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330-315-6800

May 25, 2018
L-18-121

10 CFR 50.54

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT:
Beaver Valley Power Station, Unit No. 1
Docket No. 50-334, License No. DPR-66

Davis-Besse Nuclear Power Station
Docket No. 50-346, License No. NPF-3

Perry Nuclear Power Plant
Docket No. 50-440, License No. NPF-58
Response to Request for Supplemental Information Regarding Generic Letter 2016-01, "Monitoring of Neutron-Absorbing Materials in Spent Fuel Pools,"
(EPID L-2016-LRC-0001)

By correspondence dated April 7, 2016, the Nuclear Regulatory Commission (NRC) issued Generic Letter (GL) 2016-01, "Monitoring of Neutron Adsorbing Materials in Spent Fuel Pools," (Accession No. ML16097A169) to address the degradation of neutron-adsorbing materials in wet storage systems for reactor fuel at power and non-power reactors. The NRC, in GL 2016-01, requested each licensee to submit a written response in accordance with 10 CFR 50.54(f). The FirstEnergy Nuclear Operating Company (FENOC) provided separate responses for the Perry Nuclear Power Plant (PNPP) on October 19, 2016 (Accession No. ML16294A072), the Beaver Valley Power Station, Unit 1 (BVPS) on October 31, 2016 (Accession No. ML16305A344), and the Davis-Besse Nuclear Power Station (DBNPS) on November 1, 2016 (Accession No. ML16307A074).

By correspondence dated November 7, 2017 (Accession No. ML17303B158), the NRC staff requested FENOC provide supplemental information for the GL responses. During a discussion with the NRC staff on November 7, 2017, it was agreed that FENOC would provide the responses to the requested supplemental information by close of business on May 31, 2018. The FENOC responses to the requested supplemental information is provided in Attachment 1 for the BVPS, Unit 1, Attachment 2 for the DBNPS, and Attachment 3 for the PNPP. Supplemental information was not requested for BVPS, Unit 2.

There are no regulatory commitments contained in this submittal. If there are any questions or if additional information is required, please contact Mr. Thomas A. Lentz, Manager – Fleet Licensing, at 330-315-6810.

I declare under penalty of perjury that the foregoing is true and correct. Executed on May 25, 2018.

Sincerely,

Donald A. Moul

Attachments:
1. Response to November 7, 2017 Generic Letter 2016-01 Request for Supplemental Information for the Beaver Valley Power Station, Unit 1
2. Responses to November 7, 2017 Generic Letter 2016-01 Request for Supplemental Information for the Davis-Besse Nuclear Power Station
3. Responses to November 7, 2017 Generic Letter 2016-01 Request for Supplemental Information for the Perry Nuclear Power Plant

cc:
NRC Region I Administrator
NRC Region III Administrator
NRC Resident Inspector – Beaver Valley
NRC Resident Inspector – Davis-Besse
NRC Resident Inspector – Perry
NRC Project Manager – FENOC Fleet
Director BRP/DEP
Site BRP/DEP Representative
Utility Radiological Safety Board
Branch Chief, Ohio Emergency Management Agency, State of Ohio (NRC Liaison)

The requested information is presented below in bold type, followed by the FENOC response.

Generic Boral-RAI-2

Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.68, "Criticality accident requirements," and General Design Criterion (GDC) 62, "Prevention of Criticality in Fuel Storage and Handling," provide the requirements for licensees with regards to maintaining subcriticality in the spent fuel pool (SFP). For licensees that utilize neutron absorbing materials (NAM) in the SFP, the properties of the NAM must be known so that the assumptions in the SFP nuclear criticality safety (NCS) analysis of record (AOR) are supported. In order to verify whether or not the requirements of 10 CFR 50.68 and GDC 62 will be met, the NRC staff needs to verify that the potential reactivity changes due to degradation or physical changes to the NAM are accounted for in the SFP NCS AOR. This includes any changes that would affect the neutron spectrum for the SFP in addition to any loss of neutron attenuation capability.

Industry operating experience, as described in Information Notice 2009-26, "Degradation of Neutron-Absorbing Materials in the Spent Fuel Pool," (ADAMS Accession No. ML092440545) has demonstrated that certain manufacturing processes and plant conditions (dose, chemistry, length of time installed, and installation configuration) have resulted in material deformation as a result of blisters associated with Boral.

BVPS has indicated that similar operating experience was identified as a result of their site-specific monitoring program. Please discuss the criticality impact due to the material deformation identified at BVPS, and how it can be accommodated by the nuclear criticality safety AOR at BVPS without exceeding NRC subcriticality requirements.

Response to Generic Boral-RAI-2

To date, the industry operating experience (OE), has revealed no instances of an impact on spent fuel pool (SFP) criticality due to observed Boral deformation (blistering) or degradation (pitting). The Neutron Adsorber Users Group (NAUG), through the Electric Power Research Institute (EPRI), has recently completed a study (EPRI Report 3002013119), which analyzes the criticality impact of blisters and pits on Boral. Simulations were performed for varying enrichment, burnup, areal density values, at unborated conditions (0 ppm), which is conservative for PWRs such as the BVPS. The study results demonstrate that pitting and blistering, on a scale much larger than any that has been observed in the industry OE, has an insignificant impact on SFP criticality. Therefore, the SFP criticality safety analysis of record remains applicable.

The requested information is presented below in bold type, followed by the FENOC response.

Generic Boral-RAI-2

Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.68, "Criticality accident requirements," and General Design Criterion (GDC) 62, "Prevention of Criticality in Fuel Storage and Handling," provide the requirements for licensees with regards to maintaining subcriticality in the spent fuel pool (SFP). For licensees that utilize neutron absorbing materials (NAM) in the SFP, the properties of the NAM must be known so that the assumptions in the SFP nuclear criticality safety (NCS) analysis of record (AOR) are supported. In order to verify whether or not the requirements of 10 CFR 50.68 and GDC 62 will be met, the NRC staff needs to verify that the potential reactivity changes due to degradation or physical changes to the NAM are accounted for in the SFP NCS AOR. This includes any changes that would affect the neutron spectrum for the SFP in addition to any loss of neutron attenuation capability.

Industry operating experience, as described in Information Notice 2009-26, "Degradation of Neutron-Absorbing Materials in the Spent Fuel Pool," (ADAMS Accession No. ML092440545) has demonstrated that certain manufacturing processes and plant conditions (dose, chemistry, length of time installed, and installation configuration) have resulted in material deformation as a result of blisters associated with Boral.

DBNPS has indicated that similar operating experience was identified as a result of their site-specific monitoring program. Please discuss the criticality impact due to the material deformation identified at DBNPS, and how it can be accommodated by the nuclear criticality safety AOR at DBNPS without exceeding NRC subcriticality requirements.

Response Generic Boral-RAI-2

To date, the industry OE has revealed no instances of an impact on SFP criticality due to observed Boral deformation (blistering) or degradation (pitting). The NAUG, through EPRI, has recently completed a study (EPRI Report 3002013119), which analyzes the criticality impact of blisters and pits on Boral. Simulations were performed for varying enrichment, burnup, areal density values, at unborated conditions (0 ppm), which is conservative for PWRs such as the DBNPS. The study results demonstrate that pitting and blistering, on a scale much larger than any that has been observed in the industry OE, has an insignificant impact on SFP criticality. Therefore, the SFP criticality safety analysis of record remains applicable.

Plant-Specific Monitoring Information

Regulation 10 CFR Section 50.68, "Criticality accident requirements," and General Design Criterion (GDC) 62, "Prevention of Criticality in Fuel Storage and Handling," provide the requirements for licensees with regards to maintaining subcriticality in the SFP. For licensees that utilize neutron absorbing materials (NAM) in the SFP, the ^{10}B areal density (AD) of the NAM must be verified so that the assumption for the ^{10}B minimum AD in the SFP criticality analysis is supported. In order for the NRC staff to verify that the requirements of 10 CFR 50.68 and GDC 62 are met, the staff needs to ensure the programs in place to monitor the condition of the NAM in the SFP are appropriate for their intended purpose. By evaluating the programs that monitor the condition of the NAM in the SFP, the staff will be able to determine whether or not the requirements of 10 CFR 50.68 and GDC 62 will be met. In addition, the condition of the NAM must be considered in the SFP NCS AOR. In order to verify whether or not the requirements of 10 CFR 50.68 and GDC 62 will be met, the staff needs to verify that the potential reactivity changes due to degradation or physical changes to the NAM are accounted for in the SFP NCS AOR.

DBNPS-1. In the response to Question (2)a)iii), the licensee states that "acceptance criteria are based on confirming the ^{10}B AD assumed in the SFP criticality analysis." The information provided in response to Question (1)e)ii) is unclear with regards to the specific value used for ^{10}B AD in the nuclear criticality safety analysis of record.

Provide the specific value for the ^{10}B AD acceptance criterion used in the monitoring program.

Response to DBNPS-1

The ^{10}B AD acceptance criteria used in the monitoring program and in the nuclear criticality analysis of record is a minimum ^{10}B AD of 0.030 gram per square centimeter.

The requested information is presented below in bold type, followed by the FENOC response.

Generic Boral-RAI-1

Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.68, "Criticality accident requirements," and General Design Criterion (GDC) 62, "Prevention of Criticality in Fuel Storage and Handling," provide the requirements for licensees with regards to maintaining subcriticality in the spent fuel pool (SFP). For licensees that utilize neutron absorbing materials (NAMs) in the SFP, the ^{10}B areal density (AD) of the NAM must be known so that the assumption for the ^{10}B minimum AD in the SFP nuclear criticality safety (NCS) analysis of record (AOR) is supported. In order for the NRC staff to verify that the requirements of 10 CFR 50.68 and GDC 62 are met, the staff needs to ensure that licensees are taking appropriate action to confirm that the ^{10}B AD of their NAM can reasonably be expected to remain above the minimum assumed in the SFP NCS AOR. In addition, the condition of the NAM must be considered in the SFP NCS AOR. In order to verify whether or not the requirements of 10 CFR 50.68 and GDC 62 will be met, the staff needs to verify that the potential reactivity changes due to degradation or physical changes to the NAM are accounted for in the SFP NCS AOR. This includes any changes that would affect the neutron spectrum for the SFP in addition to any loss of neutron attenuation capability.

Industry operating experience, as described in Information Notice 2009-26, "Degradation of Neutron Absorbing Materials in the Spent Fuel Pool," (ADAMS Accession No. ML092440545) and 1983-29, "Fuel Binding Caused by Fuel Rack Deformation," (ADAMS Accession No. ML14043A291) has demonstrated that certain manufacturing processes and plant conditions (dose, chemistry, length of time installed, and installation configuration) have resulted in material deformation as a result of blisters or bulging associated with Boral.

PNPP does not have a site-specific monitoring program, and consequently, is relying on general industry operating experience as a surrogate for the condition of the Boral installed in the spent fuel pool.

a. **Please describe how industry operating experience bounds the condition of the Boral at PNPP, thereby, providing assurance that any degradation or deformation that may affect the Boral at PNPP is identified.**

Response to Generic Boral-RAI-1.a

Through its nuclear safety culture, procedures, and processes, the PNPP systematically and effectively collects, evaluates, and implements relevant internal and external OE in a timely manner. Issues emerging from the use of Boral in the spent fuel racks are monitored through the FENOC OE program and corrective action program.

As indicated in the original generic letter response for the PNPP, the site will continue to monitor industry OE related to Boral, which includes ongoing participation in the EPRI NAUG, and its related programs, such as the industrywide learning aging management program (i-LAMP). To date, within the industry there have been no indications of a loss of Boral material of a nature that diminished the neutron-absorbing capability of the Boral (EPRI Report 1021052). The PNPP follows the EPRI Water Chemistry Control Program, and there have been no indications of a loss of Boral neutron-absorbing capabilities at a plant following the guidelines. In addition, to date there are no plant-specific operating conditions or rack attributes that would merit concern that the PNPP spent fuel racks or SFP environment are not bounded by the industry-wide OE. Finally, EPRI Report 3002013119 documents that observed or foreseen degradation or deformation of the Boral has an insignificant impact on SFP criticality. The industry OE aligns with the PNPP licensing basis.

The NAUG, through EPRI, is currently developing an industry-wide program/database to aid in monitoring indications of potential Boral degradation and deformation. Over 70,000 water chemistry data points have been collected to date, from over 30 SFPs, for this program. Surveillance data from 50 coupons across 25 SFPs has also been collected to date. The program, supported by EPRI NAUG and industry participants, is described in EPRI Report 3002013122 and includes insights and feedback received from numerous communications with the NRC. Relevant issues emerging from this industry effort will be monitored through the FENOC OE program and corrective action program.

b. In addition, please discuss the criticality impact due to relevant material deformation identified in general industry operating experience, and how it can be accommodated by the nuclear criticality safety AOR for PNPP without exceeding NRC subcriticality requirements.

Response to Generic Boral-RAI-1.b

To date, the industry OE has revealed no instances of an impact on SFP criticality due to observed Boral deformation (blistering) or degradation (pitting). The NAUG, through EPRI, has recently completed a study (EPRI Report 3002013119), which analyzes the criticality impact of blisters and pits on Boral. Simulations were performed at unborated conditions (0 ppm) to ensure applicability to BWRs such as PNPP. The study results demonstrate that pitting and blistering, on a scale much larger than any that has been observed in the industry OE, has an insignificant impact on SFP criticality. Therefore, the SFP criticality safety analysis of record remains applicable.

Plant-Specific Monitoring Information

Regulation 10 CFR Section 50.68, "Criticality accident requirements," and General Design Criterion (GDC) 62, "Prevention of Criticality in Fuel Storage and Handling," provide the requirements for licensees with regards to maintaining sub-criticality in the SFP. For licensees that utilize (NAMs) in the SFP, the ^{10}B AD of the NAM must be verified so that the assumption for the ^{10}B minimum AD in the SFP criticality analysis is supported. In order for the NRC staff to verify the requirements of 10 CFR 50.68 and GDC 62 are met, the staff needs to ensure the programs in place to monitor the condition of the NAM in the SFP are appropriate for their intended purpose. By evaluating the programs that monitor the condition of the NAM in the SFP, the NRC staff will be able to determine whether or not the requirements of 10 CFR 50.68 and GDC 62 will be met. In addition, the condition of the NAM must be considered in the SFP NCS AOR. In order to verify whether or not the requirements of 10 CFR 50.68 and GDC 62 will be met, the staff needs to verify that the potential reactivity changes due to degradation or physical changes to the NAM are accounted for in the SFP NCS AOR.

PNPP-1 **In response to Question (1) (a) of the Generic Letter (GL) 2016-01, the licensee states that the SFP racks were initially installed in 1982 and were then "...subsequently removed, cleaned, and reinstalled in September - October 1984." Given the changing environmental the SFP racks were exposed to (e.g., removal, cleaning, environmental changes), how does the licensee have assurance that no unexpected degradation or deformation of the Boral material has occurred (e.g., blistering, bulging, loss of neutron attenuation capability/^{10}B, weight, dimensional, density, material loss, etc.)?**

Response to PNPP-1

In 1984, prior to initial fuel receipt, it was determined that the SFP racks did not meet Class B cleanliness criteria because of a light dirt film on the outer surface of the aluminum plates. Therefore, a simple cleaning of the racks was completed using manual and hydrolase methods using materials such as Scotchbrite® pads, lint free rags, and demineralized water. No adverse impacts are expected to the racks due to this simple cleaning since it was performed using demineralized water and without chemicals, and the Boral plates are contained within sealed envelopes in the spent fuel racks. Following cleaning and reinstallation of the SFP racks, the pools were flooded with demineralized water for tests of the fuel pool cooling and cleanup system.

There have been no interference conditions noted during fuel handling activities with the PNPP SFP racks. In addition, debris checks of the SFP racks have not revealed any visual indications of degradation.