November 17, 2005

L-MT-05-114
10 CFR Part 54

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Monticello Nuclear Generating Plant
Docket 50-263
License No. DPR-22

Supplement to Responses to Requests for Additional Information Regarding the Monticello Nuclear Generating Plant License Renewal Application (TAC No. MC6440)

References:
1) NMC letter to NRC, "Application for Renewed Operating License," dated March 16, 2005 (ADAMS Accession No. ML050880241)

2) NRC letter to NMC, "Summary of a Telephone Conference Call Held On September 1, 2005, Between the U.S. Nuclear Regulatory Commission (NRC) and Nuclear Management Company, LLC, Concerning Information Pertaining to the Monticello Nuclear Generating Plant License Renewal Application," September 27, 2005 (ADAMS Accession No. ML052700456)

3) NRC letter to NMC, "Summary of a Telephone Conference Call Held On September 7, 2005," September 27, 2005 (ADAMS Accession No. ML052700227)

4) NRC Letter to NMC, "Summary of Telephone Conference Call Held on October 6, 2005," October 21, 2005 (ADAMS Accession No. ML052970210)

5) NRC Letter to NMC, "Summary of Telephone Conference Call Held on October 28, 2005," October 31, 2005

6) NRC Telephone Conference Call on November 4, 2005

Pursuant to 10 CFR Part 54, the Nuclear Management Company, (NMC) LLC submitted a License Renewal Application (LRA) (Reference 1) to renew the operating license for the Monticello Nuclear Generating Plant (MNGP).

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In telephone conference calls between the NRC and NMC held in September 2005 through November 2005 (References 2 – 6), the NRC requested supplemental information related to four previous Requests for Additional Information (RAIs):

- Grouted walls and buried pipe as seismic anchors (RAI 2.1-2)
- Aging effects of elastomers in air (RAI 3.3.2.3-8)
- Boral surveillance program (RAI 3.5.2.1.15-1)
- Emergency Filtration Train System bolting (B2.1.4-01)

Enclosure 1 provides the NMC responses to these NRC requests.

This letter contains no new commitments or changes any previous commitments.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on November 17, 2005.

John T. Conway
Site Vice President, Monticello Nuclear Generating Plant
Nuclear Management Company, LLC

Enclosure

cc: Administrator, Region III, USNRC
Project Manager, Monticello, USNRC
License Renewal Project Manager, Monticello, USNRC
Resident Inspector, Monticello, USNRC
Minnesota Department of Commerce
Pillsbury, Winthrop, Shaw, Pittman; LLP (David Lewis)

ENCLOSURE 1

MONTICELLO NUCLEAR GENERATING PLANT
LICENSE RENEWAL APPLICATION SUPPLEMENT RESPONSES TO REQUESTS FOR ADDITIONAL INFORMATION RAI 2.1-2, RAI 3.3.2.3-8, RAI 3.5.2.1-15, and RAI B2.1.4-01

A. NRC RAI 2.1-2: Grouted Walls and Buried Pipe as Seismic Anchors

The original RAI stated:

Based on the staff's review of the applicant's scoping evaluation related to the 10 CFR 54.4a(2) criterion, the staff requires additional information to complete its review. Specifically, the staff requests the applicant:

(a) Provide the technical basis for establishing the grouted wall penetrations as an equivalent anchor location; and

(b) Verify that non-grouted wall penetrations were not used as equivalent anchor locations for NSR piping systems connected to SR piping systems.

The U.S. Nuclear Regulatory Commission staff (the staff) and representatives of Nuclear Management Company, LLC (NMC), held a telephone conference call on September 7, 2005, to discuss and clarify the applicant's response to request for additional information, RAI 2.1-2, provided in a letter dated August 16, 2005, concerning the Monticello Nuclear Generating Plant license renewal application. The following issues were discussed during the telephone conference call.

1. The applicant was requested to provide technical justification for using the ground as a seismic anchor. The applicant was also requested to discuss where the use of the ground as a seismic anchor is detailed in their site procedures.

NMC Response

Grouted Penetrations

(a) The Monticello Nuclear Generating Plant (MNGP) piping analysis specification defines an anchor as an "engineered component designed to limit translation and rotation in three orthogonal directions." As long as the wall/floor penetration is grouted solid, it meets the criteria for an anchor and can be used as an equivalent anchor for license renewal. The grout used to fill the space between the pipe and the surrounding concrete is as strong as or stronger than the concrete and provides a means to transfer the forces and moments to the surrounding concrete. In addition, the walls/floors are designed for piping reaction loads.

Site piping analysis practice is to consider grouted penetrations as anchors. A review of the non-safety related (NSR) piping attached to safety related (SR) piping identified 17 instances where a wall/floor penetration is

considered an equivalent anchor. Of these, 14 are based on an existing piping analysis. These 14 penetrations are categorized as follows:

- Nine of the penetrations are grouted solid.

- Five of the penetrations are not grouted – these penetrations are exterior wall penetrations that are not grouted. The piping analysis deemed the ground to act as an equivalent anchor.

The three penetration equivalent anchors not based on an existing piping analysis are categorized as follows:

- One of the penetrations is a grouted solid penetration. In addition, the piping on the other side of the anchor is included in-scope for the spaces approach.

- Two of the penetrations are exterior wall penetrations that are not grouted. The ground is taken as the equivalent anchor.

Industry piping analysis practice also considers grouted penetrations as anchors. Chapter B4, Stress Analysis of Piping Systems, of the Piping Handbook, 7th Edition, identifies building penetrations as possible anchors. In addition, American Society of Civil Engineers (ASCE) Paper, Seismic Design and Retrofit of Piping Systems, July 2002, Section 5.1 describes "fully constrained wall penetrations" as typical anchor points for piping analysis.

Therefore, based on plant and industry piping analysis practices, using grouted penetrations as equivalent anchors for NSR lines attached to SR lines, without an existing piping analysis, is acceptable.

(b) A walkdown was performed of the one instance where a grouted penetration is considered an equivalent anchor and is not based on an existing piping analysis or does not go underground. The walkdown indicated that this penetration is grouted.

Ground as Anchor

The MNGP also relies on the ground as an equivalent anchor. As stated in Nuclear Energy Institute (NEI) publication NEI 95-10, Revision 6, Appendix F, the ground acts like an anchor if the buried portion of the piping is well founded on compacted soil that is not susceptible to liquefaction. As described in the MNGP Updated Safety Analysis Report (USAR) Sections 2.5 and 12.2, the soil conditions around the plant are compacted and not subject to liquefaction.

In keeping with the guidance provided by NEI 95-10, Revision 6, the analysis considers the buried portion of piping as an anchor point; therefore, the license

renewal (LR) boundary endpoint is taken where the piping run returns to above-grade. This ensures that the analysis endpoint is enveloped.

For the purposes of clarification, using the ground as an equivalent anchor requires that the below grade piping be included in-scope for license renewal. Therefore, a review of the additional in-scope piping was performed to determine the changes/additions required to material, environment, aging effects and aging management programs. The following clarifications were made:

1. LRA Section 2.1.4.2.2, Scoping Criterion 2 - Non-Safety Related Affecting Safety Related, Part b was revised to state:

   Examples that constitute the first equivalent anchor include: a true anchor; a large piece of plant equipment; a building penetration; buried piping; and, two levels of support in each orthogonal direction. In general, equivalent anchors were selected consistent with the pipe analyses of record that demonstrate seismic adequacy of the various configurations. The piping components and supports up to and including the first equivalent anchor and buried piping used as an equivalent anchor are in-scope for license renewal.

A change to the implementing technical report will also be made to indicate that buried piping used as an equivalent anchor is in the scope of license renewal.

2. For the Condensate Storage (CST) system:

   The in-scope portion of lines C11-20"-HK, SC16-10"-HK, C22-4"-HK and C23-4"-HK was extended underground to the point where they exit the ground on license renewal drawing LR-36039 (B4, B5). These lines are stainless steel.

   Therefore, the following information was added to the CST System, LRA Table 3.4.2-1 Steam and Power Conversion System - Condensate Storage System - Summary of Aging Management Evaluation:

Comp Type	Intended Func	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Volume 2 Line Item	Table 1 Item	Notes
Piping and Fittings	Pressure Boundary	Stainless Steel	Buried in Ground (Ext)	Loss of Material - Crevice Corrosion	Buried Piping & Tanks Inspection			J, 404, 415
				Loss of Material - MIC	Buried Piping & Tanks Inspection			J, 404, 415
				Loss of Material - Pitting Corrosion	Buried Piping & Tanks Inspection			J, 404, 415

3. For the Service and Seal Water (SSW) system:

   a. The in-scope portion of line SW8-14"-JF was extended underground to the point where it connects to the 78" diameter circulating water line on license renewal drawings LR-36041 (D4) and LR-36489 (B1). This line is carbon steel.

   b. The in-scope portion of line SW6-24"-JF was extended underground to the point where it connects to the 108" diameter circulating water line on license renewal drawings LR-36664 (B8) and LR-36489 (B2). This line is carbon steel.

   Therefore, the following information was added to the SSW system, LRA Table 3.3.2-16 Auxiliary Systems - Service and Seal Water System - Summary of Aging Management Evaluation:

Comp Type	Intended Func	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG 1801 Volume 2 Line Item	Table 1 Item	Notes
Piping and Fittings	Pressure Boundary	Carbon Steel	Buried In Ground (Ext)	Loss of Material - Crevice Corrosion	Buried Piping & Tanks Inspection	VII.C1.1-b	3.3.1-18	A, 315
				Loss of Material - Galvanic Corrosion	Buried Piping & Tanks Inspection	VII.C1.1-b	3.3.1-18	A, 312, 315
				Loss of Material - General Corrosion	Buried Piping & Tanks Inspection	VII.C1.1-b	3.3.1-18	A, 315
				Loss of Material - MIC	Buried Piping & Tanks Inspection	VII.C1.1-b	3.3.1-18	A, 315
				Loss of Material - Pitting Corrosion	Buried Piping & Tanks Inspection	VII.C1.1-b	3.3.1-18	A, 315

   c. In addition, Drawing LR-36489 is added to LRA Section 2.3.3.16, Service and Seal Water System, License Renewal Drawings.

4. For the Circulating Water System (CWT) system:

   From the SSW system, lines SW8-14"-JF on license renewal drawing LR-36041 (D4) and SW6-24"-JF on license renewal drawing LR-36664 (B8) were extended underground to the circulating water piping. The underground portion of the circulating water piping from the SW6-24"-JF connection point on license renewal drawing LR-36489 (B2) to the turbine building on license renewal drawing LR-36489 (C2) is considered part of the buried piping equivalent anchor and therefore, is also included in-scope. This line is carbon steel.

Therefore, the following information was added to the CWT system, LRA Table 3.3.2-3 Auxiliary Systems- Circulating Water System - Summary of Aging Management Evaluation:

Comp	Intended Func	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Volume 2 Line Item	Table 1 Item	Notes
Piping and Fittings	Pressure Boundary	Carbon Steel	Buried in Ground (Ext)	Loss of Material - Crevice Corrosion	Buried Piping & Tanks Inspection	VII.C1.1-b	3.3.1-18	A, 315
				Loss of Material - Galvanic Corrosion	Buried Piping & Tanks Inspection	VII.C1.1-b	3.3.1-18	A, 312, 315
				Loss of Material - General Corrosion	Buried Piping & Tanks Inspection	VII.C1.1-b	3.3.1-18	A, 315
				Loss of Material - MIC	Buried Piping & Tanks Inspection	VII.C1.1-b	3.3.1-18	A, 315
				Loss of Material - Pitting Corrosion	Buried Piping & Tanks Inspection	VII.C1.1-b	3.3.1-18	A, 315

5. For the Heating Ventilation (HTV) system:

   The in-scope portion of the ducting (below grade portion is piping) from the Off-Gas Storage and Compressor Building (OGSB) fan room was extended underground to the point where it exits the ground on license renewal drawing LR-51142-1 (B6). This line is carbon steel and contains flanged connections with bolts.

Therefore, the following information was added to the HTV system, LRA Table 3.3.2-11 Auxiliary Systems - Heating and Ventilation - Summary of Aging Management Evaluation:

Comp Type	Intended Func	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Volume 2 Line Item	Table 1 Item	Notes
Piping and Fittings	Pressure Boundary	Carbon Steel	Buried in Ground (Ext)	Loss of Material - Crevice Corrosion	Buried Piping & Tanks Inspection	VII.C1.1-b	3.3.1-18	A, 315
				Loss of Material - Galvanic Corrosion	Buried Piping & Tanks Inspection	VII.C1.1-b	3.3.1-18	A, 312, 315
				Loss of Material - General Corrosion	Buried Piping & Tanks Inspection	VII.C1.1-b	3.3.1-18	A, 315
				Loss of Material - MIC	Buried Piping & Tanks Inspection	VII.C1.1-b	3.3.1-18	A, 315
				Loss of Material - Pitting Corrosion	Buried Piping & Tanks Inspection	VII.C1.1-b	3.3.1-18	A, 315

Comp Type	Intended Func	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Volume 2 Line Item	Table 1 Item	Notes
Fasteners/ Bolting	Pressure Boundary	Carbon Steel	Buried in Ground (Ext)	Loss of Material - Crevice Corrosion	Bolting Integrity	VII.C1.1-b	3.3.1-18	E, 301, 306, 309, 315
				Loss of Material - Galvanic Corrosion	Bolting Integrity	VII.C1.1-b	3.3.1-18	E, 301, 306, 309, 312, 315
				Loss of Material - General Corrosion	Bolting Integrity	VII.C1.1-b	3.3.1-18	E, 301, 306, 309, 315
				Loss of Material - MIC	Bolting Integrity	VII.C1.1-b	3.3.1-18	E, 301, 306, 309, 315
				Loss of Material - Pitting Corrosion	Bolting Integrity	VII.C1.1-b	3.3.1-18	E, 301, 306, 309, 315

6. As stated above, the Buried Piping and Tanks Inspection Program is used to manage the aging effects for these new in-scope buried components. The following clarifications were made to LRA Section A2.1.5, Buried Piping & Tanks Inspection and B2.1.5, Buried Piping & Tanks Inspection:

   a. The program was updated to reflect that it will be used to manage stainless steel for loss of material due to crevice corrosion, microbiologically influenced corrosion (MIC) and pitting corrosion (LRA Section A2.1.5 and B2.1.5).

   b. The program was updated to include the following additional systems; Circulating Water (CWT), Condensate Storage (CST), Heating and Ventilating (HTV) and Service and Seal Water (SSW) (LRA Section B2.1.5 only).

B. NRC RAI 3.3.2.3-8: Aging Effects of Elastomers in Air

In response to RAI 3.3.2.3-4, the applicant has referenced EPRI Report 1002950, "Structural Tools," dated May 2003 that replaces TR-114881, dated April 2000. This report contains a review of industry failure data and NRC generic communications. It is the staffs understanding that this report is a proprietary document and is not accessible to the staff through normal channels. The applicant is requested to provide this EPRI report for staff review of the relevant data.

The applicant, in its response, has not provided information related to degradation of rubber by oxidation resulting from exposure to ozone in air. The applicant is requested to provide the specific designations of the different types of elastomers that are installed at the plant and the data related to exposure to ozone in air for each of these elastomers, if available. Also explain how degradation caused by oxidation from exposure to ozone is evaluated.

Some of the elastomers in question may not be long-lived components designed for 60 years. The applicant's response does not clearly state that these are not long-lived components to be replaced at specified intervals. If this indeed is the case, the applicant is requested to confirm this and provide supporting data.

NMC Response

Electric Power Research Institute (EPRI) Technical Report 1002950, "Structural Tools," Revision 1, dated August 2003, was mailed to Mr. Daniel J. Merzke - Project Manager, USNRC on September 22, 2005 by Dr. John Carey - Project Manager, EPRI.

After further evaluation of this issue, NMC has taken the conservative approach of managing change in material properties due to ozone for elastomers in an air environment, specifically for natural rubber. This is a result of the fact that neither representative ozone concentrations nor technically substantiated thresholds could be adequately or consistently determined, even though plant specific operating experience has indicated that there has been no change in material properties due to ozone for these elastomer components. Further evaluation also revealed the inability to confirm that none of these components are fabricated from natural rubber.

As a result, elastomers in an external air environment in the following LRA tables will utilize the System Condition Monitoring Program to manage the potential aging effect of changes in material properties due to ozone which shall be assigned to these components.

- Table 3.3.2-3 expansion joints in the Circulating Water System
- Table 3.3.2-5 piping and fittings in the Demineralized Water System
- Table 3.3.2-6 piping and fittings in the Emergency Diesel Generators System
- Table 3.3.2-7 ventilation seals in the Emergency Filtration Train System
- Table 3.3.2-16 expansion joints in the Service and Seal Water System
- Table 3.4.2-2 expansion joints in the Condensate and Feedwater System (those which were not previously managed externally)

Elastomers in Table 3.2.2-8 (ventilation seals in the Secondary Containment System) are presently being managed utilizing the One-Time Inspection Program for the internal surfaces and the System Condition Monitoring Program for the external surfaces. These Aging Management Programs (AMPs) were initially credited to manage change in material properties and cracking due to thermal

exposure, since a temperature threshold of greater than 95°F was assigned to these components. Consequently, these same AMPs will also manage change in material properties due to ozone which shall be assigned to these components.

Elastomers (expansion joints) in Table 3.4.2-3 (Main Condenser System) do not require aging management since these components do not serve a pressure boundary intended function but provide for plate-out and holdup of radioactive material during design basis events. Condenser integrity is continuously demonstrated during normal plant operation thus validating that this intended function is maintained as stated in the plant-specific notes for these components in Section 3.4 of the LRA.

Elastomers in an internal air environment in Table 3.3.2-6 (piping and fittings in the Emergency Diesel Generators System) and Table 3.3.2-7 (ventilation seals in the Emergency Filtration Train System) will utilize the One-Time Inspection Program to manage the potential aging effect of change in material properties due to ozone which shall be assigned to these components.

Elastomers in both an internal and external air environment in Table 3.3.2-11 (ventilation seals in the Heating and Ventilation System) were inadvertently omitted from this table. These components shall be managed for the potential aging effect of change in material properties due to ozone utilizing the One-Time Inspection Program for the internal surfaces and the System Condition Monitoring Program for the external surfaces which shall be assigned to these components.

All the elastomers addressed are long-lived components. Any component that is not long-lived and replaced at specified intervals is eliminated from AMR consideration during the screening process. Although the expansion joints are presently under review for replacement on a fixed periodicity, this change has not been effected and they remain as and have been analyzed as long-lived components.

Any degradation of elastomer components in an air environment resulting from change in material properties due to ozone for the external surfaces of these components shall be evaluated as discussed in the response to RAI B2.1.32-02 which addresses the System Condition Monitoring AMP.

This response also applies to the previous RAI responses concerning elastomers including RAI 3.3.2.3-3, RAI 3.3.2.3-4, RAI 3.3.2.3-5, RAI 3.3.2.3-6, and RAI 3.4-01.

C. NRC RAI 3.5.2.1.15-1: Boral Surveillance Program

The U.S. Nuclear Regulatory Commission staff (the staff) and representatives of Nuclear Management Company, LLC (NMC), held a telephone conference call on October 6, 2005, to discuss and clarify the applicant's response to request for additional information, RAI 3.5.2.1.15-1, provided in letter dated September 16, 2005, concerning the Monticello Nuclear Generating Plant license renewal application. The following issues were discussed during the telephone conference call:

1. The applicant was asked to provide technical justification for not conducting inspections of the Boral coupons into the period of extended operation after the One-Time Inspection is performed. The applicant was also asked to explain the criteria to be used in determining additional inspections would not be required after the One-Time Inspection.

The applicant indicated that the question is clear and will provide a written response as a supplement to the RAI response provided.

NMC Response

NMC has evaluated the removal of the remaining set of three Boral coupons (two clad in stainless steel and one bare coupon) for sampling. It has been determined that minimal benefit would be provided by testing the coupons prior to extended operation, consistent with the One Time Inspection Program.

This conclusion is based on a review of prior test results and trends which have demonstrated no adverse performance; a review of industry and manufacturer experience which has shown no degradation in neutron absorption capability; and, a conservative analysis of Boral blistering impacts on reactivity control which has shown minimal effect if any. Each of these results is discussed in more detail below.

NMC will revise the One Time Inspection Program to visually examine the unclad Boral coupon sample prior to extended operation. The coupon will be removed from the spent fuel pool for a brief period of time, visually examined, and then immediately returned to the spent fuel pool. The three coupons will then be removed at a later date, sometime during the period of extended operation, for surveillance testing. Removal will be scheduled in accordance with prior test results and continued evaluation of industry experience.

As noted in response to RAI 3.5.2.1.15-1, NMC intends to manage the aging effects of Boral with the Plant Chemistry Program for spent fuel pool water quality control and by confirming the effectiveness of chemistry control through a one-time inspection of the final remaining set of Boral coupon samples in the spent fuel pool. Consistent with the requirements of the One Time Inspection Program, the original approach was to perform this final inspection prior to the

period of extended operation. These actions were deemed sufficient to manage the loss of neutron absorption aging effect for Boral on the basis that test results and industry experience to date have demonstrated the Boral has maintained its neutron absorption capability with no degradation or adverse performance trends. The final coupon tests were to further confirm this conclusion. Any test issues would be evaluated in accordance with the MNGP Corrective Action Program. However, it has been determined that testing in the near future would provide minimal benefit and, therefore, the final set of coupons will remain in the spent fuel pool and be removed for testing sometime during the period of extended operation. A visual exam of the unclad Boral coupon will be performed prior to extended operation to confirm this approach. This one visual exam is considered sufficient based on the following:

- Sample coupon tests for the MNGP span a 20 year period. Coupon characteristics critical to neutron absorption capability (areal density) have consistently exceeded test acceptance criteria and no adverse trends have been noted.

- Blistering identified on recent unclad (bare) coupon samples does not impact their License Renewal intended function.

- Industry and manufacturer experience demonstrate Boral is effective as a long term neutron absorption mechanism.

- Both the Plant Chemistry and One Time Inspection aging management programs are required to evaluate emergent issues through the MNGP Corrective Action Program.

The most important measurements for characterizing the performance of Boral used in the MNGP high density fuel storage racks are thickness (to identify swelling) and neutron attenuation tests (to assure the continued presence of Boron-10). Test results for these key parameters for the Boral sample coupons are summarized below. The first sets of coupons ("A" and "B" coupons) are clad in stainless steel and representative of the MNGP high density fuel racks. They include vent holes to the Boral for hydrogen release similar to the fuel racks. The final sets of coupons ("C" coupons) are bare samples of Boral.

Stainless Steel Clad Coupons (A and B Coupons)

Coupon Sample	Date Removed from Spent Fuel Pool	Areal Density (B-10 gm/square centimeter)	Boral Thickness (inches)
1A	November 1979	Not available	Not available
1B	November 1979	Not available	Not available
2A	May 1980	0.0166	0.079
2B	May 1980	0.0166	0.078
4A	July 1985	0.0165	0.077
4B	July 1985	0.0165	0.076
3A	September 1990	0.0164	0.078
3B	September 1990	0.0170	0.081
5A	June 1995.	0.0165	0.080

Coupon Sample	Date Removed from Spent Fuel Pool	Areal Density (B-10 gm/square centimeter)	Boral Thickness (inches)
5B	June 1995	0.0167	0.080
6A	August 2000	0.0161	0.081
6B	August 2000	0.0161	0.082
7A	Still in spent fuel pool	Not yet available	Not yet available
7B	Still in spent fuel pool	Not yet available	Not yet available

Bare Boral Coupons (C Coupons)

Coupon Sample	Date Removed from Spent Fuel Pool	Areal Density (B-10 gm/square centimeter)	Boral Thickness (inches)
1C	November 1979	Not available	Not available
2C	May 1980	0.0173	0.074
4C	July 1985	0.0185	0.078
3C	September 1990	0.0195	0.076
5C	June 1995	0.0188	0.076 (also see below)
6C	August 2000	0.0178	0.073 (also see below)
7C	Still in spent fuel pool	Not yet available	Not yet available

As this data demonstrates, no adverse trend in performance over a 20-year period has been noted. Test values consistently exceed acceptance criteria of 0.0135 B-10 gm/square centimeter for areal density and nominal thickness measurements are comparable to original bare coupon receipt inspection values. For Coupon 5C, the test report noted the thickness is the average thickness for areas without blisters and that the maximum total thickness measured over the blisters was 0.100 inches. For Coupon 6C, the test report noted the thickness measurement is the average thickness for areas where there were no blisters and that the maximum thickness measured in blistered areas is approximately that found in 1995 for Coupon 5C of 0.100 inches. For both Coupons 5C and 6C, the respective test reports noted the blisters were small and on the edge of the coupon on both front and back surfaces. No blisters were noted on the stainless steel clad coupons or the Boral encased therein (coupons 5A, 5B, 6A, and 6B) and no blisters were identified on any previous coupons examined. Despite the presence of Boral blisters, no degradation in nuclear properties was noted. Areal density measurements exceeded test acceptance criteria and were comparable to prior coupon tests (see above).

The Boral coupon test reports did not identify an apparent cause for the blistering of the bare coupon samples. According to the manufacturer (see NRC ADAMS Accession Number ML041550942), blisters can form from water which penetrates into the center area (core) of the Boral through the interconnected porosity that can occur during manufacturing. Boral is a laminated composite material of aluminum cladding enclosing an inner core of aluminum and boron carbide powders. The powders are blended, combined in an aluminum box (ingot), heated, hot rolled into sheets, and sheared to finished sheet dimensions.

Some porosity remains in the core in the form of small voids during this manufacturing process. Some of these voids can be interconnected through micro-pathways into the core. Once placed in the spent fuel pool, water that enters the core through these micro-pathways can react with exposed aluminum powder surfaces to form aluminum oxide and hydrogen. Usually, the hydrogen escapes from the core through the porosity. This same hydrogen is then vented through holes in the stainless steel cladding originally installed in the fuel racks to prevent bulging of the channels (see response to RAI 3.5.2.1.15-2 for further details on bulging). In some cases the growth of the aluminum oxide can restrict or close off pathways for the hydrogen to escape, thus causing blisters on the aluminum cladding if enough hydrogen forms. The manufacturer further notes numerous tests and evaluations performed by the manufacturer, utilities, and other organizations have demonstrated the Boral remains intact and the blisters do not reduce the ability of the Boral core to absorb thermal neutrons. Areal density measurements of the MNGP coupons and the continued lack of any adverse trends confirm this conclusion. Based on this apparent cause, blisters are likely to form when sufficient exposure of the Boral core to water has occurred. It is also possible the blister could allow additional blisters to form by impacting the micro-pathways available for water intrusion. Blisters have not been observed in any of the stainless steel clad coupons, which more accurately represent fuel rack design and cladding vents have effectively prevented fuel channel bulging.

Since testing has demonstrated blisters do not impact neutron absorption capability, the only remaining potential impact to reactivity control is the displacement of water moderator at the blister locations with hydrogen voids. This effect was recently described by the NRC as a reduction in the flux trap size, i.e., a reduction in water moderator normally present between adjacent fuel assemblies (see ADAMS Accession Number ML052420110). Though it is likely any pathway formed to allow water intrusion and initial void formation would also allow the smaller hydrogen molecules to subsequently vent out, Florida Power and Light (FPL) Energy conservatively evaluated the impact of such voiding on reactivity control assuming no venting. In a recent license amendment proposed by FPL Energy for the Seabrook Station (see Table 5 under ADAMS Accession Number ML050900352), a blister Δk penalty as a function of blister thickness was proposed. This penalty was conservatively calculated on the assumption that the blister gap did not refill with water and covered the entire length and width of the Boral. The Seabrook Station fuel and rack designs are different than those at the MNGP; however, adopting their analytical results for a blister gap of 27 mils results in a penalty of 0.003 Δk. Imposing this penalty on the MNGP high density fuel storage racks has minimal to no impact on the License Renewal reactivity control intended function. Criticality results for the MNGP fuel racks were submitted to the NRC as part of the original license amendment request transmitted on August 17, 1977, as supplemented on December 8, 1977. A number of cases were evaluated resulting in a worse case k_∞ of 0.8674, well below an acceptance limit of 0.95 even with an added penalty of 0.003 Δk. The impact on k_∞ at different fuel assembly spacing (pitch) was evaluated in the MNGP submittal. Interpolating between the calculated results of a k_∞ of 0.8674

at a pitch of 6.563 inches and a k_∞ of 0.8364 at a pitch of 6.832 inches, results in a k_∞ impact of approximately 0.003 for a blister void of 27 mils. Therefore, the reactivity control function is not impacted based on the MNGP data. The areal density results for the MNGP coupons indicate a minimum value of 0.0161 B-10 gm/square centimeter for all coupon tests to date. The criticality analysis for the MNGP is based on a boron concentration of 0.013 B-10 gm/square centimeter, thus providing added margin to compensate for any blister void impacts on k_∞.

Industry and manufacturer experience demonstrate Boral is effective as a long term neutron absorption mechanism. This absorption (boron concentration) is not impacted by blistering. This was noted by the Boral manufacturer (see ADAMS Accession Number ML041550942) and further substantiated by the MNGP coupon test results spanning 20 years of coupon exposure. The NRC has noted (see NUREG-1787, page 3-406, ADAMS Accession Number ML040300170) that potential aging effects resulting from sustained irradiation of Boral were previously evaluated by the staff and determined to be insignificant.

A requirement of both the Plant Chemistry and One Time Inspection aging management programs is to evaluate issues emerging from fuel pool water quality or Boral performance, respectively. These issues are identified through review of plant and industry operating experience and evaluated in the site Corrective Action Program.

As no discernable performance trend has been identified based on 20 years of plant test experience combined with additional industry and manufacturer experience, NMC has decided to delay removal and testing of the final coupon set (Coupon Set 7) until sometime during the period of extended operation. Industry experience will continue to be evaluated and any emergent issues will be analyzed through the site Corrective Action Program consistent with the requirements of the applicable aging management programs. It is believed this approach takes best advantage of the remaining coupons in evaluating the long term performance of Boral. Removal and testing of the final coupon set prior to the period of extended operation would provide limited benefit as no discernable trend has been noted in past performance. The original NMC commitment to perform periodic testing (contained in a letter dated August 17, 1977 to the NRC on "Replacement of Spent Fuel Storage Racks") has been satisfied by testing performed to date and by the MNGP and industry experience which demonstrate loss of neutron absorption capability due to aging effects, such as corrosion, is not occurring. A visual exam of the bare coupon will be performed prior to the period of extended operation to satisfy the requirements for a one-time inspection and confirm Boral performance is being maintained.

D. NRC RAI B2.1.4-01: Emergency Filtration Train System Bolting

Table Item Numbers 3.3.1-18, 3.3.1-24 and 3.4.1-08 in the LRA provide a general discussion of the Bolting Integrity Program as applied to the ESF, auxiliary, and SPC systems. The discussion section for each system states that while loss of preload is not specifically identified as an aging effect in the respective AMR table, it is managed for carbon steel and stainless steel closure bolting used in pressure retaining joints by the Bolting Integrity Program through periodic inspections, material selection, thread lubrication control, assembly and torque requirements, and repair and replacement activities. Based on this discussion, the staff considers closure bolting in the ESF, auxiliary and SPC systems to be managed for loss of preload by the Bolting Integrity Program. The applicant is requested to discuss whether all closure bolting in the ESF, auxiliary and SPC systems is managed for loss of preload by the Bolting Integrity Program although the AMR tables do not contain specific line items for this aging effect.

In a phone conversation with the NRC on November 4, 2005, additional information was requested regarding the NMC response to RAI B2.1.4-01. An explanation of why closure bolting of the Emergency Filtration Train (EFT) System is not susceptible to aging effects and not included in the Bolting Integrity Program was requested.

NMC Response

Closure bolting of the EFT System is included in the Bolting Integrity Program for loss of preload.

As noted in the response to RAI B2.1.4-01, bolting of the EFT System is not susceptible to aging effects (e.g., corrosion) due to its location in a controlled air environment. As noted in Tables 3.1.1, 3.2.1, 3.3.1, and 3.4.1 and Footnote 306 of the LRA, loss of preload is managed by the Bolting Integrity Program. Footnote 306 applies to bolting of the EFT System as shown in Table 3.3.2-7 of the LRA. Therefore, the NMC response to RAI B2.1.4-01 is supplemented as follows:

> Closure bolting of the EFT System is managed by the Bolting Integrity Program for loss of preload. Section B.2.1.4, Scope of Program, of the LRA for the Bolting Integrity Program is revised to include the EFT System.