holding Tank, Conductivity Probes, Demineralizers and Ion Exchangers, Distillate Cooler, Eductors, Evaporator, Evaporator Condenser, Excess Letdown Heat Exchanger, Feed Preheater, Filter Housings, Flow Elements, Flow Indicators, Flow Orifices, Holdup Tanks, Letdown Heat Exchanger, Monitor Tanks, Pipe, Pulsation Dampeners, Pumps, Regenerative Heat Exchanger, Seal Water Heat Exchanger, Standpipes, Stripping Column, Suction Stabilizers, Tank Heaters, Tubing, Valves, Vent Condenser, Volume Control Tank
Circulating Water	Chlorine Monitoring Water Pump, Circulating Water Pumps, Condensers, Flow Elements, Flow Indicators, Pipe, Recirculating Water Pump, Tubing, Valves
Component Cooling	Component Cooling Heat Exchangers, Component Cooling Pumps, Component Cooling Surge Tank, Flow Elements, Flow Orifices, Pipe, Strainer Housings, Tubing, Valves
Condensate	Condensate Storage Tanks, Feedwater Heaters, Feedwater Seal Water Startup Filter Housings, Flow Elements, Flow Switches, Pipe, Strainer Housings, Tubing, Valves
Containment Vessel Internal Spray	Caustic Additive Filter Housing, Caustic Additive Recirculation & Fill Pump, Caustic Additive Standpipe, Caustic Fill Tank, Containment Spray Pump Gland Seal Coolers, Containment Spray Pumps, Flow Elements, Flow Orifices, Pipe, Tubing, Valves

Structures and Components with Aging Effects Managed by the Work Control Process Program	
System/Structure Name	**Component Group/Commodity**
Control Room Air Conditioning	Air Handling Units, Chiller Pumps, Damper Housings, Ductwork, Evaporator, Expansion Tanks, Fan/blower Housings, Flexible Connections, Pipe, Smoke Detector, Steam Humidifier Sparger, Temperature Elements, Tubing, Valves
Diesel Generator	Diesel Generator Cooling Water Heat Exchangers, Diesel Generator Fuel Oil Day Tanks, Exhaust Manifold, Exhaust Mufflers and Silencers, Expansion Tanks, Filter Housings, Flame Arrestors, Hoods and Caps, Flexible Connections, Float Chamber, Heater, Lube Oil Coolers, Oil Sumps, Oilers, Pipe, Pumps, Radiator, Sight Glass, Standpipes, Starting Air Precoolers and Aftercoolers, Strainer Housings, Tubing, Turbocharger Aftercoolers, Turbocharger Casings, Valves
Feedwater	Breakdown Orifices, Feedwater Heaters, Feedwater Pumps, Feedwater Pumps Oil Coolers, Filter Housings, Flow Elements/Nozzles, Oil Pumps, Oil Reservoirs, Pipe, Straightening Vanes, Tubing, Valves
Fire Protection	CO2 Storage Tank Compressor, Flame Arrestor, Flexible Hoses, Pipe, Reactor Coolant Pump Oil Collection Tank, Tubing, Turbine Bearing Fire Protection CO2 Vaporizer, Valves
Fuel Handling	Fuel transfer equipment (carriage, lifting frame, support frame, rails and fasteners)
Gaseous Waste Processing and Discharge	Filter Housings, Gas Decay Tanks, Heat Exchangers, Moisture Separators, Orifices, Pipe, Strainer Housings, Tubing, Valves, Waste Gas Compressors
Heater and Moisture Separator Drains	Constant Head Chamber, Expansion Joints, Flow Elements, Heater Drain Pumps, Heater Drain Tank, Level Glass, Pipe, Reheater Drain Tanks, Standpipes, Strainer Housings, Tubing, Valves
Heating Steam	Boric Acid Evaporator Cond Return Tank, Boric Acid Evaporator Cond Return Unit Heat Exchanger, Condensate Return Pumps, Condenser Water Box Priming Ejector, Control Room A/C HW Pump, Control Room A/C Steam Humidifier, Control Room Humidification Steam Boiler, Heating Coils, Heating System Condensate Drain Tank, Pipe, Sight Glasses, Strainer Housings, Traps, Tubing, Valves
Liquid Waste Processing and Discharge	Deaerated Drains Tank, Deaerated Drains Tank Pump, Distillate Cooler, Evaporator Condenser, Filter Housings, Flexible Hoses, Flow Elements, Flow Orifices, Flow Transmitters, Laundry and Hot Shower Tanks, Laundry Pump, Level Switches, Pipe, Reactor Cavity Filtration Pump, Reactor Coolant Drain Pumps, Reactor Coolant Drain Tank, Sludge Interceptor Pump, Sludge Interceptor Tank, Standpipes, Strainer Housings, Sump Tank Pumps, Sump Tanks, Tubing, Valves, Waste Condensate Pumps, Waste Condensate Tanks, Waste Evaporator Concentrates Sample Cooler, Waste Evaporator Feed Pump, Waste Holdup Tank

Structures and Components with Aging Effects Managed by the Work Control Process Program	
System/Structure Name	**Component Group/Commodity**
Main Generator (Mechanical) and Auxiliaries	Air Side Seal Oil Backup Pump, Air Side Seal Oil Cooler, Air Side Seal Oil Pump, Defoaming Tanks, Filter Housings, Generator Bearing Oil Drain Line Loop Seal, Generator Hydrogen Coolers, Hydrogen Side Drain Regulator, Hydrogen Side Seal Oil Cooler, Hydrogen Side Seal Oil Pump, Oil Level Gauge, Pipe, Tubing, Valves
Main Steam and Steam Dump	Condensing Chambers, Flex Connections, Flow Elements, Flow Orifices, Moisture Separator, Pipe, Rupture Discs, Strainer Housings, Traps, Tubing, Valves
Makeup and Demineralized Water	Filter Housing, Flow Elements, Flow Indicators, Pipe, Strainer Housing, Tubing, Valves
Miscellaneous Drains and Sumps	Annulus Sump Pumps, Deaerated Drains Tank Emergency Pumps, Flow Elements, Orifices, Pipe, Reactor Containment Vessel Sump Pumps, RHR Pump Pit Sump Pumps, Safeguards Alley Sump Pumps, Screen House Sump Pumps, Valves
Miscellaneous Gas	CO2 Vaporizer, Gas Bottles/Cylinders, Hoses, Pipe, SFP Gate, Inflatable Seal N2 Rubber Hoses, Tubing, Valves
Miscellaneous Structural Commodities	Gaskets/seals in junction, terminal, and pull boxes
Potable Water	Nozzles, Pipe, Valves
Primary Sampling	Filter Housings, Flow Indicators, Rupture Disks, Sample Heat Exchangers, Sample Pressure Vessel, Tubing, Valves
Radiation Monitoring	Radiation Detectors, Tubing, Valves
Reactor Building Ventilation	Containment Fan Coil Units, Damper Housings, Drip Pans, Ductwork, Electric Heater Housings, Fan/blower Housings, Filter Assemblies, Flexible Connections, Pipe, Shroud Cooling Coils, Tubing, Valves
Reactor Containment Vessel	Reactor Cavity Seal Ring
Reactor Coolant	Pipe, Pressurizer Relief Tank, RxCP Motor Lower Bearing Oil Coolers, RxCP Motor Upper Bearing Oil Coolers, RxCP Thermal Barriers
Reactor Vessel	Vessel Flange Leakage Monitor Lines
Residual Heat Removal	Flow Elements, Miniflow Orifice, Pipe, Residual Heat Exchangers, Residual Heat Removal Pumps, Rupture Disks, Shaft Seal Heat, Exchangers, Tubing, Valves
Safety Injection	Accumulators, Flow Elements, Flow Indicators, Flow Orifices, Pipe, Refueling Water Storage Tank, Safety Injection Pump Gland Seal, Coolers, Safety Injection Pumps, SI Pump Lube Oil Reservoirs, Sight Glass, Tubing, Valve Enclosures, Valves
Secondary Sampling	Cation Conductivity Electrodes, Cooler Units, Coolers, Flow Indicators, FW Sample Line Chiller, PH Electrodes, Pipe, Recirculation Pumps, Refrigeration Unit Chiller Condenser, Refrigeration Unit Chiller Evaporator, Sodium Analyzer Elements, Storage Tank, Tubing, Valves

Structures and Components with Aging Effects Managed by the Work Control Process Program	
System/Structure Name	**Component Group/Commodity**
Service Water	Filter Housings, Flexible Hoses, Flow Switches, Orifices, Pipe, Sight Flow Indicators, Standpipes, Strainer Housings, Tubing, Valves
Service Water Pretreatment	Filter Housings, Flow Elements, Mixers, Pipe, Tubing, Valves
Shield Building Ventilation	Damper Housings, Ductwork, Fan/Blower Housings, Flexible Connections, Reactor Building Discharge Vent, Shield Building Vent Filter Assemblies, Tubing
Spent Fuel Pool Cooling	Convection Tank, Filter Housings, Pipe, Pumps, Spent Fuel Pool Demineralizer, Spent Fuel Pool Heat Exchanger, Tubing, Valves
Spent Fuel Storage	Spent Fuel Storage Racks
Station and Instrument Air	Aftercoolers, Compressors, Filter/Regulators, SFP Gate Inflatable Seal IA Rubber Hoses, Traps, Tubing, Valves
Steam Generator Blowdown Treatment	Filter Housings, Flow Indicators, Pipe, Resin Trap, Rupture Disk, SGBT Recovery Ion Exchangers, SGBT Standpipe, Steam Generator Blowdown Heat Exchangers, Steam Generator Blowdown Tank, Tubing, Valves
Technical Support Center Ventilation	Air Conditioning Units, Air Handling Units, Damper Housings, Ductwork, Fan/blower Housings, Flexible Connections
Turbine	Accumulators, Electro Hydraulic Control System Oil Coolers, Pipe, Sight Glasses, Tubing, Turbine Casings, Turbine Exhaust Hoods, Turbine Gland Steam Condenser, Turbine Oil Coolers, Valves
Turbine Building and Screenhouse Ventilation	Damper Housings, Ductwork, Fan Coil Units, Fan/blower Housings, Flexible Connections, Flow Elements, Temperature Elements
Turbine Oil Purification	Pipe, Tubing, Turbine Oil Circulating and Transfer Pump, Valves
Turbine Room Traps and Drains	Pipe, Steam Traps, Tubing, Valves

Element 3 – Parameters Monitored or Inspected

NRC Request for Additional Information

While the element lists some of the materials and associated aging effects that it applies to, it does not list *any* of the parameters that would be monitored (i.e., measurement of wall thickness, detection and sizing of cracks, dissolved oxygen levels, etc.) nor does the element establish a specific link between a structure or component's intended function and the parameter being monitored.

Dominion Response

The Kewaunee LRA includes the following information for Element 3:

The aging effects monitored by the Work Control Process are consistent with the materials of fabrication as listed below:

- *Aluminum - Loss of material and reduction of heat transfer*
- *Copper Alloys - Cracking, loss of material, and reduction of heat transfer*
- *Elastomers - Change in material properties, cracking, hardening and loss of strength, loss of material, and loss of sealing*
- *Nickel Alloys - Loss of material*
- *Non-Metallic - Loss of strength*
- *Stainless steel - Cracking, loss of material, and reduction of heat transfer*
- *Steel - Loss of material and reduction of heat transfer*

The following supplemental information is provided for Element 3:

Work Control Process program inspection activities will monitor structures and components (SC) for the following visually observable parameters: abnormal surface conditions; loss of material; presence of corrosion products; excessive deposits on surfaces due to silting and macrofouling; cracking/crazing, discoloration, swelling, reduced resilience of elastomers; and signs of cracking in steel materials. The results of the inspection activities will be documented in the work package and reviewed for identification of adverse aging effects or trends. Adverse conditions or trends are evaluated and corrected prior to affecting the intended function of the SC.

The majority of the Work Control Process program applications in the LRA as an aging management program involve management of the loss of material aging effect. Aging-related loss of material can be caused by processes such as general corrosion, crevice corrosion, pitting, and erosion. The loss of material that is significant to performance of intended functions would be identifiable during visual inspections as irregular surface conditions or loss of wall thickness.

Change in material properties, hardening, and cracking of elastomeric materials are also managed by the Work Control Process program. Maintenance activities performed in accordance with the Work Control Process program provide opportunities to visually inspect the internal surfaces of these components. Aging effects are visually observable for these elastomeric components by monitoring such parameters as evidence of cracking and crazing, discoloration, distortion, evidence of swelling, tackiness, evaluation of resiliency and indentation recovery prior to affecting the pressure boundary intended function.

For selected heat exchangers, the Work Control Process program also manages reduction of heat transfer due to visibly observable fouling of heat transfer surfaces that could affect their ability to perform the heat transfer intended function.

Cracking of a limited number of stainless steel components is managed by the Work Control Process program where chemistry control measures are not applicable or not effective in preventing the aging effect. Adverse conditions identified through visual inspections performed by the Work Control Process program will be entered into the corrective action program. The corrective action program will require an engineering

evaluation to determine the cause and the extent of condition. The cause evaluation may require additional inspections, including the use of NDE techniques, which are effective for detecting cracking.

Loss of sealing due to deterioration of reactor cavity seal ring and spent fuel pool gate elastomeric seals, and of electrical junction and terminal box gaskets, is managed by the Work Control Process program. Current visual inspections performed during maintenance and surveillance activities can effectively identify degradation of these components that could affect the component intended function.

The loss of strength of Station and Instrument Air System filter regulator paper elements is managed through maintenance of compressed air system components by the Work Control Process program. Visible degradation of the paper element is recognizable during maintenance activities prior to affecting the paper element filtration intended function.

Element 4 – Detection of Aging Effects

NRC Request for Additional Information

As in Element 3, this element does not discuss the parameters to be monitored nor does it establish a link to an associated aging effect. While performing inspections on a *representative sample* of components and structures (as is discussed in the element) is acceptable, the element does not include the basis for 1) the breadth and depth of the selection process or 2) determining the appropriate frequency of the various inspections. The element states that Work Control Process performs *visual inspections* of various component types and structural elements. What is unclear is the type and extent of visual inspections that the Work Control Process will provide. What is also unclear is how visual inspections would be an appropriate detection tool under *all* circumstances. For example, visual inspections may not be an effective tool for detecting changes in material properties (e.g., fracture toughness, hardness, elastic properties, etc.).

Dominion Response

The Kewaunee LRA includes the following information for Element 4:

The Work Control Process program performs visual inspections on a representative sample of various component types and structural elements during scheduled maintenance or surveillance activities. The inspections are implemented in accordance with the work management process, which includes all surveillance procedures, preventive and corrective maintenance procedures, or other routinely scheduled tasks.

Due to the comprehensive scope of the work management process, the process provides the opportunity to visually inspect the internal surfaces of components constructed of typical system materials and exposed to typical system environments,

including stagnant locations, during preventive and corrective maintenance activities on an ongoing basis.

To verify that the inspection opportunities provide a representative sample of the material and environment combinations found in the plant, a review of the inspection opportunities afforded by the Work Control Process program for the systems in the scope of license renewal has been performed. The review identified the number of inspection opportunities for the systems, material/environment combinations, and component types in the scope of the program. The results of the review documented that the Work Control Process program provides the opportunity to inspect a representative sample of the systems, material/environment combinations, and component types.

Personnel performing maintenance activities on a component inspect the internal surfaces of the component and adjacent components and piping to identify component and commodity aging. The maintenance procedures require that these "As Found" conditions be documented. The "As Found" descriptions detail the inspection extent and results even when no signs of aging degradation are found in order to allow meaningful trending of aging effects.

The Work Control Process program inspections provide support for the Bolting Integrity, Compressed Air Monitoring, Fire Protection, and Open-Cycle Cooling Water System programs for managing the components and supports within the scope of those programs.

The following supplemental information is provided for Element 4:

The Work Control Process program provides the opportunity for visual inspections that are broadly applied and of sufficient frequency to be effective for managing aging effects. Work Control Process program inspection activities will monitor SCs for abnormal surface conditions; loss of material; presence of corrosion products; excessive deposits on surfaces due to silting and macrofouling; cracking/crazing, discoloration, swelling, reduced resilience of elastomers; and signs of cracking in steel materials. The results of the inspection activities will be documented in the work package and reviewed for identification of adverse aging effects or trends. Adverse conditions are documented in the Corrective Action Program and evaluated to determine necessary corrective measures, including initiation of repairs, performance of extent of condition reviews, and implementation of revisions to plant programs and practices to prevent recurrence of the condition. The evaluation of the adverse condition, and the extent of condition reviews, may require more detailed inspections, including the use of NDE techniques, and the inspection of additional components that may be susceptible to similar aging effects. The Corrective Action Program is described in LRA Appendix B, Section B1.3.

Opportunities to visually inspect the internal surfaces of components constructed of typical system materials and exposed to typical system environments, including stagnant locations, are provided on an ongoing basis due to the comprehensive scope

of the work management process. In order to verify that the inspection opportunities provide a representative sample, a review of more than ten years of historical maintenance and surveillance activity records was performed.

The maintenance history review identified the number of inspection opportunities for each of the in-scope systems and structures, for each of the material and environment combinations, and for each of the component types for which the Work Control Process program is credited in the LRA. For component material and environment combinations for which sufficient opportunity for inspection could not be identified from the historical review, specific visual inspections will be added to the scope of the Work Control Process program.

The results of the inspection opportunities reviewed indicated that only a limited number of component material and environment combinations were not sufficiently represented in the maintenance and surveillance history. Additionally, the review determined that three component types were subject to component-specific aging effects, but were not sufficiently represented in the maintenance and surveillance history. LRA Appendix B, Section B2.1.32, Enhancement 2, provides the commitment to include supplemental Work Control Process program visual inspections in the scope of the program in order to effectively manage the applicable aging effects in the event that sufficient inspection opportunities are not presented prior to the period of extended operation.

Specifically, the following items will be included in the enhanced program:

- Material/Environment Combination: Elastomeric material in raw water environment
- Component Types: Accumulators, Flame Arrestors, Hoses

With the implementation of the Work Control Process program enhancement described above, the number of inspection opportunities expected to be available through the performance of surveillance and maintenance activities, based on the historical review, provide for the frequent and comprehensive assessment of plant component aging. The Work Control Process program provides significantly more opportunity to assess aging effects than a one-time inspection approach, and will continue to provide inspections through the period of extended operation.

The majority of applications of the Work Control Process program in the LRA as an aging management program involve management of the loss of material aging effect. Aging-related loss of material can be caused by processes such as general corrosion, crevice corrosion, pitting, and erosion. The loss of material that is significant to performance of intended functions would be identifiable during visual inspections as irregular surface conditions or loss of wall thickness.

Change in material properties, hardening, and cracking of elastomeric materials are also managed by the Work Control Process program. Maintenance activities performed in accordance with the Work Control Process program provide opportunities to visually inspect the internal surfaces of these components. Aging effects are visually observable for these elastomeric components by such conditions as evidence of

cracking and crazing, discoloration, distortion, evidence of swelling, tackiness, evaluation of resiliency and indentation recovery prior to affecting the pressure boundary intended function.

For selected heat exchangers, the Work Control Process program also manages reduction of heat transfer due to visibly observable fouling of heat transfer surfaces that could affect the ability to perform the heat transfer intended function.

Cracking of a limited number of stainless steel components is managed by the Work Control Process program where chemistry control measures are not applicable or not effective in preventing the aging effect. Adverse conditions identified through visual inspections performed by the Work Control Process program will be entered into the corrective action program. The corrective action program will require an engineering evaluation to determine the cause and the extent of condition. The cause evaluation may require additional inspections, including the use of NDE techniques, which are effective for detecting cracking.

Loss of sealing due to deterioration of reactor cavity seal ring and spent fuel pool gate elastomeric seals, and of electrical junction and terminal box gaskets, is managed by the Work Control Process program. Current visual inspections performed during maintenance and surveillance activities can effectively identify degradation of these components that could affect the component function.

The loss of strength of Station and Instrument Air System filter regulator paper elements is managed through maintenance of compressed air system components by the Work Control Process program. Visible degradation of the paper element is recognizable during maintenance activities prior to affecting the paper element filtration intended function.

Note that aging effects resulting from changes in fracture toughness of steels are not managed by the Work Control Process program.

Element 5 – Monitoring and Trending

NRC Request for Additional Information

The element discusses System Engineers periodically monitoring the performance of structures and components and the use of the Corrective Actions Program (CAP) as a means of trending performance issues. What the element does not discuss is the threshold that will be applied for the generation of a condition report (CR) and whether the CR database can be searched specifically for aging-related issues. Also, the element does not discuss how the Work Control Process inspections might be expanded (short term) based on the results of "extent of condition" reviews. Finally, the element does not address if/how trending data and operating experience will be used to make long term decisions regarding the scope and frequency of inspections performed using the Work Control Process.

Dominion Response

The Kewaunee LRA includes the following information for Element 5:

The frequencies of maintenance activities vary based on the preventive maintenance determinations made in accordance with the implementing procedures. These procedures establish the requirements and guidelines for development, implementation, and maintenance of the preventive maintenance program to ensure plant equipment is maintained at a quality level to perform its intended function and provide guidance for performing reviews and evaluations of the preventive maintenance activities.

The "As Found" descriptions detail the inspection extent and results even when no signs of aging degradation are found in order to allow meaningful trending of aging effects.

If the Work Control Process program inspections identify degradation of the components, a Corrective Action Program condition report will be initiated to determine the cause of the degradation, including aging, and to identify the appropriate corrective actions. Additional monitoring of the system, structure, or component during the Period of Extended Operation is a possible corrective action and would be performed by the Work Control Process program. This additional condition monitoring would be implemented with the work management process.

The Systems Engineers monitor the performance of their systems including reviewing the Corrective Action Program items, maintaining overall cognizance of long term effects on their systems, monitoring the effects of continued use of aging equipment for system performance degradation, monitoring the availability of parts on aging and obsolete plant equipment and changes in technology.

The following supplemental information is provided for Element 5:

The Work Control Process program provides the opportunity for visual inspections that are broadly applied and of sufficient frequency to be effective for managing aging effects. Work Control Process program inspection activities will monitor SCs for abnormal surface conditions; loss of material; presence of corrosion products; excessive deposits on surfaces due to silting and macrofouling; cracking/crazing, discoloration, swelling, reduced resilience of elastomers; and signs of cracking in steel materials. The results of the inspection activities will be documented in the work package and reviewed for identification of adverse aging effects or trends. Adverse conditions are documented in the Corrective Action Program and evaluated to determine necessary corrective measures, including initiation of repairs, performance of extent of condition reviews, and implementation of revisions to plant programs and practices to prevent recurrence of the condition. The evaluation of the adverse condition, and the extent of condition reviews, may require more detailed inspections, including the use of NDE techniques, and the inspection of additional components that

may be susceptible to similar aging effects. The Corrective Action Program is described in LRA Appendix B, Section B1.3.

The Work Control Process program inspections are implemented in accordance with the work management process, which includes all surveillance procedures, preventive and corrective maintenance procedures, or other routinely scheduled tasks. The personnel performing these activities are required to document the "As Found" equipment condition with sufficient detail to support monitoring and trending of aging effects.

This monitoring is currently implemented by the Dominion Fleet work management procedures. The "As Found" equipment condition is recorded in the work package for in-scope components. "As Found" equipment condition criteria include degradation exceeding normal wear; internal sediment or debris; general corrosion, localized corrosion, pitting, and/or crevice corrosion; erosion; cracking; or any separation or delamination of material (including cladding, sealant, and long lived gaskets). The Fleet procedures require a supervisor review of the work package to verify that the "As Found" conditions are properly documented with sufficient detail to enable trending reviews and extent of condition determinations.

As part of the implementation of the License Renewal programs at North Anna, Surry, and Millstone Power Stations, Dominion Fleet license renewal program procedures have been developed. These Fleet procedures require that the site license renewal coordinator monitor the Work Control Process program inspection results to: (1) identify any new aging effects not previously considered, (2) monitor and/or perform walkdown activities to verify adequate identification and documentation of aging effects and initiation of corrective actions, (3) perform trending and tracking of aging management inspection results, and (4) review site operating experience through the plant corrective action process to ensure that new aging effects are addressed.

Full implementation of these Fleet procedures will occur at Kewaunee when the Work Control Process program is fully implemented prior to the period of extended operation as identified in LRA Appendix A, Table A6.0-1, Commitment 25.

The Kewaunee Corrective Action Program procedures direct that a condition report be initiated when degradation, damage, failure, malfunction, or loss of plant equipment is identified. The Corrective Action Program evaluation of the condition report would determine the cause of the degradation, including aging, consider the extent of the condition, and identify the appropriate corrective actions. Additional monitoring of the affected SC, and potentially additional similar SCs, could be required based on the results of the extent of condition review and cause determination. Examples of condition report evaluations are provided in Element 10, supplemented below.

The Corrective Action Program also performs trending of condition reports to provide a method for recognizing declining performance, performance below acceptable standards, and performance strengths or improving trends. These trending activities support common cause analysis, condition report investigation, determination of extent of condition, and department self-evaluation activities. Parameters trended by the

Corrective Action Program include aging effects, such as corrosion, erosion, cracking, and wear. The data collected is formally analyzed on a quarterly basis. For example, the fourth quarter 2008 trend report identified a potential trend for the identification of corrosion and wear. A condition report was initiated for this potential trend.

In addition to the activities performed by the Corrective Action Program, the System Engineers monitor the performance of their systems including reviewing the corrective action items, maintaining overall cognizance of long-term effects on their systems, monitoring the effects of continued use of aging equipment for system performance degradation, monitoring the availability of parts on aging and obsolete plant equipment and changes in technology. The results of this monitoring are documented in system health reports in accordance with plant procedures.

Element 6 – Acceptance Criteria

NRC Request for Additional Information

The element does not discuss or provide a basis for the acceptance criteria to be applied for the various Work Control Process inspections.

Dominion Response

The Kewaunee LRA includes the following information for Element 6:

The Work Control Process program inspections are implemented in accordance with the work management process. The work management process includes all surveillance procedures, preventive and corrective maintenance procedures, or other routinely scheduled tasks. The program inspections provide the opportunity to detect the effect of aging prior to the loss of component intended function. The implementing procedures have establish the acceptance criteria and require that the "As Found" condition descriptions should detail the extent of the inspection and results to allow meaningful trending of aging effects.

The personnel performing the inspections will be trained to perform these activities in accordance with the qualification program.

The following supplemental information is provided for Element 6:

The Work Control Process program implementing procedures establish acceptance criteria for visual inspections and unacceptable conditions are documented in the Corrective Action Program for resolution and to determine the affect on the component function.

The "As Found" equipment condition is recorded in the work package for in-scope components in accordance with Dominion Fleet work management procedures. "As Found" equipment condition criteria include degradation exceeding normal wear;

internal sediment or debris; general corrosion, localized corrosion, pitting, and/or crevice corrosion; erosion; cracking; or any separation or delamination of material (including cladding, sealant, and long lived gaskets). Full implementation of these Fleet procedures will occur at Kewaunee when the Work Control Process program is fully implemented prior to the period of extended operation as identified in LRA Appendix A, Table A6.0-1, Commitment 25.

The Kewaunee Corrective Action Program procedures direct that a condition report be initiated when degradation, damage, failure, malfunction, or loss of plant equipment is identified. The Corrective Action Program evaluation of the condition report would determine the cause of the degradation, including aging, consider the extent of the condition, and identify the appropriate corrective actions. Additional monitoring of the affected SC, and potentially additional similar SCs, could be required based on the results of the extent of condition review and cause determination. Examples of condition report evaluations are provided in Element 10, supplemented below.

Element 10 – Operating Experience

NRC Request for Additional Information

While the element lists a few examples of how the Work Control Process had been successfully applied in the past as an aging management program, this is insufficient for the staff to be able to evaluate whether operating experience had been appropriately considered, given the range of AMR line items for which the Work Control Process AMP is credited. Additionally, the element does not discuss the role operating experience will play on an on-going basis to periodically validate the scope and frequency of inspections performed using the Work Control Process.

Dominion Response

The Kewaunee LRA includes the following information for Element 10:

Operating experience indicates that the Work Control Process program is effective in identifying the monitored aging effects, evaluating the degradation, and implementing corrective actions. When degradation has been identified, corrective actions have been implemented to ensure that the intended functions of the affected components are maintained.

The following representative examples of internal operating experience are based on a review of Corrective Action Program items and were considered in evaluating the effectiveness of the program:

In April 2002, maintenance personnel were replacing the fire protection jockey pump discharge relief valve and identified the adjacent piping was approximately 90 percent blocked with rust-like debris. Additionally, it was identified that a nearby pipe nipple was

corroded and required replacement. The work order instructions were revised, the piping was cleaned, and the welded nipple was replaced.

In July 2006, after completing a surveillance test, an I&C technician identified that the 3/8-inch copper process tubing connected to the 3/8-inch brass Swagelok cross fitting for a differential pressure indicator was loose, even though the Swagelok nut was tight. The I&C technician noted that the copper tubing might be cracked next to the ferrules, causing inaccurate indication. The surveillance test results were acceptable and did not indicate any abnormalities. The tubing was replaced restoring the design configuration.

In April 2008, a detailed inspection of a service water valve revealed that disc guides in the valve body were eroded. The inspection was performed in response to a work order written in 2006 when poor valve seat contact was visually noted during service water pipe replacement. It was noted in 2006 that the seat conditions would probably cause the valve to weep. Visual inspection of the valve at that time indicated the valve would continue to perform its isolation function. As a result of the 2008 inspection, it was determined that the guides could not be repaired and the valve was replaced.

The following supplemental information is provided for Element 10:

Additional examples of operating experience with the Work Control Process program are provided below.

Documentation of As Found Condition of Component Cooling Water Pump 'B'

In April 2008, during an overhaul of the 'B' Component Cooling Water (CCW) pump, the lower pump casing was found to have an area of material loss on the outboard wear ring casing groove land. Engineering personnel and a representative from the pump vendor inspected the pump and attributed the loss of material to erosion. Based on an evaluation by Engineering and the pump vendor representative, the condition appeared to have been slowly occurring over a long period of time, most likely since the pump was installed in October 2001.

Although the erosion was not significant with respect to the pressure boundary intended function of the pump, had the erosion been significantly worse, it could have caused undercutting of the casing beneath the wear ring, allowing bypass flow from the high pressure side of the impeller to the low pressure side of the impeller. A bypass flow condition would have resulted in decreased hydraulic performance and increased vibrations due to an imbalance, which would have been observed during performance testing.

A review of operating experience did not identify any horizontal pumps with similar conditions. As part of the extent of condition review, the historical operating performance of the 'A' and 'B' CCW pumps was reviewed and the results indicated that these pumps were operating at or near the reference vibration levels and hydraulic performance values that were established during initial installation.

Periodic performance testing (vibrations and hydraulic performance) of the 'B' CCW pump is being performed to validate the continued operability of the pump and the pump is scheduled to be replaced in 2009. Additionally, the 'A' CCW pump is scheduled to be overhauled and inspected during the 2009 refueling outage.

Emergency Diesel Generator 'A' Air Intake Filter Housing to Turbocharger Cracking

In March 2007, while performing work on the 'A' emergency diesel generator (EDG), a crack was observed on the air filter housing. The crack on the top surface of the EDG air filter intake housing resulted in a small pathway for air to enter into the turbocharger without first passing through the filters.

Following discovery, the crack in the housing was inspected, measured, and documented, and the 'A' EDG was inspected to characterize the condition and evaluate any adverse effects on EDG performance. The results of the inspections determined that there was no damage to the turbocharger blades and no foreign material was present inside the air filter housing or air filters. The crack in the 'A' EDG air filter housing was repaired and procurement of a replacement air filter housing was initiated. As part of the extent of condition review, the 'B' EDG air filter housing was visually inspected to verify that cracking was not present.

Based on a review of the inspection results, the cause of the 'A' EDG air filter housing crack was determined to be related to the following:

- An undetermined fabrication defect or unacceptable welding process.
- High residual stresses related to bowing on the top surface and/or improper fit up/tolerances.
- An overload event during shipment, storage, installation, or some other time, which could have promoted crack initiation.
- Fatigue that may have contributed to crack propagation.

As an additional corrective action, 'A' EDG air filter housing visual inspections are performed after each EDG operation to ensure that a gap has not developed in the exterior shell, allowing air to by-pass the filter and enter the 'A' EDG. These augmented visual examinations are planned to be performed until the air filter housing replacement is complete. The surveillance procedures for the EDGs were also revised to specify detailed visual examination of the air filter housings to verify that cracking is not present.

Main Generator Hydrogen Cooler Tube Leakage

On January 20, 2004, a "Hydrogen Panel Trouble" alarm was received in the control room. Investigation revealed that the "Generator Leak Detector Level High" alarm was illuminated on the local hydrogen panel, indicating a possible service water leak in one of the main generator hydrogen coolers. In accordance with the abnormal operating

procedure, the equipment operator drained all three leak detection pots, subsequently clearing the alarm. However, approximately 20 minutes after each instance of draining the leak detection pots, the alarm continued to recur. Chemical analysis of the pot drains verified the presence of service water, confirming a cooler leak. The location of the leak was identified with a fiber optic probe and the leaking tube was further inspected by eddy current testing.

During the previous outage, the tubes in the hydrogen coolers had undergone eddy current testing and the results indicated that the tubes appeared to be satisfactory for continued operation. However, as part of the extent of condition review based on the newly identified tube leak, an extensive re-evaluation of the eddy current data from the prior outage was performed. The re-evaluation identified that four of the 752 total tubes previously inspected had recorded indications similar to the leaking tube. The failed tube and the additional four tubes were plugged.

The cause of the tube leak was attributed to both mechanical impact and service-related conditions. There was evidence of mechanical contact with the tube wall and the subsequent flaw from the damage created a condition that was conducive to erosion/corrosion during service.

As part of the extent of condition review, Engineering identified that the finned cooler design of the exciter air cooler is comparable to the design of the main generator hydrogen coolers and may experience similar degradation. Corrective action was initiated to review the results from the previous eddy current inspection of the exciter air cooler. The re-evaluation did not identify any similar indications.

Evaluation of Stress Corrosion Cracking in Piping Containing Stagnant Borated Water

In August 2007, it was noted that various industry operating experiences had indicated that sensitized stainless steel piping systems containing stagnant borated water may be susceptible to stress corrosion cracking (SCC).

At North Anna, SCC and leakage had been observed at stainless steel welds in piping containing stagnant borated water. Analysis of the weld metal determined that it had been sensitized as a result of improper heat controls and high heat input during the welding process.

An assessment was initiated to determine whether stainless steel welds or piping that could be sensitized and potentially susceptible to SCC, and eventual through-wall failure, were present at Kewaunee. The primary objectives of the assessment were to (1) determine the conditions and/or locations where the possibility for SCC was high enough that cracking could occur, and (2) review the SCC risk factors for each identified location to determine whether additional inservice inspection, metallography, or replacement might be warranted.

The Containment Spray, Safety Injection, Residual Heat Removal, and Chemical and Volume Control Systems were the primary focus of the assessment, with 504 piping segments and approximately 1700 field welds evaluated within these systems. The majority of the weld and piping population was found to have low SCC susceptibility based on the material properties (low carbon content and low excess carbon index), contamination levels, and normal operating temperatures. Ongoing inservice inspections (ISI) monitor these piping segments and welds.

Although no sensitized stainless steel piping was identified, a limited number of piping segments and welds were determined to potentially include the risk factors simultaneously required for SCC. A review of the fourth interval ISI Plan determined that three of the potentially susceptible welds were scheduled to be examined in the second and third periods of the fourth interval. These inspections will provide a representative sample of the susceptible material to indicate if SCC is occurring. System water chemistry controls and monitoring will continue to verify halogens and sulfates levels are maintained within acceptable limits such that the potential for SCC will remain low.

Sediment in 'B' Emergency Diesel Generator Fuel Oil Storage Tank

On November 12, 2006, sediment was discovered in the 'B' emergency diesel generator (EDG) fuel oil storage tank. Laboratory analysis of the sediment indicated that particulate limits were not exceeded. However, although particulate limits were not exceeded, an apparent cause evaluation was initiated to determine the cause of the sediment and to ensure operability of the EDGs.

The sediment was determined to be magnetic, indicating that the source was most likely caused by corrosion of carbon steel piping in the siphon line, which had undergone maintenance in the prior outage. It was determined that these maintenance activities may have resulted in flushing corrosion products into the 'B' EDG fuel oil storage tank.

As part of the extent of condition review, the 'B' EDG fuel oil day tank was sampled and no indications of water, sediment, or particulates were identified. A trend review of the differential pressure across the in-service fuel oil filter did not identify any evidence of increasing differential pressure, thus providing assurance that the fuel oil reaching the 'B' EDG was clear of sediment. The 'A' EDG fuel oil storage tank was also sampled and results showed no unusual sediment present. Historic trends of particulates in the two EDG fuel oil storage tanks were also reviewed with no abnormal trends noted.

Residual Heat Removal System Leak

In April 2003, leakage near a RHR system flow orifice was discovered in the North Penetration Room. The source of the leak was determined to be a pipe plug on the pressure tap connections of the flow orifice. Further investigation determined that the pipe plug was fabricated from carbon steel and had evidence of corrosion. The installed pipe plug should have been fabricated from stainless steel as required by the engineering specifications.

The extent of condition review determined that the other three plugs associated with the flow orifice were correctly fabricated from stainless steel. However, examination of the similar flow orifice on the opposite RHR train identified two additional carbon steel plugs. The three carbon steel plugs were replaced with stainless steel plugs.

Walkdowns of the North Penetration Room, East Penetration Room, Charging Pump Room, safety injection pump area, containment spray pump area, and piping near the boric acid pumps were performed as part of the extent of condition review to inspect visible pipe plugs and caps for the evidence of carbon steel. No additional carbon steel caps or plugs were identified.

Extent of Condition Review for Aging Degradation of Copper-Based Heat Exchanger Tubes

Subsequent to a November 2005 hydrogen cooler tube leak, a root cause evaluation determined that the leak was a result of general aging of the soft copper-based tubes in a raw water environment. As a result of the conclusions of the root cause evaluation for this event, an extent of condition review was initiated to determine if other plant heat exchangers/coolers with copper-based alloy tubes in raw water systems could be susceptible to the same failure mechanism. Specifically, the scope of the review considered heat exchangers/coolers that were (1) safety-related or (2) whose failure would result in unit down-power or shutdown (i.e., heat exchangers/coolers necessary for power production).

The following factors were considered as part of the extent of condition review:

- Length of time in service - Equipment installed since original plant start-up or for an extended period of time were identified.
- Degradation management - Options such as tube plugging or inspections were evaluated to manage degradation.
- Replacement availability - The on-site availability of spare parts was reviewed to ensure they could be obtained if and when they were needed.

The following recommendations and corrective actions resulted from the review:

- Procure spare reactor vessel shroud fan coil units since these units are not monitored or inspected by current testing, tubes are unable to be plugged due to the design, and there are no spares available onsite. As a result of this recommendation, spare fan coil unit procurement has been initiated.
- Replace the cooling coils in the 1A and 1B heater drain pump motors, 1A and 1B condensate pump motors, and 1A and 1B circulating water pump motors on a 10-year frequency. Historically, the cooling coils for these motors have been managed as "run to failure" and the review determined that the cooling coils in the heater drain pump motors and condensate pump motors had previously failed. Although the circulating water pump motor cooling coils have not experienced

failures, the review indicated that failures can be anticipated in the future. As a result of this recommendation, replacement of the cooling coils has been added to the scope of the 10-year motor refurbishment.

'B' Emergency Diesel Generator Service Water Leak

In April 2006, a leak was discovered on the 'B' emergency diesel generator (EDG) service water supply piping elbow that directs cooling water to the jacket water heat exchanger. The 'B' service water train was declared inoperable and the plant was shutdown to replace the failed elbow.

A team of on-site and off-site experts was assembled to evaluate the failed elbow and determine the failure mechanism. The preliminary assessment determined that the failure was a result of general under-deposit corrosion aided by intermittent flow conditions.

The failed elbow was located in a normally isolated portion of the Service Water System. As part of an extent of condition review, Kewaunee piping inspections results, active work requests, corrective actions, open work orders, and industry operating experience was reviewed in order to identify the potential for this type of degradation on other dead-leg locations in the Service Water System. Ultimately, forty-one safety-related branch lines were identified that could potentially experience similar degradation.

The inspection history and replacement history of the forty-one pipe segments was compiled and reviewed. For each pipe segment, the remaining wall thickness was identified and projected seven years into the future in order to ensure through-wall leakage would not occur in the near-term. The results of the projections identified two sections of piping that required immediate replacement, two sections of piping that required replacement during the next refueling outage, and three segments that required replacement within three operating cycles.

Extent of Condition Review Due to 'A' EDG Fuel Oil Leak

In August 2006, the 'A' emergency diesel generator (EDG) was removed from service due to a leaking fuel oil fitting. The cause of the fitting failure was attributed to vibration resulting in fatigue cracking due to cyclic stresses. In addition to replacement of the failed fitting, a root cause evaluation recommended an extent of condition review of the EDGs and TSC diesel generator piping and tubing to identify locations that may be susceptible to failure due to vibration or work hardening. The scope of the review included engineering walkdowns of the fuel oil, lube oil, jacket cooling water, and starting air subsystems for these diesel engines. In addition to piping and tubing locations recommended for replacement, the walkdowns identified several additional components (e.g., check valves, flexible hoses, etc.) that also required replacement.

Summary of Operating Experience Review

The Work Control Process program inspections are implemented in accordance with the Kewaunee work management process. The work management process includes all surveillance procedures, preventive and corrective maintenance procedures, or other routinely scheduled tasks. Therefore, the program has a comprehensive scope, which provides the opportunity to visually inspect the internal surfaces of components constructed of typical system materials and exposed to typical system environments, including stagnant locations, on an ongoing basis.

The operating experience generated by the program is documented in condition reports and is evaluated by the Corrective Action Program. The Corrective Action Program evaluation determines the cause of the degradation, including aging, and identifies the appropriate corrective actions. Additional monitoring of the system, structure, or component prior to or during the period of extended operation is a possible corrective action and would be performed by the Work Control Process program. The Corrective Action Program also performs trending of condition reports to provide a method for recognizing declining performance, performance below acceptable standards, and performance strengths or improving trends. A condition report is initiated when potential adverse trends are identified.

Therefore, the condition reports evaluated by the Corrective Action Program, initiated by the Work Control Process program or by some other means, provide the information to periodically validate the scope and frequency of the inspections performed by the Work Control Process program.