

POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2 (PBN) SUBSEQUENT LICENSE RENEWAL APPLICATION (SLRA) REQUEST FOR ADDITIONAL INFORMATION (RAI) SAFETY - SET 10

Note: This is a follow-up RAI to address the applicant's responses to RAIs B.2.3.8-2, dated August 11, 2021 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21223A308).

SLRA Section B.2.3.8, "Flow-Accelerated Corrosion"

RAI B.2.3.8-2a (Software Quality Assurance)

Regulatory Basis

Section 54.21(a)(3) of Title 10 of the *Code of Federal Regulations* (10 CFR) requires an applicant to demonstrate that the effects of aging for structures and components will be adequately managed so that the intended function(s) will be maintained consistent with the current licensing basis for the period of extended operation.

One of the findings that the U.S. Nuclear Regulatory Commission (NRC) staff must make to issue a renewed license (10 CFR 54.29(a)) is that actions have been identified and have been or will be taken with respect to managing the effects of aging during the period of extended operation on the functionality of structures and components that have been identified to require review under 10 CFR 54.21, such that there is reasonable assurance that the activities authorized by the renewed license will continue to be conducted in accordance with the current licensing basis. In order to complete its review and enable making a finding under 10 CFR 54.29(a), the staff requires additional information in regard to the matters described below.

Background

NextEra's August 11, 2021 (ADAMS Accession No. ML21223A308), response to the NRC's Request for Additional Information (RAI) B.2.3.8-2 (ADAMS Accession No. ML21208A189) clarified that CHECWORKS™ Steam/Feedwater Application (SFA) and FAC Manager Web Edition (FMWE) are the software products used in the PBN Flow-Accelerated Corrosion (FAC) program and that they are both classified as software quality assurance (SQA) Level C. The response stated that error notification is the responsibility of the FAC Program Fleet Engineer, referenced ER-AA-111-1000, "Flow-Accelerated Corrosion (FAC) Activities," for a description of those responsibilities, and stated that those activities would continue during the subsequent period of extended operation (SPEO). In addition, the response stated that verification and

validation (V&V), although not required, is performed on a 5–7 year frequency, or after major plant modifications, to ensure that CHECWORKS™ SFA input and functionality are correct. The last V&V was performed in January 2019.

Issue

The August 11, 2021, response to RAI B.2.3.8-2 did not identify documents that describe the V&V performed on a 5–7 year frequency and the NRC staff did not identify any documents on the applicant ePortal. Based on the response, it is unclear whether the V&V also applies to FMWE. In addition, although ER-AA-111, “Flow-Accelerated Corrosion (FAC) Program,” states “Ultrasonic inspection data should be evaluated using an approved (i.e., validated and verified) software program,” the response does not explicitly state that the V&V performed on a 5–7 year frequency will continue during the SPEO.

In addition, IM-AA-101, “Software Quality Assurance Program,” notes that vendor error notification is included in the purchasing and procurement documents. IM-AA-101, Table 1, “SQA Program Requirements for Software,” specifies that “Software Quality Assurance Plan” is required for software levels A, B, and C, and “Procurement” is required for software levels A, B, C, and D. For the SQA plan, Section 5.8 of IM-AA-101 states that the plan shall identify “The methods for error reporting and corrective action.” For procurement of contracted software, Section 5.9 of IM-AA-101 states, “The supplier shall report software errors or failures to the purchaser and the purchaser shall report software errors to the supplier.” It is not clear how the requirements of Sections 5.8 and 5.9 of IM-AA-101 regarding software errors are accomplished through the current FAC program procedures ER-AA-111 or ER-AA-111-1000.

Request

1. Please identify the document(s) that describes the V&V that is performed on a 5–7 year frequency. In addition, please clarify whether the V&V that is performed on a 5–7 year frequency will continue to be performed during the SPEO.
2. Please clarify whether the V&V that is performed on a 5–7 year frequency applies to FMWE.
3. Please discuss how the required software error notification is accomplished through the current FAC program procedures.

Note: This is a follow-up RAI to address the applicant's response to RAIs B.2.3.34-1, dated August 11, 2021 (ADAMS Accession No. ML21223A308).

SLRA Section B.2.3.34, "Structures Monitoring"

RAI B.2.3.34-1a

Regulatory Basis

Section 54.21(a)(3) of Title 10 of the *Code of Federal Regulations* (10 CFR) requires an applicant to demonstrate that the effects of aging for structures and components will be adequately managed so that the intended function(s) will be maintained consistent with the current licensing basis for the period of extended operation.

One of the findings that the U.S. Nuclear Regulatory Commission (NRC) staff must make to issue a renewed license (10 CFR 54.29(a)) is that actions have been identified and have been or will be taken with respect to managing the effects of aging during the period of extended operation on the functionality of structures and components that have been identified to require review under 10 CFR 54.21, such that there is reasonable assurance that the activities authorized by the renewed license will continue to be conducted in accordance with the current licensing basis. In order to complete its review and enable making a finding under 10 CFR 54.29(a), the staff requires additional information in regard to the matters described below.

Background

By letter dated July 13, 2021 (ADAMS Accession No. ML21208A189), the NRC staff issued RAI B.2.3.34-1 seeking additional clarification and/or justification to demonstrate that the aging effects for epoxy grouted anchors/bolts will be adequately managed for the period of extended operation using the Structures Monitoring program, as credited in the PBN SLRA. NextEra's response to the RAI is documented in ADAMS Accession No. ML21223A308. In its response, NextEra described, in part, how the aging effects for the epoxy (adhesive) anchors were determined to be the same as other typical steel and grout anchor components, stated that epoxy (adhesive) anchors and epoxy resin-based grout have been evaluated or used in support plate modifications associated with safety-related components that are within the scope of license renewal, and proposed an enhancement to the "detection of aging effects" program element to specify inspection for degradation due to loss of anchor capacity for epoxy (adhesive) anchors and epoxy resin-based grout components/materials.

The NRC staff has not to date generically endorsed the use of adhesive anchors in related regulatory guidance (e.g., Regulatory Guide 1.199, Revision 1, "Anchoring Components and Structural Supports in Concrete"). In general, the GALL-SLR Report does not address epoxy grouted anchors as a component subject to an AMR or provide a comprehensive list of all

potential aging effects that may be applicable to the epoxy grouted anchors. However, pursuant to 10 CFR 54.21(a)(3), a license renewal applicant is still required to demonstrate that the effects of aging on structures and components subject to an AMR are adequately identified and managed for the period of extended operation. To help address the aging management demonstration that has not been addressed specifically in other guidance documents, the NRC included the Branch Technical Position (RLSB-1) in Appendix A of the SRP-SLR.

SRP-SLR, Appendix A, Section A.1.2.3.3 provides program element acceptance criteria for the “parameters monitored or inspected” program element. As stated therein, parameters monitored or inspected should be capable of detecting the presence and extent of aging effects. Further, it should provide a link between the parameter or parameters that will be monitored and how the monitoring of these parameters will ensure adequate aging management.

SRP-SLR, Appendix A, Section A.1.2.3.4 provides program element acceptance criteria for detection of aging effects. To summarize: Detection of aging effects should occur before there is a loss of intended function(s) and the parameters to be monitored or inspected should be appropriate to accomplish that. The program element should address how the program element would be capable of detecting or identifying the occurrence of the aging effect prior to loss of intended function. This includes aspects such as method or technique, frequency, data collection, and timing of new inspections to ensure timely detection of aging effects.

SRP-SLR, Appendix A, Section A.1.2.3.6 states that the acceptance criteria of the program and its basis should be described. The acceptance criteria, against which the need for corrective actions is evaluated, should ensure that the structure- and component-intended function(s) are maintained consistent with all CLB design conditions during the period of extended operation. The program should include a methodology for analyzing the results against applicable acceptance criteria.

As also described by the SRP-SLR, the determination of applicable aging effects is based on degradation mechanisms that have occurred and those that potentially could cause structure and component degradation, considering relevant operating experience and other information. The SRP-SLR also states that an aging effect should be identified as applicable for license renewal even if there is a prevention or mitigation program associated with that aging effect. Preventive actions may be implemented based on operating experience and should be specified for condition monitoring programs, as necessary.

NRC Information Notice No. (IN) 83-40, “Need to Environmentally Qualify Epoxy Grouts and Sealers,” discusses industry operating experiences regarding the use of epoxy grouts for anchor bolt installations, the potential degradations of epoxy formulations due to elevated temperature and radiation environments, and potential degradations due to the relatively low creep strength of epoxies. In this regard the IN states: “[w]here anchor bolts are bedded in epoxy grout, and

tensioned to any appreciable preload, it may be important to periodically verify that the preload has not been lost due to creep in the grout.”

In 2006, the collapse of the Boston I-90 tunnel ceiling demonstrated epoxy anchors’ poor resistance to creep when subjected to long-term loads, and recognized the challenges involved during the installation process of epoxy anchors (e.g., proper mixing, environment condition, hole cleaning, etc.) (NASA System Failure Case Studies, Vol. 2 Issue 5, Tunnel of Terror, June 2008). The National Transportation Safety Board (NTSB) Accident Report No. HAR-07/02 (PB2007-916203), “Ceiling Collapse in the Interstate 90 Connector Tunnel Boston, Massachusetts,” provides relevant operating experience, findings, and recommendations related to the long-term performance of adhesive anchors and aging mechanisms. Based on the findings of the NTSB report, adhesive anchors should be periodically inspected for displacement (quantitative) of the anchors and periodically subjected to proof load testing with appropriate acceptance criteria for the acceptable displacement of the anchors under the proof load.

Of particular note, the limited availability of qualified epoxies and/or epoxy grout material for use in safety-related applications (i.e., in accordance with 10 CFR Part 50, Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants”) also represents an overall challenge to the nuclear industry. At the same time, the recognized concrete standards development organization, American Concrete Institute (ACI), has most recently updated its codes and standards (e.g., ACI 318-14 and later editions and ACI 355.4) to include new provisions that address the proper evaluation, design, and qualification of epoxy (adhesive) anchors. These code provisions and requirements include design considerations, qualification, installation, and quality control requirements that should be considered within the program’s acceptance criteria.

Issue

Based on the NRC staff review of the information provided in the RAI B.2.3.34-1 response, additional information is necessary for the staff to understand whether the existing anchors are qualified for long-term performance in safety-related applications, whether the applicant has identified all applicable environment and aging effect combinations for epoxy anchor or epoxy resin-based grout, and whether a sufficient demonstration has been made that the associated aging effects will be adequately managed by the Structures Monitoring Program during the subsequent period of extended operation. Specifically, the following issues requiring additional justification were identified:

1. The RAI response stated that the epoxy (adhesive) anchors and epoxy resin-based grout were evaluated for use in the support plate for the Service Water and Component Cooling Water pump, which is a nuclear safety-related system. The response further stated that the materials were considered to be similar to other “polymer” or “polymeric”

materials used in various mechanical systems. However, it is not clear if these materials were qualified for use in safety-related applications in accordance with 10 CFR Part 50, Appendix B or if the qualification process considered the difference in material characteristics and intended function between epoxy anchors and polymeric materials used in mechanical systems.

2. The RAI response revised SLRA Table 3.5.2-13 and added a new AMR line item that proposes the use of the Structures Monitoring program to manage the aging effects of “reduction in concrete anchor capacity” for expansion and grouted anchor components installed with “grout” material. The associated plant-specific Note 2 further states that the component includes epoxy (adhesive) anchors or epoxy resin-based grout components since they are subject to the same aging effects.
 - a. The stated “grout” material is not considered to be similar to “epoxy (adhesive)” or “epoxy resin-based grout” because grout is typically a strictly cementitious material and the epoxy will be made from different materials (i.e., made only using chemicals and/or a combination of a chemical with other cementitious materials). Furthermore, the epoxy materials will experience different properties and aging mechanisms that should be considered and evaluated accordingly (e.g., creep due to long-term loads, elevated temperatures, radiation, etc.).
 - b. The “epoxy (adhesive)” or “epoxy resin-based grout” serves as a third element/material, not normally found in typical mechanical anchors system, that interacts between the substrate (e.g., concrete) and the anchor/bolt itself. Therefore, adhesive anchors introduce a new failure mode when compared to the mechanical anchors system: “bond failure of the adhesive” or “pull-out failure,” which can be characterized as a reduction in bonding anchor capacity aging effect. However, it is not clear how this aging effect has been considered and/or evaluated in the SLRA or addressed in the RAI response.
3. The RAI response, SLRA, and Structures Monitoring program are not clear on how the acceptance criteria, against which the need for corrective actions is evaluated, is derived for epoxy (adhesive) and epoxy resin-based grouted anchors to ensure that the intended function of the epoxy anchor or epoxy resin-based grout is maintained consistent with all CLB design conditions during the period of extended operation. The NRC staff notes that criteria are typically derived from credited codes and standards; however, the version of the ACI 318 code credited in the UFSAR does not include provisions that address the evaluation and qualification of epoxy anchors.
4. The RAI response includes several general statements from vendors regarding the chemical resistance of some adhesive anchors, and also states that none of the installed

epoxy anchors are located in an environment associated with the potential aging effects identified in NRC IN 83-40. However, it is not clear what preventive actions will be taken by the Structures Monitoring program to address this operating experience and other operating experiences associated with the failure of epoxy anchors to mitigate or prevent aging degradation and ensure bolting integrity for anchors installed during the period of extended operations. The NRC staff also notes that currently no provision prohibits NextEra from using such anchors for future application in an environment or other conditions associated with the operating experience described previously.

Proper selection of bonding material considering the exposed environment, proper storage of material per manufacturer's recommendations, implementation of applicable codes and standards provision (e.g., ACI 318-11 and ACI 355.4), and proper installation by qualified personnel in accordance with applicable codes and using the Manufacturer's Printed Installation Instructions, may be necessary to ensure that bolting integrity is maintained.

5. The proposed new enhancement (SLR Commitment 38(g)) to the detection of aging effects program element states: "Update the governing AMP procedure and other applicable procedures to specify inspection of structural support applications employing epoxy (adhesive) anchors and epoxy resin-based grout for degradation that could cause a loss of anchor capacity." However, the enhancement does not specify what parameters will be monitored, the inspection method and inspection frequency, how the inspection method is capable of detecting loss of anchor capacity, or why the inspection frequency is adequate to detect the aging effect prior to a loss of intended function. The enhancement also does not specify acceptance criteria for this component. Furthermore, since the enhancement will only be implemented prior to entering the SPEO and the anchors are already installed or may continue to be installed before the SPEO, it is not clear how it will be verified that there is no loss of anchor capacity prior to entering the SPEO such that the components remain capable of performing their intended function during the SPEO.
6. The SLRA did not discuss what operating experience was reviewed to determine that all appropriate aging effects were identified for "epoxy (adhesive)" or "epoxy resin-based grout" materials.

Requests

1. In order for the NRC staff to better understand the potential aging mechanisms, indicate whether the epoxy adhesive and epoxy resin-based grout materials have been qualified for use as anchors in safety-related applications to standards consistent with 10 CFR Part 50, Appendix B and provide any supporting qualification documentation.

2. Update SLRA Table 3.5.2-13 to include the associated AMR line items addressing all applicable material, environment, and aging effect/mechanism combinations for “epoxy (adhesive)” and “epoxy resin-based grout” anchors that needs to be evaluated considering the difference in material properties (i.e., vs. “grout” material as identified in the response) and all applicable failure modes associated with this component.
3. Clarify what codes and standards are used to derive the acceptance criteria applicable to epoxy (adhesive) and epoxy grout anchors. Otherwise, provide technical justification for the acceptance criteria if they are not based on consensus codes and standards. Update the SLRA AMP as necessary.
4. Describe what preventive actions will be implemented to maintain bolting integrity and to mitigate or prevent aging degradations identified in operating experiences (e.g., proper storage, selection of bonding material, used of the Manufacturer’s Printed Installation Instructions and applicable codes and standards provision for proper installation and qualification requirements).
5. With regard to SLR Commitment 38(g) related to epoxy (adhesive) anchors and epoxy resin-based grout components: (a) identify the parameters that will be monitored or inspected/tested and describe the link regarding how monitoring these parameters will result in adequate aging management; (b) state the inspection and testing method(s) and inspection/test frequency that will be used to detect and manage loss of anchor capacity (e.g., a proof loading program established in accordance with ACI 355.4); (c) justify the adequacy of the inspection/testing method(s) and frequency to detect and manage the relevant aging effect(s); (d) describe how it will be verified that there is no loss of anchor capacity of the epoxy anchors or epoxy-resin grout components prior to entering the SPEO; and (e) revise the SLRA accordingly.
6. Update the SLRA to include the significant and relevant operating experience with regard to long-term performance and failure of adhesive anchors that was evaluated in determining the parameters monitored or inspected, the inspection and testing methods, and inspection/testing frequency proposed in response to Request 5 above.