REQUEST FOR ADDITIONAL INFORMATION

NUCLEAR ENERGY INSTITUTE

NEI 16-03, "GUIDANCE FOR MONITORING OF FIXED NEUTRON ABSORBERS IN SPENT FUEL POOLS"

By letter dated August 19, 2022, as supplemented by letters dated October 12 and December 15, 2022 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML22231B041, ML22298A281, and ML22349A656, respectively), the Nuclear Energy Institute (NEI) submitted guidance document NEI 16-03, Revision 1, "Guidance for Monitoring of Fixed Neutron Absorbers in Spent Fuel Pools," on behalf of its members for U.S. Nuclear Regulatory Commission (NRC) review and endorsement. NEI 16-03, Revision 1, includes Electric Power Research Institute Technical Report 3002018497, "Industrywide Learning Aging Management Program (i-LAMP): Global Neutron Absorber Material Monitoring Program for Spent Fuel Pools," dated August 2022, as an alternative monitoring approach.

Regulatory Basis

The credited neutron absorbing materials (NAMs) installed in spent fuel pool (SFP) storage racks ensures that the effective multiplication factor (k_{eff}) does not exceed the values and assumptions used in the criticality analysis of record (AOR) and other licensing basis documents. The AOR is the basis, in part, for demonstrating compliance with plant technical specifications and with applicable NRC regulations. Degradation or deformation of the credited NAM may reduce safety margin and potentially challenge the subcriticality requirement. NAMs utilized in SFP racks exposed to treated water or treated borated water may be susceptible to reduction of neutron absorbing capacity, changes in dimension that increase k_{eff}, and loss of material. A monitoring program is implemented to ensure that degradation of the NAM used in SFPs, which could compromise the ability of the NAM to perform its safety function as assumed in the AOR, will be detected. The NRC's regulatory requirements and corresponding staff review criteria and guidance for NAM monitoring programs are contained in the following documents:

- Part 50.68(b)(4) of Title 10 of the *Code of Federal Regulation* (CFR), "Criticality accident requirements," states that if the licensee does not credit soluble boron in the SFP criticality AOR, the k-effective (k_{eff}) of the SFP storage racks must not exceed 0.95 at a 95 percent probability, 95 percent confidence level. If the licensee does take credit for soluble boron, the k_{eff} of the SFP storage racks must not exceed 0.95 at a 95 percent probability, 95 percent confidence level, if flooded with borated water, and if flooded with unborated water, the k_{eff} must remain below 1.0 at a 95 percent probability, 95 percent confidence level. The k_{eff} is defined as the effective neutron multiplication factor.

- General Design Criteria (GDC) as described in 10 CFR Part 50, Appendix A," General Design Criteria for Nuclear Power Plants," Criterion 61 "Fuel storage and handling and radioactivity control," which states that "The fuel storage and handling, radioactive waste, and other systems which may contain radioactivity shall be designed to assure adequate safety under normal and postulated accident

conditions. These systems shall be designed (1) with a capability to permit appropriate periodic inspection and testing of components important to safety…"

- GDC Criterion 62, "Prevention of Criticality in Fuel Storage and Handling," which states that "Criticality in the fuel storage and handling system shall be prevented by physical systems or processes, preferably by use of geometrically safe configurations."

- NUREG-0800, "Standard Review Plan [SRP]," Section 9.1.1, Revision 3, "Criticality Safety of Fresh and Spent Fuel Storage and Handling" (ADAMS Accession No. ML070570006). This NUREG section provides guidance regarding the acceptance criteria and review procedures to ensure that the proposed changes satisfy the requirements in 10 CFR 50.68.

- NUREG-0800, "Standard Review Plan," Section 9.1.2, Revision 4, "New and Spent Fuel Storage" (ADAMS Accession No. ML103490041). This NUREG section provides guidance regarding the acceptance criteria and review procedures to ensure that the proposed changes satisfy the requirements in 10 CFR 50.68.

- NUREG-1801, "Generic Aging Lessons Learned (GALL) Report," Revision 2. This NUREG provides guidance on what constitutes an acceptable monitoring program for NAM credited for criticality control in the SFP.

Requests for Additional Information (RAI)

To complete the review, the staff requires the following additional information.

RAI #1

Issue/Request:

Section 1.2 "Background" on page 1 states that, "In some cases, sufficient operating experience was acquired over several decades to allow individual licensees not to need coupons or in-situ examinations, but to rely on the collective industry experience." The staff is unaware of any licensees that have cited "collective industry experience" in lieu of in-situ or coupon testing for any neutron absorbing material. In addition, this is not consistent with the guidance in NUREG-1801, Revision 2. Please provide the plants and associated NAMs that are relying on collective industry experience instead of in-situ examinations/coupons or modify the background language. The staff recognizes that this statement was also included in Revision 0 of NEI 16-03 (ADAMS Accession No. ML16265A248).

RAI #2

Issue/Request:

The foreword and background state that i-LAMP is intended to replace a water chemistry monitoring approach from Revision 0 that was not accepted by the NRC to be considered as a stand-alone monitoring approach. It is unclear to the NRC staff what the purpose of this statement is. If the intention of this revision is to make i-LAMP an acceptable stand-alone monitoring approach, why would the current revision reference an approach that was previously rejected and does not appear in the approved Revision 0?

RAI #3

Issue/Request:

The last paragraph of the “Background” section discusses options for licensees to modify their current licensing basis with respect to neutron absorbing material surveillance programs. This paragraph seems insufficient to address the wide variety of individual plant licensing scenarios. The previously approved revision of this guidance focused on the material surveillance program and did not address plant-specific licensing scenarios. Please clarify that the Revision 1 guidance is not intended to address individual licensing scenarios.

RAI #4

Issue/Request:

Section 2.2.3 states that the 2-bin approach will eliminate regulatory submissions and the need for plant-specific review by the regulator. It is unclear to the NRC staff how the proposed binning approach would absolve a plant from the regulatory process and licensing requirements. Any licensee seeking to adopt an i-LAMP monitoring approach would need to modify their current monitoring program and associated licensing commitments. Please discuss why the proposed binning method would eliminate regulatory submissions and plant-specific reviews by the NRC?

RAI #5

Issue/Request:

Section 2.2.3 states that the 2-bin approach is applicable until loss of ^{10}B is identified by global operating experience. However, this does not account for the potential scenario where a plant or plants with the oldest Boral runs out of coupons or ceases operation without transferring their remaining coupons to another operating plant. In this scenario there will be a subset of plants that relied on the data from the plant with the oldest Boral that will no longer be bounded by the collective data set. If a plant is not monitoring a specific sibling plant’s data but relies on the generic i-LAMP program, as a whole, they may be unaware that they are no longer bounded by the program. How does NEI proposes to account for this scenario?

RAI #6

Issue/Request:

There is a potential scenario where a Boral degradation mechanism that results in loss of ^{10}B is identified in the future. If this occurs all plants relying on i-LAMP for their neutron absorber monitoring programs face regulatory uncertainty. Plants relying on a generic 2-bin approach would not have the plant-specific analysis available to rule out the degradation mechanism for their site based on material age or other applicable parameters. How would i-LAMP participating plants demonstrate their material condition and continued criticality safety without plant-specific analysis or the analysis of a sibling plant with closely related material and spent fuel pool conditions? *Specifically, how does the degradation feedback loop from other boral plants work or apply.*

RAI #7

Issue/Request:

Temperature and cumulative dose (gamma and neutron) are listed in Section 2.2.1 as parameters affecting neutron absorber aging. Why are these parameters not included in the list of sibling pool criteria discussed in Section 2.2.2?

RAI #8

Issue/Request:

Appendix A Section A.3.1.4 proposes actions that the pilot plant may make pending regulatory approval. The NRC staff does not intend to perform any regulatory assessment of plant-specific neutron absorber programs as part of its review of NEI 16-03, Rev. 1. Please clarify the intent of this section of Appendix A.

RAI #9

Issue/Request:

Section 2.2.1.1 states that water chemistry is used as a monitoring tool for early indications of anomalies. In the case of Boraflex, water chemistry programs identified excess silica in the spent fuel pool water. For Boral, the primary material composition is Aluminum (Al). However, Appendix A Section A1.2 states that “very few pools also measure Al” and “the majority of utilities discontinued this practice”. For pools that do not have their own Boral coupons, plant-specific data such as dissolved Al is essential for ensuring the integrity of the Boral. This is exemplified by the other industry programs (reactor vessel integrity and steam generator integrity) that are cited in NEI 16-03 as examples of industrywide monitoring programs that rely on water chemistry measurements. How can water chemistry readings identify early signs of Boral degradation if pools are not testing for the primary element comprising the Boral material (Al)?