Dominion Nuclear Connecticut, Inc.
Millstone Power Station
Rope Ferry Road
Waterford, CT 06385

Dominion

June 2, 2005

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Serial No.:	05-292
LR/DEA	R0
Docket Nos.:	50-336
	50-423
License Nos.:	DPR-65
	NPF-49

DOMINION NUCLEAR CONNECTICUT, INC. (DNC)
MILLSTONE POWER STATION UNITS 2 AND 3
ADDITIONAL INFORMATION IN SUPPORT OF
LICENSE RENEWAL APPLICATIONS

By letter dated April 1, 2005, Dominion provided the response to five (5) of the six (6) identified open items for the "Safety Evaluation Report with Open Items Related to the License Renewal Applications for Millstone Power Station, Units 2 and 3." Attachment 1 to this letter provides the response to OI-4.7.3-1(a), the remaining open item.

Supplemental information was also requested by the staff regarding responses previously provided by letters dated January 11, 2005 (S/N: 04-720A) and April 1, 2005 (S/N: 05-080). The supplemental responses are included as Attachment 2.

By letter dated December 3, 2004 (Serial No. 04-720), Dominion provided a response to RAI 3.5-3 in which settlement of the Unit 3 Containment structure was not considered a TLAA. As a result of further evaluation by Dominion, a supplemental response is being submitted as Attachment 3.

Should you have any questions regarding this letter, please contact Mr. William D. Corbin, Director, Nuclear Projects, Dominion Resources Services, Inc., 5000 Dominion Blvd., Glen Allen, VA, 23060.

Very truly yours,

E. S. Grecheck
Vice President – Nuclear Support Services

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Attachments:

1. Response to SER Open Item 4.7.3-1(a)
2. Supplemental Responses to Previous Open Item and Confirmatory Item Responses
3. Supplemental Response to Previous Request for Additional Information Response (RAI 3.5-3)

Commitments made in this letter:

None.

cc: U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, PA 19406-1415

Mr. V. Nerses
Senior Project Manager,
Millstone Unit 2
U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Mail Stop 8C2
Rockville, MD 20852-2738

Mr. G. F. Wunder
Project Manager, Millstone Unit 3
U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Mail Stop 8B1A
Rockville, MD 20852-2738

Mr. J. H. Eads
Senior Project Manager
U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Mail Stop 11F1
Rockville, MD 20852-2738

Mr. S. M. Schneider
NRC Senior Resident Inspector
Millstone Power Station

Honorable Wayne L. Fraser
First Selectman
P.O. Box 519
Niantic, CT 06357-0519

Mr. Stephen Page
Central VT PSC
77 Grove Street
Rutland, VT 06701

Honorable Andrea Stillman
CT State Senate
5 Coolidge Court
Waterford, CT 06385

Mr. Denny Galloway
Supervising Radiation Control Physicist
State of Connecticut – DEP
Division of Radiation
79 Elm Street
Hartford, CT 06106-5127

Honorable Christopher Dodd
US Senate
100 Great Meadow Road
Wethersfield, CT 06109

Ms. Catherine Marx
Governor's Eastern Office
P.O. Box 1007
171 Salem Turnpike
Norwich, CT 06360-1007

Mr. William Meinert
MMWEC
P.O. Box 426
Ludlow, MA 01056-0426

Honorable Elizabeth Ritter
CT House of Representatives
24 Old Mill Road
Quaker Hill, CT 06375

Honorable Ed Jutila
CT House of Representatives
23 Brainard Road
Niantic, CT 06357

Honorable Robert Simmons
US Congress
2 Courthouse Square
Norwich, CT 06360

Mr. Thomas Wagner
Town of Waterford
Town Planner
15 Rope Ferry Road
Waterford, CT 06385

Dr. Edward L. Wilds
Director, Division of Radiation
State of Connecticut – DEP
79 Elm Street
Hartford, CT 06106-5127

Chairman Donald Downes
DPUC
10 Franklin Square
New Britain, CT 06051

Honorable Dennis L. Popp
Chairman – Council of
Governments
Municipal Building
295 Meridian Street
Groton, CT 06340

Chief Murray J. Pendleton
Director of Emergency
Management
41 Avery Lane
Waterford, CT 06385-2806

Honorable Richard Blumenthal
Attorney General
55 Elm Street
Hartford, CT 06106-1774

Mr. John Markowicz
Co-Chairman – NEAC
9 Susan Terrace
Waterford, CT 06385

Mr. Evan Woolacott
Co-Chairman – NEAC
128 Terry's Plain Road
Simsbury, CT 06070

Honorable M. Jodi Rell
Governor
State Capitol
Hartford, CT 06106

Mr. Mark Powers
4 Round Rock Road
Niantic, CT 06357
Mr. Jay Levin
23 Worthington Road
New London, CT 06320

Mr. Jim Butler
Executive Director – Council of
Governments
8 Connecticut Avenue
Norwich, CT 06360

Mr. Bill Palomba
Executive Director, DPUC
10 Franklin Square
New Britain, CT 06051

Honorable Ernest Hewett
CT House of Representatives
29 Colman Street
New London, CT 06320

Honorable Terry Backer
CT House of Representatives
Legislative Office Building
Room 2102
Hartford, CT 06106

Honorable Kevin DelGobbo
CT House of Representatives
83 Meadow Street
Naugautuck, CT 06770

Honorable Thomas Herlihy
CT Senate
12 Riverwalk
Simsbury, CT 06089

Honorable Cathy Cook
CT Senate, 18th District
43 Pequot Avenue
Mystic, CT 06355

Mr. Edward Mann
Office of Senator Dodd
Putnam Park
100 Great Meadow Road
Wethersfield, CT 06109

Chairperson Pam Katz
CT Siting Council
10 Franklin Square
New Britain, CT 06051

Mr. Ken Decko
CBIA
350 Church Street
Hartford, CT 06103

Honorable Paul Eccard
First Selectman
Town of Waterford
15 Rope Ferry Road
Waterford, CT 06385

Mr. Richard Brown
City Manager
New London City Hall
181 State Street
New London, CT 06320

Honorable Jane G. Glover
Mayor, New London
New London City Hall
181 State Street
New London, CT 06320

SN: 05-292
Docket Nos.: 50-336/423
Subject: Additional Information in Support of License Renewal Applications

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Eugene S. Grecheck, who is the Vice President – Nuclear Support Services, of Dominion Nuclear Connecticut, Inc. He has affirmed before me that he 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 his knowledge, information, and belief.

Acknowledged before me this 2nd day of June, 2005.

My Commission Expires: May 31, 2006

Vicki L. Hull
Notary Public

(SEAL)

Attachment 1

Response to SER Open Item 4.7.3.-1(a)

Millstone Power Station Units 2 and 3
Dominion Nuclear Connecticut, Inc.

OI 4.7.3-1(a)

In response to RAI 4.7.3-1(a), the applicant stated that a fracture mechanics evaluation, performed as a part of a Combustion Engineering Owners Group CEN-412, Revision 2, Supplement 2 activity, has been performed for the Millstone Unit 2 reactor coolant pumps (RCPs). The applicant also stated that for Millstone Unit 2, the limiting end-point crack size is 0.39t, significantly greater than the 1/4t flaw postulated in ASME Code Case N-481. The time for the Millstone Unit 2 RCP casing to reach the limiting end-point crack size is projected to be 103 years. To confirm the methodology and fracture mechanics results, the applicant was requested to provide the fracture mechanics evaluation. In a follow-up response, dated February 8, 2005, the applicant stated that the material's composition was not available and therefore the aged fracture toughness was determined using the procedure outlined in Section 3.1 of NUREG-4315, Rev.1. This approach produced the lower bound aged fracture toughness value that was used in the evaluation. The staff requests the applicant to provide this lower bound aged fracture toughness value that was calculated and the following information:

- Is the CASS material ASTM A351?
- What is the material grade?
- What is the casting method?
- What is the service temperature?
- What is the ferrite content and how was it determined?

The applicant also stated in the February 8, 2005, response letter that a conservative LEFM analysis was used and the acceptance criteria for the LEFM analysis approach was consistent with IWB-3610 of Section XI of the ASME Code. To verify this evaluation, the staff requests the following:

- limiting stress
- limiting transient
- maximum flaw size calculated vs. the critical flaw size
- stress intensity factors (KI, KIA, and KIC)
- summary of the evaluation and how the stresses were determined

This is Open Item 4.7.3-1(a).

Dominion Response:

The response to RAI 4.7.3-1(a) provided in the letter dated April 1, 2005 (Serial No. 05-047) addressed the fracture mechanics evaluation for both the Unit 2 RCP casings and the Unit 3 pressurizer spray head assembly. The SER with Open Items addressed the fracture mechanics evaluations for these two components as separate items. Specifically, the Unit 2 RCP casings fracture mechanics evaluation was addressed in

Open Item 4.7.3-1(a) and the Unit 3 pressurizer spray head assembly fracture mechanics evaluation was addressed in CI-3.1.3-3. Therefore, the response for these two components are addressed separately. The response to Open Item 4.7.3-1(a) is provided below and the supplemental response to CI-3.1.3-3 is provided in Attachment 2 of this letter.

Unit 2 RCP Casings

In its LRA submittal of January 2004, Dominion identified a TLAA for the Millstone Unit 2 Reactor Coolant Pump (RCP) casing CASS material. As a result of the NRC staff's review of the submittal and subsequent RAIs, Dominion is supplementing the LRA for the Millstone Unit 2 RCP casings, to identify and credit ASME Section XI inspections including the alternative requirements in Code Case N-481. As described in Section XI.M12 of the GALL Report, if the inspections required by the Code (including those required by Code Case N-481) are used to manage the aging of the RCP casings [i.e., 10 CFR 54.21 (c)(1), Option (iii)], screening for susceptibility to thermal aging embrittlement is not required, based on the assessment documented in a letter from Christopher Grimes (NRC) to Douglas Walters (NEI) dated May 19, 2000. Section XI.M12 of the GALL states that "The staff's conservative bounding integrity analysis shows that thermally aged CASS valve bodies and pump casings are resistant to failure. For all pump casings and valve bodies greater than nominal pipe size (NPS) 4 in., the existing ASME Section XI inspection requirements, including the alternative requirements of ASME Code Case N-481 for pump casings, are adequate". Therefore, consistent with GALL and in accordance with 10 CFR 54.21 (c)(1), Option (iii), aging of the reactor coolant pump casing will be adequately managed through the period of extended operation through inspections performed under the "Inservice Inspection Program: Systems, Components and Supports" aging management program.

Attachment 2

Supplemental Responses to Previous Open Item and Confirmatory Item Responses

Millstone Power Station Units 2 and 3
Dominion Nuclear Connecticut, Inc.

OI-3.0.3.2.18-1 (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.

Dominion Response: (provided in Dominion letter 05-080 on April 1, 2005)

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.

Supplemental Response:

As a result of further questions by the staff during an April 14, 2005 telephone conversation, Dominion is superseding the original response to Open Item 3.0.3.2.18-1 with this Supplemental Response.

Except as applied to ASME Class 1 bolting, loss of preload has not been identified as an aging effect requiring management for in-scope bolting, for Millstone Units 2 and 3. For all in-scope bolting, the Millstone Bolting Integrity Aging Management Program (AMP) follows the recommendations for good bolting practices described in NUREG-1801, Section XI.M18, and the corresponding industry documents. Millstone has established good bolting practices (such as proper preload control) in plant maintenance procedures for all in-scope bolting to preclude the potential for loss of preload as an aging effect requiring management.

As described in the Millstone Bolting Integrity Aging Management Program, plant procedures include requirements for the following:

- Proper disassembly, inspection, and assembly of connections with threaded fasteners
- Methods for minimizing bolted joint problems (e.g., vibration loosening)
- Guidelines for proper torquing (bolting preload control) as identified in NRC generic correspondence and industry recommendations.

Industry and plant operating experience indicate that loss of preload for bolted connections, other than Class 1 connections, is attributable to inadequate design or improper installation practices. Millstone has established good bolting practices (such as proper preload control) such that loss of preload need not be applied as an aging effect requiring management for in-scope bolting at Millstone Units 2 and Unit 3, other than as applied to ASME Class 1 bolting.

The related changes to the Bolting Integrity AMP description in the FSAR Supplement are provided in the Supplemental Response to CI-3.0.3.2.18-1.

CI-3.0.3.2.18-1

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.

Dominion Response: (provided in Dominion letter 05-080 on April 1, 2005)

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.

Supplemental Response:

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 to read as follows:

> "The Bolting Integrity Program corresponds to NUREG-1801, Section XI.M18, "Bolting Integrity". The program manages the aging effects of cracking, loss of material, and for ASME Class 1 bolting, loss of preload."

During the development of the supplemental response to OI-3.0.3.2.18-1, it was recognized that a clarification was required in LRA Appendix A for the Inservice Inspection Program: Systems, Components and Supports AMP. In the Program Description in LRA Appendix A, "FSAR Supplement", the last sentence of the first paragraph in Sections A2.1.18 for Unit 2 and A2.1.17 for Unit 3 should be modified. Specifically, the following statement:

> "Inservice Inspection Program: Systems, Components and Supports manages the aging effects of cracking, loss of fracture toughness, loss of material, and loss of pre-load."

should be replaced with the following statement:

> "Inservice Inspection Program: Systems, Components and Supports manages the aging effects of cracking, loss of fracture toughness and loss of material. Additionally, for Class 1 components only, the program manages the aging effect of loss of preload."

Consistent with the initial 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 in the evaluation meets the requirements of 10CFR54.21(c)(1)(ii), as described in the response to RAI 4.3.1-5 in the Dominion letter dated January 11, 2005, Serial Number 04-720A.

Supplemental Response:

In an e-mail dated March 24, 2005, the staff requested that the response to RAI 4.3.1-5, provided in Dominion letter dated January 11, 2005 (Serial No. 04-720A), be supplemented to include additional information. The response to this request for additional information is included in the Dominion Supplemental Response to RAI 4.3.1-5 that follows.

RAI 4.3.1-5 (initially received by email on December 12, 2004 and responded to in Dominion letter 04-720A on January 11, 2005)

The applicant stated in Section 4.3.1 of the Millstone Unit 3 LRA that the cast austenitic stainless steel pressurizer spray head assembly has been evaluated for susceptibility to thermal embrittlement using the guidance and information contained in ERPI 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 requires the CASS material to be evaluated based on the criteria set forth in the May 19, 2000, NRC letter to determine susceptibility to thermal aging embrittlement. This letter provided the staff's position on thermal aging embrittlement. The staff requests that the applicant confirm that the evaluation performed meets the guidelines of the 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 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 10 CFR 54.21(c)(1)(i), (ii) or (iii).

Supplemental Response:

Note: This supplemental response supercedes Dominion's original response to RAI 4.3.1-5, which was submitted in Dominion's January 11, 2005 letter (Serial Number 04-720A). In addition, the response to CI-3.1.3-3 (from Millstone's *SER With Open Items*, issued February 24, 2005), which was sent in Dominion's April 1, 2005 letter (Serial Number 05-080), has been modified to reference this response, instead of the original response to RAI 4.3.1-5.

In its LRA submittal of January 2004, Dominion identified a TLAA for the Millstone Unit 3 pressurizer spray head CASS material. The NRC staff's review of the submittal, the issuance of RAI 4.3.1-5, and follow-up emails and phone calls have clarified that the guidance contained in the staff letter to NEI, dated May 19, 2000, in addition to the guidance contained in EPRI Report TR-106092, "Evaluation of Thermal Aging Embrittlement for Cast Austenitic Stainless Steel Components in LWR Reactor Coolant Systems" should be used in analyzing the pressurizer spray head CASS material through the period of extended operation. Therefore, Dominion is supplementing the LRA for Millstone Unit 3 to identify how it intends to manage thermal aging of the pressurizer spray head through the period of extended operation.

Dominion has performed an initial crack growth evaluation for the Millstone Unit 3 pressurizer spray head to determine the growth over the period of extended operation in accordance with GALL Section XI.M12 "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)", Item 6 (Acceptance Criteria) and the Flaw Evaluation section of the staff letter to NEI, dated May 19, 2000. The evaluation utilizes unit specific information and NUREG/CR-4513 "Estimation of Fracture Toughness of Cast Austenitic Stainless Steels during Thermal Aging in LWR Systems". As stated in GALL Section XI.M12, the flaw tolerance evaluation for CASS components with ferrite values up to 25% is performed according to the principles associated with the ASME Boiler and Pressure Vessel Code Subsection IWB-3640 procedure for submerged arc welds (SAW) [disregarding the Code restriction of 20% ferrite in IWB-3641(b)(1)].

Dominion researched the ferrite content of its Millstone Unit 3 pressurizer spray head and determined that, in all likelihood, the ferrite content is <25%. This is based on discussions with the vendor and the statements contained in NUREG-4513. Therefore, Dominion performed its unit specific flaw tolerance evaluation based on this assumption. The evaluation yielded acceptable results for the pressurizer spray head, for the period of extended operation. While Dominion is confident of the results of this evaluation, it can not yet confirm the <25% ferrite content of the spray head with absolute certainty. Therefore, absent this confirmation, Dominion will conservatively manage thermal aging of the Millstone Unit 3 pressurizer spray head in accordance with 10 CFR 54.21(c)(1), Option (iii).

Consistent with GALL and in accordance with 10 CFR 54.21(c)(1), Option (iii), thermal aging of the pressurizer spray head will be adequately managed through the period of extended operation using either an enhanced volumetric examination or a unit or component specific flaw tolerance evaluation (considering reduced fracture toughness and unit specific geometry and stress information). This commitment is contained in Millstone Unit 3 LRA Appendix A "FSAR Supplement", Section A2.1.17, Inservice Inspection Program: Systems, Components and Supports, and in Millstone Unit 3 Appendix A, Section A6.0, Table A6.0-1 "License Renewal Commitments", Item 28.

As a result of this revised TLAA, the third paragraph of Section 4.3.1 of the Millstone Unit 3 LRA should say the following:

> "Dominion has performed an initial crack growth evaluation for the Millstone Unit 3 pressurizer spray head to determine the growth over the period of extended operation in accordance with GALL Section XI.M12 "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)", Item 6 (Acceptance Criteria) and the Flaw Evaluation section of the staff letter to NEI, dated May 19, 2000. The evaluation utilizes unit specific information and NUREG/CR-4513 "Estimation of Fracture Toughness of Cast Austenitic Stainless Steels during Thermal Aging in LWR Systems" information. As stated in GALL Section XI.M12, the flaw tolerance evaluation for CASS components with ferrite values up to 25% is performed according to the principles associated with the ASME Boiler and Pressure Vessel Code Subsection IWB-3640 procedure for submerged arc welds (SAW) [disregarding the Code restriction of 20% ferrite in IWB-3641(b)(1)].

While Dominion is confident in the results of this evaluation, it can not yet confirm the <25% ferrite content of the spray head with absolute certainty. Therefore, absent this confirmation, Dominion will conservatively manage thermal aging of the Millstone Unit 3 pressurizer spray head through the period of extended operation."

The conclusion for Millstone Unit 3 LRA Section 4.3.1 should say:

"The evaluations of these components represent time-limited aging analyses per 10 CFR 54.3 since the evaluations involve the use of time-limited assumptions such as thermal and pressure transients, and operating cycles. For all ASME Section III, Class 1 components, except for the pressurizer spray head, acceptable thermal and pressure transients, and operating cycles have been projected through the period of extended operation, consistent with 10 CFR 54.21(c)(1), Option (ii). Thermal aging of the pressurizer spray head will be managed, consistent with 10 CFR 54.21(c)(1), Option (iii), through implementation of the Inservice Inspection Program: Systems, Components and Supports. This commitment is identified in Appendix A, Table A6.0-1 "License Renewal Commitments", Item 28."

The last paragraph of Millstone Unit 3 LRA Appendix A, "FSAR Supplement", Section A3.2.1 has been replaced with the following:

"Except for the pressurizer spray head, acceptable thermal and pressure transients, and operating cycles have been projected for ASME Section III, Class 1 components, through the period of extended operation. Thermal aging of the pressurizer spray head will be managed through the period of extended operation.

"Actions To Be Taken

"Thermal aging of the pressurizer spray head will be managed by the Inservice Inspection Program: Systems, Components and Supports. This commitment is identified in Appendix A, Table A6.0-1 "License Renewal Commitments", Item 28."

Attachment 3

Supplemental Response to Previous
Request for Additional Information Response (RAI 3.5-3)

Millstone Power Station Units 2 and 3
Dominion Nuclear Connecticut, Inc.

RAI 3.5-3 (Unit 3)

In item number 3.5.1-08, the applicant asserts that settlement is not expected to occur during the period of extended operation. Further evaluation provided in Subsection 3.5.2.2.1.2 indicates that the containment and part of the engineering safety feature building foundation mats are sitting on porous concrete foundation. During years 1996-1997, it was revealed that drainage water through the porous foundation consisted of significant amount of high alumina cement, and that the applicant was monitoring depletion of cement and settlement of the affected structures (see NRC Info Notice 97-11). The applicant is requested to provide a summary of the quantitative assessment of the depletion of cement and its affects on the settlement of the structures during the period of extended operation. Also, the applicant is requested to justify why this item should not require a TLAA.

Dominion Response:

Dominion responded in a letter dated December 3, 2004 (S/N 04-720), by stating that it did not consider the Unit 3 containment subfoundation evaluation to be a TLAA. Even assuming the worst case situation, which represented by a complete loss of all concrete in the porous concrete subfoundation, the resultant change in frequency characteristics are within the uncertainty range allowed for the peak broadened spectra used in the design of the Containment structure.

Supplemental Response:

In response to a review of its project documentation in early 2005, Dominion determined that, although a specific time component was never identified for this particular evaluation, a time component could be inferred. Therefore, to be conservative, Dominion is supplementing its original response to RAI 3.5-3 to identify the Unit 3 Containment subfoundation evaluation as a TLAA.

The Section 4 description of this TLAA and the description that has been included in the FSAR Supplement are provided below.

Supplement to Section 4 of the Millstone Unit 3 LRA:

4.7.5 MILLSTONE UNIT 3 CONTAINMENT SUBFOUNDATION

Description

The Unit 3 Containment basemat is 10 feet thick and is supported by a subfoundation, which is founded on bedrock. The subfoundation consists of (from bottom to top): (1) a 10 inch layer of porous concrete made of Portland cement and coarse aggregate, (2) approximately 1/16-inch rubber waterproofing membrane, (3) a 2 inch layer of Portland cement (PC) mortar seal, (4) a 9 inch layer of porous concrete made of calcium aluminate cement and coarse aggregate [High Alumina Cement, or HAC layer], and (5) thin mortar seal. Six-inch diameter porous concrete pipes are installed in the HAC layer to collect and drain groundwater seeping around and below the foundation mat. This same subfoundation extends under a portion of the Engineered Safety Features (ESF) building, which is adjacent to the containment.

In 1987, Unit 3 identified cement constituents in the drainage system installed in the HAC layer of the Containment subfoundation. An evaluation determined that the rubber waterproofing membrane had developed leaks, which allowed for the ingress of water into the HAC layer. The station began monitoring and collecting white residue that was being deposited in collection sumps from the drainage system, to determine if further analysis was required.

In 1997, it was decided that the strength and deformation characteristics of the HAC layer should be further investigated. Core tests and plate bearing tests were conducted, along with additional testing on HAC mock-ups that were built to the same specifications as used in the original construction of the MP3 foundation.

Several core samples were removed from the HAC porous concrete layer in the subfoundation of the ESF Building, where a portion of the building subfoundation is the same as that for the Containment basemat. Tests were conducted on these samples to quantify the available margin in the bearing stresses below the Containment basemat for the current license period of 40 years. The average confined compressive strength of the sample cores removed from the HAC layer was 2,850 psi. The design basis value of 214.51 psi is less than 10% of the measured value. The measured deflection was only 0.001 inches at 214.51 psi. Thus, it was determined that the HAC porous layer would have adequate margin against failure under bearing stresses and there would be no concern about settlement due to crushing of the porous concrete for the current operating license (40 years) and beyond.

In situ testing of the basemat was also performed to determine the compressibility and bearing strength of the actual porous layers. The HAC porous layer was exposed by core drilling through the ESF Building floor mat. Vertical bearing stresses were applied by means of a hydraulic actuator mounted on a tripod with a load cell. The results of these tests showed very small deflections, on the order of 0.004 inches at a compressive stress of 1,500 psi, and no signs of damage or permanent deformations. Unit 3 is committed to continued monitoring of containment structure settlement, the groundwater chemistry and the amount of white residue in the ESF building sumps (including the sub-containment drainage piping in the sumps) to ensure the conclusions previously described remained valid.

In 2005, a condition assessment was performed to determine the acceptability of the Unit 3 containment subfoundation porous concrete layers for the period of extended operation. The assessment used the results of the condition assessment performed in 1997 and the findings of monitoring and surveillance through 2004.

Monocalciumaluminate (CA) is the main ingredient in HAC. Different hydration products are developed in the HAC, depending on the environmental temperature, with most of the hydration products developing during the first 24 hours of the placement of the concrete. However, at temperatures above 68°F, the hydration products of CAH10 and C2AH8 are not stable and convert to C3AH6 (forming the white residue collected in the sumps) and water. When the temperature drops below the threshold value of 68°F (after a nominal 40 days after placement) the conversion process slows significantly. Since the HAC layer has been submerged in groundwater, at low temperature, essentially ever since it was covered over during construction, little to no further conversion of the HAC layer would be expected. Therefore, the majority of the HAC residue collected in the ESF sumps was most likely formed during hydration of the Containment subfoundation.

Analysis of the white residue from the collection points in the ESF Building shows that the amount of residue collected is small (an average of approximately 85 lb per year, for the period 1987 through 2004). The amount of the residue that will be collected from plant construction through the period of extended operation was calculated using the following highly conservative assumptions: 1) a rate of removal of 100 lb per year, from 1975 to end of the period of extended operation, equating to 7,100 pounds, and 2) an additional total of 20,239 pounds of residue assumed to be occupying the full volume of the drainage pipes. The total loss, compared with the original 670,000 pounds (total weight of the two porous concrete layers), results in a nominal loss of 4.1% of the total weight of the porous concrete layers.

Computation of bearing stresses on the porous concrete surface showed that for a loss of even as much as 7.4% in foundation area (or volume), which is considered to be conservative, the bearing stress remains less than 10% of the tested strength of 2850 psi for the HAC layer. The amount of loss in this scenario bounds the projection of the total amount of white residue that is conservatively calculated to be collected from the construction of the plant through the period of extended operation.

At the conclusion of the extensive investigations and testing completed in 1997, Unit 3 was committed to monitor and trend the conditions of the Containment subfoundation. The resulting collected data has not revealed any evidence of structural settlement or sign of distress that could be related to weakening of the HAC layer. Additionally, chemical analyses have not produced results that would indicate a significant change in the groundwater environment.

Conclusion

The evaluation of the Millstone Unit 3 Containment subfoundation represents a time-limited aging analysis per 10 CFR 54.3 since it involves the use of time limited assumptions such as the maximum amount of calcium-alumina that can be leached over time from the HAC layer and still maintain adequate support for the containment basemat.

The structural integrity of the Millstone 3 (MP3) Containment subfoundation has been demonstrated through the period of extended operation. Consistent with 10CFR54.21(c)(1), Option (ii), the analyses have been projected to the end of the period of extended operation.

Description Included in the Millstone Unit 3 LRA FSAR Supplement:

A3.5.4 CONTAINMENT SUBFOUNDATION

The Unit 3 Containment basemat is 10 feet thick and is supported by a subfoundation, which is founded on bedrock. The subfoundation consists of (from bottom to top): (1) a 10 inch layer of porous concrete made of Portland cement and coarse aggregate, (2) approximately 1/16-inch rubber waterproofing membrane, (3) a 2 inch layer of Portland cement (PC) mortar seal, (4) a 9 inch layer of porous concrete made of calcium aluminate cement and coarse aggregate [High Alumina Cement, or HAC layer], and (5) thin mortar seal.

In 1987, Unit 3 identified cement constituents (calcium-alumina, which forms a white residue) in the drainage system installed in the HAC layer of the Containment subfoundation. An evaluation determined that the rubber waterproofing membrane had developed leaks, which allowed for the ingress of water into the HAC layer.

Core tests and plate bearing tests were conducted, along with additional testing on HAC mock-ups that were built to the same specifications as used in the original construction of the MP3 subfoundation.

Several core samples were removed from the HAC porous concrete layer in the subfoundation of the ESF Building, where a portion of the building subfoundation is the same as that for the containment basemat. Tests were conducted on these samples to quantify the available margin in the bearing stresses below the containment basemat, for the current license period of 40 years.

In 2005, a condition assessment was performed to determine the acceptability of the Unit 3 containment subfoundation porous concrete layers for the period of extended operation. Computation of bearing stresses on the porous cement surface showed that for a bounding loss of even as much as 7.4% in foundation area (or volume), the bearing stress remains significantly less than the tested strength of 2850 psi. The amount of loss in this scenario bounds the projection of the total amount of white residue that is conservatively calculated to be collected from the construction of the plant through the period of extended operation.

The evaluation of the Millstone Unit 3 containment subfoundation represents a time-limited aging analysis per 10 CFR 54.3 since it involves the use of time limited assumptions such as the maximum amount of calcium-alumina that can be leached over time from the HAC layer and still maintain adequate support for the containment basemat.

The structural integrity of the Millstone 3 (MP3) Containment subfoundation has been demonstrated through the period of extended operation. Consistent with 10CFR54.21(c)(1), Option (ii), the analyses have been projected to the end of the period of extended operation.