OMB Control No.: 3150-0011

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
OFFICE OF FEDERAL AND STATE MATERIALS AND
ENVIRONMENTAL MANAGEMENT PROGRAMS
WASHINGTON, DC 20555-0001

Month XX, 20XX

NRC GENERIC LETTER 201X-XX: MONITORING OF NEUTRON-ABSORBING MATERIALS IN SPENT FUEL POOLS

ADDRESSEES

All nuclear power reactors, including those that have permanently shutdown and have spent fuel in spent fuel pools, with a license issued under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities."

All holders of an operating license for a non-power reactor (research reactor, test reactor, or critical assembly) under 10 CFR Part 50 who have a reactor pool, fuel storage pool, or other wet locations designed for the purpose of fuel storage, except those who have permanently ceased operations with all reactor fuel removed from onsite wet storage.

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC) is issuing this generic letter (GL) to address degradation of neutron-absorbing materials in the spent fuel pool (SFP) of power reactors and the fuel storage pool, reactor pool, or other wet locations designed for the purpose of fuel storage, as applicable, in the case of some non-power reactors (NPRs). This GL has its primary focus on the credited use of these materials at power reactors; however, the NRC staff is aware of the use of neutron-absorbing materials in similar applications at some NPRs for which the staff needs additional information. Specifically, the NRC is issuing this GL for two purposes:

(1) To request that addressees submit information demonstrating that credited neutron-absorbing materials in the SFP of power reactors and the fuel storage pool, reactor pool, or other wet locations designed for the purpose of fuel storage, as applicable, for NPRs are in compliance with the current licensing and design basis, as well as applicable regulatory requirements, and that there are measures in place to maintain this compliance.

(2) To collect the requested information and determine if additional regulatory action is required.

Under 10 CFR 50.54(f), addressees are required to submit a written response to this GL.

BACKGROUND

The NRC requires the power reactor license holder to maintain SFP subcriticality[1] in accordance with 10 CFR 50.68, "Criticality Accident Requirements," and General Design Criterion (GDC) 62, "Prevention of Criticality in Fuel Storage and Handling," in Appendix A, "General Design Criteria for Nuclear Power Plants," of 10 CFR Part 50. The NRC has a similar requirement included in the Technical Specification for NPRs. Additionally, one of the NRC's safety strategic outcomes is to: "Prevent the occurrence of any inadvertent criticality[2] events."

The license holder usually documents the nuclear criticality safety (NCS) analyses in the updated final safety analysis report (UFSAR). The NCS analyses form the basis for demonstrating compliance with plant technical specifications (TS), compliance with NRC regulations, and adequate subcriticality for both normal operating conditions and design-basis events. In many SFP NCS analyses, neutron-absorbing materials, with assumptions on dimensions and boron-10 (^{10}B) areal density, are credited for maintaining subcriticality in the SFP. Hence, these materials must be able to perform their safety function during both normal operating conditions and design-basis events. Unidentified, unmitigated, and unmonitored degradation or deformation of the credited neutron-absorbing materials may reduce the safety margin and potentially challenge the subcriticality requirement, especially when subjected to additional stressors during and following design-basis events. Many license holders use integrated defense-in-depth design features to account for the neutron-absorbing material's degradation. For example, some pressurized-water reactors have been approved to take credit for the soluble boron in the SFP water.

Neutron-absorbing materials are composed of a neutron-absorbing component, generally ^{10}B as boron carbide, in a matrix. Both metal matrix and non-metal matrix materials have been used. Different neutron-absorbing materials used in U.S. nuclear power plants include boron carbide in a silicone polymer (e.g., Boraflex), boron carbide in a phenol formaldehyde resin matrix (e.g., Carborundum), and metal matrix composites, such as a cermet of boron carbide and aluminum (e.g., Boral®), a metal matrix of an aluminum and boron carbide (e.g., Metamic™), and borated stainless steel.

In the 1980s, Boraflex was the first neutron-absorbing material to exhibit significant degradation, as documented in Information Notice (IN) 87-43 (Reference 1), IN 93-70 (Reference 2), IN 95-38 (Reference 3), and GL 96-04 (Reference 4). The NRC staff documented additional concerns regarding monitoring and mitigating degradation of Boraflex in IN 12-13 (Reference 5). Several license holders identified instances of degradation or deformation of Carborundum and Boral® neutron-absorbing materials in SFPs, such as that documented in IN 83-29 (Reference 6) and IN 09-26 (Reference 7).

Surveillance of neutron-absorbing material degradation can involve the use of monitoring methods to assess or measure degradation of the material and computer codes to model and predict the condition of the materials used in the SFP. For Boraflex, a combination of the RACKLIFE computer code and the Boron Areal Density Gauge for Evaluating Racks (BADGER) in-situ measurement tool has been employed to manage degradation. The RACKLIFE computer code was developed in the mid-1990s to track and predict the loss of Boraflex and to manage the storage patterns of spent fuel in the SFP. The BADGER system was originally

1 The condition in which a nuclear reaction fails to initiate its own repetition (i.e., fails to achieve criticality).

2 The condition in which each fission event releases a sufficient number of neutrons to sustain an ongoing series of reactions (i.e., a self-sustaining nuclear chain reaction).

designed, assembled, and tested in the early to mid-1990s by Northeast Technologies Company (NETCO, now a subsidiary of Curtiss–Wright) as a nondestructive scoping tool to evaluate neutron-absorbing materials placed in spent fuel racks. Although BADGER was designed and is employed primarily to measure the degradation of Boraflex, it is theoretically applicable to any neutron-absorbing material and has been used for Carborundum and Boral®. Other surveillance methods include testing of representative coupon samples. These tests may include dimensional, neutron attenuation, and weight tests.

Operating Experience

On October 6, 2003, Florida Power and Light (FPL) Energy Seabrook, LLC, reported a condition involving Boral® SFP test coupons (Reference 8). The licensee reported that inspection of test coupons revealed bulging or blistering of the aluminum cladding. Boral® test coupons had been placed in the SFP as monitoring specimens to assess the performance of similar Boral® neutron-absorbing material incorporated in the SFP racks. The licensee measured the ^{10}B areal density in the Boral® coupons by neutron-attenuation testing. The licensee reported that the areal density results were within specification, and that there was no loss of ^{10}B material. Furthermore, the licensee stated that the impact of the Boral® blistering on the flux trap racks was determined to be small and within the bounds of the NCS analyses. Thus, the Boral® maintained its design function. As a result of this event, the licensee developed a Boral® Monitoring Program and added a blistering allowance in the SFP criticality curves to account for the potential bulging or blistering of the material in the SFP racks.

In July 2008, the licensee for Palisades Nuclear Plant (Palisades) identified severe degradation of the SFP neutron-absorbing material Carborundum. Palisades performed blackness testing[3] to determine if the Carborundum neutron-absorbing material in the racks remained capable of performing its safety function. The testing revealed that several Carborundum panels were so severely degraded that only approximately one-third of their original ^{10}B remained. As a result, the licensee was unable to demonstrate that the SFP satisfied the subcriticality requirements in accordance with NRC regulations and plant TS (Reference 7). Because the licensee had not performed routine surveillance of the neutron-absorbing capacity of the material, the time of degradation onset and the degradation rate were unknown.

In January 2009, the licensee for Beaver Valley Power Station, Units 1 and 2 (Beaver Valley), submitted supplemental information identifying Boral® degradation in the SFP in support of its license renewal application (Reference 9). The licensee stated that inspections conducted in 2007 of the Boral® neutron-absorbing material coupons identified numerous blisters of the aluminum cladding, while only a few small blisters were identified in 2002. This degradation posed a potential safety concern because blisters may displace water from the flux trap between the deformed cladding and the boron-containing core in certain fuel storage racks that challenge the dimensional assumptions used in the NCS analyses. Based on these inspections, the licensee determined that the Boral® aluminum cladding blistering was an aging effect requiring management and decided to credit the existing Boral® Surveillance Program for management of this aging effect in its license renewal application. From this experience, Beaver Valley and others, identified neutron-absorbing material degradation and developed or enhanced their monitoring programs.

---

3 An in-situ testing technique with a neutron source and detector that measures the presence of neutron-absorbing material.

In September 2009, FPL informed the NRC staff that because of challenges with procuring Metamic™ neutron-absorbing material inserts, Turkey Point Nuclear Generating Unit 3 (Turkey Point 3) would be unable to fully implement license amendment No. 234. In this amendment, the NRC approved the replacement of Boraflex with a combination of rod cluster control assemblies, Metamic™ rack inserts, and administrative controls that required mixing storage of higher reactivity fuel with lower reactivity fuel. As a result of the failure to procure Metamic™ rack inserts and the continued Boraflex degradation, Turkey Point 3 was not in compliance with its TSs (Reference 10). In addition, FPL implemented compensatory measures, including increasing soluble boron concentration levels, to ensure that the SFP remained subcritical, as the NRC acknowledged in a confirmatory action letter (Reference 11). The NRC determined that the safety significance warranted findings for failure to comply with TSs and failure to implement effective corrective actions for the Unit 3 Boraflex degradation (Reference 10).

To address Boraflex degradation in 2010, Peach Bottom Atomic Power Station, Units 2 and 3 (Peach Bottom), performed an operability determination (OD) based on the RACKLIFE surveillance program that concluded that sufficient margin to criticality in its SFP would be maintained until 2014. However, the NRC's review of the OD concluded that the licensee had not accurately projected the rate of Boraflex degradation and had used several nonconservative assumptions in the analysis. The licensee performed a re-analysis and determined that several Boraflex panels had degraded below the TS requirements as early as the fourth quarter of 2008. As a result, contrary to 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," Criterion XVI, "Corrective Action," the licensee had not implemented corrective actions to prevent the Boraflex panels from degrading below the TS requirements (Reference 12). Although the licensee had initiated a neutron-absorbing material monitoring program, the program did not adequately monitor and manage degradation of the Boraflex panels in the SFP to ensure maintenance of sufficient margin. This previously unidentified and unmitigated degradation posed a potential safety concern because it reduced the margin to criticality.

NRC Actions

The operating experience coupled with regulatory actions (e.g., plant site audits and review of license renewal applications and license amendments), indicated a gap in the NRC staff's knowledge base of neutron-absorbing materials. In addition, the staff determined that existing regulatory guidance did not adequately address the management of the effects of aging on the neutron-absorbing materials. The staff developed license renewal interim staff guidance (Reference 13) for a neutron-absorbing materials aging management program. This regulatory guidance on aging management of neutron-absorbing materials was incorporated into NUREG-1801, Revision 2, "Generic Aging Lessons Learned (GALL) Report," (Reference 14).

License holders may rely on neutron-absorbing materials to provide criticality control in SFPs during normal operating conditions and design-basis events. The NRC is performing confirmatory research on SFP neutron-absorbing materials used in the U.S. commercial nuclear power industry, the surveillance methodologies used by the industry, and the surveillance intervals of the neutron-absorbing materials used in the SFPs.

The NRC recently issued two technical letter reports (TLRs) (References 15 and 16) discussing some of the methods that license holders use to monitor the degradation of neutron-absorbing materials. The staff commissioned these reports to gather more information on surveillance methodologies for neutron-absorbing materials employed in SFPs.

These TLRs also identify uncertainties in the methodologies employed to monitor the performance of neutron-absorbing materials. The reports provide a generic overview on the use of the RACKLIFE computational tool and the BADGER in-situ measurement technique. The reports discuss the reliability of these methodologies for certain applications. Some license holders use these surveillance tools to demonstrate compliance with their TSs and NRC regulations.

A third TLR was recently published that summarizes the characteristics of the phenolic resin type neutron-absorbing materials Carborundum and Tetrabor®, the qualification testing results, and the operating experience pertaining to degradation (Reference 17). The report also describes phenolic resin degradation mechanisms and analyzes current surveillance methods.

DISCUSSION

Reactivity and, therefore, criticality is determined by local phenomenon, including how far a neutron is expected to travel in the given environment. In the SFP environment, the minimum critical volume[4] may be as small as four fuel assemblies, certainly much smaller than the entire SFP. The conditions within the minimum critical volume will determine whether or not an inadvertent criticality event can occur and if the subcriticality requirements are met. The use of SFP-wide parameters, such as average neutron-absorbing material areal density or degradation, may not be appropriate to verify subcriticality requirements that are dependent on local properties.

To ensure that the requirements of 10 CFR 50.68 and GDC 62 are met, the appropriate parameters on a local level must be known and appropriately considered. For license holders that credit neutron-absorbing material in their NCS analyses, this requires that the present condition of the neutron-absorbing material be known and that its future condition be managed. Two TLRs (References 15 and 16) issued by the NRC staff identify uncertainties with tools commonly used in the industry to monitor the condition of the neutron-absorbing materials used in SFPs. As described in the Operating Experience Section of these two TLRs (References 15 and 16), many license holders have had difficulty in managing their neutron-absorbing material's current condition and, in some cases, compliance with regulatory requirements was not ensured.

SFP neutron-absorbing materials that are credited for maintaining subcriticality must be able to perform their safety function during both normal operating conditions and design-basis events. Monitoring of neutron-absorbing materials is intended to identify when degradation may impact their ability to perform their safety function, so that appropriate corrective action can be taken. Therefore, the NRC staff is requesting information to determine if the addressees are in compliance with the regulations and to determine if additional regulatory action is required.

For new reactors, NRC staff was aware of the concerns discussed in this GL and considered them in the licensing review for the plants licensed under 10 CFR Part 52 (i.e., Vogtle Electric Generating Plant, Units 3 and 4; V.C. Summer Nuclear Station, Units 2 and 3). During the licensing review, NRC staff was able to obtain sufficient information to confirm regulatory compliance of the planned design and imposed a license condition that requires 10 CFR Part 52 licensees to provide the necessary information on the surveillance/monitoring programs before operation. As for the additional information on the operation of the SFP being requested by this GL, this information would not apply to Part 52 licensees at this time because no 10 CFR

[4] The minimum volume of fuel required to sustain a nuclear chain reaction.

Part 52 licensees currently have a SFP in operation and will not for several years. Consequently, 10 CFR Part 52 licensees are not being included among the addressees for this GL.

APPLICABLE REGULATORY REQUIREMENTS

10 CFR 50.68, "Criticality Accident Requirements" (Not applicable to NPRs)

> Contains the regulations for maintaining SFP subcriticality. The NRC uses this regulation to develop acceptance criteria for SFP neutron-absorbing material monitoring programs.

10 CFR 70.24, "Criticality Accident Requirements"

> Requires license holders that possess nuclear material to monitor the areas where the material is stored to detect accidental criticality.

10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants" (Not applicable to NPRs)

> Requires license holders to monitor the performance or condition of structures, systems, and components against licensee-established goals, in a manner sufficient to provide reasonable assurance that these structures, systems, and components are capable of fulfilling their intended functions.

10 CFR 50.36, "Technical Specifications"

> Contains requirements applicable to spent fuel pool storage.

10 CFR 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," Sections XI and XII

> Establishes requirements for planned and systematic actions necessary to provide adequate confidence that a structure, system, or component used to prevent or mitigate the consequences of postulated accidents will perform satisfactorily in service. In particular, Sections XI and XII establish requirements for testing and control of measuring/testing equipment to confirm that all structures, systems, or components will perform satisfactorily in service, including operational tests conducted during nuclear power plant operation.

Appendix A of 10 CFR Part 50 provides several operating requirements applicable to criticality control in fuel storage. (Not applicable to NPRs) These include but are not limited to:

General Design Criterion (GDC) 2, "Design Bases for Protection against Natural Phenomena"

> Requires that structures, systems, and components important to safety shall be designed to withstand the effects of natural phenomena.

GDC 61, "Fuel Storage and Handling and Radioactivity Control"

Requires that fuel storage and handling, radioactive waste, and other systems that may contain radioactivity shall be designed to ensure adequate safety under normal and postulated accident conditions. These systems shall be designed with a capability to permit appropriate periodic inspection and testing of components important to safety.

GDC 62, "Prevention of Criticality in Fuel Storage and Handling"

Requires that criticality in the fuel storage and handling system be prevented by physical systems or processes.

REQUESTED INFORMATION FROM POWER REACTOR ADDRESSEES

The NRC requests that each power reactor addressee provide the following information for use in verifying compliance:

(1) a description of the neutron-absorbing material credited in the SFP NCS analysis of record (AOR) and its configuration in the SFP

(2) a description of the surveillance or monitoring program used to confirm that the neutron-absorbing material is performing its intended function, including the frequency, limitations, and accuracy of the methodologies used

(3) a description of the technical basis for determining the interval of surveillance or monitoring for the neutron-absorbing material

(4) a description of how the credited neutron-absorbing material is modeled in the SFP NCS AOR and how the monitoring or surveillance program ensures that the actual condition of the neutron-absorbing material is bounded by the NCS AOR

(5) a description of the technical basis for concluding that the design basis for the neutron-absorbing material as an engineered safety feature in the spent fuel pool will be maintained during design-basis events

Appendix A provides details on the specific information that could be included in the responses to each item requested above.

REQUESTED INFORMATION FROM NON-POWER REACTOR ADDRESSEES

The NRC requests that each non-power reactor addressee provides the following information for use in determining the reliance on neutron-absorbing materials for nuclear criticality safety of reactor fuel and/or spent fuel in storage contained within reactor pools, fuel storage pools, or other wet locations designed for the purpose of fuel storage, as applicable:

(1) Are neutron-absorbing materials utilized in a reactor pool, fuel storage pool, or other wet locations designed for the storage of reactor and/or spent fuel?

(2) If neutron-absorbing materials are utilized, is their use credited[5] in the licensing or design basis (i.e.; criticality safety analysis) for the storage of reactor fuel and/or spent fuel in a reactor pool, fuel storage pool, or other wet locations, as applicable?

(3) If neutron-absorbing materials are credited in the facility licensing or design basis for the storage of reactor and/or spent fuel in a reactor pool, fuel storage pool, or other wet locations, as applicable, then provide a description and technical basis of any surveillance or monitoring programs used to confirm continued acceptable performance of the neutron-absorbing materials over time.

REQUIRED RESPONSE

In accordance with 10 CFR 50.54(f), an addressee must respond as described below:

Within 90 days of the date of this GL, each addressee is requested to submit a written response consistent with the information requested above, and for power reactors, as described in Appendix A.

If an addressee cannot meet the requested response date, the addressee must provide a response within 30 days of the date of this GL and describe the alternative course of action that it proposes to take in place of providing this information, the basis for the acceptability of the proposed alternative course of action, and the estimated completion dates.

The required written response, signed under oath and affirmation, should be addressed "ATTN: Document Control Desk, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001," in accordance with 10 CFR 50.4, "Written Communications." In addition, addressees should submit a copy of the response to the appropriate regional office and NRC resident inspector.

---

[5] Is the neutron-absorbing material necessary to limit the maximum k_{eff} , under optimum conditions of moderation and reflection, to less than that assumed in the licensing and design basis (e.g; criticality safety analysis, accident analysis and Technical Specification limit)?

REASON FOR INFORMATION REQUEST

The NRC is authorized under Section 182.a of the Atomic Energy Act of 1954, as amended, and 10 CFR 50.54(f) to require the addressees of this GL to submit to the NRC the information described in "Requested Response." The NRC staff has determined that the information collection and reporting burden to be imposed on nuclear power plant and NPR license holders by this GL is justified in view of the potential safety significance of the issue of degradation of neutron-absorbing materials in the SFP of nuclear power plants and the reactor pool, reactor tank, or fuel storage pool of NPRs. Unidentified and unmitigated degradation of these materials may challenge the subcriticality margin of the SFP for nuclear power plants and the reactor pool, reactor tank, or fuel storage pool for NPRs required by the existing regulations. The existing regulatory criteria for subcriticality margin are designed to prevent an inadvertent criticality event. If local conditions in the SFP are such that criticality is achieved, the local heat generation is likely to increase due to power generation through fission. Such an event could challenge the ability of the SFP safety-related structures, systems, and components to maintain adequate cooling of the fuel.

This GL requests information from the addressees so that the NRC can determine if the degradation of the neutron-absorbing materials in the SFP for nuclear power plants and the reactor pool, reactor tank, or fuel storage pool for NPRs is being managed to maintain reasonable assurance that the materials are capable of performing their intended safety function, and if the addressees are in compliance with the regulations. The level of detail required to perform this determination is not found in documents readily available to the NRC, such as the Final Safety Analysis Reports. The NRC is not requiring any new analyses or new programs to be developed and implemented. Accordingly, the burden to licensees is estimated to be no more than 120 hours per site for all but two power reactors and no more than 20 hours per site for non-power reactors in order to collect the information from documents available to the licensees and submit a final response to the NRC. Two power reactor licensees credit several neutron-absorbing materials to meet regulatory requirements, so they may take up to 200 hours. However, most licensees are expected to expend much fewer hours to respond to this GL.

RELATED GENERIC COMMUNICATIONS

Document Number	Document Name	ADAMS Accession No. (If Any)
IN 12-13	Boraflex Degradation Surveillance Programs and Corrective Actions in the Spent Fuel Pool	ML121660156
IN 09-26	Degradation of Neutron-Absorbing Materials in the Spent Fuel Pool	ML092440545
GL 96-04	Boraflex Degradation in Spent Fuel Pool Storage Racks	ML031110008
IN 95-38	Degradation of Boraflex Neutron Absorber in Spent Fuel Storage Racks	ML031060277
IN 93-70	Degradation of Boraflex Neutron Absorber Coupons	ML031070107
IN 87-43	Gaps in Neutron-Absorbing Material in High-Density Spent Fuel Storage Racks	ML031130349
IN 83-29	Fuel Binding Caused by Fuel Rack Deformation	ML14043A291

Document Number	Document Name	ADAMS Accession No. (If Any)
GL 78-11	Review and Acceptance of Spent Fuel Storage and Handling Application	ML031280383

BACKFITTING AND ISSUE FINALITY DISCUSSION

The proposed generic letter, if finalized, would request information from holders of Part 50 operating licenses, including licensees who have submitted the certification under 10 CFR 50.82(a)(1) unless they have removed all fuel from the spent fuel pool. This generic letter is also applicable to non-power reactors if they have fuel onsite in wet storage in a fuel storage pool, reactor pool, or reactor tank. This generic letter is not addressed to, and is not applicable to the two holders of combined licenses under 10 CFR Part 52: Southern Nuclear Operating Company, Inc. (Vogtle Electric Generating Plant, Units 3 and 4) and South Carolina Electric & Gas Company (V.C. Summer Nuclear Station, Units 2 and 3).

The NRC is requesting information in order to determine if neutron absorbing materials in the spent fuel pool of power reactors and the fuel storage pool, reactor pool, or reactor tank, as applicable, for non-power reactors are in compliance with the current licensing and design basis, as well as applicable regulatory requirements, and that there are measures in place to maintain this compliance. Based upon this information, the NRC will determine if additional regulatory action is required. If the NRC imposes regulatory action on holders of Part 50 operating licenses for nuclear power plants with respect to neutron absorbers in spent fuel pools as a result of NRC's evaluation of the information submitted in response to this generic letter, then the NRC will address the requirements of the Backfit Rule, 10 CFR 50.109 no later than the time it imposes the regulatory action. In addition, the information requested by the NRC in this generic letter is not required, solely as a result of the NRC's request, to be included or reflected in the updated final safety analysis report (UFSAR) under 10 CFR 50.71(e). If the NRC takes regulatory action to require that the information submitted in response to this generic letter information be treated by the licensee as part of the design or licensing basis for that licensee's facility, then the NRC will address the requirements of the Backfit Rule, 10 CFR 50.109 no later than the time it requires the licensee to do. For these reasons, the NRC concludes that the proposed generic letter, if finalized, would not effectively constitute backfitting of holders of Part 50 operating licenses.

This draft generic letter is not addressed to the two holders of combined licenses under 10 CFR Part 52 (Southern Nuclear Operating Company, Inc. and South Carolina Electric & Gas Company), for the reasons set forth under the **Discussion**. Therefore, the issuance of this generic letter in final form would not be inconsistent with the issue finality provisions applicable to those combined license holders in 10 CFR 52.98.

Holders of licenses for non-power reactors are not accorded backfitting protection under the Backfit Rule, and are not licensed under Part 52. Therefore, this generic letter may be issued to no-power reactor licensees without consideration of backfitting or issue finality under Part 52.

FEDERAL REGISTER NOTIFICATION

The NRC will publish a notice of opportunity for public comment on this draft GL in the *Federal Register*.

CONGRESSIONAL REVIEW ACT

The Congressional Review Act requirements will be addressed as part of the final issuance of this GL.

PAPERWORK REDUCTION ACT STATEMENT

This generic letter contains information collection requirements that are subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.). These information collections were approved by the Office of Management and Budget (OMB), approval number 3150-0011. This collection of information is required under the provisions of Section 182a of the Atomic Energy Act of 1954, as amended and 10 CFR 50.54(f).

The burden to the public for these mandatory information collections is estimated to be no more than 120 hours per response for all but two power reactor sites licensed under 10 CFR Part 50 and no more than 20 hours per response for non-power reactors, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the information collection. Two power reactor licensees credit several neutron-absorbing materials to meet regulatory requirements, so they may take up to 200 hours. However, most licensees are expected to expend much fewer hours to respond to this GL.

Send comments on this burden estimate or any other aspect of these information collections, including suggestions for reducing the burden, to the FOIA, Privacy, and Information Collection Branch (T5-F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or to Infocollects.Resource@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0011), Office of Management and Budget, Washington, DC 20503.

PUBLIC PROTECTION NOTIFICATION

The NRC may neither conduct nor sponsor, and a person is not required to respond to, information or an information collection request or requirement unless the requesting document displays a currently valid OMB control number.

REFERENCES

1. Information Notice 87-43, "Gaps in Neutron-Absorbing Material in High-Density Spent Fuel Storage Racks," September 8, 1987, Agencywide Documents Access and Management System (ADAMS) Accession No. ML031130349

2. Information Notice 93-70, "Degradation of Boraflex Neutron Absorber Coupons," September 10, 1993, ADAMS Accession No. ML031070107

3. Information Notice 95-38, "Degradation of Boraflex Neutron Absorber in Spent Fuel Storage Racks," September 8, 1995, ADAMS Accession No. ML031060277

4. Generic Letter 96-04, “Boraflex Degradation in Spent Fuel Pool Storage Racks,” June 26, 1996, ADAMS Accession No. ML031110008

5. Information Notice 12-13, Boraflex Degradation Surveillance Programs and Corrective Actions in the Spent Fuel Pool,” August 10, 2012, ADAMS Accession No. ML121660156

6 Information Notice 83-29, “Fuel Binding Caused by Fuel Rack Deformation,” May 6, 1983, ADAMS Accession No. ML14043A291

7. Information Notice 09-26, “Degradation of Neutron-Absorbing Materials in the Spent Fuel Pool,” October 28, 2009, ADAMS Accession No. ML092440545

8. Letter from Florida Power & Light Energy Seabrook, LLC to NRC, “Boral Spent Fuel Pool Test Coupons Report Pursuant to 10 CFR Part 21.21,” October 6, 2003, ADAMS Accession No. ML032880525

9. Letter from FirstEnergy Nuclear Operating Co, “Supplemental Information for the Review of Beaver Valley Power Station, Units 1 and 2, License Renewal Application and License Renewal Application Amendment No. 34,” January 19, 2009, ADAMS Accession No. ML090220216

10. Notice of Violation from NRC to Florida Power & Light Co, “Final Significance Determination of White Finding and Notice of Violation; NOV and Proposed Imposition of Civil Penalty – $70,000 (NRC Inspection Report 2010009 – Turkey Point),” June 21, 2010, ADAMS Accession No. ML101730313

11. Confirmatory Action Letter CAL-2-2010-002, “Turkey Point Unit 3 Commitments to Address Degraded Spent Fuel Pool Storage Rack Neutron Absorber,” February 19, 2010, ADAMS Accession No. ML100539266

12. NRC Integrated Inspection Report from NRC to Pacilio, M J, “IR 05000277-12-002 & 05000278-12-002, on 01-01-12 – 03-31-12, Peach Bottom Atomic Power Station,” May 7, 2012, ADAMS Accession No. ML12129A016

13. LR-ISG-2009-01, “Aging Management of Spent Fuel Pool Neutron-Absorbing Materials Other than Boraflex,” April 27, 2012, ADAMS Accession No. ML100621321

14. NUREG-1801, Revision 2, “Generic Aging Lessons Learned (GALL) Report,” December 2010, ADAMS Accession No. ML103490041

15. Technical Letter Report, “Boraflex, RACKLIFE and BADGER: Description and Uncertainties,” September 30, 2012, ADAMS Accession No. ML12216A307

16. Technical Letter Report, “Initial Assessment of Uncertainties Associated with BADGER Methodology,” September 30, 2012, Accession No. ML12254A064

17. Technical Letter Report, “Monitoring Degradation of Phenolic Resin-Based Neutron Absorbers in Spent Nuclear Fuel Pools,” June 5, 2013, ADAMS Accession No. ML13141A182

CONTACT

Please direct any questions about this matter to the technical contact or the lead project manager listed below or to the appropriate Office of Nuclear Reactor Regulation project manager.

Larry W. Camper, Director
Division of Waste Management and Environmental Protection
Office of Federal and State Materials and Environmental Management Programs

Lawrence E. Kokajko, Director
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Technical Contact: Scott Krepel, NRR/DSS
301-302-0399
E-mail: Scott.Krepel@nrc.gov

NPR Technical Contact: Greg Schoenebeck, NRR/DPR
301-415-6345
E-mail: Greg.Schoenebeck@nrc.gov

Lead Project Manager: Serita Sanders, NRR/DPR
301-415-2956
E-mail: Serita.Sanders@nrc.gov

Note: NRC generic communications may be found on the NRC public Web site, http://www.nrc.gov, under NRC Library/Document Collections.

Enclosures: Appendix A

CONTACT

Please direct any questions about this matter to the technical contact or the lead project manager listed below or to the appropriate Office of Nuclear Reactor Regulation project manager.

Larry W. Camper, Director
Division of Waste Management and Environmental Protection
Office of Federal and State Materials and Environmental Management Programs

Lawrence E. Kokajko, Director
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Technical Contact: Scott Krepel, NRR/DSS
301-302-0399
E-mail: Scott.Krepel@nrc.gov

NPR Technical Contact: Greg Schoenebeck, NRR/DPR
301-415-6345
E-mail: Greg.Schoenebeck@nrc.gov

Lead Project Manager: Serita Sanders, NRR/DPR
301-415-2956
E-mail: Serita.Sanders@nrc.gov

Note: NRC generic communications may be found on the NRC public Web site, http://www.nrc.gov, under NRC Library/Document Collections.

Enclosures: Appendix A

DISTRIBUTION: RidsNsir

ADAMS ACCESSION NUMBER: ML13100A086 *via e-mail TAC MF0581

OFFICIAL RECORD COPY

OFFICE	NRR/DSS/ SRXB	NRR/DE/ ESGB*	NRR/DSS/ SRXB*	Tech Editor*	NRR/DLR*	FSME/DURLD/ RDB/BC *
NAME	SKrepel	EWong	KWood	J Dougherty	AHiser	BWatson
DATE	11/21/2013	11/5/2013	11/19/2013	7/19/2013	7/16/2013	11/18/2013
OFFICE	NRR/DPR/PR LB/BC *	NRR/DSS/ SRXB/BC *	NRR/DE/ ESGB/BC *	NRR/DSS/D *	NRR/DE/D *	NRR/ DORL/D *
NAME	AAdams	CJackson	GKulesa	TMcGinty	PHiland	MEvans
DATE	11/19/2013	11/6/2013	11/5/2013	11/5/2013	11/12/2013	11/12/2013
OFFICE	FSME/DWME P/D *	NRR/ PMDA *	OIS *	OE *	OGC*	
NAME	AMohensi (for LCamper)	LHill	T Donnell	TMarenchin	GMizuno	
DATE	11/14/2013	11/7/2013	11/15/2013	11/18/2013	2/7/2014	
OFFICE	NRR/DPR/PG CB:LA*	NRR/DPR/ PGCB:PM*	NRR/DPR/ PGCB:BC*	NRR/DPR/ DD*	NRR/DPR:D*	
NAME	CHawes	SSanders	SStuchell	SBahadur	LKokajko	
DATE	2/24/2014	2/24/2014	2/24/2014	2/25/2014	2/25/2014	

Appendix A

This appendix describes the minimum level of detail that is expected from each power reactor addressee in its response to the requested information.

1) A description of the addressees' neutron-absorbing material credited in the spent fuel pool (SFP) nuclear criticality safety (NCS) analysis of record (AOR) and its configuration in the SFP, including but not limited to:

    a) manufacturer, dates of manufacture, and date(s) of material installation in the SFP

    b) neutron-absorbing material specifications

        i. materials of construction, including the certified content of neutron-absorbing component expressed as weight percent

        ii. minimum certified, minimum as-built, maximum as-built, and nominal as-built areal density of the neutron-absorbing component

        iii. material characteristics, including porosity, density, and dimensions

    c) qualification testing approach for compatibility with the SFP environment and results from the testing

    d) configuration in the SFP

        i. method of integrating neutron-absorbing material into racks (e.g., inserts, welded in place, spot welded in place, rodlets)

        ii. sheathing and exposure of neutron-absorbing materials to SFP environment

    e) current condition of the credited neutron-absorbing material in the SFP

        i. current minimum areal density

        ii. current credited areal density of the neutron-absorbing material in the NCS AOR

        iii. recorded degradation and deformations of the neutron-absorbing material in the SFP (e.g., blisters, swelling, gaps, cracks, loss of material, loss of neutron-attenuation capability)

2) A description of the surveillance or monitoring program used to confirm that the neutron-absorbing material is performing its intended function, including the frequency, limitations, and accuracy of the methodologies used. Please include:

    a) The technical basis for the surveillance or monitoring method, including a description of how the method can detect degradation mechanisms that affect the material's ability to perform its intended function. Also, include a description and technical basis for the technique(s) and method(s) used in the surveillance or monitoring program including:

i. approach used to determine frequency, calculations, and sample size

ii. parameters to be inspected and data collected

iii. acceptance criteria of the program and how it ensures that the material's structure and function are maintained within the assumptions of the NCS AOR

iv. monitoring and trending of the surveillance or monitoring program data

v. industry standards used

b) For the following methods, include these additional discussion items:

i. If there is visual inspection of in-service material:

1. Describe the visual inspection performed on each sample.

2. Describe the scope of the inspection (i.e., number of panels or inspection points per inspection period).

ii. If there is a coupon monitoring program:

1. Provide a description and technical basis for how the coupons are representative of the material in the racks. Include in the discussion, at a minimum, the material radiation exposure levels, SFP environment conditions, exposure to the SFP water, location of the coupons, configuration of the coupons (e.g., jacketing or sheathing, venting, bolted on or glued on or free in the jacket, water flow past the material, bends, shapes, galvanic considerations, and stress-relaxation considerations), and dimensions of the coupons.

2. Provide the date(s) of coupon installation for each set of coupons.

3. If the coupons are returned to the SFP for further evaluation, provide the technical justification for why the reinserted coupons would remain representative of the materials in the rack.

4. Provide the number of coupons remaining to be tested and whether there are enough coupons for testing for the life of the SFP. Also discuss the schedule for coupon removal and testing.

iii. If RACKLIFE is used:

1. State the version of RACKLIFE being used (e.g., 1.10, 2.1).

2. State the frequency at which the RACKLIFE code is run.

3. Describe the confirmatory testing (e.g., in-situ testing) being performed and how the results confirm that RACKLIFE is conservative or representative with respect to neutron attenuation.

4. Provide the current minimum RACKLIFE predicted areal density of the neutron-absorbing material in the SFP. Discuss how this areal density is calculated in RACKLIFE. Include in the discussion whether the areal densities calculated in RACKLIFE are based on the actual as-manufactured areal density of each panel, the nominal areal density of all of the panels, the minimum certified areal density, the minimum as-manufactured areal density, or the areal density credited by the NCS AOR. Also include a discussion on the use of the escape coefficient and the total silica rate of Boraflex degradation in the SFP.

iv. If in-situ testing with a neutron source and detector is used (e.g., BADGER testing, blackness testing):

1. Describe the method and criteria for choosing panels to be tested and include whether the most susceptible panels are chosen to be tested. Provide the statistical sampling plan that accounts for both sampling and measurement error and consideration of potential correlation in sample results. State whether it is statistically significant enough that the result can be extrapolated to the state of the entire pool.

2. State if the results of the in-situ testing are trended and whether there is repeat panel testing from campaign to campaign.

3. Describe the sources of uncertainties when using the in-situ testing device and how they are incorporated in the testing results. Include the uncertainties outlined in the Technical Letter Report titled “Initial Assessment of Uncertainties Associated with BADGER Methodology,” September 30, 2012 ((Agencywide Access and Management Systems (ADAMS) Accession No. ML12254A064). Discuss the effect of rack cell deformation and detector or head misalignment such as tilt, twist, offset, or other misalignments of the heads and how they are managed and accounted for in the analysis.

4. Describe the calibration of the in-situ testing device, including the following:

   a. Describe how the materials used in the calibration standard compare to the SFP rack materials and how any differences are accounted for in the calibration/results.

b. Describe how potential material changes in the SFP rack materials due to degradation or aging are accounted for in the calibration/results.

c. If the calibration includes in-situ measurement of a SFP rack ‘reference panel’, explain the following:

i. The methodology for selecting the reference panel(s) and how the reference panels are verified to meet the requirements,

ii. whether the same reference panel(s) are used for all surveillance campaigns,

1. if the same reference panels are not used for each measurement surveillance, describe how the use of different reference panels affects the ability to make comparisons from one campaign to the next.

3) Describe the technical basis for determining the interval of surveillance or monitoring for the neutron-absorbing material. Include a justification of why the material properties of the neutron-absorbing material remain in compliance with the regulations between surveillances/monitoring intervals.

4) Describe how the neutron-absorbing material is modeled in the SFP NCS AOR, and how the monitoring or surveillance program ensures that the actual condition of the neutron-absorbing material is bounded by the NCS AOR:

a) Describe the technical basis for the method of modeling the neutron-absorbing material in the NCS AOR. Discuss whether the modeling addresses degraded neutron-absorbing material, including loss of material, deformation of material (such as blisters, gaps, cracks, and shrinkage), and localized effects such as non-uniform degradation.

b) Describe how the results of the monitoring or surveillance program are used to ensure that the SFP NCS AOR is in compliance with the regulations.

i. If a coupon monitoring program is used, provide a description and technical basis for the coupon tests and acceptance criteria used to ensure the material properties of the neutron-absorbing material are maintained within the assumptions of the NCS AOR. Include a discussion on the measured dimensional changes, visual inspection, observed surface corrosion, observed degradation or deformation of the material (e.g., blistering, bulging, pitting, or warping), and neutron-attenuation measurements of the coupons.

c) Describe how the bias and uncertainty of the monitoring/surveillance program are propagated in the SFP NCS AOR.

d) Describe how the degradation in adjacent panels is correlated and accounted for in the NCS AOR.

5) Describe the technical basis for concluding that the design basis for the neutron-absorbing material as an engineered safety feature in the spent fuel pool will be maintained during design-basis events (e.g., a design-basis seismic event).

a) For each design-basis event that would have an effect on the neutron absorbing material, describe the technical basis for concluding the design basis event effects on the material condition of the neutron-absorbing material during the design-basis event, including but not limited to:

i. shifting or settling relative to the active fuel

ii. increased dissolution or corrosion

iii. changes of state or loss of material properties that hinder the neutron-absorbing material's ability to perform its safety function

b) Describe how the monitoring program ensures that the current material condition of the neutron-absorbing material will withstand the effects during a design-basis event and remain within the assumptions of the NCS AOR, including but not limited to:

i. Monitoring methodology

ii. Parameters monitored

iii. Acceptance criteria

iv. Intervals of monitoring