NEXTera ENERGY POINT BEACH

November 4, 2021

L-2021-199
10 CFR 54.17

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
11545 Rockville Pike
One White Flint North
Rockville, MD 20852-2746

Point Beach Nuclear Plant Units 1 and 2
Dockets 50-266 and 50-301
Renewed License Nos. DPR-24 and DPR-27

SUBSEQUENT LICENSE RENEWAL APPLICATION - AGING MANAGEMENT REQUESTS FOR ADDITIONAL INFORMATION (RAI) SET 10 RESPONSES

References:

1. NextEra Energy Point Beach, LLC (NEPB) Letter NRC 2020-0032 dated November 16, 2020, Application for Subsequent Renewed Facility Operating Licenses (ADAMS Package Accession No. ML20329A292)
2. NEPB Letter L-2021-144 dated August 11, 2021, Subsequent License Renewal Application – Aging Management Requests for Additional information (RAI) Set 2 Responses (ADAMS Accession No. ML21223A308)
3. NRC Email and Attachment dated October 5, 2021, Point Beach SLRA RAI Safety Set 10 Final (ADAMS Accession Nos. ML21286A603, ML21286A604)

NEPB, owner and licensee for Point Beach Nuclear Plant (PBN) Units 1 and 2, has submitted a subsequent license renewal application (SLRA) for the Facility Operating Licenses for PBN Units 1 and 2 (Reference 1). Based on NEPB's responses to RAIs B.2.3.8-2 and B.2.3.34-1 (Reference 2 Attachments 7 and 25), the NRC issued its Set 10 RAIs to NEPB (Reference 3). The attachments to this letter provide responses supplementing and superseding Reference 2 Attachments 7 and 25, respectively.

For ease of reference, the index of attached information is provided on page 3 of this letter. Certain attachments include associated revisions to the SLRA (Enclosure 3 Attachment 1 of Reference 1) denoted by ~~strikethrough~~ (deletion) and/or **bold red underline** (insertion) text. Previous SLRA revisions are denoted by **bold black** text. SLRA table revisions are included as excerpts from each affected table.

Should you have any questions regarding this submittal, please contact me at (561) 304-6256 or William.Maher@fpl.com.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on the 4th day of November 2021.

Sincerely,

William Maher

Digitally signed by William Maher
DN: cn=William Maher, o=Nuclear, ou=Nuclear Licensing Projects, email=william.maher@fpl.com, c=US
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William D. Maher
Licensing Director - Nuclear Licensing Projects

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Attachments Index		
Attachment No.	RAI No.	Subject
1	B.2.3.8-2a	Flow Accelerated Corrosion – Software Quality Assurance
2	B.2.3.34-1a	Structures Monitoring – Epoxy Grouted Anchors and Bolts

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.

NEPB Response:

The numbered responses below correspond to the numbered requests above:

1. A validation and verification (V&V) of the Flow Accelerated Corrosion (FAC) Aging Management Program (AMP) CHECWORKS™ SFA software was recently performed in January 2019. The documents that provide the description of that V&V (17-0299-TR-004 and 17-0299-TR-005) have been posted in the PBN FAC AMP references folder on the ePortal.

   Past V&V activities of CHECWORKS™ SFA were driven by the extended power uprate (2012) and a revised susceptibility analysis (2019). Currently, there is no document that requires that a V&V be performed at a specific frequency. Thus, the SLRA is revised to include an enhancement to the FAC AMP specifying that V&V of the FAC software (including CHECWORKS™ SFA and FMWE) will be performed on

a frequency of no longer than every 7 years through the SPEO. The enhancement will clarify that V&V of FMWE must occur at least once prior to the SPEO.

2. Although the software V&V documents described above were focused on CHECWORKS™ SFA, several components in the PBN Units 1 and 2 FAC Manager database were updated as a result of the CHECWORKS™ SFA database V&V efforts. Per the enhancement described above, the periodic V&V will also apply to FAC Manager Web Edition (FMWE) including one prior to the SPEO.

3. The requirement for error notification is not explicitly identified in the FAC program procedures. Accordingly, an additional responsibility will be added for the FAC program fleet engineer in these procedures which states the following:

   "Ensure that the requirements of Sections 5.8 and 5.9 of IM-AA-101 for error reporting are applied to FAC software."

   Accordingly, the SLRA is revised to include an enhancement to the FAC AMP for this requirement.

References:

1. NextEra Energy Point Beach, LLC (NEPB) Letter to NRC L-2021-144 dated August 11, 2021, Subsequent License Renewal Application – Aging Management Requests for Additional Information (RAI) Set 2 Responses (ADAMS Accession No. ML21223A308)

2. NextEra Energy Point Beach, LLC (NEPB) Letter to NRC L-2021-081 dated April 21, 2021, Subsequent License Renewal Application – Aging Management Supplement 1 (ADAMS Accession No. ML21111A155)

Associated SLRA Revisions:

SLRA Appendix A.16.4, Table 16-3, pages A-67 through 68, as modified by Reference 2, is revised as follows:

Table 16-3
List of SLR Commitments and Implementation Schedule

No.	Aging Management Program or Activity (Section)	NUREG-2191 Section	Commitment	Implementation Schedule
12	Flow-Accelerated Corrosion (16.2.2.8)	XI.M17	Continue the existing PBN Flow-Accelerated Corrosion AMP, including enhancement to: a) Reassess piping systems excluded from wall thickness monitoring due to operation less than 2% of plant operating time (as allowed by NSAC-202L **-R4**) to ensure the exclusion remains valid and applicable for operation beyond 60 years. b) Formalize a separate **erosion program scope, and an** erosion susceptibility evaluation (ESE) that will include all components determined to be susceptible to wall loss due to erosion through OE and industry guidance. c) Perform or compile baseline inspections of erosion susceptible locations where site OE indicates periodic monitoring may be warranted instead of design or operational correction to eliminate the cause of erosion. d) Revise or develop procedural guidance relative to erosion based on the results that includes – • Components treated in a manner similar to "susceptible-not-modeled" lines discussed in NSAC-202L**-R4**. e) Consideration of EPRI 1011231 for identifying potential damage locations and EPRI TR-112657 and/or NUREG/CR–6031 guidance for cavitation erosion as warranted. **f) Validation and verification of flow accelerated corrosion software (including CHECWORKS™ Steam/Feedwater Application (SFA) and FAC Manager Web Edition (FMWE)) will be performed prior to the SPEO and on a frequency of no longer than every 7 years through the SPEO.** **g) Revise FAC program procedures to ensure the requirement for error reporting is applied to FAC software.**	No later than 6 months prior to the SPEO, i.e.: PBN1: 04/05/2030 PBN2: 09/08/2032

SLRA Appendix B.2.3.8, Enhancements Table on Pages B-79 through 80, as modified by Reference 2, is revised as follows:

Enhancements

The PBN Flow-Accelerated Corrosion AMP will be enhanced as follows for alignment with NUREG-2191. Enhancements are to be implemented no later than six months prior to entering the SPEO.

Element Affected	Enhancement
1. Scope of Program	• Reassess piping systems excluded from wall thickness monitoring due to operation less than 2 percent of plant operating time (as allowed by NSAC-202L**-R4**) to ensure the exclusion remains valid and applicable for operation beyond 60 years. • Formalize a separate **erosion program scope, and an** erosion susceptibility evaluation (ESE) that will include all components determined to be susceptible to wall loss due to erosion through OE and industry guidance.
4. Detection of Aging Effects	• Perform or compile baseline inspections of erosion susceptible locations where site OE indicates periodic monitoring may be warranted instead of design or operational correction to eliminate the cause of erosion. • Revise or develop procedural guidance relative to erosion based on the results that includes – o Components treated in a manner similar to "susceptible-not-modeled" lines discussed in NSAC-202L **-R4**. o Consideration of EPRI 1011231 for identifying potential damage locations and EPRI TR-112657 and/or NUREG/CR–6031 guidance for cavitation erosion as warranted.
5. Monitoring and Trending	• **Validation and verification of flow accelerated corrosion software (including CHECWORKS™ Steam/Feedwater Application (SFA) and FAC Manager Web Edition (FMWE)) will be performed prior to the SPEO and on a frequency of no longer than every 7 years through the SPEO.** • **Revise FAC program procedures to ensure the requirement for error reporting is applied to FAC software.**

Associated Enclosures:

None.

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.

NEPB Response:

This response supersedes in its entirety the previous response provided to RAI B.2.3.34-1 in Attachment 25 of L-2021-144 [Ref. 3].

The SLRA and NextEra's response to RAI B.2.3.34-1 were based on an understanding that post-installed epoxy adhesive anchors had been evaluated and installed as structural commodity items in scope for SLR at Point Beach. It has been confirmed that post-installed epoxy adhesive anchors (as defined in ACI 318-14) are not installed as structural commodity items in scope for SLR at Point Beach.

One of the issues addressed by this RAI and reflected in referenced industry operating experience is the need for proper design and installation of concrete anchors to ensure the ability to sustain design basis loads. The older operating experience specifically concerns concrete expansion anchors, as described in IEB 79-02 and Regulatory Guide 1.199, Revision 0. Concrete expansion anchors rely on mechanical interaction and friction between the anchoring mechanism and the concrete. The pullout strength of concrete expansion anchors cannot be reliably predicted by analysis without empirical test data for each of the various anchor designs. This is reflected in Code requirements for expansion anchors and more generally for post-installed anchors. Post-installed anchors include expansion anchors, undercut anchors, adhesive anchors, and grouted embedments.

The use of adhesive anchors resulted in similar industry operating experience reflecting the importance of design rigor and proper installation. Post-installed adhesive anchors rely on an epoxy bonding material between the concrete surface and the steel anchor, without the benefit of aggregate and without the benefit of friction or concrete undercut. Adhesive anchors and other post-installed anchors also do not have the benefit of a direct bearing surface to resist pullout, i.e., an embedded bolt head, J or L bolt, or nut and washer.

PBN does not use adhesive anchors. PBN uses an epoxy resin-based grout as an alternative to Portland cement-based grout for installing baseplates for new equipment, and for upgrading or replacing existing equipment baseplates. In cases where upgrading or replacing existing equipment baseplates requires removal and replacement of existing anchor bolts, the existing anchor bolts are removed by core boring to the desired embedment depth of the new anchors. The concrete surface, including the vertical walls of the cylindrical bore holes, are prepared in accordance with the Manufacturers Installation Instructions and the anchor bolts are embedded as part of the grout installation process. Procedure steps are included to ensure full embedment and proper positioning of the new anchor bolts, including Quality Control, Engineering and Supervisor Hold Points. Compressive strength test cubes were cast for each batch during installation and tested to confirm the cured strength.

Based on the operation and maintenance history of some safety-related pumps at PBN, it was determined that an upgrade to the pump and driver anchorage was necessary to ensure long-term reliability. API-686 (April 1996), "Recommended Practices for Machinery Installation and Installation Design", American Petroleum Institute, provides guidance for equipment anchorage design and installation and is intended to supplement the OEM installation instructions. This Recommended Practice (RP) defines grout as:

> ***Grout**: An epoxy or cementitious material used to provide a uniform foundation support and load transfer link for the installation of rotating machinery. This material is typically placed between a piece of equipment's concrete foundation and its mounting plate.*

The upgrade was implemented using the engineering change (EC) process consistent with 10 CFR 50 Appendix B requirements. The EC required removal of the old grout from the top of the reinforced concrete pedestal. The original cast-in anchors could not be reused and were bored out to allow for the installation of new anchors. The new anchors for pumps are ASTM SA193 threaded rod with ASTM SA194 hex nuts with washers. The rods were embedded with nut and washer bearing surface a minimum of 12 inches into the reinforced concrete floor by grouting into the prepared bore holes as the initial baseplate grout placement activity. The robust anchorage design is verified by conservative engineering analyses consistent with applicable industry Codes and Standards.

The new grout (MasterFlow 648, BASF Corporation) is a high-strength, high-temperature, high-flow epoxy resin-based grout. It is a three-component modified epoxy resin-based grout that combines high-temperature performance and crack resistance with excellent flow characteristics. This grout was selected primarily to improve pump and motor stability and load transfer to the concrete structure, but it also has sufficient strength and bonding properties to provide a stable, predictable anchor embedment design.

SLRA Section 3.5.2.1.13, SLRA Table 3.5.2-13, SLRA Table 16-3 (Item No. 38), and SLRA Section B.2.3.34, as amended by SLRA Aging Management Supplement 1 [Ref. 2] are revised as described below. Information addressing each request is provided below.

1. Epoxy resin-based grout has been qualified for use in safety-related applications at PBN. The grout is an engineered product designed for heavy industrial applications. The grout is similar to cementitious grout except that an epoxy resin and hardener replaces Portland cement as the binding agent for the aggregate filler. Epoxy properties and proportions are specifically designed to be mixed with the dry aggregate and used as an effective substitute for cementitious grout. The epoxy resin-based grout used at PBN has good flowability and high effective bearing area demonstrated by lab testing (ASTM C 1339 "Standard Test Method for Flowability and Bearing Area of Chemical Resistant Polymer Machinery Grouts") which ensures good load distribution. Testing also demonstrates good bond strength to both steel and concrete, minimal shrinkage, and low creep, helping to ensure full baseplate contact under load over long periods of time. These properties improve the stability of the anchorage, resulting in lower vibration and improved seal and bearing performance.

   An anchorage calculation confirmed the design of the anchors by conservatively calculating stresses associated with potential anchor failure modes in accordance with applicable PBN Design Standards and ACI 318-05, Appendix D (CCW pumps) or ACI 318-63 (SW pumps). Conservative values for applicable properties of existing concrete and cured epoxy resin-based grout are used.

   The epoxy resin-based grout supports and secures the sole plate and anchor bolts for the service water pumps and component cooling water pumps. The grout is installed in accordance with Manufacturer's Installation Instructions and site procedures. During the modification process, the prior-existing anchor bolts were removed, and the bolt locations were bored out to accommodate room for the replacement anchor bolts. All grouted concrete surfaces, including the sides of the bore holes for the new anchor embedments, are roughened to a concrete surface profile (CSP) of 5 – 9, cleaned and dried. In addition, the concrete baseplate immediately beneath the pump was cut down (this thickness was replaced by the same epoxy resin-based grout as described below). New anchor bolts were installed within the bored-out holes, followed by the new baseplate. The pump baseplate was located and leveled above the existing as-cut concrete base so that the anchor bolt holes, and the space between the concrete and new baseplate, would all be filled by the epoxy resin-based grout. A form was installed around the baseplate and the grout was poured. It was ensured that the grout filled the anchor bolt holes before the remaining grout was poured. Thus, the entire epoxy resin-based grout pour filled down into the anchor holes as well as making a continuous plate of grout extending the entire area underneath the pump baseplate. This grout fill is expected to be substantially stronger and creates a robust mass block and stiff foundation for the component. The increased stiffness dampens the natural vibrational frequency of the equipment such that it does not align with the rotational speed of the pump thereby minimizing vibration amplitude (e.g., displacement). The improved bonding of the epoxy grout improves the composite action between the substrate and the pump base further improving the reduction in vibration. The robust mass block is also a good thermal heat sink minimizing changes in temperature during normal and abnormal operations. This type of repair is best characterized as a structural replacement rather than a standard grout or anchorage repair.

   The new anchor bore holes for the Service Water pumps were approximately 2-1/2" diameter and the new anchor bolts are 7/8" diameter. Given that the holes were greater than 1.5 times the anchor diameter, this application does not meet the definition of an adhesive anchor as defined in ACI 318. The minimum diameter of the core bore for the new Component Cooling Water pump anchors was 2-3/8", and the diameter of the new anchor

bolts is 3/4". Given that the holes were greater than 1.5 times the anchor diameter, this application also does not meet the definition of an adhesive anchor as defined in ACI 318.

ACI Standard 349-13, Code Requirements for Nuclear Safety-Related Concrete Structures covers the design and construction of concrete structures that form part of a nuclear facility and that have nuclear safety-related functions. Appendix D of ACI 349-13 addresses anchoring to concrete, and Section D.12 is specific to grouted embedments and addresses both cementitious grout and "special grouts, containing epoxy or other binding media." The standard requires that special grouts, including those containing epoxy, to be qualified for use by the licensed design professional and specified in contract documents. The remainder of ACI 349-13 Section D.12 does not differentiate between cementitious grout or other types of grout.

Safety-related modifications are prepared under the direct supervision of a licensed design professional as part of the standard PBN design process. Epoxy resin-based grout for the Service Water and Component Cooling Water pump replacements was identified as being approved for use in nuclear safety-related applications by the manufacturer (BASF). To ensure a sufficient quantity for the installations, some of the grout was commercially dedicated for use in safety-related applications at a nuclear power plant licensed pursuant to 10 CFR Part 50. The pertinent engineering change documents have been provided on the ePortal (22 files are located in a folder named "Epoxy Grout PBN").

The following properties were verified by a testing laboratory and the results were referenced in and attached to the safety-related Structural Anchorage Analysis calculations for the respective pumps:

- Compressive strength in accordance with ASTM C 579 (Test Method B)
- Tensile strength in accordance with ASTM C 307
- Flexural strength in accordance with ASTM C 580
- Modulus of Elasticity in accordance with ASTM C 580
- Coefficient of Thermal Expansion in accordance with ASTM C 531
- Slant Shear in accordance with ASTM C 882
- Linear Shrinkage in accordance with ASTM C 531

Furthermore, destructive testing was performed on compressive strength test cubes to verify compressive strength in accordance with ASTM standards and approved work plans. The results of the strength tests are documented in the completed work order packages; work is not allowed to proceed until the tests confirm that the grout meets the compressive strength requirements.

The use of epoxy resin-based grout for future installations of embedded anchors will continue to be evaluated on a case-by-case basis to ensure that the grout is qualified for use in the specific application through the PBN engineering change process. Epoxy resin-based grout cannot be released for installation of embedded anchors in safety-related applications without engineering documentation approving the specific application.

2. A Failure Modes and Effects Analysis was performed as part of the procurement evaluation for the epoxy resin-based grout that is in use at PBN. The potential failure modes that were identified in the evaluation were:

- Deformation: Excessive expansion or shrinkage of cured concrete/grout may cause fracture leading to the loss of structural integrity.
- Fracture: Excessive compressive loads may cause fracture and lead to the loss of structural integrity.

The evaluation concluded that successful verification of markings, configuration, unit weight (bulk density) and compressive strength ensures that the grout has the proper properties as required by the purchase order and engineering requirements, and that this will provide reasonable assurance that the grout will perform its intended safety function and maintain the integrity of the safety-related equipment. In addition to the procurement evaluation, a Failure Modes and Effects Analysis is required as part of the Design Change Package preparation procedure.

The aging effect and mechanism listed in NUREG-2191 for the "Concrete; grout" material is "Reduction in concrete anchor capacity due to local concrete degradation/service-induced cracking or other concrete aging effects." Both of the failure modes identified for the epoxy resin-based grout during the Failure Modes and Effects Analysis are aging mechanisms that may also affect concrete and cementitious materials and could lead to a reduction in anchor capacity.

The epoxy compound (resin plus hardener) constituent of the installed grout is a polymer, which could be affected by aging mechanisms that may also contribute to a reduction of anchor capacity (including high temperatures, radiation exposure, ultraviolet exposure, and creep). Also, as discussed in the response to Request 6 below, IN 83-40 was generated to alert licensees to potential degradation of epoxy formulations from heat and radiation, and states that the specific compounds that were in use at Watts Bar had shown significant loss of strength at temperatures above 120°F. The only locations where anchors are embedded using epoxy resin-based grout at PBN are under pump support plates, where high temperatures (in excess of 120°F) are not normally experienced, radiation exposure is not a concern, and ultraviolet exposure is minimal.

The PBN Structures Monitoring AMP will be enhanced prior to entering the SPEO to include periodic inspections for tightness (e.g., torque checks, as applicable) of all anchors within the scope of license renewal that are embedded in epoxy resin-based grout to ensure that proper installation is maintained and verify that preload has not been lost due to creep. The inspections for tightness will supplement the visual monitoring activities described in the response to Request 5 below. It would also serve as an indication that the grout is not yielding by crushing or by creep. Proper installation of the anchorage is a key element in the design and a loss of tightness may indicate a reduction in anchor capacity. Furthermore, the PBN Structures Monitoring AMP will be enhanced to prohibit the use of epoxy resin-based grout in safety-related applications in locations where normal temperatures exceed 120°F, or in posted high radiation areas as defined in 10 CFR Part 20.

A new row is added to SLRA Table 3.5.2-13 for epoxy resin-based grout exposed to air-indoor uncontrolled, along with Plant Specific Note 2, which clarifies that the component material includes epoxy resin-based grout. Plant Specific Note 2 also provides further clarification regarding aging mechanisms for epoxy resin-based grout.

3. As described in the response to Request 1 above, ACI 349-13 addresses anchoring to concrete in Appendix D, and Section D.12 specifically addresses grouted embedments. Section D.12.1 states that "grouted embedments shall meet the applicable requirements of

this appendix," (referring to Appendix D of ACI 349-13). The only differentiation between cement grout and epoxy resin-based grout is a requirement that epoxy resin-based grout is required to be qualified for use by the licensed design professional and specified in the contract documents. PBN performed a procurement evaluation and safety-related design calculations to ensure that the epoxy resin-based grout was qualified for use in safety-related applications. Aside from this additional requirement, ACI 349-13 does not distinguish between grout types in its design requirements.

As described in the response to Request 2 above, a Failure Modes and Effects Analysis was performed as part of the procurement evaluation and as part of the design change package for the epoxy resin-based grout that is in use at PBN. The failure modes that were identified for the epoxy resin-based grout are aging effects that may also affect concrete and cementitious materials. Therefore, the acceptance criteria for epoxy resin-based grout are the same as those for cement grout.

The design change packages included safety-related calculations to qualify the new anchorage. Both calculations reference ACI 318 (as indicated in response to Request 1 above) and conclude that the new anchorage is structurally adequate. Each new application of epoxy resin-based grout will be similarly evaluated to ensure that the anchorage will be structurally adequate.

4. The preventive actions implemented for epoxy resin-based grout include proper storage, qualification of selected epoxy resin-based grout, and use of the manufacturer's installation instructions and site procedures to ensure proper installation.

    a) Proper storage: The epoxy resin-based grout in use at PBN is a three-component modified epoxy resin-based grout. The three components include a resin, a hardener, and aggregate. The manufacturer's technical data guide (posted to the ePortal folder identified in the response to Request 1 above) specifies that the resin, hardener, and aggregate are to be stored in unopened containers at 60°F to 80°F in clean, dry conditions. The shelf life is two years (for both resin and hardener) when properly stored. Following these storage specifications ensures that any un-opened epoxy resin-based grout will remain qualified for future use.

    b) Qualification of selected epoxy resin-based grout: The design change procedure is followed for every engineering change. As part of this process, the epoxy resin-based grout is evaluated for the specific conditions in which the grout will be used to ensure that the grout is appropriate and qualified for use. Material properties of the epoxy resin-based grout used for anchorage design have been tested at temperatures above the service temperature. Compressive strength test cubes are taken during installation and tested to verify cure strength of the installed grout.

    c) Proper installation: Grout installation was performed in accordance with the grout manufacturer's requirements and site procedures, including preparing the surfaces of the concrete in the grout pocket and destructive testing of compressive strength test cubes from each grout batch to determine final grout strength. The vendor's installation instructions are included in the work order packages.

        - For the service water pumps, assembly of the pump was not permitted until the grout was shown to meet the minimum required compressive strength of 500 psi. Torquing of the anchor bolts was not permitted until the anchor bolt grout strength was shown to meet the minimum required compressive

strength of 7500 psi. Operation of the pump was not permitted until the anchor bolt grout and the sole plate grout were shown to meet the minimum required compressive strength of 7500 psi.

- For the component cooling water pumps, the installation of the new pump was not permitted until the grout was shown to meet the minimum required compressive strength of 1,000 psi. Final torquing of the anchor bolts and operation of the pump were not permitted until the grout was shown to meet the minimum required compressive strength of 5,000 psi.

The PBN Structures Monitoring AMP will be enhanced to include periodic inspections for tightness (e.g., torque checks, as applicable) of all anchors within the scope of license renewal that are embedded in the epoxy resin-based grout during normally scheduled walkdowns, which occur at least once every 5 years, to ensure that proper installation is maintained and verify that preload has not been lost due to creep.

5. The five specified sub-topics regarding SLR Commitment 38(g) are individually addressed below.

   a) The epoxy resin-based grout involves cross-linked thermosetting material that, once cured, will be chemically stable. The material is resistant to chemical attack and will maintain required mechanical properties under the installed environmental conditions. Significant age-related degradation is not expected. If degradation such as hardening were to occur, causing the material to become more brittle, it would be detected by observing aging effects such as cracking, scaling, or spalling similar to aged concrete or mortar. Similarly, if softening were to occur, causing a general weakening of the material, it would be detected by observing aging effects such as settlement, deflection, or other physical movements. Weakening by unexpected chemical attack would be detected by direct visual inspection of exposed surfaces. Softening or weakening would also be detected by periodic inspection for tightness of the anchor bolts to verify preload has not been lost due to creep.

      The following degradation effects or mechanisms are monitored for all concrete structures (including all grout) at PBN:

      - Passive cracks
      - Leaching and chemical attack
      - Abrasion, erosion, and cavitation
      - Drummy areas
      - Popouts and voids
      - Scaling
      - Spalling
      - Corrosion (reinforcing steel or anchorage components)
      - Settlements, deflections, or other physical movements
      - Rust stains

In addition, the following degradation effects or mechanisms are monitored for component supports and fasteners:

- Coating degradation
- Corrosion/rust
- Cracked welds
- Cracking
- Deflection, distortion, twisting, deformation, physical damage
- Overall alignment
- Loose fasteners or anchors
- Missing/out of place fasteners or anchors
- Missing or degraded grout under base plates
- Thread engagement
- Missing/improper washers

In addition to the above parameters, vibration testing is utilized by PBN as one of the methods that informs the Structures Monitoring AMP relative to the anchors in the plant, including those that are embedded in epoxy resin-based grout.

PBN committed in the SLRA to enhance the PBN Structures Monitoring AMP to also include inspection of concrete structures for increase in porosity and permeability, loss of strength, and reduction in concrete anchor capacity due to local concrete degradation. SLR Commitment 38(d) is updated to clarify that grout materials (including epoxy resin-based grout) are included.

b) Visual inspections of grouted anchors, including those using epoxy resin-based grout, are performed under the scope of the PBN Structures Monitoring AMP on a frequency not to exceed once every 5 years. In addition to visual inspections, the PBN Structures Monitoring AMP will be enhanced to include periodic inspections for tightness (e.g., torque checks, as applicable) of all anchors within the scope of license renewal that are embedded in the epoxy resin-based grout during normally scheduled walkdowns to ensure that proper installation is maintained and verify that preload has not been lost due to creep.

c) As described in response to Request 6 below, a review of plant-specific and industry operating experience did not identify any incidents involving failure of epoxy resin-based grouted anchors. ACI 349-13 does not differentiate between grouted embedments using epoxy resin-based grout or those using cement grout, with the exception of an additional requirement that the epoxy resin-based grout be qualified for use by the licensed design professional and specified in the contract documents. The Structures Monitoring AMP inspection frequency has been demonstrated to be adequate to identify any loss of anchor capacity prior to failure. The epoxy resin-based grouted anchors will be subject to all of the corrective actions indicated by the PBN Structures Monitoring AMP, including consideration of increased inspection frequencies if degradation is observed. Therefore, the normal inspection frequency of the PBN Structures Monitoring AMP is adequate to

provide reasonable assurance that degradation is not occurring in epoxy resin-based grouted anchors.

To ensure proper installation of the anchors embedded in epoxy resin-based grout has been maintained, the first inspection for tightness (torque check) will be performed no later than the last RFO prior to the SPEO.

d) Refer to the 'Associated SLRA Revisions' for updates reflecting the enhancements discussed above.

6. A review of plant-specific operating experience spanning the time frame from January 1, 2010 through January 1, 2020 did not identify any incidents or observations involving the epoxy resin-based grout in use at PBN.

   The following keywords were entered into the INPO IRIS database: "Epoxy and Grout," "Anchor and Grout," and "Epoxy and Anchor." No failures were identified in the industry for anchors embedded in epoxy resin-based grout. Some documented instances of degraded epoxy resin-based grout were identified and corrected prior to failure of the associated anchor. One example documents that voids were found under approximately 25% of the pump base plate area. The epoxy resin-based grout had degraded and lost contact with the baseplate and underlying pump pedestal, resulting in void formation. It was concluded that the flexing of the baseplate due to high resonance vibration of the pump resulted in the degradation of the grout mounting the baseplate on the underlying concrete pedestal. The pump was stabilized by the injection of grout/epoxy under the baseplate. No issues were documented with the anchors.

   NRC Information Notice (IN) 83-40 identified experience at TVA with "epoxy grouts, used to install various anchor bolts" and also refers to "anchor bolts bedded in epoxy grout." TVA reported that tests at temperatures up to 160°F had been performed, and that the compounds had shown significant loss of strength at temperatures above 120°F. The safety-related applications of epoxy resin-based grout at PBN are in locations outside of containment that do not normally experience high temperatures (in excess of 120°F) or radiation exposure, although epoxy resin-based grout used at PBN is designed for elevated service temperatures. Manufacturer test results show the tested strength of the epoxy resin-based grout is greater than the bond strength assumed for grout-to-concrete bonding in the anchorage calculations. Test results show a reduction in strength at elevated temperature; however, the strengths at the manufacturer's testing limit of 170°F remain above levels used in design.

   NRC IN 83-40 identifies the need to consider the creep strength of epoxies. IN 83-40 recommends that where 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 by creep in the grout. PBN uses an epoxy resin-based grout designed to minimize creep. As described in response to Request 1 above, anchors have been installed in epoxy resin-based grout to replace existing rotating equipment anchors. Routine vibration monitoring and trending provides early indication of loose anchorage and has not detected loosening of anchors installed in epoxy resin-based grout. For SLR, PBN will enhance the Structures Monitoring program to periodically check the torque of anchor bolts embedded in epoxy resin-based grout to verify that preload has not been lost due to creep.

The PBN Structures Monitoring AMP will be enhanced to prohibit the use of epoxy resin-based grout in safety-related applications in locations where normal temperatures exceed 120°F or in posted high radiation areas as defined in 10 CFR Part 20.

References:

1. "Point Beach Nuclear Plant Units 1 and 2 Subsequent License Renewal Application (Public Version)," Enclosure 3, Attachment 1, dated November 2020 (ADAMS Accession No. ML20329A247)
2. NextEra Energy Point Beach, LLC (NEPB) Letter to NRC L-2021-081 dated April 21, 2021, Subsequent License Renewal Application – Aging Management Supplement 1 (ADAMS Accession No. ML21111A155)
3. NextEra Energy Point Beach, LLC (NEPB) Letter to NRC L-2021-144 dated August 11, 2021, Subsequent License Renewal Application – Aging Management Requests for Additional Information (RAI) Set 2 Responses (ADAMS Accession No. ML21223A308)

Associated SLRA Revisions:

SLRA Section 3.5.2.1.13 (page 3.5-15) is revised as follows:

3.5.2.1.13 Component Support Commodity

Materials

The materials of construction for the component support commodity are:

- Aluminum
- Concrete (reinforced)
- Elastomer
- Grout (including epoxy ~~(adhesive) or~~ resin-based)
- High strength steel
- Stainless steel
- Steel (including galvanized steel)

SLRA Table 3.5.2-13 (pages 3.5-136 to 3.5-138, as amended by SLRA Aging Management Supplement 1) is revised as follows:

Table 3.5.2-13: Component Supports Commodity Group – Summary of Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-2191 Item	Table 1 Item	Notes
Anchorage / embedment	Structural support	Steel	Air – indoor uncontrolled	Loss of preload	Structures Monitoring (B.2.3.34)	III.A3.TP-261	3.5-1, 088	A, ~~2~~
Anchorage / embedment	Structural Support	Stainless steel	Air – indoor uncontrolled	Loss of material	Structures Monitoring (B.2.3.34)	III.B3.T-37b	3.5-1, 100	A
Anchorage / embedment	Structural support	Steel	Air – outdoor	Loss of material	Structures Monitoring (B.2.3.34)	III.B3.TP-248	3.5-1, 080	A
Anchorage / embedment	Structural support	Steel	Air with borated water leakage	Loss of material	Boric Acid Corrosion (B.2.3.4)	III.B1.1.T-25	3.5-1, 089	A
ASME Class 2 and 3 structural bolting	Structural support	High-strength steel	Air – indoor uncontrolled	Cracking	ASME Section XI, Subsection IWF (B.2.3.31)	III.B1.1.TP-41	3.5-1, 068	B, 1
ASME Class 2 and 3 structural bolting	Structural support	Steel	Air – indoor uncontrolled	Loss of preload	ASME Section XI, Subsection IWF (B.2.3.31)	III.B1.2.TP-229	3.5-1, 087	B, 1
ASME Class 2 and 3 supports	Pipe whip restraint Structural support	Steel	Air with borated water leakage	Loss of material	Boric Acid Corrosion (B.2.3.4)	III.B1.1.T-25	3.5-1, 089	B, 1

Table 3.5.2-13: Component Supports Commodity Group – Summary of Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-2191 Item	Table 1 Item	Notes
ASME Class 2 and 3 supports	Pipe whip restraint Structural support	Steel	Air – indoor uncontrolled	Loss of material	ASME Section XI, Subsection IWF (B.2.3.31)	III.B1.1.T-24	3.5-1, 091	B, 1, 3
ASME Class 2 and 3 supports (hangers, guides, stops)	**Structural support**	**Steel**	**Air – indoor uncontrolled**	**Loss of mechanical function**	**ASME Section XI, Subsection IWF (B.2.3.31)**	**III.B1.2.T-28**	**3.5-1, 057**	**A, 4**
Building concrete at locations of expansion and grouted anchors; grout pads for support base plates	Structural support	Concrete (reinforced)	Air – indoor uncontrolled	Reduction in concrete anchor capacity	Structures Monitoring (B.2.3.34)	III.B2.TP-42	3.5-1, 055	A
Building concrete at locations of expansion and grouted anchors; grout pads for support base plates	Structural support	Concrete (reinforced)	Air – outdoor	Reduction in concrete anchor capacity	Structures Monitoring (B.2.3.34)	III.B2.TP-42	3.5-1, 055	A

Table 3.5.2-13: Component Supports Commodity Group – Summary of Aging Management Evaluation								
Component Type	**Intended Function**	**Material**	**Environment**	**Aging Effect Requiring Management**	**Aging Management Program**	**NUREG-2191 Item**	**Table 1 Item**	**Notes**
Building concrete at locations of expansion and grouted anchors; grout pads for support base plates	Structural support	Grout	Air – outdoor	Reduction in concrete anchor capacity	Structures Monitoring (B.2.3.34)	III.B2.TP-42	3.5-1, 055	A, ~~2~~
Building concrete at locations of expansion and grouted anchors; grout pads for support base plates	Structural support	Grout	Air – indoor uncontrolled	Reduction in concrete anchor capacity	Structures Monitoring (B.2.3.34)	III.B2.TP-42	3.5-1, 055	A, ~~2~~
Building concrete at locations of expansion and grouted anchors; grout pads for support base plates	**Structural support**	**Epoxy resin-based grout**	**Air – indoor uncontrolled**	**Reduction in anchor capacity** **Loss of anchor preload**	**Structures Monitoring (B.2.3.34)**	**-**	**-**	**F, 2**
Component supports	**Structural support**	**Stainless steel**	**Air – indoor uncontrolled** **Air – outdoor**	**Cracking** **Loss of material**	**Structures Monitoring (B.2.3.34)**	**III.B2.T-37b**	**3.5-1, 100**	**A**

Table 3.5.2-13: Component Supports Commodity Group – Summary of Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-2191 Item	Table 1 Item	Notes
Component supports	Structural support	Steel	Air – indoor uncontrolled Air – outdoor	Loss of material	Structures Monitoring (B.2.3.34)	III.B4.T-43	3.5-1, 092	A
Component supports	Structural support	Steel	Air with borated water leakage	Loss of material	Boric Acid Corrosion (B.2.3.4)	III.B4.T-25	3.5-1, 089	A
Electrical Enclosures – Panels, boxes, cabinets, consoles, raceways	Shelter, protection Structural support	Steel	Air with borated water leakage	Loss of material	Boric Acid Corrosion (B.2.3.4)	III.B3.T-25	3.5-1, 089	A
Electrical Enclosures – Panels, boxes, cabinets, consoles, raceways	Shelter, protection Structural support	Steel	Air – indoor uncontrolled	Loss of material	Structures Monitoring (B.2.3.34)	III.B3.T-43	3.5-1, 092	A
Insulation	Insulation Jacket integrity	Stainless Steel	Air – outdoor	**Cracking** Loss of material	External Surfaces Monitoring of Mechanical Components (B.2.3.23)	III.B2.T-37c	3.5-1, 100	C

Table 3.5.2-13: Component Supports Commodity Group – Summary of Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-2191 Item	Table 1 Item	Notes
Insulation	Insulation Jacket integrity	Aluminum	Air – outdoor	**Cracking** Loss of material	External Surfaces Monitoring of Mechanical Components (B.2.3.23)	III.B2.T-37c	3.5-1, 100	C
Insulation	Insulation Jacket integrity	Stainless Steel	Air – indoor uncontrolled	**Cracking** Loss of material	External Surfaces Monitoring of Mechanical Components (B.2.3.23)	III.B2.T-37c	3.5-1, 100	C
Insulation	Insulation Jacket integrity	Aluminum	Air – indoor uncontrolled	**Cracking** Loss of material	External Surfaces Monitoring of Mechanical Components (B.2.3.23)	III.B2.T-37c	3.5-1, 100	C
Pipe restraints and HVAC duct supports	Pipe whip restraint Structural support	Steel	Air with borated water leakage	Loss of material	Boric Acid Corrosion (B.2.3.4)	III.B2.T-25	3.5-1, 089	A
Pipe restraints and HVAC duct supports	Pipe whip restraint Structural support	Steel	Air – indoor uncontrolled	Loss of material	Structures Monitoring (B.2.3.34)	III.B2.TP-43	3.5-1, 092	A

Table 3.5.2-13: Component Supports Commodity Group – Summary of Aging Management Evaluation								
Component Type	**Intended Function**	**Material**	**Environment**	**Aging Effect Requiring Management**	**Aging Management Program**	**NUREG-2191 Item**	**Table 1 Item**	**Notes**
Structural bolting	Structural support	Steel	Air – indoor uncontrolled	Loss of preload	Structures Monitoring (B.2.3.34)	III.A3.TP-261	3.5-1, 088	A
Structural bolting	Structural support	Steel	Air – indoor uncontrolled	Loss of material	Structures Monitoring (B.2.3.34)	III.B3.TP-248	3.5-1, 080	A
Structural bolting	Structural support	Steel	Air – outdoor	Loss of material	Structures Monitoring (B.2.3.34)	III.A3.TP-274	3.5-1, 082	A
Structural bolting	Structural support	High-strength steel	Air – indoor uncontrolled	Cracking	Structures Monitoring (B.2.3.34)	III.B1.1.TP-41	3.5-1, 068	E
Vibration isolation elements	Structural support	Non-metallic; Elastomer	Air – indoor uncontrolled	Reduction or loss of isolation function	ASME Section XI, Subsection IWF (B.2.3.31)	III.B1.1.T-33	3.5-1, 094	B
Vibration isolation elements	Structural support	Non-metallic; Elastomer	Air – indoor uncontrolled	Reduction or loss of isolation function	Structures Monitoring (B.2.3.34)	III.B4.TP-44	3.5-1, 094	A

SLRA Table 3.5.2-13 (pages 3.5-136 to 3.5-138) revision continued:

Generic Notes

A. Consistent with component, material, environment, aging effect and aging management program listed for NUREG-2191 line item. AMP is consistent with NUREG-2191 AMP description.

B. Consistent with component, material, environment, aging effect and aging management program listed for NUREG-2191 line item. AMP has exceptions to NUREG-2191 AMP description

C. Component is different, but consistent with material, environment, aging effect and aging management program listed for NUREG-2191 line item. AMP is consistent with NUREG-2191 AMP description.

E. Consistent with NUREG-2191 material, environment, and aging effect but a different aging management program is credited or NUREG-2191 identifies a plant-specific aging management program.

F. Material not in NUREG-2191 for this component.

Plant Specific Notes

1. RCS Class 1 major equipment supports are addressed in Table 3.5.2-1.
2. **Includes epoxy resin-based grout, which is~~are~~ not generically addressed by NUREG-2191. The use of such materials is a design-driven criterion. AMR concluded that installations employing this material at PBN are subject to ~~the same~~ similar aging effects as those identified by other items for anchors and grout. In addition, epoxy resin-based grout is not used in locations where normal temperatures exceed 120°F or in posted high radiation areas as defined in 10 CFR Part 20. The Structures Monitoring AMP will be enhanced to include periodic inspections for tightness (e.g., torque checks, as applicable) of all anchors within the scope of license renewal that are embedded in epoxy resin-based grout to ensure that proper installation is maintained, and verify that preload has not been lost due to creep.**
3. **Galvanized steel ASME Class 2 and 3 supports are considered same as carbon steel supports.**
4. **Passive portions of constant and variable spring hangers (e.g., attachment to structure).**

SLRA Table 16-3 (Item No. 38)—Appendix A, Section 16.4 (pages A-105 and A-106, as amended by SLRA Aging Management Supplement 1) is revised as follows:

Table 16-3
List of SLR Commitments and Implementation Schedule

No.	Aging Management Program or Activity (Section)	NUREG-2191 Section	Commitment	Implementation Schedule
38	Structures Monitoring (16.2.2.34)	XI.S6	Continue the existing PBN Structures Monitoring AMP, including enhancement to: a) Revise inspection procedures to include guidance and acceptance criteria on inspections of stainless steel and aluminum components for pitting and crevice corrosion, and evidence of cracking due to SCC. Perform an evaluation if stainless steel or aluminum surfaces exhibit evidence of SCC, pitting, or crevice corrosion. **b) Revise inspection procedure scope to include polystyrene foam that is mounted to the underside of manhole covers as an elastomer material.** c) Revise implementing procedures to **include** preventive actions to ensure **bolting integrity for replacement and maintenance activities by specifying proper selection of bolting material and lubricants, and appropriate installation torque or tension to prevent or minimize loss of bolting preload and cracking of high strength bolting. Also, ensure** proper selection and storage of high strength bolting in accordance with Section 2 of the Research Council for Structural Connections publication, "Specification for Structural Joints Using High-Strength Bolts". **Additionally, molybdenum disulfide and other lubricants containing sulfur will not be used.** d) Revise inspection procedures to additionally inspect for the following items: • Increase in porosity and permeability, loss of strength, and reduction in ~~concrete~~ anchor capacity due to local concrete **and grout (including epoxy resin-based grout)** degradation in concrete **and grout (including epoxy resin-based grout)** structures.	No later than 6 months prior to the SPEO, i.e.: PBN1: 04/05/30 PBN2: 09/08/32 **Perform the first inspection for tightness (torque check) of all anchors within the scope of license renewal that are embedded in epoxy resin-based grout no later than the last RFO prior to the SPEO.**

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List of SLR Commitments and Implementation Schedule

No.	Aging Management Program or Activity (Section)	NUREG-2191 Section	Commitment	Implementation Schedule
			• Loss of material, **blistering,** and loss of strength for elastomers/**polymers (including polystyrene inserts for manhole covers)**. • Pitting and crevice corrosion, and evidence of cracking due to SCC for stainless steel and aluminum components. • Confirmation of the absence of water in-leakage through concrete. • **Localized distortion of the biological shield wall liner as a leading indicator of radiation induced volumetric expansion of the underlying concrete.** • **Loss of form of the earthen berm surrounding the fuel oil storage tanks.** **e)** Revise inspection procedures to include guidance on MEB inspection for loss of material (external bus duct enclosure surfaces and structural supports) and elastomer degradation (exterior housing gaskets, boots, and sealants). **f)** Clarify that if ground water leakage is identified then engineering evaluation, more frequent inspections, or destructive testing of affected concrete (to validate properties and determine pH) are required. **When leakage volumes allow, assessments may include analysis of the leakage pH, along with mineral, chloride, sulfate, and iron content in the water.** **g) Update the governing AMP procedure and other applicable procedures to specify inspection of structural support applications employing epoxy resin-based grout for degradation that could cause a loss of anchor capacity.** **hg) Revise inspection procedure to specify that the responsible engineer (RE) shall be a registered professional engineer with knowledge in the design, evaluation, and in-service inspection of**	

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List of SLR Commitments and Implementation Schedule

No.	Aging Management Program or Activity (Section)	NUREG-2191 Section	Commitment	Implementation Schedule
			concrete structures and performance requirements of nuclear safety-related structures; or a degreed civil or structural engineer with at least ten years' experience in the design, construction, and inspection of concrete structures, with knowledge of the performance requirements of nuclear safety-related structures and potential degradation processes. **i~~h~~) Revise inspection procedure to specify that accessible areas subject to similar conditions (material, environment, etc.) may be inspected in lieu of inaccessible areas, and include guidance for evaluating the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of, or result in, degradation to the inaccessible areas.** **j~~i~~) Update the governing procedure to specify that, for non-ASME high-strength bolting in scope for SLR and greater than one inch nominal diameter, volumetric examination capable of detecting cracking will be performed in addition to the VT-3 examination. Within 10 years prior to entering the SPEO, and in each 10-year period during the SPEO, a representative sample of bolts will be inspected. The sample will be 20% of the population (for a material / environment combination) up to a maximum of 25 bolts.** **k~~j~~) Ensure quantitative baselines have been established for all structures within the scope of LR prior to entering the SPEO.** l~~k~~) Revise inspection procedure to include the following acceptance criteria: • For Elastomers/**polymers (including polystyrene inserts for manhole covers)**: No loss of material**, no blistering,** and no indications of loss of strength such as unacceptable surface cracking, crazing, scuffing, dimensional change (e.g., "ballooning" and "necking"), shrinkage, discoloration, or hardening.	

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List of SLR Commitments and Implementation Schedule

No.	Aging Management Program or Activity (Section)	NUREG-2191 Section	Commitment	Implementation Schedule
			• For Bolting and Fasteners: Loose bolts and nuts are not acceptable unless accepted by engineering evaluation. • For Structural Sealants: Observed loss of material, cracking, and hardening will not result in loss of sealing. • **For earthen berm: No evidence of:** o **Settlement – unusual localized or overall settlement, depressions, sinkholes** o **Slope instability – variance from originally constructed slopes, unusual changes from original crest alignment and elevation, evidence of movement** o **Erosion – gullies or notches in slope** **m) Revise the implementing procedure to include periodic inspections for tightness (e.g., torque checks, as applicable) of all anchors within the scope of license renewal that are embedded in epoxy resin-based grout during normally scheduled walkdowns to ensure that proper installation is maintained and verify that preload has not been lost due to creep.** **To ensure proper installation of the anchors embedded in epoxy resin-based grout has been maintained, the first inspection for tightness will be performed no later than the last RFO prior to the SPEO.** **n) Revise implementing documents to prohibit the use of epoxy resin-based grout in safety-related applications in locations where normal temperatures exceed 120°F, or in posted high radiation areas as defined in 10 CFR Part 20.**	

SLRA Section B.2.3.34 (pages B-239 and B-240, as amended by SLRA Aging Management Supplement 1) is revised as follows:

Element Affected	Enhancement
1. Scope	Update the governing AMP procedure and other applicable procedures to add stainless steel and aluminum as a material that is inspected for pitting and crevice corrosion, and evidence of cracking due to SCC. **Update the governing AMP procedure scope to include polystyrene foam that is mounted to the underside of manhole covers as an elastomer material.**
2. Preventive Actions	Update the governing AMP procedure and other applicable procedures to include preventive actions to ensure bolting integrity for replacement and maintenance activities by specifying proper selection of bolting material and lubricants, and appropriate installation torque or tension to prevent or minimize loss of bolting preload and cracking of high strength bolting. Also, ensure proper selection and storage of high strength bolting in accordance with Section 2 of the Research Council for Structural Connections publication, "Specification for Structural Joints Using High Strength Bolts". **Additionally, molybdenum disulfide and other lubricants containing sulfur will not be used.** **Update the governing AMP and other applicable documents to prohibit the use of epoxy resin-based grout in safety-related applications in locations where normal temperatures exceed 120°F, or in posted high radiation areas as defined in 10 CFR Part 20.**
3. Parameters Monitored or Inspected	Update the governing AMP procedure and other applicable procedures to additionally inspect the following elements: • Concrete **and grout (including epoxy resin-based grout)** Structures will be inspected for increase in porosity and permeability, loss of strength, and reduction in ~~concrete~~ anchor capacity due to local concrete **and grout (including epoxy resin-based grout)** degradation. • Elastomer/**polymer (including polystyrene inserts for manhole covers)** will also be inspected for loss of material**, blistering,** and loss of strength. • Pitting and crevice corrosion and evidence of cracking due to SCC for stainless steel and aluminum components

SLRA Section B.2.3.34 (pages B-239 and B-240) revision continued:

Element Affected	Enhancement
	• Concrete will be monitored to confirm the absence of water in-leakage • **Localized distortion of the biological shield wall liner as a leading indicator of radiation induced volumetric expansion of the underlying concrete.** • **Earthen berm will be monitored for loss of form**
4. Detection of Aging Effects	Update the governing AMP procedure and other applicable procedures to include guidance on inspections for pitting and crevice corrosion, and evidence of cracking due to SCC for stainless steel and aluminum components. Update the governing AMP procedure and other applicable procedures to include guidance on MEB inspection for loss of material (external bus duct enclosure surfaces and structural supports) and elastomer degradation (exterior housing gaskets, boots, and sealants). Update the governing AMP procedure and other applicable procedures to clarify that if ground water leakage is identified then engineering evaluation, more frequent inspections, or destructive testing of affected concrete (to validate properties and determine pH) are required. When leakage volumes allow, assessments may include analysis of the leakage pH, along with mineral, chloride, sulfate and iron content in the water. **Update the governing AMP procedure and other applicable procedures to specify inspection of structural support applications employing epoxy resin-based grout for degradation that could cause a loss of anchor capacity.** **Update the governing procedure to specify that the responsible engineer (RE) shall be a registered professional engineer with knowledge in the design, evaluation, and in-service inspection of concrete structures and performance requirements of nuclear safety-related structures; or a degreed civil or structural engineer with at least ten years' experience in the design, construction, and inspection of concrete structures, with knowledge of the performance**

SLRA Section B.2.3.34 (pages B-239 and B-240) revision continued:

Element Affected	Enhancement
	requirements of nuclear safety-related structures and potential degradation processes. **Revise inspection procedure to specify that accessible areas subject to similar conditions (material, environment, etc.) may be inspected in lieu of inaccessible areas, and include guidance for evaluating the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of, or result in, degradation to the inaccessible areas.** **Update the governing procedure to specify that, for non-ASME high-strength bolting in scope for SLR and greater than one inch nominal diameter, volumetric examination capable of detecting cracking will be performed in addition to the VT-3 examination. In each 10-year period during the SPEO, a representative sample of bolts will be inspected. The sample will be 20% of the population (for a material / environment combination) up to a maximum of 25 bolts.** **Update the governing AMP and other applicable procedures to include periodic inspections for tightness (e.g., torque checks, as applicable) of all anchors within the scope of license renewal that are embedded in epoxy resin-based grout during normally scheduled walkdowns to ensure that proper installation is maintained and verify that preload has not been lost due to creep. The first inspection for tightness will be performed no later than the last RFO prior to the SPEO.**
5. Monitoring and Trending	**Ensure quantitative baselines have been established for all structures within the scope of LR prior to entering the SPEO.**

SLRA Section B.2.3.34 (pages B-239 and B-240) revision continued:

Element Affected	Enhancement
6. Acceptance Criteria	Update the governing AMP procedure and other applicable procedures to include acceptance criteria on inspection of stainless steel and aluminum components for pitting and crevice corrosion, and evidence of cracking due to SCC. In addition, require performance of an evaluation if stainless steel or aluminum surfaces exhibit evidence of SCC, pitting, or crevice corrosion. Update the governing AMP procedure and other applicable procedures to include the following acceptance criteria: • Elastomers**/polymers (including polystyrene inserts for manhole covers)**: No loss of material**, blistering,** and no indications of loss of strength such as unacceptable surface cracking, crazing, scuffing, dimensional change (e.g., "ballooning" and "necking"), shrinkage, discoloration, or hardening. • Bolting and Fasteners: Loose bolts and nuts are not acceptable unless accepted by engineering evaluation. • Structural Sealants: Acceptable if the observed loss of material, cracking, and hardening will not result in loss of sealing. • **Earthen berm: No evidence of:** o **Settlement – unusual localized or overall settlement, depressions, sinkholes** o **Slope instability – variance from originally constructed slopes, unusual changes from original crest alignment and elevation, evidence of movement** o **Erosion – gullies or notches in slope**

Associated Enclosures:

None.