FINAL LICENSE RENEWAL INTERIM STAFF GUIDANCE
LR-ISG-2009-01

AGING MANAGEMENT OF SPENT FUEL POOL NEUTRON-ABSORBING MATERIALS OTHER THAN BORAFLEX

INTRODUCTION

This final license renewal interim staff guidance (LR-ISG) LR-ISG-2009-01, "Aging Management of Spent Fuel Pool Neutron-Absorbing Materials other than Boraflex," provides guidance as to one acceptable approach for managing the effects of aging during the period of extended operation for certain neutron-absorbing spent fuel pool components within the scope of the License Renewal Rule (Title 10 of the *Code of Federal Regulations*, Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants" (10 CFR Part 54)). This LR-ISG recommends an aging management program (AMP) to address the potential loss of material and loss of neutron-absorbing capability of these components during the period of extended operation. A license renewal applicant may reference this AMP in its license renewal application (LRA) to demonstrate that the programs at its facility are acceptable to the U.S. Nuclear Regulatory Commission (NRC or the staff) for compliance with the License Renewal Rule, until the guidance in this final LR-ISG is implemented into the next update of the license renewal guidance documents. This LR-ISG does not apply to Boraflex, for which Section XI.M22, "Boraflex Monitoring," of the Generic Aging Lessons Learned (GALL) Report (NRC, 2005a) describes adequate AMP characteristics.

DISCUSSION

Pursuant to 10 CFR 54.21, a license renewal applicant is required to demonstrate that the effects of aging on structures and components subject to an aging management review (AMR) will be adequately managed so that the intended functions will be maintained consistent with the current licensing basis for the period of extended operation. The Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants (SRP-LR) (NRC, 2005b) provides guidance to the staff reviewers performing safety reviews of applications to renew nuclear power plant licenses in accordance with 10 CFR Part 54. SRP-LR Section 3.3.2.2.6 provides acceptance criteria for spent fuel pool neutron-absorbing materials subject to an AMR.

Licensees use many neutron-absorbing materials in spent fuel pools, such as Boraflex, Boral, Metamic, boron steel, and carborundum. As previously mentioned, the GALL Report describes adequate AMP characteristics for Boraflex monitoring; however, management of the aging effects of the other materials has generally not been adequately addressed in current guidance.

Recent operating experience indicates several instances of degradation and/or deformation of neutron-absorbing materials in the spent fuel pools of operating reactors, as described in NRC Information Notice 2009-26, "Degradation of Neutron-Absorbing Materials in the Spent Fuel Pool" (NRC, 2009a). Operating experience related to two specific spent fuel pool neutron-absorbing materials is described in the following sections.

Carborundum

In July 2008, the licensee of Palisades Nuclear Plant discovered that the region 1 fuel storage rack contained less neutron-absorbing material than assumed in the spent fuel pool criticality analysis of record (Entergy Nuclear Operations, Inc., 2008). The Electric Power Research Institute (EPRI) defines region 1 fuel storage racks as those that receive high reactivity, unburned reload fuel (EPRI, 2006). The lack of neutron-absorbing material resulted in noncompliance with the spent fuel pool criticality requirements in Technical Specification 4.3.1.1.b. In response to this concern, the licensee performed "blackness testing" of the region 1 spent fuel pool racks to validate that the racks would continue to perform neutron attenuation as credited in the licensee's criticality analysis of record and to satisfy regulatory requirements and renewed license commitments.

The licensee performed in situ Boron-10 Areal Density Gauge for Evaluating Racks (BADGER) testing of approximately two percent of the storage locations, which revealed that the Boron-10 areal density of the spent fuel pool racks was, at a minimum, approximately one-third of its original design value. The neutron-absorbing material, plate-type carborundum, which is relied on to maintain subcriticality in the spent fuel pool, was much less effective than assumed in the criticality analysis. Therefore, region 1 of the spent fuel pool no longer met the requirements of 10 CFR 50.68, "Criticality Accident Requirements," or Technical Specification 4.3.1.1.b, which require that K-effective (Keff) for region 1 fuel racks be less than or equal to 0.95 if fully flooded with unborated water.

The licensee determined that the apparent cause of the degradation of the carborundum B_4C plates was the spent fuel pool environment. The exact degradation mechanism or mechanisms are not clearly understood, but likely involve changes in the physical properties of the carborundum B_4C plates that occur during prolonged exposure to the spent fuel pool environment. The swelling of the racks, which prevents fuel assemblies from being inserted or removed, may indicate a potential problem with neutron-absorbing capacity. The swelling in the racks could result from dimensional changes of the carborundum, which may be replaced by a gas-filled space, and could challenge the assumptions of the criticality analysis. This degradation may have been occurring as early as 1988 when the first impedance to inserting a fuel assembly was documented at Palisades Nuclear Plant. Since there was no surveillance of the neutron-absorbing capacity of the material, the start of the degradation and the degradation rate are unknown.

Boral

An LRA supplement (FirstEnergy Nuclear Operating Company, 2009) indicates that inspections of the Boral neutron-absorber material coupons at the Beaver Valley Power Station in 2007 identified numerous blisters of the aluminum cladding, while only a few small blisters were identified in 2002. In region 1 fuel storage racks, blisters can displace water from the flux traps between storage cells and challenge dimensional assumptions used in the criticality analysis. Based on these inspections, the licensee for Beaver Valley Power Station determined that the blistering of Boral aluminum cladding was an aging effect and that it would credit the existing Boral Surveillance Program for management of this aging. In addition, blistering of Boral neutron-absorbing material has also been observed at Seabrook Station (FPL Energy Seabrook Station, 2003).

In a letter responding to a staff request for additional information (PPL Susquehanna, LLC, 2009), the licensee for Susquehanna Steam Electric Station stated that it identified a significant

bulge in a poison can wall. Although the licensee did not definitively determine the cause of the bulge, its letter states that it may be the result of hydrogen gas generation from either moisture contained in the Boral at the time of manufacture or a leaking seal weld in the poison can. This bulge prevented the placement of a blade guide into the deformed cell.

Also, Section B.3.28, "Water Chemistry Control Program" of the LRA for Vogtle Electric Generating Plant (Southern Nuclear Operating Co., Inc (SNC), 2007) states that the spent fuel pool water chemistry program showed an increase in the concentration of aluminum, which may indicate loss of material from the Boral neutron-absorbing material.

Further, an Electric Power Research Institute report (EPRI, 2006), states the following concerning Boral:

> … in-pool blistering of BORAL™ has, to date, proved to be primarily an esthetic effect; however, the potential effects on fuel assembly clearance and the reactivity state of Region 1 racks have been noted. In addition, it has been noted that, in a few instances, rack cell wall deformation has occurred making it difficult to remove fuel. With plant life extension now the norm at most [light water reactors] in the US, some BORAL™, which originally had a design service life of 40 years, will be in service more than 60 years. This suggests a prudent course is continued vigilance and surveillance so that onset of any degradation can be detected early and appropriate mitigation measures applied.

ACTION

The recent instances of degradation and deformation of spent fuel pool neutron-absorbing materials, as discussed above, have led the staff to re-evaluate the SRP-LR and GALL Report guidance in this area. Based on the operating experience and other industry information, the staff has identified that the current license renewal guidance documents do not provide sufficient guidance to address the information that should be included in an LRA to demonstrate adequate management of the potential loss of material and loss of neutron-absorbing capability of the neutron-absorber material in spent fuel pools for the period of extended operation. As such, the staff has determined that the existing guidance requires clarification to address that, for each type of neutron-absorber material used in the applicant's spent fuel pool(s), the applicant should demonstrate in their specific spent fuel pool environment for their specific material(s) that degradation has not occurred in a manner that could adversely impact the material's intended function. The staff has also developed a generic AMP, "Monitoring of Neutron-Absorbing Materials other than Boraflex," that is recommend for managing the aging effects associated with these spent fuel pool neutron-absorbing materials.

Necessary revisions to the various license renewal guidance documents are in Appendix A, "Revisions to SRP-LR," Appendix B, "Revisions to GALL Report, Volume 1," and Appendix C, "Revisions to GALL Report, Volume 2." Appendix D, "Mark-Up Showing Changes to the License Renewal Guidance Documents," shows these revisions as compared to the current license renewal guidance documents. An overview of these changes is discussed below.

In the GALL Report, the generic AMP referenced above will be included under a new Section XI.M40 in GALL Report, Volume 2. Aging management of spent fuel pool neutron-absorbing materials other than Boraflex is addressed under two specific line items, VII.A2-3 and VII.A2-5, in GALL Report, Volume 2. These items currently recommend a plant-specific AMP and further evaluation. However, since the staff has determined that the new generic program

is adequate for managing the associated aging effects with no further evaluation recommended, a plant-specific program is no longer recommended and corresponding changes the line items' "Aging Management Program (AMP)" and "Further Evaluation" descriptions are necessary. In addition, the staff has determined that the "Material" and "Aging Effect/Mechanism" descriptions for these line items require clarification. Changes to the GALL Report, Volume 1, Table 3 summary item (identification number 13) related to these two line items are also necessary to reflect the changes to GALL Report, Volume 2. The final changes to the GALL Report are in Appendices B and C.

Several changes are also necessary to the SRP-LR. Due to the staff's determination that the new generic AMP is adequate for managing the aging effects with no further plant-specific evaluation recommended, the acceptance criteria and review procedures in SRP-LR Sections 3.3.2.2.6 and 3.3.3.2.6, respectively, are no longer necessary. Revisions to SRP-LR Table 3.3-1 are also necessary for consistency with the changes to Table 3 of GALL Report, Volume 1. In addition, an example final safety analysis report supplement for the new AMP needs to be added to SRP-LR Table 3.3-2. The final changes to the SRP-LR are in Appendix A.

The staff also notes that applicants should consider both plant-specific and industry operating experience in the LRA. The applicant's plant-specific operating experience should be based on either data from on-going inspection and/or monitoring programs, or from other operational findings. The use of test data that does not bound the age of the material at the end of the period of extended operation is not sufficient since there is not sufficient evidence that extrapolation or accelerated testing is valid in these cases. For instance, the licensee for the Palisades Nuclear Plant extrapolated data through the period of extended operation which projected that no significant degradation was to be expected, but a surveillance inspection revealed unexpected degradation of the neutron-absorbing capacity of plate-type carborundum. If the applicant has a surveillance program in place for the material, a description of the program and results can be applied to the AMR as operating experience. This program should provide reasonable assurance that the material will be properly managed and that future degradation will be detected in the period of extended operation. In addition, continuation of an on-going coupon inspection program is adequate, but if there is no on-going coupon sample program, then the LRA will need to propose a new inspection program.

The guidance in this final LR-ISG is approved for use by the staff and stakeholders. On December 1, 2009, the staff issued a *Federal Register* notice (NRC, 2009b) to request public comments on draft LR-ISG-2009-01, "Staff Guidance Regarding Plant-Specific Aging Management Review and Aging Management Program for the Neutron-Absorber Material in the Spent Fuel Pool Associated with License Renewal Applications." In response, by letters dated December 17, 2009 (SNC, 2009), and December 28, 2009 (Exelon Generation Company, LLC, 2009), the NRC received comments from SNC and Exelon Generation Company, LLC, respectively. The NRC also received comments form the Nuclear Energy Institute (NEI) by letter dated December 31, 2009 (NEI, 2009a), and by email dated January 6, 2010 (NEI, 2010). The NRC staff considered these comments in developing the final LR-ISG-2009-01. The staff's responses to these comments are in Appendix E, "Resolution of Public Comments on Draft LR-ISG-2009-01." The title of the LR-ISG has been changed from the draft title, "Staff Guidance Regarding Plant-Specific Aging Management Review and Aging Management Program for the Neutron-Absorber Material in the Spent Fuel Pool Associated with License Renewal Applications," to the final, "Aging Management of Spent Fuel Pool Neutron-Absorbing Materials other than Boraflex," to clarify that this LR-ISG provides guidance concerning generic, not plant-specific, aging management recommendations.

BACKFITTING DISCUSSION

This LR-ISG contains guidance as to one acceptable approach for managing the effects of aging during the period of extended operation for certain spent fuel pool neutron-absorbing materials within the scope of license renewal. Set forth below is the staff's discussion on: (i) whether this LR-ISG addresses "newly identified" systems, structures, or components (SSCs) subject to aging management under 10 CFR 54.37(b), and (ii) compliance with the requirements of the Backfit Rule, 10 CFR 50.109.

Newly Identified SSCs under 10 CFR 54.37(b)

The NRC is not proposing to treat neutron-absorbing materials (other than Boraflex) in the spent fuel pools as "newly identified" SSCs under 10 CFR 54.37(b). Therefore, any additional action on such materials which the NRC may impose upon current holders of renewed operating licenses under 10 CFR Part 54 would not fall within the scope of 10 CFR 54.37(b). The NRC would have to address compliance with the requirements of 10 CFR 50.109, before it may impose any new aging management requirements for these neutron absorbing materials on current holders of renewed operating licenses (see discussion below).

Compliance with the Backfit Rule

Issuance of this LR-ISG does not constitute backfitting as defined in 10 CFR 50.109(a)(1), and the NRC staff did not prepare a backfit analysis for issuing this LR-ISG. There are several rationales for this conclusion, depending upon the status of the nuclear power plant licensee.

Current operating license holders who have not applied for renewed licenses – This LR-ISG is not directed at holders of (original) operating licenses. Although the NRC is evaluating the issues identified in this LR-ISG for applicability to holders of original operating licenses, the NRC has not yet determined whether additional regulatory action must be initiated to address these issues. Any regulatory requirements imposed by the NRC as the result of this evaluation must be implemented consistent with the provisions of 10 CFR Part 50 and the Backfit Rule. Therefore, issuance of this ISG does not constitute backfitting as applied to current holders of (original) operating licenses.

Licensees who are currently in the license renewal process – This LR-ISG is directed to current applicants for license renewal. However, this LR-ISG is not backfitting as defined in 10 CFR 50.109(a)(1). This guidance is non-binding and provides one approach acceptable to the NRC staff for managing the effects of aging of neutron-absorbing materials in the spent fuel pools in accordance with the requirements of 10 CFR Part 54. License renewal applicants are not required to use this guidance. Applicants may elect to propose an alternative approach for managing the aging of neutron-absorbing materials in spent fuel pools during the period of extended operation. In addition, the Backfit Rule does not protect license renewal applicants voluntarily requesting renewed licenses from changes in NRC requirements or guidance on license renewal prior to or during the pendency of their renewal application (NRC, 2008). Therefore, issuance of this LR-ISG does not constitute backfitting as applied to current applicants for license renewal.

Licensees who already hold a renewed license – This guidance is also directed to licensees who already hold a renewed license. However, this guidance is non-binding and the LR-ISG does not require current holders of renewed licenses to take any action (*i.e.*, programmatic or plant hardware changes for managing the aging of neutron-absorbing materials in spent fuel

pools). However, the NRC expects renewed license holders to review the information in this LR-ISG and consider actions consistent with this guidance as appropriate. If, in the future, the NRC decides to take additional action and impose requirements for management of neutron-absorbing materials in spent fuel pools, then the NRC will follow the requirements of the Backfit Rule.

REFERENCES

10 CFR Part 54, *Requirements for Renewal of Operating Licenses for Nuclear Power Plants*, Office of the Federal Register, National Archives and Records Administration, 2010.

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U.S. Nuclear Regulatory Commission (NRC). 2008. Memorandum from Dale E. Klein, Chairman, to Hubert T. Bell, Office of the Inspector General, "Response to Recommendation 8 of 9/6/07 Audit Report on NRC's License Renewal Program." (April 1, 2008). ADAMS No. ML080870286.

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APPENDIX A

REVISIONS TO SRP-LR

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report						
ID	**Type**	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Related Item**
13	BWR/ PWR	Boral, boron steel and other materials (excluding Boraflex) utilized as neutron absorbers in spent fuel storage racks neutron-absorbing sheets exposed to treated water or treated borated water	Reduction of neutron-absorbing capacity, changes in dimension that increase Keff, and loss of material due to neutron-absorber degradation and radiation	Monitoring of Neutron-Absorbing Materials other than Boraflex	No	A-88 A-89

Table 3.3-2. FSAR Supplement for Aging Management of Auxiliary Systems		
Program	**Description of Program**	**Implementation Schedule***
Monitoring of Neutron-Absorbing Materials other than Boraflex	The program is implemented to assure that degradation of spent fuel pool neutron-absorbing material that could compromise the criticality analysis will be detected in the period of extended operation. The loss of material and the degradation of the neutron-absorbing material capacity are determined through coupon testing, direct in situ testing, or both. Such testing includes periodic verification of boron loss through areal density measurement of coupons or through direct in situ techniques, such as measurement of boron areal density, measurement of geometric changes in the material (blistering, pitting, and bulging), and detection of gaps through blackness testing.	Program should be implemented before the period of extended operation.

APPENDIX B

REVISIONS TO GALL REPORT, VOLUME 1

Table 3. Summary of Aging Management Programs for the Auxiliary Systems Evaluated in Chapter VII of the GALL Report							
ID	**Type**	**Component**	**Aging Effect/Mechanism**	**Aging Management Programs**	**Further Evaluation Recommended**	**Related Generic Item**	**Unique Item**
13	BWR/ PWR	Boral, boron steel and other materials (excluding Boraflex) utilized as neutron absorbers in spent fuel storage racks neutron-absorbing sheets exposed to treated water or treated borated water	Reduction of neutron-absorbing capacity, changes in dimension that increase Keff, and loss of material due to neutron-absorber degradation and radiation	Monitoring of Neutron-Absorbing Materials other than Boraflex	No	A-88 A-89	VII.A2-5 VII.A2-3

APPENDIX C

REVISIONS TO GALL REPORT, VOLUME 2

VII AUXILIARY SYSTEMS A2 Spent Fuel Storage							
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
VII.A2-3 (A-89)	VII.A2.1-b	Spent fuel storage racks Neutron-absorbing sheets - BWR	Boral, boron steel and other materials (excluding Boraflex) utilized as neutron absorbers	Treated water	Reduction of neutron-absorbing capacity, changes in dimension that increase Keff, and loss of material due to neutron-absorber degradation and radiation	Chapter XI.M40, “Monitoring of Neutron-Absorbing Materials other than Boraflex”	No
VII.A2-5 (A-88)	VII.A2.1-b	Spent fuel storage racks Neutron-absorbing sheets - PWR	Boral, boron steel and other materials (excluding Boraflex) utilized as neutron absorbers	Treated borated water	Reduction of neutron-absorbing capacity, changes in dimension that increase Keff, and loss of material due to neutron-absorber degradation and radiation	Chapter XI.M40, “Monitoring of Neutron-Absorbing Materials other then Boraflex”	No

XI.M40 MONITORING OF NEUTRON-ABSORBING MATERIALS OTHER THAN BORAFLEX

Program Description

A monitoring program is implemented to assure that degradation of the neutron-absorbing material used in spent fuel pools that could compromise the criticality analysis will be detected. The applicable aging management program (AMP) relies on periodic inspection, testing, monitoring, and analysis of the criticality design to assure that the required five percent subcriticality margin is maintained during the renewed license period.

Evaluation and Technical Basis

1. ***Scope of Program*:** The AMP manages the effects of aging on neutron-absorbing components/materials used in spent fuel racks.

2. ***Preventive Actions*:** This AMP is a condition monitoring program and therefore there are no preventative actions.

3. ***Parameters Monitored/Inspected*:** For these materials, gamma irradiation and/or long-term exposure to the wet pool environment may cause shrinkage resulting in loss of material, and changes in dimension (such as gap formation, formation of blisters, pits and bulges) which could result in loss of neutron absorbing capability of the material. The parameters monitored include the physical condition of the neutron-absorbing materials, such as in situ gap formation, geometric changes in the material (formation of blisters, pits, and bulges) as observed from coupons or in situ, and decreased boron areal density, etc. The parameters monitored should be directly related to determination of the loss of material or loss of neutron absorption capability of the material(s).

4. ***Detection of Aging Effects*:** The loss of material and the degradation of the neutron-absorbing material capacity are determined through coupon and/or direct in situ testing. Such testing should include periodic verification of boron loss through areal density measurement of coupons or through direct in situ techniques which may include measurement of boron areal density, geometric changes in the material (blistering, pitting, and bulging), and detection of gaps through blackness testing. The frequency of the inspection and testing depends on the condition of the neutron-absorbing material and should be determined and justified with plant-specific operating experience by the licensee, not to exceed 10 years.

5. ***Monitoring and Trending*:** The measurements from periodic inspections and analysis are compared to baseline information or prior measurements and analysis for trend analysis. The approach for relating the measurements to the performance of the spent fuel neutron absorber materials shall be specified by the applicant, considering differences in exposure conditions, vented/non-vented test samples and spent fuel racks, etc.

6. ***Acceptance Criteria*:** Although the goal is to ensure maintenance of the five percent subcriticality margin for the spent fuel pool, the specific acceptance criteria for the measurements and analyses shall be specified by the applicant.

7. ***Corrective Actions*:** Corrective actions are initiated if the results from measurements and analysis indicate that the five percent subcriticality margin cannot be maintained because of

the current or projected future degradation of the neutron-absorbing material. Corrective actions may consist of providing additional neutron-absorbing capacity with an alternate material, or applying other options, which are available to maintain the subcriticality margin. As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the corrective actions.

8. ***Confirmation Process*****:** Site quality assurance (QA) procedures, site review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B. As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B acceptable to address the confirmation process and administrative controls.

9. ***Administrative Controls*****:** As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address administrative controls.

10. ***Operating Experience*****:** Applicants for license renewal should reference plant-specific operating experience and industry experience to provide reasonable assurance that the program will be able to detect degradation of the neutron absorbing material in the applicant's spent fuel pool. Some of the industry operating experience that should be included is listed below:

    1. Loss of material from the neutron absorbing material has been seen at many plants, including loss of aluminum which was detected by monitoring the aluminum concentration in the spent fuel pool. One instance of this was documented in the Vogtle LRA Water Chemistry Program B.3.28.
    2. Blistering has also been noted at many plants. Examples include blistering at Seabrook and Beaver Valley.
    3. The significant loss of neutron-absorbing capacity of the plate-type carborundum material has been reported at Palisades.

    The applicant should describe how the monitoring program described above is capable of detecting the aforementioned degradation mechanisms.

References

Letter from Christopher J. Schwarz, Entergy Nuclear Operations, Inc., Palisades Nuclear Plant, to the U.S. Nuclear Regulatory Commission, *Commitments to Address Degraded Spent Fuel Pool Storage Rack Neutron Absorber*, August 27, 2008, (ADAMS Accession No. ML082410132).

Letter from Kevin L. Ostrowski, FirstEnergy Nuclear Operating Company, to the U.S. Nuclear Regulatory Commission, *Supplemental Information for the Review of the Beaver Valley Power Station, Units 1 and 2, License Renewal Application (TAC Nos. MD6593 and MD6594) and License Renewal Application Amendment No. 34*, January 19, 2009, (ADAMS Accession No. ML090220216).

Letter from Mark E. Warner, FPL Energy Seabrook Station, to the U.S. Nuclear Regulatory Commission, *Seabrook Station Boral Spent Fuel Pool Test Coupons Report Pursuant to 10 CFR Part 21.21*, October 6, 2003 (ADAMS Accession No. ML032880525).

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APPENDIX D

MARK-UP SHOWING CHANGES TO THE LICENSE RENEWAL GUIDANCE DOCUMENTS

control program should be verified to ensure that cracking is not occurring. The GALL Report recommends that a plant-specific aging management program be evaluated to verify the absence of cracking due to SCC and cyclic loading to ensure that these aging effects are managed adequately. An acceptable verification program is to include temperature and radioactivity monitoring of the shell side water, and eddy current testing of tubes.

2. Cracking due to SCC and cyclic loading could occur in stainless steel PWR regenerative heat exchanger components exposed to treated borated water greater than 60°C (>140°F). The existing aging management program relies on monitoring and control of primary water chemistry in PWRs to manage the aging effects of cracking due to SCC. However, control of water chemistry does not preclude cracking due to SCC and cyclic loading. Therefore, the effectiveness of the water chemistry control program should be verified to ensure that cracking is not occurring. The GALL Report recommends that a plant-specific aging management program be evaluated to verify the absence of cracking due to SCC and cyclic loading to ensure that these aging effects are managed adequately. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

3. Cracking due to SCC and cyclic loading could occur for the stainless steel pump casing for the PWR high-pressure pumps in the chemical and volume control system. The existing aging management program relies on monitoring and control of primary water chemistry in PWRs to manage the aging effects of cracking due to SCC. However, control of water chemistry does not preclude cracking due to SCC and cyclic loading. Therefore, the effectiveness of the water chemistry control program should be verified to ensure that cracking is not occurring. The GALL Report recommends that a plant-specific aging management program be evaluated to verify the absence of cracking due to SCC and cyclic loading to ensure that these aging effects are managed adequately. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

3.3.2.2.5 Hardening and Loss of Strength due to Elastomer Degradation

1. Hardening and loss of strength due to elastomer degradation could occur in elastomer seals and components of heating and ventilation systems exposed to air – indoor uncontrolled (internal/external. The GALL Report recommends further evaluation of a plant-specific aging management program to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

2. Hardening loss of strength due to elastomer degradation could occur in elastomer linings of the filters, valves, and ion exchangers in spent fuel pool cooling and cleanup systems (BWR and PWR) exposed to treated water or to treated borated water. The GALL Report recommends that a plant-specific aging management program be evaluated to determine and assesses the qualified life of the linings in the environment to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

~~3.3.2.2.6 Reduction of Neutron-Absorbing Capacity and Loss of Material due to General Corrosion~~

~~Reduction of neutron-absorbing capacity and loss of material due to general corrosion could occur in the neutron-absorbing sheets of BWR and PWR spent fuel storage racks exposed to treated water or to treated borated water. The GALL Report recommends further evaluation of a~~

~~plant-specific aging management program to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR).~~

3.3.2.2.7 Loss of Material due to General, Pitting, and Crevice Corrosion

1. Loss of material due to general, pitting, and crevice corrosion could occur in steel piping, piping components, and piping elements, including the tubing, valves, and tanks in the reactor coolant pump oil collection system, exposed to lubricating oil (as part of the fire protection system). The existing aging management program relies on the periodic sampling and analysis of lubricating oil to maintain contaminants within acceptable limits, thereby preserving an environment that is not conducive to corrosion. However, control of lube oil contaminants may not always have been adequate to preclude corrosion. Therefore, the effectiveness of lubricating oil control should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage corrosion to verify the effectiveness of the lubricating oil program. A one-time inspection of selected components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

   In addition, corrosion may occur at locations in the reactor coolant pump oil collection tank where water from wash downs may accumulate. Therefore, the effectiveness of the program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage loss of material due to general, pitting, and crevice corrosion, to include determining the thickness of the lower portion of the tank. A one-time inspection is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

2. Loss of material due to general, pitting, and crevice corrosion could occur in steel piping, piping components, and piping elements in the BWR reactor water cleanup and shutdown cooling systems exposed to treated water. The existing aging management program relies on monitoring and control of reactor water chemistry to manage the aging effects of loss of material from general, pitting and crevice corrosion. However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause general, pitting, or crevice corrosion. Therefore, the effectiveness of the chemistry control program should be verified to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage loss of material from general, pitting, and crevice corrosion to verify the effectiveness of the water chemistry program. A one-time inspection of select components at susceptible locations is an acceptable method to ensure that corrosion is not occurring and that the component's intended function will be maintained during the period of extended operation.

3. Loss of material due to general (steel only) pitting and crevice corrosion could occur for steel and stainless steel diesel exhaust piping, piping components, and piping elements exposed to diesel exhaust. The GALL Report recommends further evaluation of a plant-specific aging management program to ensure that these aging effects are adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this SRP-LR.)

monitoring of the shell side water, and eddy current testing of tubes. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

2. The GALL Report recommends further evaluation of programs to manage cracking due to SCC and cyclic loading in the stainless steel PWR regenerative heat exchanger components exposed to treated borated water greater than 60°C (>140°F). The water chemistry program relies on monitoring and control of water chemistry to manage the aging effects of cracking due to SCC and cyclic loading. The GALL Report recommends the effectiveness of the chemistry control program be verified to ensure that cracking is not occurring. The absence of cracking due to SCC and cyclic loading is to be verified. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3. The GALL Report recommends further evaluation of programs to manage cracking due to cyclic loading for the stainless steel pump casing of high-pressure pumps in the PWR chemical and volume control system. The GALL Report recommends further evaluation to ensure that these aging effects are adequately managed. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

3.3.3.2.5 Hardening and Cracking or Loss of Strength due to Elastomer Degradation

1. The GALL Report recommends further evaluation of programs to manage the Hardening and loss of strength due to elastomer degradation could occur in elastomer seals and components of heating and ventilation systems exposed to air – indoor uncontrolled (internal/external. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

2. The GALL Report also recommends further evaluation of programs to manage the hardening and cracking due to elastomer degradation of valves in spent fuel pool cooling and cleanup system (BWR and PWR). The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.

~~3.3.3.2.6 Reduction of Neutron-Absorbing Capacity and Loss of Material due to General Corrosion~~

~~The GALL Report recommends further evaluation of programs to manage reduction of neutron-absorbing capacity and loss of material due to general corrosion of the neutron-absorbing sheets in BWR and PWR spent fuel storage racks. The reviewer reviews the applicant's proposed program on a case-by-case basis to ensure that an adequate program will be in place for the management of these aging effects.~~

3.3.3.2.7 Loss of Material due to General, Pitting, and Crevice Corrosion

1. The GALL Report recommends further evaluation of programs to manage the loss of material due to general, pitting, and crevice corrosion of steel piping, piping components, and piping elements exposed to lubricating oil, including the tanks, valve bodies, and tubing in the reactor coolant pump oil collection system (as part of the fire protection system). The

Table 3.3-1. Summary of Aging Management Programs for Auxiliary Systems Evaluated in Chapter VII of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Item
11	BWR/ PWR	Elastomer seals and components exposed to air – indoor uncontrolled (internal/external)	Hardening and loss of strength due to elastomer degradation	A plant specific aging management program is to be evaluated.	Yes, plant specific (See subsection 3.3.2.2.5.1)	A-17
12	BWR/ PWR	Elastomer lining exposed to treated water or treated borated water	Hardening and loss of strength due to elastomer degradation	A plant specific aging management program is to be evaluated.	Yes, plant specific (See subsection 3.3.2.2.5.2)	A-15 A-16
13	BWR/ PWR	Boral, boron steel and other materials (excluding Boraflex) utilized as neutron absorbers in spent fuel storage racks neutron-absorbing sheets exposed to treated water or treated borated water	Reduction of neutron-absorbing capacity, changes in dimension that increase Keff, and loss of material due to neutron-absorber degradation and radiation~~general corrosion~~	~~A plant specific aging management program is to be evaluated.~~ Monitoring of Neutron-Absorbing Materials other than Boraflex	~~Yes, plant specific (See subsection 3.3.2.2.6)~~No	A-88 A-89
14	BWR/ PWR	Steel piping, piping component, and piping elements exposed to lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.3.2.2.7.1)	AP-30
15	BWR/ PWR	Steel reactor coolant pump oil collection system piping, tubing, and valve bodies exposed to lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.3.2.2.7.1)	A-83
16	BWR/ PWR	Steel reactor coolant pump oil collection system tank exposed to lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection to evaluate the thickness of the lower portion of the tank	Yes, detection of aging effects is to be evaluated (See subsection 3.3.2.2.7.1)	A-82
17	BWR	Steel piping, piping components, and piping elements exposed to treated water	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated (See subsection 3.3.2.2.7.2)	A-35

Table 3.3-2. FSAR Supplement for Aging Management of Auxiliary Systems		
Program	**Description of Program**	**Implementation Schedule***
Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (BWR/PWR)	The program visually inspects internal surfaces of steel piping, piping elements, ducting, and components in an internal environment (indoor uncontrolled air, condensation, and steam) that are not included in other aging management programs, for loss of material. Inspections are performed when the internal surfaces are accessible during the performance of periodic surveillance tests, during preventive maintenance activities or during scheduled outages. The program includes visual inspection to assure that existing environment conditions are not causing material degradation that could result in a loss of system intended functions.	Existing program
Inspection of Overhead Heavy Load and Light Load Handling System	The program evaluates the effectiveness of the maintenance monitoring program and the effects of past and future usage on the structural reliability of cranes and hoists. The number and magnitude of lifts made by the hoist or crane are also reviewed. Rails and girders are visually inspected on a routine basis for degradation. Functional tests are also performed to assure their integrity. These cranes must also comply with the maintenance rule requirements provided in 10 CFR 50.65.	Existing program
Lubricating Oil Analysis	This program ensures the oil environment in the mechanical systems is maintained to the required quality. The program maintains oil systems free of contaminants (primarily water and particulates) thereby preserving an environment that is not conducive to loss of material, cracking, or reduction of heat transfer. Lubricating oil testing activities include sampling and analysis of lubricating oil for detrimental contaminants. The presence of water or particulates may also be indicative of inleakage and corrosion product buildup.	Existing program
Monitoring of Neutron-Absorbing Materials other than Boraflex	The program is implemented to assure that degradation of spent fuel pool neutron-absorbing material that could compromise the criticality analysis will be detected in the period of extended operation. The loss of material and the degradation of the neutron-absorbing material capacity are determined through coupon testing, direct in situ testing, or both. Such testing includes periodic verification of boron loss through areal density measurement of coupons or through direct in situ techniques, such as measurement of boron areal density, measurement of geometric changes in the material (blistering, pitting, and bulging), and detection of gaps through blackness testing.	Program should be implemented before the period of extended operation.

One-Time Inspection	This program verifies the effectiveness of other aging management program by determining if the aging effect is not occurring or the aging effect is progressing slowly so that the intended function will be maintained during the period of extended operation.	The inspection should be completed before the period of extended operation.

Table 3. Summary of Aging Management Programs for the Auxiliary Systems Evaluated in Chapter VII of the GALL Report

ID	Type	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Related Generic Item	Unique Item
13	BWR/ PWR	Boral, boron steel and other materials (excluding Boraflex) utilized as neutron absorbers in spent fuel storage racks neutron-absorbing sheets exposed to treated water or treated borated water	Reduction of neutron-absorbing capacity, changes in dimension that increase Keff, and loss of material due to neutron-absorber degradation and radiation~~general corrosion~~	~~Plant specific~~ Monitoring of Neutron-Absorbing Materials other than Boraflex	~~Yes, plant specific~~No	A-88 A-89	VII.A2-5 VII.A2-3
14	BWR/ PWR	Steel piping, piping component, and piping elements exposed to lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated	AP-30	VII.C1-17 VII.C2-13 VII.E1-19 VII.E4-16 VII.F1-19 VII.F2-17 VII.F3-19 VII.F4-15 VII.G-22 VII.H2-20
15	BWR/ PWR	Steel reactor coolant pump oil collection system piping, tubing, and valve bodies exposed to lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection	Yes, detection of aging effects is to be evaluated	A-83	VII.G-26
16	BWR/ PWR	Steel reactor coolant pump oil collection system tank exposed to lubricating oil	Loss of material due to general, pitting, and crevice corrosion	Lubricating Oil Analysis and One-Time Inspection to evaluate the thickness of the lower portion of the tank	Yes, detection of aging effects is to be evaluated	A-82	VII.G-27
17	BWR	Steel piping, piping components, and piping elements exposed to treated water	Loss of material due to general, pitting, and crevice corrosion	Water Chemistry and One-Time Inspection	Yes, detection of aging effects is to be evaluated	A-35	VII.E3-18 VII.E4-17

VII AUXILIARY SYSTEMS A2 Spent Fuel Storage							
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
VII.A2-1 (AP-79)	VII.A2.	Piping, piping components, and piping elements	Stainless Steel; Steel with stainless steel cladding	Treated borated water	Loss of material/ pitting and crevice corrosion	Chapter XI.M2, "Water Chemistry," for PWR primary water	No
VII.A2-2 (A-87)	VII.A2.1-a	Spent fuel storage racks Neutron-absorbing sheets - BWR	Boraflex	Treated water	Reduction of neutron-absorbing capacity/ boraflex degradation	Chapter XI.M22, "Boraflex Monitoring"	No
VII.A2-3 (A-89)	VII.A2.1-b	Spent fuel storage racks Neutron-absorbing sheets - BWR	Boral, boron steel and other materials (excluding Boraflex) utilized as neutron absorbers	Treated water	Reduction of neutron-absorbing capacity, changes in dimension that increase Keff, and loss of material due to neutron-absorber degradation and radiation~~/ general corrosion~~	~~A plant-specific aging management program is to be evaluated.~~Chapter XI.M40, "Monitoring of Neutron-Absorbing Materials other than Boraflex"	~~Yes, plant-specific~~No
VII.A2-4 (A-86)	VII.A2.1-a	Spent fuel storage racks Neutron-absorbing sheets - PWR	Boraflex	Treated borated water	Reduction of neutron-absorbing capacity/ boraflex degradation	Chapter XI.M22, '"Boraflex Monitoring"	No

VII A2	AUXILIARY SYSTEMS Spent Fuel Storage						
Item	**Link**	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**
VII.A2-5 (A-88)	VII.A2.1-b	Spent fuel storage racks Neutron-absorbing sheets - PWR	Boral, boron steel and other materials (excluding Boraflex) utilized as neutron absorbers	Treated borated water	Reduction of neutron-absorbing capacity, changes in dimension that increase Keff, and loss of material due to neutron-absorber degradation and radiation~~/ general corrosion~~	~~A plant-specific aging management program is to be evaluated.~~Chapter XI.M40, "Monitoring of Neutron-Absorbing Materials other then Boraflex"	~~Yes, plant-specific~~No
VII.A2-6 (A-96)	VII.A2.1-c	Spent fuel storage racks Storage racks - BWR	Stainless steel	Treated water >60ºC (>140ºF)	Cracking/ stress corrosion cracking	Chapter XI.M2, "Water Chemistry," for BWR water	No
VII.A2-7 (A-97)	VII.A2.1-c	Spent fuel storage racks Storage racks - PWR	Stainless steel	Treated borated water >60ºC (>140ºF)	Cracking/ stress corrosion cracking	Chapter XI.M2, "Water Chemistry," for PWR primary water	No

XI.M40 MONITORING OF NEUTRON-ABSORBING MATERIALS OTHER THAN BORAFLEX

Program Description

A monitoring program is implemented to assure that degradation of the neutron-absorbing material used in spent fuel pools that could compromise the criticality analysis will be detected. The applicable aging management program (AMP) relies on periodic inspection, testing, monitoring, and analysis of the criticality design to assure that the required five percent subcriticality margin is maintained during the renewed license period.

Evaluation and Technical Basis

1. ***Scope of Program*:** The AMP manages the effects of aging on neutron-absorbing components/materials used in spent fuel racks.

2. ***Preventive Actions*:** This AMP is a condition monitoring program and therefore there are no preventative actions.

3. ***Parameters Monitored/Inspected*:** For these materials, gamma irradiation and/or long-term exposure to the wet pool environment may cause shrinkage resulting in loss of material, and changes in dimension (such as gap formation, formation of blisters, pits and bulges) which could result in loss of neutron absorbing capability of the material. The parameters monitored include the physical condition of the neutron-absorbing materials, such as in situ gap formation, geometric changes in the material (formation of blisters, pits, and bulges) as observed from coupons or in situ, and decreased boron areal density, etc. The parameters monitored should be directly related to determination of the loss of material or loss of neutron absorption capability of the material(s).

4. ***Detection of Aging Effects*:** The loss of material and the degradation of the neutron-absorbing material capacity are determined through coupon and/or direct in situ testing. Such testing should include periodic verification of boron loss through areal density measurement of coupons or through direct in situ techniques which may include measurement of boron areal density, geometric changes in the material (blistering, pitting, and bulging), and detection of gaps through blackness testing. The frequency of the inspection and testing depends on the condition of the neutron-absorbing material and should be determined and justified with plant-specific operating experience by the licensee, not to exceed 10 years.

5. ***Monitoring and Trending*:** The measurements from periodic inspections and analysis are compared to baseline information or prior measurements and analysis for trend analysis. The approach for relating the measurements to the performance of the spent fuel neutron absorber materials shall be specified by the applicant, considering differences in exposure conditions, vented/non-vented test samples and spent fuel racks, etc.

6. ***Acceptance Criteria*:** Although the goal is to ensure maintenance of the five percent subcriticality margin for the spent fuel pool, the specific acceptance criteria for the measurements and analyses shall be specified by the applicant.

7. ***Corrective Actions*:** Corrective actions are initiated if the results from measurements and analysis indicate that the five percent subcriticality margin cannot be maintained because of

the current or projected future degradation of the neutron-absorbing material. Corrective actions may consist of providing additional neutron-absorbing capacity with an alternate material, or applying other options, which are available to maintain the subcriticality margin. As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the corrective actions.

8. ***Confirmation Process*:** Site quality assurance (QA) procedures, site review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B. As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B acceptable to address the confirmation process and administrative controls.

9. ***Administrative Controls*:** As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address administrative controls.

10. ***Operating Experience*:** Applicants for license renewal should reference plant-specific operating experience and industry experience to provide reasonable assurance that the program will be able to detect degradation of the neutron absorbing material in the applicant's spent fuel pool. Some of the industry operating experience that should be included is listed below:

    1. Loss of material from the neutron absorbing material has been seen at many plants, including loss of aluminum which was detected by monitoring the aluminum concentration in the spent fuel pool. One instance of this was documented in the Vogtle LRA Water Chemistry Program B.3.28.
    2. Blistering has also been noted at many plants. Examples include blistering at Seabrook and Beaver Valley.
    3. The significant loss of neutron-absorbing capacity of the plate-type carborundum material has been reported at Palisades.

The applicant should describe how the monitoring program described above is capable of detecting the aforementioned degradation mechanisms.

References

Letter from Christopher J. Schwarz, Entergy Nuclear Operations, Inc., Palisades Nuclear Plant, to the U.S. Nuclear Regulatory Commission, *Commitments to Address Degraded Spent Fuel Pool Storage Rack Neutron Absorber*, August 27, 2008, (ADAMS Accession No. ML082410132).

Letter from Kevin L. Ostrowski, FirstEnergy Nuclear Operating Company, to the U.S. Nuclear Regulatory Commission, *Supplemental Information for the Review of the Beaver Valley Power Station, Units 1 and 2, License Renewal Application (TAC Nos. MD6593 and MD6594) and License Renewal Application Amendment No. 34*, January 19, 2009, (ADAMS Accession No. ML090220216).

Letter from Mark E. Warner, FPL Energy Seabrook Station, to the U.S. Nuclear Regulatory Commission, *Seabrook Station Boral Spent Fuel Pool Test Coupons Report Pursuant to 10 CFR Part 21.21*, October 6, 2003 (ADAMS Accession No. ML032880525).

License Renewal Application Vogtle Electric Generating Plant Units 1 and 2, Southern Nuclear Operating Company, Inc., June 30, 2007 (ADAMS Accession No. ML071840360).

APPENDIX E

RESOLUTION OF PUBLIC COMMENTS ON DRAFT LR-ISG-2009-01

Comment No.	Comment Source (ADAMS Accession No.)	Comment on Draft LR-ISG-2009-01	NRC Staff Response
1	Southern Nuclear Operating Company, Inc. Letter dated December 17, 2009 (ML093570197)	Southern Nuclear Operating Company (SNC) takes exception to the statement in the "Discussion" section, under the "Boral" heading, that, "Similarly, the spent fuel pool water chemistry program at Vogtle documented an increase in the concentration of aluminum, which indicates loss of material from the Boral neutron absorbing material (Ref. 7)." SNC does not believe that increasing aluminum concentration in the spent fuel pool water is conclusive evidence that loss of material from the Boral neutron absorbing material is occurring. Therefore, it is inappropriate to use the Vogtle Electric Generating Plant operating experience with aluminum concentration in the spent fuel pool as indication of degradation of the Boral neutron absorbing material.	The third paragraph under the "Boral" heading in the "Discussion" section has been revised to include the word "may" to clarify that there is the possibility that an increased aluminum concentration indicates loss of the Boral neutron-absorbing material. Regarding the Vogtle Electric Generating Plant operating experience, the increasing aluminum concentration is an indication of degradation of the Boral cladding, which may indicate a larger problem.
2	Exelon Generation Company, LLC Letter dated December 28, 2009 (ML100060388)	In item four, "Detection of Aging Effects," under the "Evaluation and Technical Basis" heading of the attached aging management program, "XI.XXXX Monitoring of Neutron Absorbing Materials other than Boraflex," clarify the intent of the requirement to specify whether in situ testing methods can be used in lieu of coupon measurements, or if both are required in lieu of the alternate methods listed.	In the aging management program description, the "Detection of Aging Effects" item has been clarified to indicate that either coupon testing or direct in situ testing, or both, may be used to detect the aging effects of concern.
3	Exelon Generation Company, LLC Letter dated December 28, 2009 (ML100060388)	In item ten, "Operating Experience," under the "Evaluation and Technical Basis" heading of the attached aging management program, "XI.XXXX Monitoring of Neutron Absorbing Materials other than Boraflex," the listed operating experience includes the loss of neutron-absorbing capacity of the material at the Palisades plant. Please clarify that material for this example was carborundum and not Boral.	In the aging management program description, the "Operating Experience" item has been clarified to reflect the Palisades Nuclear Plant operating experience concerning the plate-type carborundum material.

Comment No.	Comment Source (ADAMS Accession No.)	Comment on Draft LR-ISG-2009-01	NRC Staff Response
4	Nuclear Energy Institute Letter dated December 31, 2009 (ML100060387)	Clarify in the LR-ISG that if the neutron absorber is not credited in the licensees' criticality analysis, then a surveillance program for that neutron absorber is not required.	Some clarifications have been made as discussed in the response to Comment No. 11. No other changes to the LR-ISG are necessary because neutron absorbers not credited in the applicant's criticality analysis are not within the scope of license renewal, as defined in 10 CFR 54.4. Therefore, an aging management review of such components is not required.
5	Nuclear Energy Institute Letter dated December 31, 2009 (ML100060387)	The LR-ISG does not provide a viable option for those licensees that do not have a coupon testing program. The LR-ISG would require the performance of continuous neutron absorber areal density measurements (blackness testing). Provide a viable alternative to continuous blackness testing for the effected licensees.	No changes to the LR-ISG have been incorporated. The NRC's staff's intent is not to recommend "continuous" testing, but rather periodic coupon or in situ testing.
6	Nuclear Energy Institute Letter dated December 31, 2009 (ML100060387)	Consider the addition of allowing licensees to demonstrate that the combination of the neutron absorber manufacturing process, spent fuel pool environment and previous/existing testing provides reasonable assurance of the continued efficacy of the neutron absorber capability in lieu of a testing program.	No changes to the LR-ISG have been incorporated. The LR-ISG provides guidance as to one acceptable approach for managing the effects of aging during the period of extended operation for certain neutron-absorbing spent fuel pool components; however, this guidance does not preclude a license renewal applicant from proposing and justifying other approaches for managing the effects of aging.

Comment No.	Comment Source (ADAMS Accession No.)	Comment on Draft LR-ISG-2009-01	NRC Staff Response
7	Nuclear Energy Institute Letter dated December 31, 2009 (ML100060387)	The "Discussion" section, under the "Carborundum" heading states: "The swelling of the racks, which prevents fuel assemblies from being inserted or removed, indicates a potential problem with neutron-absorbing capacity." However, swelling of racks does not necessarily provide an indication of a loss of neutron absorption capacity. Root cause evaluations have not provided a clear link between swelling and the loss of neutron absorption. Therefore, change this sentence to: "The swelling of the racks, which prevents fuel assemblies from being inserted or removed, may indicate a potential problem with neutron-absorbing capacity."	Comment incorporated.
8	Nuclear Energy Institute Letter dated December 31, 2009 (ML100060387)	In the "Discussion" section, under the "Carborundum" heading, clarify that another form of carborundum does exist and it has not experienced similar degradation mechanisms to that of the plate type carborundum found at Palisades. Add the sentence, "This only applies to the plate type Carborundum," to the end of the second paragraph under this heading.	A clarification has been made in the subject paragraph to indicate that the discussion concerns only "plate-type carborundum."
9	Nuclear Energy Institute Letter dated December 31, 2009 (ML100060387)	On page four, under the heading, "GALL Report, Vol. 2," revise the Table VII.A2 to allow credit for water chemistry in managing the aging effect of loss of material by adding a line item to reference the aging management program in GALL Report, Volume 2, Section XI.M2, "Water Chemistry."	No changes to the LR-ISG have been incorporated. An appropriate technical basis to support incorporation of this comment has not been provided. The staff has found that a surveillance program, as described in the aging management program, is necessary for managing aging in this area.

Comment No.	Comment Source (ADAMS Accession No.)	Comment on Draft LR-ISG-2009-01	NRC Staff Response
10	Nuclear Energy Institute Letter dated December 31, 2009 (ML100060387)	On page five, under the heading, "SRP-LR," change the last sentence to: "Reduction of neutron-absorbing capacity, changes in dimension that increase Keff or negatively affect criticality and loss of material due to the effects of the SFP environment." This change would acknowledge that a decrease in Keff could occur and is not prohibited.	The LR-ISG reflects changes to the "aging effect/mechanism" description in the revised SRP-LR Table 3.3-1, item 13, GALL Report, Volume 1, Table 3, item 13, and GALL Report, Volume 2, Table VII.A2, items VII.A2-3 and VII.A2-5, to include "changes in dimension that increase Keff." The intent of the LR-ISG is to provide guidance for managing the detrimental effects of aging, and changes in dimension that decrease Keff are not detrimental aging effects. The proposed language in the comment includes the text: "or negatively affect criticality." For conciseness, this text was not incorporated because negative effects on criticality are the same as increases in Keff.
11	Nuclear Energy Institute Letter dated December 31, 2009 (ML100060387)	For clarification purposes, change the revised component item descriptions under the headings, "GALL Report, Vol. 1" and "SRP-LR," to: "Boral, boron steel and other materials (excluding Boraflex) utilized as neutron absorbers in spent fuel storage racks, exposed to treated water or treated borated water and radiation effect."	The LR-ISG reflects changes to the "component" description in the revised SRP-LR Table 3.3-1, item 13, and GALL Report, Volume 1, Table 3, item 13, to clarify that the materials are "utilized as neutron absorbers." This change is also reflected in the "material" descriptions in the revised GALL Report, Volume 2, Table VII.A2, items VII.A2-3 and VII.A2-5.
12	Nuclear Energy Institute Letter dated December 31, 2009 (ML100060387)	For clarity, in item one, "Scope of Program," under the "Evaluation and Technical Basis" heading of the attached aging management program, "XI.XXXX Monitoring of Neutron Absorbing Materials other than Boraflex," move the second sentence to item three, "Parameters Monitored/Inspected."	Comment incorporated.

Comment No.	Comment Source (ADAMS Accession No.)	Comment on Draft LR-ISG-2009-01	NRC Staff Response
13	Nuclear Energy Institute Letter dated December 31, 2009 (ML100060387)	In item three, “Parameters Monitored/Inspected,” under the “Evaluation and Technical Basis” heading of the attached aging management program, “XI.XXXX Monitoring of Neutron Absorbing Materials other than Boraflex,” add the following sentence: “Where it can be shown that for a specific material and environment test results are not site-specific, the use of shared industry coupon testing results is acceptable.”	No changes to the LR-ISG have been incorporated. The LR-ISG provides guidance as to one acceptable approach for managing the effects of aging during the period of extended operation for certain neutron-absorbing spent fuel pool components; however, this guidance does not preclude a license renewal applicant from proposing and justifying other approaches for managing the effects of aging.
14	Nuclear Energy Institute Letter dated December 31, 2009 (ML100060387)	In item four, “Detection of Aging Effects,” under the “Evaluation and Technical Basis” heading of the attached aging management program, “XI.XXXX Monitoring of Neutron Absorbing Materials other than Boraflex,” change the first sentence to: "The loss of material and the degradation of the neutron-absorbing material capacity are determined through coupon or in situ testing. Such testing includes measurement of boron areal density, geometric changes in the material (blistering, pitting, and bulging), detection of gaps through blackness testing, and periodic verification of boron loss through in-situ areal density measurements or coupon testing.” This change clarifies that in situ or coupon testing is acceptable, it also eliminate the specific reference to BADGER testing so that it does not appear NRC is advocating a specific manufacturer's type of testing.	Comment incorporated.

Comment No.	Comment Source (ADAMS Accession No.)	Comment on Draft LR-ISG-2009-01	NRC Staff Response
15	Nuclear Energy Institute Letter dated December 31, 2009 (ML100060387)	Regarding item four, "Detection of Aging Effects," under the "Evaluation and Technical Basis" heading of the attached aging management program, "XI.XXXX Monitoring of Neutron Absorbing Materials other than Boraflex," provide the basis for a testing frequency of a maximum of 10 years. Use of operating experience should be permitted to allow licensees to determine the appropriate inspection frequency requirements. Therefore, delete the words, "with a maximum of 10 years" from the last sentence of this item.	The 10-year maximum period between inspections ensures that at least one set of inspection and testing results will be acquired during the period of extended operation. This period is consistent with current industry inservice inspection requirements for component inspections under 10 CFR 50.55a and the Section XI of the American Society of Mechanical Engineers Code. In the aging management program description, the "Detection of Aging Effects" item has been clarified to state that applicants should determine and justify the inspection and testing frequency based on operating experience; however, this frequency is not to exceed 10 years.

Comment No.	Comment Source (ADAMS Accession No.)	Comment on Draft LR-ISG-2009-01	NRC Staff Response
16	Nuclear Energy Institute Letter dated December 31, 2009 (ML100060387)	Concerning the second sentence of item seven, "Corrective Actions," under the "Evaluation and Technical Basis" heading of the attached aging management program, "XI.XXXX Monitoring of Neutron Absorbing Materials other than Boraflex," (1) change "Corrective actions consist of …" to: "Corrective actions may consist of …" This change is to clarify that the licensees' corrective action process will determine the appropriate actions. Also, (2) those licensees with 10 CFR 50.68(b)(4) as their licensing basis comply with the regulatory requirement that the spent fuel pool remain subcritical without soluble boron. Therefore, the five percent subcritical margin referred to is only applicable for normal conditions for those licensees. Given these two comments, change the second sentence of item seven to: "Corrective actions may consist of providing additional neutron-absorbing capacity with an alternate material, or applying other options, which are available to maintain the appropriate subcriticality margin."	Comment incorporated.
17	Nuclear Energy Institute Email dated January 6, 2010 (ML100280648)	The term "Carborundum" is used rather than something more generic. Carborundum is the manufacturer of a neutron-absorber which consists of boron-carbide in a phenol formaldehyde resin. Other manufacturers (e.g., ESK) manufacture boron-carbide in a phenolic resin, which is a similar material. The term carborundum is used throughout the document in a generic sense and it should only be used for those specific stations that have carborundum (e.g., Palisades).	No changes to the LR-ISG have been incorporated. Carborundum is referenced in the LR-ISG either as an example of a neutron-absorbing material or in the description of plant-specific operating experience for carborundum.

Comment No.	Comment Source (ADAMS Accession No.)	Comment on Draft LR-ISG-2009-01	NRC Staff Response
18	Nuclear Energy Institute Email dated January 6, 2010 (ML100280648)	The LR-ISG uses the term, "Region 1 Fuel Storage Racks." This is specific rack defined by a specific station. This term should be better defined, for example, use "fuel storage racks that receive freshly discharged fuel," or something similar.	The definition or region 1 racks has been clarified as "high reactivity, unburned reload fuel," as defined in Electric Power Research Institute's "Handbook of Neutron Absorber Materials for Spent Fuel Transportation and Storage Applications," dated 2006.