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L-15-261

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

SUBJECT:
Beaver Valley Power Station, Unit Nos. 1 and 2
Docket No. 50-334, License No. DPR-66
Docket No. 50-412, License No. NPF-73
Response to Request for Additional Information Regarding Submittal of Reactor Vessel Internals Aging Management Program (TAC Nos. MF3416 and MF3417)

By letter dated January 27, 2014 (Agencywide Documents Access and Management System [ADAMS] Accession No. ML14030A131), FirstEnergy Nuclear Operating Company (FENOC) submitted two reports for the license renewal reactor vessel internals aging management program plan for Beaver Valley Power Station, Unit Nos. 1 and 2. The Nuclear Regulatory Commission (NRC) requested additional information by letter dated August 20, 2014 (ADAMS Accession No. ML14213A360) to complete its review of the program plan.

In accordance with the August 20, 2014 letter, Attachment 1 provides the FENOC response to the requested information.

Regulatory commitments established in this letter are identified in Attachment 2. 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 August 26, 2015.

Sincerely,

Eric A. Larson

Attachment:
1 Response to August 20, 2014 Request for Additional Information
2 Regulatory Commitment List

cc: Regional Administrator, NRC Region I
NRC Resident Inspector
NRC Project Manager
Director BRP/DEP
Site BRP/DEP Representative

The Nuclear Regulatory Commission (NRC) staff requested additional information (RAI) from FirstEnergy Nuclear Operating Company (FENOC) in a letter dated August 20, 2014 (Agencywide Documents Access and Management System [ADAMS] Accession No. ML14213A360). The NRC requested information to complete its review of the FENOC license renewal reactor vessel internals (RVI) aging management program (AMP) plan for Beaver Valley Power Station (BVPS), Unit No. 1 (BVPS-1) and Unit No. 2 (BVPS-2). The NRC staff's RAI questions are provided below in bold text followed by the corresponding FENOC response.

RAI 1:

In Section 6.2.1 of the AMP Plans, the licensee has addressed Action Item 1 from the NRC staff's safety evaluation (SE) of MRP-227, dated June 22, 2014 (Reference 3), saying that the assumptions regarding plant design and operating history made in MRP-191, "Materials Reliability Program: Screening, Categorization, and Ranking of Reactor Internals Components for Westinghouse and Combustion Engineering PWR Design," (Reference 4) are appropriate for BVPS, Units 1 and 2.

The NRC staff requests that additional information, as discussed in References 5 and 6, and outlined below, be provided to verify the applicability of MRP-227-A for each unit.

RAI 1(a):

Do the RVIs for each unit have any non-weld or bolting austenitic stainless steel components with 20 percent (%) cold work or greater, and if so, do the affected components have operating stresses greater than 30 ksi [kilopound per square inch]? If so, perform a plant-specific evaluation to determine the aging management requirements for the affected components.

The licensee may use the Electric Power Research Institute (EPRI), MRP-227-A Applicability Template Guidelines (Reference 7) to answer these RAIs.

<u>Response:</u>

An August 12, 2015 email from the NRC project manager confirmed that "bolting" in the first sentence of RAI 1(a) should have been "non-bolting." Neither BVPS-1 nor BVPS-2

have non-weld or non-bolting austenitic stainless steel RVI components with 20 percent or greater cold work.

RAI 1(b):

Has either BVPS, Unit 1 or 2, ever utilized atypical fuel design or fuel management that could make the assumptions of MRP-227-A regarding core loading/core design non-representative for that plant, including power changes/uprates? If so, describe how the differences were reconciled with the assumptions of MRP-227-A or provide a plant-specific aging management program for affected components as appropriate.

The licensee may use the Electric Power Research Institute (EPRI), MRP-227-A Applicability Template Guidelines (Reference 7) to answer these RAIs.

<u>Response:</u>

Based on comparisons of the BVPS-1 and BVPS-2 core geometries and operating characteristics to the applicability guidelines from EPRI letter MRP-227-A, *Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227-A)*, for Westinghouse-designed reactors specified in EPRI letter MRP 2013-025 *MRP-227-A Applicability Template Guideline*, October 14, 2013, neither unit has utilized atypical fuel designs nor fuel management that could invalidate the assumptions of MRP-227-A regarding core loading and core design, including power changes and uprates, over their operating lifetimes.

RAI 2:

As discussed in Section 3.3.7 of Revision 1 to the SE for MRP-227 (Reference 8), Action Item 7 requires that the licensees of Westinghouse reactors develop plant-specific analyses to be applied for their facilities to demonstrate that lower support column cast austenitic stainless steel (CASS) bodies will maintain their function during the extended period of operation. Table 6-2 of the AMP Plans includes the summary of CASS components and their susceptibility to thermal embrittlement (TE) according to the MRP-175, "Materials Reliability Program: PWR Internals Material Aging Degradation Mechanism Screening and Threshold," (Reference 9) screening criteria for TE (less than 20% is not susceptible while ≥ 20% is susceptible). The licensee's evaluation used a screening approach using the criteria of NRC Letter, "License Renewal Issue No. 98-0030, Thermal Aging Embrittlement of Cast Austenitic Stainless Steel Components," (Reference 10). The result of the screening was that some CASS components were determined to be nonsusceptible (screened out) for TE.

The staff expects components that screened out for TE should still be screened for irradiation embrittlement (IE) based on the peak neutron fluence for the component, as listed in Table 4-6 of MRP-191, for Westinghouse-designed units. In addition, the licensee should consider the combined effect of TE and IE to have an acceptable plant-specific analysis.

RAI 2(a):

Provide plant-specific analysis on the combined effect of TE and IE, or a justification on why this analysis is not required.

The staff's initial evaluation indicates that the lower support column bodies for Unit 1 are susceptible to IE even though it passes the screening to TE in MRP-191.

Response:

This question pertains to BVPS-1, as BVPS-2 utilizes wrought stainless steel instead of CASS for the lower support column bodies.

Resolution of NRC and industry positions on the potential for combined susceptibility to TE and IE is forthcoming. The Pressurized Water Reactor Owners Group (PWROG) project PA-MSC-1288, Revision 1 is expected to be approved and deliver a resolution of this issue in the second quarter of 2016, at which point FENOC will update the BVPS-1 aging management plan for the CASS lower support column bodies as needed.

RAI 2(b):

Provide additional information on the ferrite content of the lower support bodies for BVPS Unit 1, to help the NRC staff reach a decision based on the combined effect of TE and IE.

For the staff's initial evaluation of Unit 2, the lower support column bodies are not manufactured from CASS, but should still be considered susceptible to IE.

Response:

The BVPS-1 CASS lower support column bodies are static cast, A351, Grade CF-8. The ferrite content is calculated based upon the chemical compositions of the bodies and use the Hull’s equivalent factors method. Of the 68 lower support column bodies in BVPS-1, 54 have calculated ferrite contents ranging from a minimum of 2.6 percent to less than or equal to 15 percent, and 14 (one material heat) have a calculated ferrite content of 15.7 percent. All 68 lower support column bodies have a ferrite content less than or equal to 20 percent, and are therefore not susceptible to TE based on the guidelines of NRC letter “License Renewal Issue No. 98-0030, ‘Thermal Aging

Embrittlement of Cast Austenitic Stainless Steel Components,'" dated May 19, 2000.

The ferrite content values were calculated using the appropriate equations for the Hull's equivalent factors, and using the chemical compositions provided by the certified material test records (CMTRs). However, not all of the elemental chemical compositions required for the Hull's equivalent factors are provided in the CMTRs. Specifically, the molybdenum (Mo) and nitrogen (N) contents, which affect the chromium equivalent and nickel equivalent factors, respectively, are not reported in the CMTRs. Thus, for the calculations of the ferrite content of the BVPS-1 lower core support column bodies, the conservative assumption of maximum permissible Mo content (0.5 percent) and representative nitrogen content from the melt processing (0.04 percent) were used. Mo is not an intentional addition to the CF-8 alloy from which the BVPS-1 lower core support bodies were cast. Lower Mo content, as would be expected in practice, would result in significantly lower calculated ferrite contents. Mo is a permissible entrained element with a maximum value of 0.5 percent since this allows for the production of the material from a wider range of stainless steel scrap. Mo content in a melt is expected to be significantly below the 0.5 percent maximum level. Recalculation of the ferrite content for different possible levels of Mo content indicates that for the highest (15.7 percent) ferrite content lower support column bodies, the Mo content would need to have been greater than 0.39 percent for the calculated ferrite content to exceed 15 percent. FENOC proposes that the conservatism of the Mo value, used in the ferrite content calculation, should be taken into account when the calculated ferrite contents are compared with the proposed guidance value of 15 percent for highly irradiated CF-8 material.

The wrought stainless steel lower support column bodies utilized in BVPS-2 are not susceptible to TE, however they were screened for susceptibility to IE using the higher 1.5 displacements per atom screening threshold appropriate for wrought material.

RAI 2(c):

Given that the lower support column bodies for both units are susceptible to IE, clarify why the primary inspection component links to a possible expansion inspection of the lower support bodies for BVPS, Units 1 and 2, are adequate.

Response:

In Table 4-6 of MRP-227-A, the BVPS-1 CASS lower support column bodies are listed as an expansion component; they are linked to the control rod guide tube (CRGT) lower flange welds primary inspection component. In Table 4-6 of MRP-227-A, the BVPS-2 wrought lower support column bodies are listed as an expansion component; they are linked to the upper core barrel flange weld primary inspection component.

The aging management plans developed for BVPS-1 and BVPS-2 followed the MRP-227-A guidance for managing the potential embrittlement and cracking

degradation of the lower support column bodies during the period of extended operation. Table 4-6 of EPRI *Materials Reliability Program: Screening, Categorization, and Ranking of Reactor Internals Components for Westinghouse and Combustion Engineering PWR Design (MRP-191)*, November 8, 2006, identified that the CRGT lower flange welds and the upper core barrel flange weld experience lower neutron fluence than portions (near the lower core plate) of the lower support column bodies. However, the industry is updating the guidance and investigating an alternate primary component (for example, lower core barrel girth weld) as the link for the lower support column bodies as part of the revision to MRP-227-A. FENOC will implement the revised MRP-227-A document for BVPS-1 and BVPS-2 when it is approved.

Regulatory Commitment List

Regulatory Commitment	Due Date
1. FENOC will update the BVPS-1 aging management plan for the cast austenitic stainless steel lower support column bodies in accordance with the Pressurized Water Reactor Owners Group (PWROG) PA-MSC-1288, Revision 1 project resolution.	Within 180 days of PWROG project completion.
2. FENOC will implement the revised MRP-227-A guidance for BVPS-1 and BVPS-2 primary component links for the lower support column bodies.	Within 90 days of MRP-227-A revision.