

POLICY ISSUE
(Information)

March 16, 2016

SECY-16-0034

FOR: The Commissioners

FROM: Victor M. McCree
Executive Director for Operations

SUBJECT: ISSUANCE OF GENERIC LETTER 2016-xx, "MONITORING OF
NEUTRON-ABSORBING MATERIALS IN SPENT FUEL POOLS"

PURPOSE:

The purpose of this paper is to inform the Commission of the staff's intention to issue the enclosed generic letter, "Monitoring of Neutron-Absorbing Materials in Spent Fuel Pools." Management Directive 8.18, "NRC [U.S. Nuclear Regulatory Commission] Generic Communications Program," directs the staff to submit an information paper to the Commission when it intends to issue a generic letter. This generic letter would collect information regarding neutron-absorbing materials in spent fuel pools to confirm that licensees are in compliance with existing subcriticality regulatory requirements. This paper does not address any new commitments or resource implications.

SUMMARY:

Generic Letter 2016-xx (enclosure) requests information from all holders of a license issued under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," except those that have permanently ceased operations and removed all reactor fuel from the spent fuel pool or any other onsite wet storage locations. This applies to both nuclear power reactor licensees and non-power reactor licensees (e.g., research reactor, test reactor, or critical assembly licensees). The generic letter is not addressed to holders of combined licenses under 10 CFR Part 52, as the subject was considered during the NRC staff's licensing review.

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The NRC is issuing this generic letter for the following two purposes:

- (1) To request that addressees submit information, or provide references to previously docketed information, that demonstrates that credited neutron-absorbing materials in the spent fuel pool of power reactors and the fuel storage pool, reactor pool, or other wet locations designed for the purpose of fuel storage, as applicable, for non-power reactors, are in compliance with the licensing and design basis, and with applicable regulatory requirements, and that there are measures in place to maintain this compliance.
- (2) To collect the requested information in order to determine if additional regulatory action is required.

Under 10 CFR 50.54(f), the NRC requires addressees to submit a written response to this generic letter. The NRC does not require any other actions to address this generic letter.

BACKGROUND:

Maintaining subcriticality—i.e., conditions that do not allow self-sustaining fission reactions—is an important safety consideration for nuclear fuel storage. Several NRC requirements address power reactor licensees' responsibility to maintain spent fuel pool subcriticality.

- 10 CFR 50.68, "Criticality accident requirements"
- 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
- Other equivalent regulatory criteria for plants licensed before the promulgation of the GDCs

The NRC has a similar requirement included in the technical specifications for non-power reactors.

To meet these requirements, licensees typically submit a nuclear criticality safety analysis to support licensing actions related to the spent fuel pool. This analysis forms the basis for demonstrating compliance with NRC regulations related to adequate subcriticality in spent fuel pools. Because of the migration of spent fuel pools to high-density rack designs, many nuclear criticality safety analyses credit fixed neutron-absorbing materials for maintaining subcriticality. In particular, the criticality safety analyses assume certain neutron-absorbing material characteristics (dimensions and boron-10 areal density) that must be met or exceeded to ensure that subcriticality is maintained. If degradation or deformation of the credited neutron-absorbing materials occurs and the licensee does not identify, monitor, and ultimately mitigate the degradation, the safety margin may be reduced to the point where the subcriticality requirements are challenged.

Neutron-absorbing materials are composed of a neutron-absorbing component (generally boron-10 as boron carbide) in a matrix. 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, Tetrabor®)
- 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™)
- borated stainless steel

Significant degradation in Boraflex has been exhibited for several decades, as communicated through multiple information notices and Generic Letter 1996-04, "Boraflex Degradation in Spent Fuel Pool Storage Racks," issued June 26, 1996. Subsequent to these activities, the NRC staff identified additional concerns regarding monitoring and mitigating Boraflex degradation. The NRC has also identified instances of degradation or deformation in two other neutron-absorbing materials—Carborundum and Boral®. When the NRC staff conducted further technical evaluations to assess the current state of licensees' neutron-absorbing material monitoring programs in spent fuel pools, the staff identified multiple uncertainties in methods and tools used by licensees to monitor degradation.

The staff also identified incidences whereby licensees were ineffective in adequately monitoring and managing the condition of their neutron-absorbing materials. In some cases, the NRC staff found that licensees failed to ensure compliance with regulatory requirements. Licensees have implemented various corrective actions, including license amendments, to address these concerns.

The new information was discussed with the public and the industry in multiple forums, including multiple Regulatory Information Conference presentations (2010, 2013, and 2014) and various presentations at different conferences, user group meetings, or workshops.

DISCUSSION:

The smallest portion of a system that can become critical is called the minimum critical volume. In the spent fuel pool, as with the reactor core, the minimum critical volume is much smaller than the entire spent fuel pool. The size of the spent fuel pool will determine the number of potential minimum critical volumes. The subcriticality of the spent fuel pool will be set by the conditions in the minimum critical volume with the highest reactivity. Therefore, in order for licensees to meet licensing and regulatory requirements (e.g., 10 CFR 50.68, GDC 62), the parameters important to subcriticality on a local level must be understood and considered. Licensees who credit neutron-absorbing material in their nuclear criticality safety analyses are relying upon those materials to perform consistent with their analyses in order to meet regulatory and licensing requirements, and ultimately, to prevent an inadvertent criticality event.

The first indications of significant problems with the Boraflex neutron-absorbing material were identified in the 1980s. Through its inspection activities, the NRC identified that some licensees did not have adequate methodologies or surveillance programs to assess, monitor, and manage degradation and deformation of neutron-absorbing materials in their spent fuel pool. These licensees have taken appropriate corrective action to maintain safety, as discussed further in the generic letter.

In addition, research and oversight activities within the NRC have highlighted the need for focus in this area. Three technical letter reports commissioned by the Office of Nuclear Regulatory Research identified uncertainties that were not completely accounted for in some of the

methods and tools that licensees use to monitor the degradation of neutron-absorbing materials in their spent fuel pools (Agencywide Document Access and Management System (ADAMS) Accession Nos. ML12216A307, ML12254A064, and ML13141A182). The Office of the Inspector General performed an audit of the NRC's oversight of spent fuel pools (ADAMS Accession No. ML15041A567) and had some recommendations to enhance existing regulatory guidance. The NRC staff's response to this audit report (ADAMS Accession No. ML15056A651) included a commitment to issue the generic letter that is the subject of this Commission paper, among other actions.

The material condition of neutron-absorbing materials in spent fuel pools is an important safety consideration, but it is not an imminent operational safety hazard because: (1) NRC regulations and licensee technical specifications include safety margins to maintain subcriticality, and (2) licensee nuclear criticality safety analyses that demonstrate compliance with the technical specification requirements include conservative assumptions. To date, the NRC staff has not identified degradation that represents an unacceptable reduction in those safety margins and conservative assumptions, such that there is an imminent concern about an unexpected criticality event in a spent fuel pool. Nonetheless, if degradation of neutron-absorbing materials is unmanaged and unmitigated, safety margins are eroded, which may constitute noncompliance with the regulations, and, more importantly, could result in an unexpected criticality event in a spent fuel pool.

Based on the recent technical information identified in the technical letter reports, and many deficiencies identified through operating experience, the NRC is issuing this generic letter to request information from licensees of operating or decommissioning power reactors, research reactors, and test reactors. The NRC will evaluate the responses to determine if licensees are adequately managing degradation and deformation of the neutron-absorbing materials credited in maintaining compliance with 10 CFR 50.68 and GDC 62, as applicable. Since the neutron-absorbing materials perform a safety function, the information requested in this generic letter should generally be available in licensee records in accordance with 10 CFR 50 Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants." The NRC is requesting that licensees provide the requested information to describe: (1) the current condition of the neutron-absorbing materials, and (2) the monitoring being performed. The NRC is not requesting any new analyses, programs, or research.

The NRC staff published a draft version of this generic letter in the *Federal Register* for a 45-day comment period to solicit comments on its content in March 2014. The request for comment included a discussion and specific questions on the cumulative effects of regulation. The agency held a public meeting during the public comment period to allow stakeholders to engage the staff and obtain any needed clarifications on the generic letter. The NRC received 39 unique public comments from 11 different organizations. Most comments cited the imposed burden on licensees when complying with the generic letter request. Specifically, commenters questioned whether the time and resources that licensees expend fulfilling the request for information are justified when compared to the potential safety significance of the issue. The NRC staff considered all public comments, and revised the generic letter to: (1) clarify that no new analyses, programs, or research are being requested; (2) state that licensees only need to provide information if it is not on the docket; (3) increase the burden estimate for several groups of licensees; and (4) extend the response time from 90 days to 210 days.

Further public meetings were held to discuss the proposed generic letter, including the staff's resolution of the received public comments. On August 21, 2014, the NRC staff discussed the proposed generic letter with the Metallurgy and Reactor Fuels Subcommittee of the Advisory Committee on Reactor Safeguards (ACRS). On September 4, 2014, the NRC staff presented the proposed generic letter to the full ACRS. In addition to the NRC staff's presentation, the ACRS also heard a presentation from the Nuclear Energy Institute.

As a result, the ACRS supported issuance of the generic letter as noted in a September 15, 2014, letter (ADAMS Accession No. ML14252A299), but recommended that additional clarity be provided regarding the level of response required, based on a tiered approach depending on the type of neutron absorber being used and the degree to which the absorber is being credited in the pool criticality analysis.

Subsequently, the NRC staff developed a tiered approach for licensee responses that incorporates the ACRS's recommendation. This tiered approach significantly reduces licensee efforts for those who have recently provided this information as part of the license amendment request or license renewal application process. In addition, the level of detail expected in the response depends on the material being credited, with the least effort required of licensees who do not credit any neutron-absorbing materials and additional effort needed for licensees who credit neutron-absorbing materials with a history of significant loss of absorbing material. The NRC staff discussed the tiered approach with stakeholders, including the nuclear industry, at two additional public meetings. The staff emphasized that this tiered approach further reduces the burden on licensees by correlating the level of licensee effort needed to develop a response to operating experience with neutron-absorbing materials exhibiting degradation and whether a licensee's spent fuel pool contains those materials.

CONCLUSION:

Under the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.), an agency may not collect identical information from 10 or more respondents unless it first obtains approval from the Office of Management and Budget (OMB). The NRC staff submitted the proposed information collection to OMB, as published in the *Federal Register* on December 30, 2015 (80 FR 81560), and subsequently received approval. The staff intends to issue this generic letter to applicable licensees three weeks after issuance of this paper.

COORDINATION:

In addition to coordination with ACRS as described above, the staff sought and received Committee to Review Generic Requirements (CRGR) review of the proposed generic letter. At an April 1, 2015, briefing, the CRGR requested that the staff incorporate minor edits. The CRGR chairman reviewed the modified version with the edits incorporated, and concluded that these changes addressed the CRGR comments and that the proposed generic letter did not constitute a backfit. Subsequently, the meeting minutes from the CRGR briefing (ADAMS Accession No. ML15092A656; non-publicly available) were issued to document the CRGR review and endorsement of the revised generic letter.

The Commissioners

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The Office of General Counsel has reviewed this paper and the generic letter and has no legal objections to the content. The Office of General Counsel has also confirmed that the generic letter is not considered a rule under the Congressional Review Act.

/RA/

Victor M. McCree
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Enclosure:
Generic Letter 2016-XX "Monitoring of
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ADAMS Accession No.: Pkg.: ML15159B163; SECY: ML15153A075,
Enclosure GL: ML16049A374 Comment Response Documents: ML14181B130, ML15222A005, ML16033A002

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