

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 5% sub-criticality margin is maintained during the period of license renewal.

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 loss of material and changes in dimension (such as gap formation, formation of blisters, pits and bulges) that 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 are 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 is 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 is 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 5% sub-criticality margin for the spent fuel pool, the specific acceptance criteria for the measurements and analyses are specified by the applicant.
7. **Corrective Actions:** Corrective actions are initiated if the results from measurements and analysis indicate that the 5% sub-criticality margin cannot be maintained because of

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 sub-criticality margin. As discussed in the Appendix for GALL, 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 for GALL, 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 for GALL, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address administrative controls.
10. **Operating Experience:** Applicants for license renewal reference plant-specific operating experience and industry experience to provide reasonable assurance that the program is 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

Interim Staff Guidance LR-ISG-2009-01, *Aging Management of Spent Fuel Pool Neutron-Absorbing Materials Other Than Boraflex*, 2010.

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 Boron 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).

NRC Information Notice 2009-26, *Degradation of Neutron-Absorbing Materials in the Spent Fuel Pool*, U.S. Nuclear Regulatory Commission, October 28, 2009.