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Dominion

April 1, 2005

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

Serial No.: 05-080
LR/RJG R0
Docket Nos.: 50-336
50-423
License Nos.: DPR-65
NPF-49

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNITS 2 AND 3
LICENSE RENEWAL APPLICATION – RESPONSE TO SAFETY EVALUATION REPORT (SER) WITH OPEN ITEMS

By letter dated February 24, 2005, Dominion received the "Safety Evaluation Report with Open Items Related to the License Renewal Applications for Millstone Power Station, Units 2 and 3." The "SER With Open Items" identified six (6) open items and six (6) confirmatory items. Attachment 1 to this letter provides responses to five (5) of the open items. Dominion continues to formulate the response to OI-4.7.3-1(a),the remaining open item, which will be included in our letter providing overall comments to the SER. Attachment 2 to this letter provides responses to the confirmatory items.

Should you have any questions regarding this letter, please contact Mr. William D. Corbin, Director, Nuclear Engineering, Dominion Resources Services, Inc., at (804) 273-2365.

Very truly yours,

Leslie N. Hartz
Vice President – Nuclear Engineering

Attachments:

1. Response to SER Open Items
2. Response to SER Confirmatory Items

A106

Commitments made in this letter:

This letter identifies License Renewal Commitments to be added to Table A6.0-1 of the Final Safety Analysis Report (FSAR) Supplement and is proposed to support approval of the renewed operating licenses. These commitments may change during the NRC review period. A revised FSAR Supplement which contains these commitments will be submitted to the staff as input to the Millstone License Renewal Safety Evaluation Report.

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SN: 05-080
Docket Nos.: 50-336/423
Subject: Response to SER Open Items

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 the Vice President – Nuclear Engineering, of Dominion Nuclear Connecticut, Inc. She has affirmed before me that she is duly authorized to execute and file the forgoing document in behalf of that Company, and that the statements in the document are true and correct to the best of her knowledge, information, and belief.

Acknowledged before me this 1st day of April, 2005.

My Commission Expires: 3/31/2008

Maggie McClure
Notary Public

(SEAL)

Attachment 1

Response to SER Open Items

Millstone Power Station Units 2 & 3

OI-2.1.3-1 (Section 2.1.3.1.1 - Application of the Scoping Criteria in 10CFR54.4(a))

In RAI 2.1-1, the staff requested additional information regarding the scoping methodology associated with the 10CFR54.4(a)(2) evaluation. The staff requested that the applicant define the term "first equivalent anchor point" as it relates to the evaluation of NSR piping attached to SR piping and describe the methodology of its application. Additionally, in cases where plant equipment credited with providing support to NSR piping within the scope of license renewal may be equivalent to an associated piping anchor as described in NUREG-1800, the staff requested that the applicant provide justification for not including this plant equipment within the scope of license renewal. The applicant's November 9, 2004, response to the RAI stated that for the purpose of license renewal, the first equivalent anchor is defined as when the piping has been restrained in each of the three orthogonal directions. The response also recognized that, in some cases, plant equipment may be credited as providing restraint in one or more directions in the piping system seismic evaluation. Dominion stated that in these cases, the credited components are also included within the scope of license renewal. The applicant applied the following six criteria in the determination of the license renewal boundary endpoints for NSR piping attached to SR piping. However, the staff has concerns with the criteria's consistency with the CLB and whether the criteria established by the applicant would conservatively bound the equivalent anchor. This is Open Item 2.1.3-1.

Dominion Response

As stated in the response to RAI 2.1-1 by letter dated November 9, 2004, Serial Number 04-673, because the specific review of seismic evaluations for each of the Safety Related/Non-Safety Related (SR/NS) piping interfaces would be labor intensive, bounding criteria were developed and applied to the scoping process. The bounding criteria provided assurance that the license renewal (LR) scoping boundary would envelop the scope of the NS piping system included in the design basis seismic analysis, consistent with the current licensing basis.

The following additional basis is provided for the criteria applied in the determination of the LR boundary endpoints for NS piping attached to SR piping:

- Criterion 1: The LR boundary endpoint is established where the NS piping terminates at plant equipment that is mounted to a baseplate supported by a structure or mounted to a foundation (base-mounted component).

  Basis: A base-mounted component would either constitute an analysis endpoint as an anchor, or would be restricted from significant loading to or from the piping system based on the load carrying capacity of the component (such as a thin-walled tank). In the first case, the analysis endpoint and the LR boundary endpoint coincide such that the LR boundary envelops the analysis. For the second case, since the equipment is mounted to the structure and component loading is limited based on the component design, significant reactions cannot be transmitted to the piping system. The piping system support design would be required to provide adequate support prior to the component nozzle attachment. Therefore, the analysis endpoint is established prior to the piping system reaching the equipment nozzle, and the LR boundary (which includes the base-mounted component) envelops the analysis.

When the LR boundary endpoint is established at a base-mounted component, the base-mounted component and supporting structure are included in the scope of license renewal.

- Criterion 2: The LR boundary endpoint is established where the NS piping system ties into a SR piping system or returns to a SR classification.

  Basis: This constitutes an LR boundary endpoint of the NS piping system since the SR piping system is included in scope per 10CFR54.4(a)(1). Including the NS piping system in scope up to the transition back to an SR piping system ensures that the analysis endpoint is enveloped.

- Criterion 3: The LR boundary endpoint is established at flexible connections in the NS piping system. Flexible connections include expansion joints and flexible hoses that effectively decouple the piping system.

  Basis: Expansion joints and flexible hoses are designed such that significant piping system loads are not transferred across the connection. For this reason, the piping system is adequately supported to allow analysis endpoints to be established prior to the flexible connection. Therefore, establishing the LR boundary endpoint at flexible connections ensures that the analysis endpoint is enveloped.

- Criterion 4: The LR boundary endpoint is established where a direct-buried portion of a NS piping run returns above-grade such that the buried portion is included within the boundary.

  Basis: Buried portions of piping runs are considered anchor points in the piping analyses. Buried piping at Millstone is well founded on compacted soil. In addition, as discussed in Millstone Unit 2 FSAR Section 2.7.6 (and Millstone Unit 3 FSAR Section 2.5.4.8), the soil is not susceptible to liquefaction.

  Since the analysis would consider the buried portion of piping as an anchor point, the establishment of the LR boundary endpoint where the piping run returns to above-grade ensures that the analysis endpoint is enveloped.

- Criterion 5: The LR boundary endpoint is established where a NS piping run reduces to smaller diameter piping such that the area moment of inertia of the NS piping at the SR/NS interface is at least ten times greater than the smaller diameter piping.

Basis: The smaller diameter piping load carrying capacity is significantly less than that of the larger piping such that the larger piping is not adversely affected by the smaller line loads. The moment of inertia factor of ten is consistent with the Millstone piping analysis design basis for establishing analysis endpoints. Therefore, establishing the LR boundary endpoint using this criterion ensures that the analysis endpoint is enveloped.

- Criterion 6: The LR boundary endpoint is established at the free end of a NS piping run, such as a drain pipe that ends at an open floor drain.

  Basis: The piping analysis cannot continue past a free end of the piping run. Therefore, establishing the LR boundary endpoint at the free end of the NS piping run ensures that the analysis endpoint is enveloped.

As discussed in the response to RAI 2.1-1-A, these conservative criteria provide assurance that the NS piping up to, and including, the analyzed anchor point is included within the license renewal boundary. However, in some cases, this bounding approach resulted in an overly conservative license renewal boundary determination. On a case-by-case basis, specific piping analyses and/or isometric piping drawings were reviewed to determine the LR boundary based on the design basis analysis endpoint or the location of a piping anchor (or equivalent anchor). In a limited number of instances, when review of analyses or isometric drawings was not feasible, plant walkdowns were performed to determine the location of the piping anchor (or equivalent anchor).

In response to NRC staff concerns, the definition of an equivalent anchor to be used for the purposes of identifying the NS piping in the scope of license renewal during the case-by-case reviews has been changed to be two restraints in each of the three orthogonal directions. A review has been performed to apply this equivalent anchor definition to the cases where the LR boundary endpoint was previously determined through piping analysis/isometric drawing review or plant walkdown. As a result, the LR boundary has been extended where necessary to include additional supports and portions of piping systems. However, there are no additional component types as a result of these boundary extensions and no changes to the information previously supplied in response to RAI 2.1-1-A.

To reiterate, this bounding criteria approach provides for the determination of license renewal boundary endpoints that are at or beyond the location of the anchor point used in the design basis seismic analysis for NS piping that is attached to SR piping. The associated piping, supports, and plant equipment up to, and including, the license renewal boundary endpoints are included in the scope of license renewal.

<u>OI-3.0.3.2.18-1</u> (Section 3.0.3.2.18 - Bolting Integrity Program)

The applicant states that the bolting integrity program is consistent with the aging management program described in GALL AMP XI.M18, with the following exception related to loss of preload. The applicant states that the operating temperature for all other in scope bolted connections are well below the threshold temperature at which stress relaxation of pressure boundary bolting would occur. The staff finds that other factors such as vibration can contribute to loss of preload. The applicant needs to address other factors which can contribute to loss of preload and justify if loss of preload is an aging effect requiring management for all bolting within the scope of license renewal. This is Open Item 3.0.3.2.18-1.

<u>Dominion Response</u>

The Millstone Bolting Integrity AMP was provided in response to RAI 3.3.11-A-1 that was included in the Dominion letter to the NRC dated December 3, 2004, Serial Number 04-720. The Bolting Integrity AMP manages aging effects for all bolting within the scope of license renewal. As described in the Bolting Integrity AMP, the procedures for proper disassembly, inspection, and assembly of bolted joints are based on the recommendations delineated in EPRI Document NP-5067, "Good Bolting Practices – A Reference Manual for Nuclear Power Plant Maintenance Personnel, Volume 1: Large Bolt Manual and Volume 2: Small Bolts and Threaded Fasteners."

Proper joint preparation and make-up in accordance with these good practices is expected to preclude loss of preload in low-temperature closure bolting applications where stress relaxation due to metallic creep is not a concern. Factors other than high-temperature stress relaxation that could contribute to a loss of preload in closure bolting applications, such as vibration, should not result in significant loosening in a properly assembled bolted joint. A review of Millstone Unit 2 and Unit 3 operating experience has not identified vibration-related loosening of properly installed closure bolting. The loosening of closure bolting due to operating conditions such as significant vibration is considered an event-driven occurrence caused by inadequate joint design or improper fastener installation rather than an age-related phenomenon.

However, in response to the NRC staff concerns with loss of preload, the Bolting Integrity AMP has been modified to include management of loss of preload for closure bolting applications subject to significant vibration in addition to the ASME Class 1 applications. The description of the Bolting Integrity AMP in the FSAR Supplement has also been modified to include management of loss of preload for closure bolting subject to significant vibration and is provided in the response to CI-3.0.3.2.18-1.

<u>OI-3.0.3.2.18-2</u> (Section 3.0.3.2.18 - Bolting Integrity Program)

The procedures for ensuring bolting integrity at Millstone identify inspection requirements and general practices for in scope bolting that are consistent with the bolting recommendations identified in Section XI.M18, but do not directly reference EPRI NP-5769 or NUREG-1339 as applicable source documents for these recommendations. However, the Millstone procedures do reference and incorporate the good bolting practices identified in EPRI NP-5067. EPRI NP- 5769 and EPRI NP-5067 are very closely related documents that cross-reference one another and reference NUREG-1339. The staff requests clarification on how the guidance in EPRI NP- 5067 and EPRI NP-104213 meet the intent of EPRI NP-5769 and NUREG-1339 as identified in GALL AMP XI.M18. This is Open Item 3.0.3.2.18-2.

<u>Dominion Response</u>

The Millstone Bolting Integrity program is consistent with the recommendations identified in NUREG-1801, Section XI.M18. The recommendations are addressed by following the comprehensive good bolting practices established in EPRI NP-5067, Volume I (Large Bolt Manual) and Volume II (Small Bolt Manual). Although not directly referenced in Section XI.M18, the recommendations of EPRI NP-5067 form an integral part to those documents that are referenced in Section XI.M18. Generic Letter 91-17 and its enclosure NUREG-1339 (both referenced in Section XI.M18) were issued to provide guidance for addressing GSI-29, "Bolting Degradation or Failure in Nuclear Power Plants." The generic letter identifies that implementing the recommendations in the EPRI NP-5067 (used by Millstone) and EPRI NP-5769 "Degradation and Failure of Bolting in Nuclear Power Plants," Volumes 1 and 2, (with exceptions identified in NUREG-1339) will significantly improve safety and reduce costs. EPRI NP-5067 and EPRI NP-5769 similarly address those recommendations identified in Section XI.M18 for a comprehensive bolting program. In fact, EPRI NP-5769, Volume 2, Section 8, "Good Bolting Practices" and NUREG-1339, Section 2.2.2, "Supporting Data for the Resolution" defer to EPRI NP-5067 for the identification of bolting practices associated with disassembly and assembly of bolted joints, and the methods for minimizing bolted joint problems such as leaks, vibration loosening, fatigue, and stress corrosion cracking. EPRI NP-5067 has been identified as the basis for bolting integrity in other license renewal applications (such as ANO I and II), and considered to be acceptable to the staff.

EPRI NP-5769 provides guidance for engineers to address plant-specific bolting and fastener issues. Volume 1 provides the background information, task group action plan, approach to issue resolution, and the specific conclusions and recommendations (Section 11). Volume 2 compiles detailed research results, and provides a more complete reference source and data for the topics addressed. Both Volume 1 and 2 of EPRI NP-5769 refer to EPRI NP-5067 for the identification of good bolting practices that resulted from the recommendations and conclusions reached. NP-5769 (Volume 1), Section 11, "Conclusions and Recommendations, Bolting Practices" (Page 11-6), summarizes the conclusions reached and the recommended resolution of the bolting issue. This section specifically references NP-5067 (Volume 1 and 2) for identifying specific remedies to the issues described in EPRI NP-5769, Volume 1 and 2. EPRI NP-5769 (Volume 2), Section 8, "Good Bolting Practices" (Page 8-1), defers to NP-5067 (Volume 1 and 2) for the bolting practices, which help to "identify, understand, and solve or minimize bolted joint problems, such as leaks, vibration loosening, fatigue, and stress corrosion cracking."

The following table provides a comparison between EPRI NP-5769 and EPRI NP-5067, Volume 1 (Large Bolt Manual), and Volume 2 (Small Bolt Manual) based on the recommendations found in NUREG-1801, Section XI.M18, "Bolting Integrity." The table identifies those bolting integrity recommendations identified in NUREG-1801, Section XI.M18, "Bolting Integrity," that are either directly referenced to EPRI NP-5769, or do not specifically reference the corresponding source document. NP-5067, Volumes 1 and 2, are nearly identical in format and content, with minor variations based on bolting size (e.g. the small bolt manual includes a discussion on set screw selection). Unless otherwise specified, the specific references in the table to EPRI NP-5067 (including page identification) are to Volume 1 (Large Bolt Manual)[1].As the Millstone Bolting Program is based on ASME Section XI and EPRI TR-104213 requirements, bolting recommendations identified in Section XI.M18 that are attributable to these source documents have been identified as such in this comparison.

In summary, the Millstone Bolting Integrity program is consistent with the recommendations identified in NUREG-1801, Section XI.M18. The point-by-point comparison of EPRI NP-5067 to NP-5769 (with respect to Section XI.M18 recommendations) demonstrates that EPRI NP-5067 provides the same information as NP-5769 for addressing the bolting integrity recommendations in Section XI.M18.

[1] The specific references in the table to EPRI NP-5067 (including page identification) are to Volume 1 (Large Bolt Manual). The NP-5067 sections referenced and information identified in the table are the same for both Volume 1 and 2 of the manual, although some page numbering may vary in Volume 2.

Comparison of EPRI NP-5769 and NP-5067 to Address NUREG-1801 Recommendations

NUREG-1801, XI.M18, "Bolting Integrity"	EPRI NP-5769 (Volumes 1 and 2) with Exceptions as Noted in NUREG-1339	EPRI NP-5067 (Volumes 1 and 2)
Program Description:		
o Periodic Inspection of closure bolting for indication of loss of preload, cracking, and loss of material.	Volume 1, Section 11 (Page 11-6), specifically references NP-5067 (Volumes 1 and 2) for identifying specific remedies to the issues described in NP-5769. Volume 2, Section 1 (Page 1-6) includes a definition for "Visual Inspection," which recommends that bolting be visually examined for physical damage and discontinuities. The examples of discontinuities include cracking. Volume 2, Section 8, (Page 8-1), defers to NP-5067 for the bolting practices, which help to "identify, understand, and solve or minimize bolted joint problems.	*Bolt Quality* (Page 62) identifies the criteria for visual inspection, which include cracks, rust (loss of material), damaged threads, etc. *Assembly Procedures* (Page 7) provides basic recommendations for procedural steps including performing visual inspections and specification of torque settings. *Assembly Procedures, Qualification* (Page 11) identifies that preloads developed at assembly must be sufficient to maintain joint integrity throughout the service life.

NUREG-1801, XI.M18, "Bolting Integrity"	**EPRI NP-5769 (Volumes 1 and 2) with Exceptions as Noted in NUREG-1339**	**EPRI NP-5067 (Volumes 1 and 2)**
Scope of Program:		
Guidelines for: o Material Selection and testing	Volume 1, Section 11 (Page 11-7) identifies *material considerations* including recommendations for replacement materials including the use of corrosion resistant alloys, and the material characteristics that should be considered in the evaluation process. Volume 2, Section 1 (Page 1-9) identifies requirements for replacement bolting materials, including the requirement that the material be equal to or more stringent than that for the original material. Volume 1, Section 11, "Conclusions and Recommendations, Bolting Practices" (Page 11-7), identifies ultrasonic testing as a new technology for making preload more accurate.	The following are examples of material considerations that are identified throughout this document for the proper material selection for bolting: *Corrosion* (Page 25) identifies that corrosion (loss of material) problems can be solved by replacing the fasteners with ones using more corrosion resistant materials. *Fatigue Failure, Materials* (Page 38) identifies recommendations for fatigue resistant materials and identifies the material properties that should be considered. *Bolt Quality* (Page 62) identifies that testing the hardness of bolts can be used to estimate their tensile strength, and that ultrasonic testing can be used to detect possible cracks or wastage. *Inspection of Bolted Joints* (Page 61) discusses types of preload testing including torque measurement testing, and the use of datum rods or ultrasonic testing to measure the reduction in length of bolting as they are loosened.

NUREG-1801, XI.M18, "Bolting Integrity"	EPRI NP-5769 (Volumes 1 and 2) with Exceptions as Noted in NUREG-1339	EPRI NP-5067 (Volumes 1 and 2)
Scope of Program: (Continued)		
o Bolting Preload Control	Volume 1, Section 11, "Conclusions and Recommendations, Bolting Practices" (Page 11-7), identifies that bolt preload is a bolting practice that deserves additional emphasis. The same discussion (Page 11-6) specifically references NP-5067 (Volumes 1 and 2) for identifying specific remedies to the issues described in NP-5769. Volume 1, Section 11, "Conclusions and Recommendations, Bolting Practices" (Page 11-7), also identifies the factors that can cause loss of preload such as creep, thermal cycling, vibration, etc., and technologies such as ultrasonic measurement which allow for more accurate measurement of preload.	*Preload, Loss of* (Pages 81-83) identifies the causes for loss of preload and provides recommendations for minimizing preload loss. *Inspection of Bolted Joints* (Page 61) discusses types of preload testing including torque measurement testing, and the use of datum rods or ultrasonic testing to measure the reduction in length of bolting as they are loosened. Preload Issues such as creep (Page 26), thermal effects (Page 117), and vibration loosening (Page 132) are addressed throughout the document. Page 4 includes a Table A for *Preload Accuracies* and identifies the use of Ultrasonics as one of the most accurate stretch control methods available for establishing preload.
o Inservice Inspection	Volume 2, Section 9, "Bolting Rules of the ASME Boiler & Pressure Vessel Code" (Page 9-1), identifies that the report attempts to catalog the bolting rules and comment on rules where appropriate, but no attempt was made to change or extend any portion of the code.	Millstone complies with the inservice examination requirements of ASME Section XI as identified in the "Bolting Integrity" Aging Management Program description. NP-5067 makes no attempt to change or extend code requirements.

NUREG-1801, XI.M18, "Bolting Integrity"	**EPRI NP-5769 (Volumes 1 and 2) with Exceptions as Noted in NUREG-1339**	**EPRI NP-5067 (Volumes 1 and 2)**
Scope of Program: (Continued)		
o Plant Operation and Maintenance	Volume 2, Section 8, (Page 8-1), defers to NP-5067 for the bolting practices, which help to "identify, understand, and solve or minimize bolted joint problems.	EPRI NP-5067, "*Good Bolting Practices*" is identified as "A reference Manual for Nuclear Power Plant Maintenance Personnel." The *Introduction* (Page 1) identifies that this document was written for those people who must disassemble and reassemble bolted joints in nuclear power plants, and describes practices which help to identify, understand, and solve or minimize bolted joint problems.
o Evaluation of Structural Integrity of Bolted Joints	Volume 2, Section 8, (Page 8-1), defers to NP-5067 for the bolting practices, which help to "identify, understand, and solve or minimize bolted joint problems.	*Assembly Procedures, Qualification, Operating Experience-Disassembly* (Page 13) includes criteria for assessing the condition of the joint components at disassembly and revising procedures as necessary.

NUREG-1801, XI.M18, "Bolting Integrity"	EPRI NP-5769 (Volumes 1 and 2) with Exceptions as Noted in NUREG-1339	EPRI NP-5067 (Volumes 1 and 2)
Preventive Actions:		
o Selection of bolting material	See **Scope of Program**, Material Selection and Testing	See **Scope of Program**, Material Selection and Testing
o Use of lubricants and sealants	Volume 1, Section 11, "Conclusions and Recommendations, Stress Corrosion Cracking" (Page 11-4), identifies that a common factor in several SCC related failures appears to be the use of lubricants containing molydisulfides. Volume 1, Section 11, "Conclusions and Recommendations, Stress Corrosion Cracking" (Page 11-5), identifies that the role of leak sealant compounds is not clear. Limit chemical data on sealants indicate variable compositions with respect to leakable contaminants such as fluorine, chlorine, and sulfur, which could promote SCC.	*Lubricants, Selection of Lubricants* (Page 71), identifies considerations for the selection of lubricants such as compatibility (including limitation of contaminants such as chlorides, fluorides, and sulfides that contribute to SCC), lubricity (nut factor), and service temperature. *Sealants* (Volume 1, Page 98) identifies considerations associated with the use of sealants, including those situations where leak sealants should not be used, and recommendations for proper leak sealing operations. *Stress Corrosion Cracking* (Page 106) identifies the use of molydisulfides should be avoided as they encourage SCC. This section also identifies that the use of sealants, which may release chlorides and sulphides, should be avoided.

NUREG-1801, XI.M18, "Bolting Integrity"	EPRI NP-5769 (Volumes 1 and 2) with Exceptions as Noted in NUREG-1339	EPRI NP-5067 (Volumes 1 and 2)
Preventive Actions: (Continued)		
o Check of bolt torque and uniformity of gasket compression after assembly	This Section XI.M18 recommendation is directly attributed to EPRI TR-104213, Section 4.3 (Page 4-4), "Frequency of Assembly and/or Inservice Inspections."	The following are examples of material considerations that are identified throughout this document for the proper material selection for bolting: *Assembly Procedures – General – Gasketed Joints* (Page 10) includes recommendations for flange alignment and gasket installation. *Assembly Procedures – Torquing* (Page 18) identifies torquing recommendations such as applying torque at a uniform rate, and torquing as many studs as possible simultaneously. Ensure that gaskets are compressed evenly (Use caliper measurements in four quadrants, if possible.) *Flange Rotation* (Page 41) recommends avoiding potential flange rotation, where the outer edges of a raised face flange are pulled towards each other (and the gasket is compressed unevenly).

NUREG-1801, XI.M18, "Bolting Integrity"	EPRI NP-5769 (Volumes 1 and 2) with Exceptions as Noted in NUREG-1339	EPRI NP-5067 (Volumes 1 and 2)
Preventive Actions: (Continued)		
o Hot torquing of bolting as a leak prevention once the joint is brought to operating temperature and before or after it is pressurized, and thus re-establishing preload before a leaks starts.	This Section XI.M18 recommendation is directly attributed to EPRI TR-104213, Section 5.3.2 "Hot Torquing" (Page 5-7).	The Millstone Bolting Program uses EPRI TR-104213 as a bolting program basis document.

NUREG-1801, XI.M18, "Bolting Integrity"	EPRI NP-5769 (Volumes 1 and 2) with Exceptions as Noted in NUREG-1339	EPRI NP-5067 (Volumes 1 and 2)
Parameters Monitored/Inspected:		
o Monitoring of the aging effects on the intended function of closure bolting, including loss of material, cracking and loss of preload	See the **Program Description** Section in this table for the discussion that addresses this item.	See the **Program Description** Section in this table for the discussion that addresses this item.
o High strength bolts (actual yield strength greater than or equal to 150 ksi) used in NSSS components are monitored for cracking.	Volume 1, Section 11, "Support and Embedment Bolting Degradation Due to Stress Corrosion Cracking" (Page 11-6), identifies that Utilities having bolting materials with specified yield strengths greater than 150 ksi may wish to review their individual applications for SCC. NUREG-1339 cautions that actual yield strengths should be used due to the susceptibility of high strength bolting to SCC and the fact that actual yield strengths can be much higher than the specified minimum yield strength. This Section XI.M18 recommendation is also attributed to EPRI TR-104213, Section 16.11.1, "Precautions, Bolting and Nut Materials" (Page 16-6), which more conservatively identifies that SCC for bolting with a minimum specified ultimate tensile strength (always above yield) greater than 150 ksi should be evaluated for the SCC. Also, Section 9.2.2, "Preventing and Analyzing Fatigue Failure" (Page 9-4), identifies a similar precaution.	*Materials* (Page 38) discusses the use of high strength bolting for fatigue resistance, but cautions against using too high of an ultimate tensile strength due to SCC considerations. An example is given where bolting with 160 ksi tensile strength (145 ksi yield) meets these criteria. *Stress Corrosion Cracking, Basic Techniques for Fighting SCC* (Page 105) identifies that limiting the hardness of fastener material to less than 40 HRC (Rockwell Hardness, Scale C) minimizes the potential for SCC. As stated on the top of Page 103, yield strengths usually run 65-80% of the ultimate tensile strength for different materials. The above discussions do not use the term "specified minimum," nor does the definition for *yield strength* on Page 135. The Millstone Bolting Program uses EPRI TR-104213 as a bolting program basis document.

NUREG-1801, XI.M18, "Bolting Integrity"	EPRI NP-5769 (Volumes 1 and 2) with Exceptions as Noted in NUREG-1339	EPRI NP-5067 (Volumes 1 and 2)
Parameters Monitored/Inspected: (Continued)		
o Bolting for pressure retaining components is inspected for signs of leakage.	This Section XI.M18 recommendation is directly attributed to EPRI TR-104213, Section 4.4.1 (Page 4-5), "Leak Inspections. "	The Millstone Bolting Program uses EPRI TR-104213 as a bolting program basis document.
o Structural bolting is inspected for indication of potential problems including loss of coating integrity and obvious signs of corrosion, rust, etc.	This Section XI.M18 recommendation is directly attributed to EPRI TR-104213, Section 12.2 (Page 12-2), "Inservice Inspections."	The Millstone Bolting Program uses EPRI TR-104213 as a bolting program basis document.

NUREG-1801, XI.M18, "Bolting Integrity"	EPRI NP-5769 (Volumes 1 and 2) with Exceptions as Noted in NUREG-1339	EPRI NP-5067 (Volumes 1 and 2)
Detection of Aging Effects:		
o Inspection requirements are in accordance with ASME Section XI.	See **Scope of Program:** Inservice Inspection for inspection requirements in accordance with ASME Section XI.	See **Scope of Program:** Inservice Inspection for inspection requirements in accordance with ASME Section XI.
o Inspection requirements are in accordance with the recommendations of EPRI NP-5769.	Volume 1, Section 1, "Introduction, Treatment and Preloading of Bolts and Threaded Fasteners," (Pages 1-11 through 1-16), identifies recommendations for assembly of bolted joints. These recommendations include various inspection steps such as checking for complete threading during *Thread Engagement* (Page 1-12), the seated surface should be visually inspected for defects such as radial scores as part of the *Flange Make-up Procedure* (Page 1-14), studs and nuts should be visually examined after cleaning to assure freedom from burrs during *Preparation of Bolting Material* (Page 1-15), and visual inspection during *Flange Alignment and Gasket Installation*, etc.	*Assembly Procedures, General - All Joints* (Pages 7,8) and *Assembly Procedures, General – Gasketed Joints* (Pages 9,10) provides basic recommendations for procedural steps including the performance of similar inspections during assembly/disassembly.

NUREG-1801, XI.M18, "Bolting Integrity"	EPRI NP-5769 (Volumes 1 and 2) with Exceptions as Noted in NUREG-1339	EPRI NP-5067 (Volumes 1 and 2)
Detection of Aging Effects: (Continued)		
o Structural bolting both inside and outside of containment is visually inspected. Degradation of this bolting may be detected and measured either by removing the bolt, proof test by tension or torquing, by in situ ultrasonic tests, or hammer test If bolting is found corroded, a closer inspection is performed to assess the extent of corrosion.	This Section XI.M18 recommendation is directly attributed to EPRI TR-104213, Section 13.1 (Page 13-1), "Field Conditions. "	The Millstone Bolting Program uses EPRI TR-104213 as a bolting program basis document.
Monitoring and Trending:		
o If bolting for pressure retaining components (not covered by ASME Section XI) is reported to be leaking, then it may be inspected daily. If the leak rate does not increase, the inspection frequency may be decreased to weekly or biweekly.	This Section XI.M18 recommendation is directly attributed to EPRI TR-104213, Section 4.3 (Page 4-4), "Frequency of Assembly and/or Inservice Inspections."	The Millstone Bolting Program uses EPRI TR-104213 as a bolting program basis document.

NUREG-1801, XI.M18, "Bolting Integrity"	**EPRI NP-5769 (Volumes 1 and 2) with Exceptions as Noted in NUREG-1339**	**EPRI NP-5067 (Volumes 1 and 2)**
Acceptance Criteria:		
o Indications of cracking in component support bolting warrant immediate replacement of the cracked bolt.	Volume 2, Section 8, (Page 8-1), defers to NP-5067 for the bolting practices, which help to "identify, understand, and solve or minimize bolted joint problems.	*Fatigue Failure, Inspect the Surfaces* (Page 36), identifies that fatigue cracks can start at minor defects, pits, cracks, or folds in the surfaces of the bolt. Inspect the surfaces of the bolt, and discard any with defects.
o For other pressure retaining components, a leak from a joint is immediately repaired if it is a major leak and causes adverse effect such as corrosion or contamination.	This Section XI.M18 recommendation is directly attributed to EPRI TR-104213, Section 4.4, "Inspection Criteria, Leak Inspections" (Page 4-5).	The Millstone Bolting Program uses EPRI TR-104213 as a bolting program basis document.
Corrective Actions:		
o Repair and replacement is in accordance with IWB-4000.	See **Scope of Program:** Inservice Inspection for inspection requirements in accordance with ASME Section XI.	See **Scope of Program:** Inservice Inspection for inspection requirements in accordance with ASME Section XI.

NUREG-1801, XI.M18, "Bolting Integrity"	EPRI NP-5769 (Volumes 1 and 2) with Exceptions as Noted in NUREG-1339	EPRI NP-5067 (Volumes 1 and 2)
Corrective Actions: (Continued)		
o Repair and replacement is in accordance with EPRI NP-5769.	Volume 1, Section 11, "Material Considerations" provides a discussion for considering the use of corrosion-resistant alloys that are less susceptible to boric acid corrosion. Other important considerations are also identified such as coefficients of thermal expansion and adequate fracture toughness.	The following are examples of material considerations that are identified throughout this document for the proper selection of bolting materials: *Corrosion, Solving Corrosion Problems* (Page 25) discusses the use of corrosion resistant materials. *Fatigue Failure, Materials* (Page 38) identifies important considerations for material properties when selecting replacement materials including, material strength, SCC susceptibility, elongation, through hardenability and notch strength. *Thermal Effects* (Pages 117-121) identifies material considerations to address thermal effects. Figure 35 of Volume 1 (Large Bolt Manual, Page 121) provides a graph, which identifies the stress relaxation in various bolt materials when they are subjected to high temperatures. The same information is in Figure 24 of Volume 2 (Small Bolt Manual). *Vibration Loosening* (Pages 132,133) identifies design/configuration changes that will help to prevent loss of preload due to vibration loosening.

<u>OI-3.1.2-6</u>:(Section 4.1.2.4.2 - Reactor Vessel Internals)

Leakage flow past the inner reactor vessel flange O-ring is limited in the event of seal failure by the 3/16 inch-diameter hole in the reactor vessel flange, which is smaller than the inside diameter of the leak detection line. Additionally, the potential flowrate through the 3/16 inch- diameter hole in the flange is within the normal make-up capability of the chemical and volume control system such that the leak detection system does not constitute the reactor coolant system (RCS) pressure boundary. The failure of the leak detection system components has been evaluated and cannot affect the function of safety related systems, structures or components. As such, the applicant has determined that the reactor vessel flange seal leak detection system, including the leak detection line, does not meet the criteria of 10CFR54.4(a) and is not within the scope of license renewal. Therefore, the system is not subject to aging management review and there is no aging management program applicable to the leak detection line. The staff review to determine if this is acceptable is not yet complete. This is Open Item 3.1.2-6.

<u>Dominion Response</u>

As described in LRA Section 3.1.2.2.7.1, and in response to RAI 3.1.2-6A in the letter dated December 3, 2004, Serial Number 04-720, the reactor vessel flange leak detection system components do not perform an intended function in accordance with 10CFR54.4(a) and, therefore, were determined not to be within the scope of license renewal. However, in response to NRC staff concerns that the leak detection system components should be included in scope based on the inclusion of these components in NUREG-1801, Dominion has included the leak detection components within the scope of license renewal.

The leak detection system consists of piping, tubing, and valves that are long-lived, passive components and are consistent with the existing component types in the Reactor Coolant System included in LRA Table 2.3.1-3. These stainless steel components are exposed to a treated water environment and are managed for loss of material and cracking aging effects by the Chemistry Program for Primary Systems AMP and the Inservice Inspection Program: Systems, Components, and Supports as indicated for piping, tubing, and valves component types in LRA Table 3.1.2-3. Note that the loss of fracture toughness aging effect listed in Table 3.1.2-3 is not applicable to these valves since the valves are not cast austenitic stainless steel (CASS).

<u>OI-4.7.4-1</u> (Section 4.7.4 - Reactor coolant system piping leak-before-break)

The applicant reviewed and found the number and characteristics of cycles identified in CEN- 367-A to be acceptable for the period of extended operation for the RCS piping at Millstone Unit 2. However, the applicant should identify what other systems or sections of piping are covered by leak-before-break (LBB) analyses and if the analyses are applicable for the period of extended operation. The applicant should provide documented justification that the LBB analyses for systems covered by LBB analyses remain valid for the period of extended operation. The applicant should also provide justification that the analyses have been projected to the end of the period of extended operation or that the effects of aging on the intended functions of the systems covered by LBB analyses will be adequately managed for the period of extended operation. The applicant should also update the FSAR supplement as appropriate. In addition for Unit 3, if other piping, other than the RCS primary loop piping, is covered by LBB analyses, the applicant should address the analyses in accordance with 10CFR54.21(c)(1). This is Open Item 4.7.4-1.

<u>Dominion Response</u>

Additional information related to the LBB TLAA evaluation that corresponds to this Open Item was provided by the letter dated February 8, 2005, Serial Number 05-047. In the February 8, 2005 letter, a response to questions received via NRC staff e-mail dated January 5, 2005 was provided. Updates to the FSAR Supplement to include the submitted information is provided in response to Confirmatory Item 4.7.4-1 in Attachment 2 of this current letter.

Attachment 2

Response to SER Confirmatory Items

Millstone Power Station Units 2 & 3

<u>CI-3.0.3.2.18-1</u>

The staff finds that the resolution of Open Items 3.0.3.2.18-1 and 3.0.3.2.18-2 may warrant a modification to the FSAR. This issue is identified as Confirmatory Item 3.0.3.2.18-1.

<u>Dominion Response</u>

To support the response for OI-3.0.3.2.18-1, the Program Description in LRA Appendix A, "FSAR Supplement," Sections A2.1.25 (for Unit 2) and A2.1.25 (for Unit 3) has been revised as follows:

> The Bolting Integrity Program corresponds to NUREG-1801, Section XI.M18, "Bolting Integrity." The program manages the aging effects of cracking and loss of material for all in scope closure bolting. Additionally, the aging effect of loss of preload is managed for ASME Class I bolting and in scope closure bolting subject to significant vibration.

Consistent with the response for OI-3.0.3.2.18-2, no FSAR Supplement changes are required.

CI-3.1.3-3 (Section 3.1.2.2.7 - Crack Initiation and Growth Due to Stress Corrosion Cracking (SCC) or Primary Water Stress Corrosion Cracking (PWSCC))

The applicant stated in Section 4.3.1 of the Millstone Unit 3 LRA that the CASS pressurizer spray head assembly has been evaluated for susceptibility to thermal embrittlement using the guidance and information contained in EPRI Report TR-106092. In addition, the applicant stated that acceptable results employing applicable loads (e.g., thermal cycles) and material properties have been calculated over the 60-year license renewal period. The staff notes that NUREG-1801, Section XI.M12, recommends the CASS material to be evaluated based on the criteria set forth in May 19, 2000 NRC letter to determine susceptibility to thermal aging embrittlement. The staff requests that the applicant confirm that the evaluation performed meets the guidelines of a May 19, 2000 NRC letter and NUREG-1801. If the evaluation does not conform to these guidelines, provide the results of an evaluation that meets the guidelines of the May 19, 2000 NRC letter and provides the information (i.e., Molybdenum content, casting method and percent ferrite) to confirm that the spray head satisfies the criteria in the staff's letter dated May 19, 2000. The applicant is also requested to discuss how this evaluation meets the requirements of 10CFR54.21(c)(1)(i), (ii) or (iii). This is Confirmatory Item 3.1.3-3.

Dominion Response

Dominion confirms that the evaluation performed meets the guidelines set forth in the referenced May 19, 2000 NRC letter as recommended in NUREG-1801, Section XI.M12. The approach used meets the requirements of 10CFR54.21(c)(1)(ii) as described in response to RAI 4.3.1-5 in the letter dated January 11, 2005, Serial Number 04-720A.

<u>CI-3.6-1</u> (Section 3.6.2.3 - AMR Results That Are Not Consistent With or Are Not Addressed In the GALL Report)

In its letter dated November 9, 2004, the applicant confirmed that it treats splices as an integral part of the cable and that non-EQ splices are included in commodity groups, "Conductors," and, "Insulation," in LRA Table 2.5.1-1. The associated aging management review results are included in Table 3.6.2-1. This commodity includes non-EQ cables installed in raw water or damp soil. The staff requested clarification of the statement in the LRA that the external environment would remain below 95 °F and therefore would not require an AMP. The applicants provide clarification regarding the effects of ohmic heating on the cable insulation. This is Confirmatory Item 3.6-1.

<u>Dominion Response</u>

The information requested in this confirmatory item, related to the effects of ohmic heating on the cable insulation, was provided in response to RAI 3.6-3 by letter dated January 11, 2005, Serial Number 04-720A.

CI-4.3-1 (Section 4.3 - Metal Fatigue)

The staff noted that the applicant provided usage factors for the low alloy charging and safety injection nozzles, whereas NUREG/CR-6260 indicates the highest environmental usage factors for the newer vintage Combustion Engineering plant occurred in the nozzle safe-ends. During an October 12, 2004, teleconference, the staff requested that the applicant clarify this issue. By letter dated February 8, 2005, the applicant responded to the request for additional information and indicated that the highest design cumulative usage factors (CUFs) for the Millstone Unit 2 safety injection and charging nozzles occurred in the low-alloy nozzles. However, the applicant also indicated that, using worst-case environmental factors for stainless steel, the calculated CUF for the Millstone Unit 2 charging nozzle safe-end is greater than the calculated CUF for the Millstone Unit 2 low-alloy nozzle. The applicant indicated that the environmental usage factor for the safe-end is less than 1.0 using the projected number of cycles for 60 years of plant operation. Since the applicant used projected cycles instead of design cycles to evaluate the charging nozzle safe-end, the applicant's FMP should incorporate these projected cycles in the program. This is Confirmatory Item 4.3-1.

Dominion Response

Cycle counting has been incorporated in the Millstone FMP and the projected cycles versus design cycles are now used in the evaluation of the charging nozzle safe-ends, with acceptable results through the period of extended operation.

CI-4.7.4-1

The staff also concludes that the FSAR supplement requires additional clarification to provide an adequate summary description of the evaluation of the TLAA for LBB, as required by 10CFR54.21(d). This is Confirmatory Item 4.7.4-1.

Dominion Response

The LRA Appendix A "FSAR Supplement" for Unit 2 and Unit 3 has been modified as indicated below to provide a summary description of the evaluation of the TLAA for LBB.

The LBB TLAA description in Millstone Unit 2 LRA Appendix A "FSAR Supplement" Section A3.6.4 has been replaced with the following:

> The Leak-Before-Break (LBB) analyses were evaluated as time-limited aging analyses (TLAAs) to determine that the analyses remain valid for the period of extended operation. The systems and components that have been analyzed for LBB include the reactor coolant loop piping (hot leg, cold leg, and crossover piping), the pressurizer surge line, and portions of the safety injection and shutdown cooling systems.
>
> The LBB analyses were determined to remain valid for the period of extended operation by evaluating the time-based inputs to the LBB analyses. Thermal aging of cast austenitic stainless steel (CASS) materials and fatigue crack growth calculations were determined to be time-based inputs as defined in 10CFR54.3 and required evaluation for the period of extended operation.
>
> The metal fatigue TLAA evaluations described in FSAR Section 15.3.2.1 conclude that design basis limits are not exceeded for ASME Class 1 components (which envelopes the components evaluated for LBB) through the period of extended operation.
>
> Thermal aging of CASS materials for components that have been evaluated for LBB has been evaluated as a TLAA since long-term exposure of CASS materials to reactor coolant system operating temperatures results in an increase in material hardness while its ductility, impact strength and fracture toughness decrease. Fracture toughness represents one of the more important design inputs in an LBB evaluation. The degree of reduction in CASS fracture toughness is dependent on the time of thermal exposure. However, the change in material properties due to thermal aging reaches a saturation value, after which material property changes resulting from additional thermal exposure are not significant. The evaluation of the

thermal aging of CASS material for the LBB evaluations consisted of a review to determine whether the fracture toughness value used in the analysis was conservative relative to the fully aged value for fracture toughness for the CASS components. The review concluded that the analysis values were either equal to or lower than the worst-case saturation (fully aged) values for fracture toughness in all cases. Therefore, since the CASS material property values used in current design basis LBB evaluations represent fully aged (saturation) values, and since these values would not change with further exposure time, the LBB evaluations are not affected by thermal aging of CASS materials for the period of extended operation.

As a result of the TLAA evaluation performed, the LBB analyses have been projected to remain valid throughout the period of extended operation, consistent with 10CFR54.21(c)(1), Option (ii).

The LBB TLAA description in Millstone Unit 3 LRA Appendix A, "FSAR Supplement" Section A3.5.3 has been replaced with the following:

The Leak-Before-Break (LBB) analysis was evaluated as a time-limited aging analysis (TLAA) to determine that the analysis remains valid for the period of extended operation. The reactor coolant system loop piping (hot leg, cold leg and crossover piping) has been evaluated for LBB.

The LBB analysis was determined to remain valid for the period of extended operation by evaluating the time-based inputs to the LBB analysis. Thermal aging of cast austenitic stainless steel (CASS) materials and fatigue crack growth calculations were determined to be time-based inputs as defined in 10CFR54.3 and required evaluation for the period of extended operation.

The metal fatigue TLAA evaluations described in FSAR Section 19.3.2.1 conclude that design basis limits are not exceeded for ASME Class 1 components (which envelopes the components evaluated for LBB) through the period of extended operation.

Thermal aging of CASS materials for components that have been evaluated for LBB has been evaluated as a TLAA since long-term exposure of CASS materials to reactor coolant system operating temperatures results in an increase in material hardness while its ductility, impact strength and fracture toughness decrease. Fracture toughness represents one of the more important design inputs in an LBB evaluation. The degree of reduction in CASS fracture toughness is dependent on the time of thermal exposure. However, the change in material properties due to thermal aging reaches a saturation value, after which material property changes resulting from additional thermal exposure are not significant. The evaluation of the thermal aging of CASS material for the LBB evaluations consisted of a review to determine whether the fracture toughness value used in the analysis was conservative relative to the fully aged value for fracture toughness for the CASS components. The review concluded that the analysis values were either equal to or lower than the worst-case saturation (fully aged) values for fracture toughness in all cases. Therefore, since the CASS material property values used in current design basis LBB evaluations represent fully aged (saturation) values, and since these values would not change with further exposure time, the LBB evaluations are not affected by thermal aging of CASS materials for the period of extended operation.

As a result of the TLAA evaluation performed, the LBB analysis has been projected to remain valid throughout the period of extended operation, consistent with 10CFR54.21(c)(1), Option (ii).

<u>**CI-B2.1.18-3**</u> (Section B2.1.18c - Nickel Alloy Nozzles and Penetrations (XI.M11 of NUREG- 1801))

The applicant stated that Millstone Unit 2 will follow industry efforts investigating the aging effects applicable to nickel-based alloys (i.e., PWSCC in Alloy 600 base metal and Alloy 82/182 weld metals) and identifying the appropriate aging management activities, and it will implement the appropriate recommendations resulting from this guidance. This commitment is identified in Appendix A, Table A6.0-1 License Renewal Commitments, Item 14.

In RAI B2.1.18-1, the staff requested that the applicant modify its commitment to state that the aging management activities to monitor the aging effects of nickel-based alloys will be submitted three years prior to the period of extended operation in order for the staff review and approval to determine whether the program demonstrates the ability to manage the effects of aging in nickel-based components pursuant to 10CFR54.21(a)(3). In addition, the applicant was requested to address how nickel-based components will be evaluated in terms of susceptibility to PWSCC.

The applicant, by letter dated December 3, 2004, modified its commitment to submit its program prior to the period of extended operation for staff review and approval. However, the staff requested the applicant commit to submit this program to the NRC for approval at least 24 months prior to entering the period of extended operation, not just prior to the period of extended operation. This is Confirmatory Item B2.1.18-3.

<u>Dominion Response</u>

In LRA Appendix A, "FSAR Supplement," Sections A2.1.18 and A2.1.22 for Unit 2 and Sections A2.1.17 and A2.1.21 for Unit 3, the commitment to follow industry efforts regarding nickel-based alloys has been modified to read:

> The revised program description will be submitted at least two years prior to the period of extended operation for staff review and approval to determine if the program demonstrates the ability to manage the effects of aging in nickel based components per 10CFR50.54.21(a)(3).

Additionally, the schedule for Table A6.0-1, Commitment 14 [Unit 2] and 15 [Unit 3], in LRA Appendix A, "FSAR Supplement" will be changed to:

> At Least Two Years Prior to the Period of Extended Operation.