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RA-21-0332
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10 CFR 50.4
10 CFR Part 54

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

Subject: Duke Energy Carolinas, LLC (Duke Energy)
Oconee Nuclear Station (ONS), Units 1, 2, and 3
Docket Numbers 50-269, 50-270, 50-287
Renewed License Numbers DPR-38, DPR-47, DPR-55
Subsequent License Renewal Application
Responses to NRC Request for Additional Information Set 1 and Second Round Request for Additional Information B2.1.27-1a

References:

1. Duke Energy Letter (RA-21-0132) dated June 7, 2021, Application for Subsequent Renewed Operating Licenses, (ADAMS Accession Number ML21158A193)
2. NRC Letter dated July 22, 2021, Oconee Nuclear Station, Units 1, 2, and 3 - Determination of Acceptability and Sufficiency for Docketing, Proposed Review Schedule, and Opportunity for a Hearing Regarding Duke Energy Carolinas' Application for Subsequent License Renewal (ADAMS Accession Number ML21194A245)
3. NRC E-mail dated September 22, 2021, Oconee SLRA - Request for Additional Information B2.1.27-1 (ADAMS Accession Number ML21271A586)
4. Duke Energy Letter (RA-21-0281) dated October 22, 2021, Subsequent License Renewal Application, Response to Request for Additional Information B2.1.27-1 (ADAMS Accession Number ML21295A718)
5. NRC E-mail dated November 23, 2021, Oconee SLRA – Request for Additional Information Set 1 and Second Round Request for Additional Information RAI B2.1.27-1a (ADAMS Accession Number ML21327A277)

Ladies and Gentlemen:

By letter dated June 7, 2021 (Reference 1), Duke Energy Carolinas, LLC (Duke Energy) submitted an application for the subsequent license renewal of Renewed Facility Operating License Numbers DPR-38, DPR-47, and DPR-55 for the Oconee Nuclear Station (ONS), Units 1, 2, and 3 to the U.S. Nuclear Regulatory Commission (NRC). On July 22, 2021 (Reference 2), the NRC determined that ONS subsequent license renewal application (SLRA) was acceptable and sufficient for docketing. In an email from Angela X. Wu (NRC) to Steve Snider (Duke Energy) dated September 22, 2021 (Reference 3), the NRC transmitted specific requests for additional information (RAI) to support completion of the

Safety Review. The response (Reference 4) was provided on October 22, 2021. In an email from Angela X. Wu (NRC) to Steve Snider (Duke Energy) dated November 23, 2021 (Reference 5), the NRC transmitted RAI set 1 along with a second round RAI B2.1.27-1a, also to support completion of the Safety Review. These responses are provided in this submittal.

Enclosure 1, Attachments 1 through 20 contain the responses to the RAI information for Set #1 and the second round for RAI B2.1.27-1a. Enclosure 1, Attachments 15P, 17P, and 18P contains proprietary information. Enclosure 2, Attachments 1 and 2 contain affidavits for the proprietary information.

Since Enclosure 1, Attachments 15P, 17P, and 18P contain proprietary information, they are supported by an affidavit signed by the owner of the information (Enclosure 2). The affidavits set forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in 10 CFR 2.390(b)(4) and consistent with NRC Regulatory Issue Summary 2014-11, Regulatory Requirements for Withholding of Proprietary Information from Public Disclosure. Accordingly, it is respectfully requested that the proprietary information be withheld from public disclosure in accordance with 10 CFR 2.390. A redacted, non-proprietary version is provided in Enclosure 1, Attachments 15, 17 and 18. Correspondence with respect to the copyright or proprietary aspects of the vendor information or affidavits should be addressed to the vendor representative identified in the respective affidavit.

SLRA changes are provided along with the affected SLRA section(s), SLRA page number(s), and SLRA mark-ups in each affected Enclosure 1 attachment. For clarity, deletions are indicated by strikethrough and inserted text by underlined red font.

Commitments 1 and 21 in Appendix A, Table A6.0-1, Subsequent License Renewal Commitments are being revised to include volumetric inspections on full structural weld overlays, a one-time inspection for gray cast iron and periodic inspections for malleable iron and ductile iron.

Should you have any questions regarding this submittal, please contact Paul Guill at (704) 382-4753 or by email at paul.guill@duke-energy.com.

I declare under penalty of perjury that the foregoing is true and correct. Executed on January 7, 2022.

Sincerely,

Steven M. Snider
Site Vice President
Oconee Nuclear Station

Enclosures:

Enclosure 1: Responses to Requests for Additional Information Set 1 Safety Review and Second Round Request for Additional Information B2.1.27-1a

Attachment 1	RAI B2.1.21-1
Attachment 2	RAI B3.1-1
Attachment 3	RAI B3.1-2
Attachment 4	RAI 3.5.2.2.2.5-1
Attachment 5	RAI 4.3.2-1
Attachment 6	RAI 4.3.3-1
Attachment 7	RAI 4.3.3-2
Attachment 8	RAI 4.3.3-3
Attachment 9	RAI 4.3.1-1
Attachment 10	RAI 4.3.1-2
Attachment 11	RAI 4.3.1-3
Attachment 12	RAI 4.3.1-4
Attachment 13	RAI 4.3.4-1
Attachment 14	RAI 4.3.4-2
Attachment 15	RAI 4.3.4-3 – Non-Proprietary Version
Attachment 15P	RAI 4.3.4-3 – Proprietary Version
Attachment 16	RAI 4.3.4-4
Attachment 17	RAI 4.3.4-5 – Non-Proprietary Version
Attachment 17P	RAI 4.3.4-5 – Proprietary Version
Attachment 18	RAI 4.3.4-6 -– Non-Proprietary Version
Attachment 18P	RAI 4.3.4-6 -– Proprietary Version
Attachment 19	RAI 4.3.4-7
Attachment 20	RAI B2.1.27-1a

Enclosure 2: Affidavits

Attachment 1	Affidavit for Framatome, Inc.
Attachment 2	Affidavit for BWXT Canada Ltd.

CC: W/O Enclosures:

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ENCLOSURE 1

OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3
SUBSEQUENT LICENSE RENEWAL APPLICATION
RESPONSES TO REQUESTS FOR ADDITIONAL INFORMATION
SET #1 SAFETY REVIEW AND SECOND ROUND REQUEST FOR
ADDITIONAL INFORMATION B2.1.27-1A

Enclosure 1
Subsequent License Renewal Application
Response to Requests for Additional Information Set #1 Safety Review and Second Round Request for Additional Information B2.1.27-1a

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ENCLOSURE 1

OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3
SUBSEQUENT LICENSE RENEWAL APPLICATION
RESPONSES TO REQUESTS FOR ADDITIONAL INFORMATION
SET #1 SAFETY REVIEW AND SECOND ROUND REQUEST FOR
ADDITIONAL INFORMATION B2.1.27-1A

ATTACHMENT 1
RAI B2.1.21-1

Enclosure 1, Attachment 1

RAI B2.1.21-1:

Regulatory Basis

Title 10 of the Code of Federal Regulations (10 CFR) 54.21(a)(3) requires an applicant to demonstrate that the effects of aging for each structure and component identified in 10 CFR 54.21(a)(1) 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 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

SLRA Section B2.1.21, “Selective Leaching,” states the following:

- “[t]he Oconee Selective Leaching AMP is a new program that, when implemented, will be consistent with the recommendations in NUREG-2191 XI.M33, Selective Leaching.”
- “OE [operating experience] example 2 provides objective evidence that significant degradation due to selective leaching is not occurring in susceptible materials exposed to - or treated water environments at Oconee, and therefore, the use of one time inspection for selective leaching in these environments is appropriate for the SPEO [subsequent period of extended operation].”

SLRA Section 3.3.2.1.21, “Recirculating Cooling Water [RCW] System,” states components in the system are constructed of the following materials: copper alloys with greater than 15 percent zinc, glass, gray cast iron, stainless steel, and steel. In addition, SLRA Table 3.3.2-21, “Auxiliary Systems - Recirculating Cooling Water System - Aging Management Evaluation,” does not include any aging management review items for malleable iron. Furthermore, the staff notes that the only malleable iron components identified in the SLRA are high voltage electrical insulators in SLRA Table 3.6.2-1, “Electrical and Instrumentation and Controls - Electrical and Instrumentation and Controls Commodities – Aging Management Evaluation.”

During its audit, the staff reviewed AR 02354397, “¾-inch RCW pipe break at 1D2 HDP [Heater Drain Pump],” dated October 21, 2020, and noted the following: (a) although the RCW system is molybdate treated, there was evidence of internal general corrosion, pitting, and graphitic corrosion; (b) the attachment titled “Metallurgical Evaluation of Couplings” dated November 19, 2020, shows dark corrosion product layers (potentially indicative of graphitic corrosion) on the internal surfaces of malleable iron fittings.

GALL-SLR Report Table IX.C, "Use of Terms for Materials," states the following for steel:

> "[i]n some environments, carbon steel, alloy steel, gray cast iron, ductile iron, malleable iron, and high-strength low-alloy steel are vulnerable to general, pitting, and crevice corrosion, even though the rate of loss of material may vary amongst material types. Consequently, these metal types are generally grouped under the broad term "steel." Note that this does not include SS [stainless steel], which has its own category. However, gray cast iron and ductile iron are susceptible to selective leaching, and high-strength low-alloy steel is susceptible to SCC [stress corrosion cracking]. Therefore, when these aging effects are being considered, these materials are specifically identified."

GALL-SLR Report AMP XI.M33 states the following:

- "[o]ne-time inspections are only conducted for components exposed to CCCW [closed-cycle cooling water] or treated water when no plant-specific OE of selective leaching exists in these environments."
- "[o]pportunistic and periodic inspections are conducted for…components in CCCW or treated water where plant-specific OE includes selective leaching in these environments."

<u>Issue</u>
The staff has the following issues based on its review of AR 02354397:

1. Mechanical components (e.g., piping, valves) constructed of malleable iron may be within the scope of subsequent license renewal (SLR) at Oconee. The staff recognizes that this material may be currently classified in the SLRA under the material type "steel." However, as noted in GALL-SLR Report Table IX.C, cast iron materials (e.g., gray cast iron, ductile iron) are specifically identified when they are susceptible to selective leaching.
2. Malleable iron components at Oconee may be susceptible to selective leaching (based on the staff's review of "Metallurgical Evaluation of Couplings" attached to the subject AR). The staff seeks clarification regarding why selective leaching is not an aging effect requiring management for malleable iron components at Oconee.
3. Based on evidence of graphitic corrosion in the RCW system (i.e., a closed-cycle water related system), the staff seeks clarification regarding why one-time inspections (in lieu of opportunistic and periodic inspections) are appropriate for components susceptible to selective leaching exposed to treated water or CCCW environments.

<u>Request</u>
1. State if mechanical components constructed of malleable iron are within the scope of SLR at Oconee and are exposed to environments where selective leaching could occur (i.e., raw water, CCCW, treated water, waste water, or soil).
2. If mechanical components constructed of malleable iron are within the scope of SLR at Oconee and are exposed to environments where selective leaching could occur, state the basis for why selective leaching is not an aging effect requiring management. Alternatively, revise the SLRA as appropriate to reflect that malleable iron mechanical components exposed to environments where selective leaching could occur will be managed for loss of material due to selective leaching.
3. State the basis for why one-time inspections are appropriate for components susceptible to selective leaching exposed to a treated water or CCCW environment.

Response to RAI B2.1.21-1:

Background:

In October 2020, a non-safety related ¾-inch RCW system elbow broke during performance of maintenance on a Unit 1 HDP motor. The failure occurred while the elbow was subject to abnormal loading of a cantilevered pipe that was disconnected for maintenance. The elbow was sent to the Duke metallurgical laboratory for analysis. The analysis determined that the failed elbow was constructed of gray cast iron. Gray cast iron is not an approved material for small diameter pipe fittings in the RCW system. Destructive examination of the elbow was performed, and several areas of localized selective leaching were identified. The penetration depth of the dealloyed material was less than 0.040 inch after approximately 47 years in service. Loss of material is not considered the cause of the failure since the average wall thickness measured near the fracture was 0.143 inch with a minimum of 0.108 inch at a pit. This failure is considered a legacy issue caused by the installation of an elbow of an unapproved material with the failure instigated by abnormal loading which occurred while the pipe was disassembled for maintenance.

An extent of condition review was performed to determine if an unapproved material was used for other similar fittings in the RCW system. The extent of condition review consisted of the removal of nine similar small diameter (¾-inch to 1-inch) RCW system pipe fittings for metallurgical evaluation by an outside laboratory. Each of the nine fittings was sectioned to expose the interior surface of the sample and specimens were selected and excised for further evaluation. Each of the specimens exhibited microstructures consistent with malleable iron which is an approved material for RCW system pipe fittings 2-inch in diameter or less.

Internal surface degradation potentially indicative of graphitic corrosion (i.e., dark corrosion product with no significant change to component shape or dimension) was present in the cross-sectioned malleable iron pipe fittings. Subsequent reexamination of the fittings performed in October 2021 confirmed that the degradation is consistent with graphitic corrosion. The corrosion product closely matches the original shape and contours of the fittings and the corrosion products contained residual temper graphite as is expected with graphitic corrosion. In addition, the innermost layers of these corrosion products could be cut with a scalpel consistent with published characteristics of graphitic corrosion.

Each of the nine pipe fittings exhibited some degree of degradation consistent with graphitic corrosion. The locations with the greatest wall loss were under deposit pitting-type indications. Relatively minor degradation was present in eight of the nine pipe fittings with an estimated degradation rate of 0.001 inch to 0.002 inch per year. A deeper pit was present in one of the fittings indicating an accelerated degradation rate of approximately 0.0035 inch per year. Metallurgical examination of the fitting that experienced accelerated degradation identified the presence of casting defects (shrinkage porosity) and an abnormal microstructure having radial “stringers” of temper graphite. The presence of voids in the casting due to shrinkage porosity allow for electrolyte penetration thereby exacerbating degradation. The abnormal microstructure creates more of a continuous network of temper graphite within the malleable iron and a decreased anode (iron) to cathode (graphite) ratio further contributing to accelerated corrosion.

As stated above, the locations with the greatest wall loss were under internal deposits or tubercles. The RCW system operating history indicates the occurrence of under deposit microbiological activity. Microbiological activity in the RCW system has been attributed to prior use of nitrite-based corrosion inhibitor which served as a food source for bacteria within the system. Graphitic corrosion is often driven by localized electrochemical corrosion mechanisms including microbiological influenced corrosion.

Request 1:

Mechanical components constructed of malleable iron are within the scope of SLR at Oconee and are exposed to aqueous environments where selective leaching could occur. A review of station design documents (e.g., flow diagrams, calculations, vendor manuals) has determined that malleable iron pipe fittings are installed in various Oconee systems. The systems in which malleable iron pipe fittings are installed, as well as the intended functions, environments, aging effects, and aging management programs for these malleable iron pipe fittings, are summarized below in the subsequent license renewal application (SLRA) revisions.

Request 2:

The Oconee SLRA is revised as shown below in SLRA revisions to reflect that malleable iron mechanical components exposed to environments where selective leaching could occur will be managed for loss of material due to selective leaching.

Request 3:

Based on the OE described above, the Oconee SLRA is revised as shown below in SLRA revisions to reflect that malleable iron mechanical components exposed to environments where selective leaching could occur will be managed for loss of material due to selective leaching. Due to the similarities between malleable iron and ductile iron microstructures, components constructed of these two materials and exposed to closed cycle cooling water will be evaluated as a single sample population in the *Selective Leaching* aging management program (AMP). Malleable and ductile iron will also be grouped together in sample populations for other environments where selective leaching could occur. Periodic inspections will be performed for malleable iron and ductile iron components exposed to closed cycle cooling water.

The *Selective Leaching* AMP will perform one-time inspections for components constructed of susceptible materials exposed to treated water and for components constructed of susceptible materials other than malleable and ductile iron exposed to closed cycle cooling water. There is no OE at Oconee of unacceptable selective leaching occurring in susceptible materials other than malleable iron exposed to a closed cycle cooling water environment or for any susceptible material in a treated water environment. NRC guidance, as documented in NUREG-2191, Chapter XI.M33, recommends performing inspections in each material/environment sample populations since the results of inspections of components in one material/environment sample population cannot be considered representative of the condition of components in a different material/environment sample population. Consistent with this guidance, the OE indicating degradation is occurring in malleable iron exposed to closed cycle cooling water is not considered representative of the condition of susceptible components in other sample populations. Additional information regarding susceptible materials other than malleable and ductile iron exposed to closed cycle cooling water or treated water is provided below.

Gray Cast Iron/Closed Cycle Cooling Water Sample Population – As discussed above, destructive examination of a gray cast iron RCW system elbow performed in October 2020 identified evidence of superficial graphitic corrosion. The penetration depth of the dealloyed material was less than 0.040 inch after approximately 47 years in service. Based on the measured penetration depth, a conservative linear degradation rate of 0.001 inch per year is assumed for gray cast iron components in a closed cycle cooling water environment. If this conservative corrosion rate is assumed, localized selective leaching with a penetration depth of up to 0.080 inch could occur by the end of the SPEO. Gray cast iron components within the scope of subsequent license renewal and exposed to a closed cycle cooling water system are limited to pump casings, heat exchanger heads, and valve bodies which are thicker-walled, heavier castings. As such, selective leaching of gray cast iron component exposed to closed cycle-cooling water is not expected to impact the performance of component intended functions through the end of the SPEO. One-time inspections of a representative sample of these components will be performed to confirm that the assumed selective leaching rate is conservative.

Copper Alloy with Greater Than Fifteen Percent Zinc/Closed Cycle Cooling Water Sample Population – Components identified in the SLRA as constructed of copper alloy with greater than fifteen percent zinc and exposed to a closed cycle cooling water environment are limited to a series of RCW system valves and the heat exchanger heads for the condensate booster pump and ‘E’ HDP oil coolers. These components were conservatively assumed to be constructed of a material susceptible to selective leaching (i.e., uninhibited copper alloy with greater than fifteen percent zinc) based on inconclusive documentation and/or field walkdowns indicating a copper-based material. Subsequently, field material analysis of a representative sample of these components was performed. Approximately twenty percent of the components in this population were tested using a laser induced breakdown spectroscopy (LIBS) analyzer. The results of the field material analysis indicate that none of the components are constructed of copper alloy with greater than fifteen percent zinc. Based on the above, the Oconee SLRA is revised as shown below in SLRA revisions to correct the discrepancy associated with the material of construction identified for these components. There are no components constructed of copper alloy with greater than fifteen percent zinc and exposed to closed cycle cooling water within the scope of the *Selective Leaching* AMP.

Any Susceptible Material/Treated Water Sample Populations – Environmental factors that influence the likelihood of occurrence and extent of selective leaching are similar to other corrosion mechanisms and include pH, concentration of contaminants, dissolved oxygen content, and electrolyte conductivity. Chemistry parameters for closed cycle cooling water and treated water are maintained in accordance with industry guidance contained in EPRI 3002000590 and EPRI 3002010645, respectively. Significant differences exist in the parameters known to influence the likelihood of occurrence and extent of selective leaching between these two service environments. Accelerated selective leaching can be caused by localized conditions including flow rate, stray currents, elevated stresses, tubercles/ microbiologically influenced corrosion, and in local galvanic regions. Localized stressors can exist in both closed cycle cooling water systems and treated water systems. However, internal tuberculation and microbiological growth which are suspected to have contributed to the occurrence of graphitic corrosion in the RCW system are not expected in treated water systems. A review of industry OE has not identified any failures of susceptible components exposed to a treated water environment attributed to selective leaching. Based on the above, the Oconee OE indicating that graphitic corrosion of malleable iron has occurred in closed cycle cooling water is not representative of the expected condition of other components constructed of susceptible materials in a treated water environment and, therefore, one-time inspections are appropriate.

SLRA Revisions:

SLRA Section 3.3.2.1.1 (pages 3-318 and 3-319) is revised as follows:

3.3.2.1.1 Auxiliary Instrument Air System

Materials

Components in the Auxiliary Instrument Air System are constructed of the following materials:

* Galvanized Steel
* **Malleable Iron**
* Stainless Steel
* Steel

Aging Management Programs

The aging effects for components in the Auxiliary Instrument Air System are managed by the following AMPs:

* Bolting Integrity (B2.1.9)
* Boric Acid Corrosion (B2.1.4)
* External Surfaces Monitoring of Mechanical Components (B2.1.23)
* Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.24)
* One-Time Inspection (B2.1.20)
* **Selective Leaching (B2.1.21)**

SLRA Section 3.3.2.1.4 (pages 3-324 and 3-325) is revised as follows:

3.3.2.1.4 Instrument Air System

Materials

Components in the Instrument Air System are constructed of the following materials:

* Copper Alloy
* Copper Alloy (>15% Zn)
* Elastomer
* Galvanized Steel
* Glass
* **Malleable Iron**
* Stainless Steel
* Steel

Aging Management Programs

The aging effects for components in the Instrument Air System are managed by the following AMPs:

* Bolting Integrity (B2.1.9)
* Boric Acid Corrosion (B2.1.4)
* Buried and Underground Piping and Tanks (B2.1.26)
* Compressed Air Monitoring (B2.1.14)
* External Surfaces Monitoring of Mechanical Components (B2.1.23)
* Fire Water System (B2.1.16)
* Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.24)
* One-Time Inspection (B2.1.20)
* **Selective Leaching (B2.1.21)**
* TLAA

SLRA Section 3.3.2.1.6 (pages 3-328 and 3-329) is revised as follows:

3.3.2.1.6 Keowee Depressing Air System

Materials

Components in the Keowee Depressing Air System are constructed of the following materials:

* Galvanized Steel
* **Malleable Iron**
* Stainless Steel
* Steel

Aging Management Programs

The aging effects for components in the Keowee Depressing Air System are managed by the following AMPs:

* Bolting Integrity (B2.1.9)
* External Surfaces Monitoring of Mechanical Components (B2.1.23)
* Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.24)
* One-Time Inspection (B2.1.20)
* **Selective Leaching (B2.1.21)**

SLRA Section 3.3.2.1.8 (pages 3-332 and 3-333) is revised as follows:

3.3.2.1.8 Keowee Station Air System

Materials

Components in the Keowee Station Air System are constructed of the following materials:

* **Malleable Iron**
* Stainless Steel
* Steel

Aging Management Programs

The aging effects for components in the Keowee Station Air System are managed by the following AMPs:

* Bolting Integrity (B2.1.9)
* External Surfaces Monitoring of Mechanical Components (B2.1.23)
* Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.24)
* One-Time Inspection (B2.1.20)
* Open-Cycle Cooling Water System (B2.1.11)
* **Selective Leaching (B2.1.21)**

SLRA Section 3.3.2.1.10 (pages 3-336 and 3-337) is revised as follows:

3.3.2.1.10 Service Air System

Materials

Components in the Service Air System are constructed of the following materials:

* Aluminum
* Copper Alloy
* Galvanized Steel
* Glass
* **Malleable Iron**
* Stainless Steel
* Steel

Aging Management Programs

The aging effects for components in the Service Air System are managed by the following AMPs:

* Bolting Integrity (B2.1.9)
* Buried and Underground Piping and Tanks (B2.1.26)
* External Surfaces Monitoring of Mechanical Components (B2.1.23)
* Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.24)
* One-Time Inspection (B2.1.20)
* **Selective Leaching (B2.1.21)**

SLRA Section 3.3.2.1.18 (page 3-352) is revised as follows:

3.3.2.1.18 Alternate Chilled Water System

Materials

Components in the Alternate Chilled Water System are constructed of the following materials:

* Aluminum
* Copper Alloy
* Copper Alloy (>15% Zn)
* Ductile Iron
* Elastomer
* Gray Cast Iron
* **Malleable Iron**
* Stainless Steel
* Steel

SLRA Section 3.3.2.1.20 (pages 3-356 and 3-357) is revised as follows:

3.3.2.1.20 Chilled Water (Non-Vital Loads) System

Materials

Components in the Chilled Water (Non-Vital Loads) System are constructed of the following materials:

* Copper Alloy
* Copper Alloy (>15% Zn)
* Glass
* Malleable Iron
* Stainless Steel
* Steel

Aging Management Programs

The aging effects for components in the Chilled Water (Non-Vital Loads) System are managed by the following AMPs:

* Bolting Integrity (B2.1.9)
* Boric Acid Corrosion (B2.1.4)
* Closed Treated Water System (B2.1.12)
* External Surfaces Monitoring of Mechanical Components (B2.1.23)
* One-Time Inspection (B2.1.20)
* Open-Cycle Cooling Water System (B2.1.11)
* Selective Leaching (B2.1.21)

SLRA Section 3.3.2.1.21 (page 3-358) is revised as follows:

3.3.2.1.21 Recirculating Cooling Water System

Materials

Components in the Recirculating Cooling Water System are constructed of the following materials:

* Copper Alloy (>15% Zn)
* Glass
* Gray Cast Iron
* **Malleable Iron**
* Stainless Steel
* Steel

SLRA Section 3.3.2.1.22 (page 3-360) is revised as follows:

3.3.2.1.22 Sample Cooling Water System

Materials

Components in the Sample Cooling Water System are constructed of the following materials:

* Copper Alloy
* Copper Alloy (>15% Zn)
* Gray Cast Iron
* **Malleable Iron**
* Stainless Steel
* Steel

SLRA Section 3.3.2.1.23 (page 3-362) is revised as follows:

3.3.2.1.23 Chilled Water (Vital Loads) System

Materials

Components in the Chilled Water (Vital Loads) System are constructed of the following materials:

* Aluminum
* Copper Alloy
* Glass
* Gray Cast Iron
* **Malleable Iron**
* Polymeric
* Stainless Steel
* Steel

SLRA Section 3.3.2.1.24 (page 3-364) is revised as follows:

3.3.2.1.24 High Pressure Service Water System

Materials

Components in the High Pressure Service Water System are constructed of the following materials:

* Aluminum
* Copper Alloy
* Copper Alloy (>15% Zn)
* Ductile Iron
* Ductile Iron (w. Cement Lining)
* Elastomer
* Galvanized Steel
* Gray Cast Iron
* **Malleable Iron**
* Stainless Steel
* Steel
* Steel with Internal Coating/Lining

SLRA Section 3.3.2.1.25 (page 3-366) is revised as follows:

3.3.2.1.25 Keowee Service Water System

Materials

Components in the Keowee Service Water System are constructed of the following materials:

* Copper Alloy
* Galvanized Steel
* Gray Cast Iron
* **Malleable Iron**
* Polymeric
* PVC
* Stainless Steel
* Steel

SLRA Section 3.3.2.1.26 (page 3-368) is revised as follows:

3.3.2.1.26 Keowee Fire Detection/Protection System

Materials

Components in the Keowee Fire Detection/Protection System are constructed of the following materials:

* Copper Alloy
* Copper Alloy (>15% Zn)
* Ductile Iron
* Ductile Iron (w. Cement Lining)
* Gray Cast Iron
* **Malleable Iron**
* Stainless Steel
* Steel

SLRA Section 3.3.2.1.36 (pages 3-387 and 3-388) is revised as follows:

3.3.2.1.36 Plant Drinking Water System

Materials

Components in the Plant Drinking Water System are constructed of the following materials:

* Copper Alloy
* Galvanized Steel
* Glass
* Malleable Iron
* Polymeric
* PVC
* Stainless Steel
* Steel
* Steel with Internal Coating/Lining

Aging Management Programs

The aging effects for components in the Plant Drinking Water System are managed by the following AMPs:

* Bolting Integrity (B2.1.9)
* Boric Acid Corrosion (B2.1.4)
* External Surfaces Monitoring of Mechanical Components (B2.1.23)
* Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.24)
* One-Time Inspection (B2.1.20)
* Selective Leaching (B2.1.21)

SLRA Section 3.3.2.1.41 (page 3-397) is revised as follows:

3.3.2.1.41 Vacuum System

Materials

Components in the Vacuum System are constructed of the following materials:

* Copper Alloy
* Ductile Iron
* Glass
* Gray Cast Iron
* **Malleable Iron**
* Stainless Steel
* Steel

SLRA Section 3.3.2.1.48 (page 3-410) is revised as follows:

3.3.2.1.48 Condenser Circulating Water System

Materials

Components in the Condenser Circulating Water System are constructed of the following materials:

* Copper Alloy
* Ductile Iron
* Elastomer
* Gray Cast Iron
* **Malleable Iron**
* Stainless Steel
* Steel
* Steel with Internal Coating/Lining

SLRA Section 3.3.2.1.49 (page 3-412) is revised as follows:

3.3.2.1.49 Low Pressure Service Water System

Materials

Components in the Low Pressure Service Water System are constructed of the following materials:

* Aluminum
* Copper Alloy
* Copper Alloy (>15% Zn)
* Ductile Iron
* Elastomer
* Glass
* Gray Cast Iron
* Malleable Iron
* Stainless Steel
* Steel
* Steel with Internal Coating/Lining

SLRA Section 3.3.2.1.59 (pages 3-432 and 3-433) is revised as follows:

3.3.2.1.59 Liquid Waste Disposal System

Materials

Components in the Liquid Waste Disposal System are constructed of the following materials:

* Copper Alloy
* Glass
* **Malleable Iron**
* Stainless Steel
* Steel
* Steel (with Stainless Steel Cladding)

Aging Management Programs

The aging effects for components in the Liquid Waste Disposal System are managed by the following AMPs:

* Bolting Integrity (B2.1.9)
* Boric Acid Corrosion (B2.1.4)
* External Surfaces Monitoring of Mechanical Components (B2.1.23)
* Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.24)
* One-Time Inspection (B2.1.20)
* **Selective Leaching (B2.1.21)**
* TLAA

SLRA Table 3.3.2-1 (page 3-507) is revised as follows:

Table 3.3.2-1 Auxiliary Systems – Auxiliary Instrument Air System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Structural Integrity	Malleable Iron	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-77	3.3.1- 078	A
			Waste Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VII.E5.A-785	3.3.1- 193	A
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.24)	VII.E5.AP-281	3.3.1- 091	A, 1
					Selective Leaching (B2.1.21)	None	None	H

SLRA Table 3.3.2-4 (page 3-523) is revised as follows:

Table 3.3.2-4 Auxiliary Systems – Instrument Air System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Pressure Boundary	Malleable Iron	Air – Dry (Internal)	Loss of Material	Compressed Air Monitoring (B2.1.14)	VII.D.A-764	3.3.1- 235	A
			Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-77	3.3.1- 078	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B2.1.4)	VII.I.A-79	3.3.1- 009	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.24)	VII.D.A-26	3.3.1- 055	A
			Waste Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VII.E5.A-785	3.3.1- 193	A
				Loss of Material	Selective Leaching (B2.1.21)	None	None	H
				Loss of Material, Flow Blockage	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.24)	VII.E5.AP-281	3.3.1- 091	A

SLRA Table 3.3.2-4 (page 3-526) is revised as follows:

Table 3.3.2-4 Auxiliary Systems –Instrument Air System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Structural Integrity	Malleable Iron	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-77	3.3.1- 078	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.24)	VII.D.A-26	3.3.1-055	A
			Waste Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VII.E5.A-785	3.3.1- 193	A
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.24)	VII.E5.AP-281	3.3.1- 091	A, 3
					Selective Leaching (B2.1.21)	None	None	H

SLRA Table 3.3.2-6 (page 3-538) is revised as follows:

Table 3.3.2-6 Auxiliary Systems – Keowee Depressing Air System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Structural Integrity	Malleable Iron	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-77	3.3.1- 078	A
			Waste Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VII.E5.A-785	3.3.1- 193	A
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.24)	VII.E5.AP-281	3.3.1- 091	A, 1
					Selective Leaching (B2.1.21)	None	None	H

SLRA Table 3.3.2-8 (page 3-546) is revised as follows:

Table 3.3.2-8 Auxiliary Systems – Keowee Station Air System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Structural Integrity	Malleable Iron	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-77	3.3.1- 078	A
			Waste Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VII.E5.A-785	3.3.1- 193	A
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.24)	VII.E5.AP-281	3.3.1- 091	A, 1
					Selective Leaching (B2.1.21)	None	None	H

SLRA Table 3.3.2-10 (page 3-558) is revised as follows:

Table 3.3.2-10 Auxiliary Systems – Service Air System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Pressure Boundary	Malleable Iron	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-77	3.3.1- 078	A
			Condensation (Internal)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.24)	VII.D.A-26	3.3.1- 055	A
			Waste Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VII.E5.A-785	3.3.1- 193	A
				Loss of Material	Selective Leaching (B2.1.21)	None	None	H
				Loss of Material, Flow Blockage	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.24)	VII.E5.AP-281	3.3.1- 091	A

SLRA Table 3.3.2-10 (page 3-559) is revised as follows:

Table 3.3.2-10 Auxiliary Systems – Service Air System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Structural Integrity	Malleable Iron	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-77	3.3.1- 078	A
			Waste Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VII.E5.A-785	3.3.1- 193	A
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.24)	VII.E5.AP-281	3.3.1- 091	A, 1
					Selective Leaching (B2.1.21)	None	None	H

SLRA Table 3.3.2-18 (page 3-654) is revised as follows:

Table 3.3.2-18 Auxiliary Systems – Alternate Chilled Water System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Pressure Boundary	Malleable Iron	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-77	3.3.1- 078	A
			Air – Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-24	3.3.1- 080	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B2.1.4)	VII.I.A-79	3.3.1- 009	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water System (B2.1.12)	VII.C2.AP-202	3.3.1- 045	A
					Selective Leaching (B2.1.21)	None	None	H

SLRA Table 3.3.2-18 (page 3-655) is revised as follows:

Table 3.3.2-18 Auxiliary Systems – Alternate Chilled Water System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Structural Integrity	Malleable Iron	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-77	3.3.1- 078	A
			Air - Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-24	3.3.1- 080	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B2.1.4)	VII.I.A-79	3.3.1- 009	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water System (B2.1.12)	VII.C2.AP-202	3.3.1- 045	A
					Selective Leaching (B2.1.21)	None	None	H

SLRA Table 3.3.2-20 (page 3-675) is revised as follows:

Table 3.3.2-20 Auxiliary Systems –Chilled Water (Non-Vital Loads) System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Pressure Boundary	Malleable Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B2.1.4)	VII.I.A-79	3.3.1- 009	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water System (B2.1.12)	VII.C2.AP-202	3.3.1- 045	A
					Selective Leaching (B2.1.21)	None	None	H
			Condensation (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-405a	3.3.1- 132	A

SLRA Table 3.3.2-20 (page 3-675) is revised as follows:

Table 3.3.2-20 Auxiliary Systems – Chilled Water (Non-Vital Loads) System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Structural Integrity	Malleable Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B2.1.4)	VII.I.A-79	3.3.1- 009	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water System (B2.1.12)	VII.C2.AP-202	3.3.1- 045	A
					Selective Leaching (B2.1.21)	None	None	H
			Condensation (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-405a	3.3.1- 132	A

SLRA Table 3.3.2-21 (page 3-686) is revised as follows:

Table 3.3.2-21 Auxiliary Systems – Recirculating Cooling Water System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Pressure Boundary	Malleable Iron	Air – Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-77	3.3.1- 078	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B2.1.4)	VII.I.A-79	3.3.1- 009	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water System (B2.1.12)	VII.C2.AP-202	3.3.1- 045	A
					Selective Leaching (B2.1.21)	None	None	H

SLRA Table 3.3.2-21 (page 3-687) is revised as follows:

Table 3.3.2-21 Auxiliary Systems – Recirculating Cooling Water System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Structural Integrity	Malleable Iron	Air – Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-77	3.3.1- 078	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B2.1.4)	VII.I.A-79	3.3.1- 009	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water System (B2.1.12)	VII.C2.AP-202	3.3.1- 045	A
					Selective Leaching (B2.1.21)	None	None	H

SLRA Table 3.3.2-21 (pages 3-689 and 3-690) is revised as follows:

Table 3.3.2-21 Auxiliary Systems – Recirculating Cooling Water System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Valve Body	Pressure Boundary	~~Copper Alloy (>15% Zn)~~	~~Closed-Cycle Cooling Water (Internal)~~	~~Cracking~~	~~Closed Treated Water System (B2.1.12)~~	~~VII.C2-A-473a~~	~~3.3.1- 160~~	~~A~~
				~~Loss of Material~~	~~Closed Treated Water System (B2.1.12)~~	~~VII.C2.AP-199~~	~~3.3.1- 046~~	~~A~~
					~~Selective Leaching (B2.1.21)~~	~~VII.C2.AP-43~~	~~3.3.1- 072~~	~~A~~

SLRA Table 3.3.2-21 (pages 3-690 and 3-691) is revised as follows:

Table 3.3.2-21 Auxiliary Systems – Recirculating Cooling Water System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Valve Body	Structural Integrity	~~Copper Alloy (>15% Zn)~~	~~Closed-Cycle Cooling Water (Internal)~~	~~Cracking~~	~~Closed Treated Water System (B2.1.12)~~	~~VII.C2-A-473a~~	~~3.3.1- 160~~	~~A~~
				~~Loss of Material~~	~~Closed Treated Water System (B2.1.12)~~	~~VII.C2.AP-199~~	~~3.3.1- 046~~	~~A~~
					~~Selective Leaching (B2.1.21)~~	~~VII.C2.AP-43~~	~~3.3.1- 072~~	~~A~~

SLRA Table 3.3.2-22 (page 3-694) is revised as follows:

Table 3.3.2-22 Auxiliary Systems – Sample Cooling Water System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Structural Integrity	Malleable Iron	Air - Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-77	3.3.1- 078	A
			Raw Water (Potable) (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VII.G.A-532	3.3.1- 193	A
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.24)	VII.E5.AP-270	3.3.1- 088	A, 1
					Selective Leaching (B2.1.21)	None	None	H

SLRA Table 3.3.2-23 (page 3-705) is revised as follows:

Table 3.3.2-23 Auxiliary Systems – Chilled Water (Vital Loads) System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Pressure Boundary	Malleable Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B2.1.4)	VII.I.A-79	3.3.1- 009	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water System (B2.1.12)	VII.C2.AP-202	3.3.1- 045	A
					Selective Leaching (B2.1.21)	None	None	H
			Condensation (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-405a	3.3.1- 132	A

SLRA Table 3.3.2-23 (page 3-706) is revised as follows:

Table 3.3.2-23 Auxiliary Systems – Chilled Water (Vital Loads) System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Structural Integrity	Malleable Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B2.1.4)	VII.I.A-79	3.3.1- 009	A
			Closed Cycle Cooling Water (Internal)	Loss of Material	Closed Treated Water System (B2.1.12)	VII.C2.AP-202	3.3.1- 045	A
					Selective Leaching (B2.1.21)	None	None	H
			Condensation (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-405a	3.3.1- 132	A

SLRA Table 3.3.2-24 (page 3-719) is revised as follows:

Table 3.3.2-24 Auxiliary Systems – High Pressure Service Water System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Pressure Boundary	Malleable Iron	Air – Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-24	3.3.1- 080	A
			Air – Outdoor (Internal)	Loss of Material	Fire Water System (B2.1.16)	VII.G.A-722	3.3.1- 157	B
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B2.1.4)	VII.I.A-79	3.3.1- 009	A
			Condensation (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-77	3.3.1- 078	A
			Condensation (Internal)	Loss of Material	Fire Water System (B2.1.16)	VII.G.AP-143	3.3.1- 089	B
			Raw Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VII.C1.A-532	3.3.1- 193	A
				Loss of Material	Selective Leaching (B2.1.21)	None	None	H
				Loss of Material, Flow Blockage	Fire Water System (B2.1.16)	VII.G.A-33	3.3.1- 064	B
			Underground (External)	Loss of Material	Buried and Underground Piping and Tanks (B2.1.26)	VII.I.AP-284	3.3.1- 109	B

SLRA Table 3.3.2-24 (page 3-721) is revised as follows:

Table 3.3.2-24 Auxiliary Systems – High Pressure Service Water System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Structural Integrity	Malleable Iron	Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B2.1.4)	VII.I.A-79	3.3.1- 009	A
			Condensation (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.G.A-649	3.3.1- 197	A
			Raw Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VII.C1.A-532	3.3.1- 193	A
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.24)	VII.C1.A-727	3.3.1- 134	A, 2
					Selective Leaching (B2.1.21)	None	None	H

SLRA Table 3.3.2-25 (page 3-731) is revised as follows:

Table 3.3.2-25 Auxiliary Systems – Keowee Service Water System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Structural Integrity	Malleable Iron	Condensation (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.G.A-649	3.3.1- 197	A
			Raw Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VII.C1.A-532	3.3.1- 193	A
				Loss of Material	Open-Cycle Cooling Water System (B2.1.11)	VII.C1.AP-194	3.3.1- 037	B, 1
					Selective Leaching (B2.1.21)	None	None	H

SLRA Table 3.3.2-26 (page 3-738) is revised as follows:

Table 3.3.2-26 Auxiliary Systems – Keowee Fire Detection/Protection System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Pressure Boundary	Malleable Iron	Condensation (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-77	3.3.1- 078	A
			Condensation (Internal)	Loss of Material	Fire Water System (B2.1.16)	VII.G.AP-143	3.3.1- 089	B
			Raw Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VII.C1.A-532	3.3.1- 193	A
				Loss of Material	Selective Leaching (B2.1.21)	None	None	H
				Loss of Material, Flow Blockage	Fire Water System (B2.1.16)	VII.G.A-33	3.3.1- 064	B

SLRA Table 3.3.2-36 (page 3-839) is revised as follows:

Table 3.3.2-36 Auxiliary Systems – Plant Drinking Water System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Structural Integrity	Malleable Iron	Air – Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-77	3.3.1- 078	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B2.1.4)	VII.I.A-79	3.3.1- 009	A
			Raw Water (Potable) (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VII.G.A-532	3.3.1- 193	A
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.24)	VII.E5.AP-270	3.3.1- 088	A, 1
					Selective Leaching (B2.1.21)	None	None	H

SLRA Table 3.3.2-41 (page 3-875) is revised as follows:

Table 3.3.2-41 Auxiliary Systems – Vacuum System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Structural Integrity	Malleable Iron	Air – Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-77	3.3.1- 078	A
			Raw Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VII.G.A-532	3.3.1- 193	A
				Loss of Material	Open-Cycle Cooling Water System (B2.1.11)	VII.C1.AP-194	3.3.1- 037	B, 1
					Selective Leaching (B2.1.21)	None	None	H

SLRA Table 3.3.2-48 (page 3-921) is revised as follows:

Table 3.3.2-48 Auxiliary Systems – Condenser Circulating Water System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Pressure Boundary	Malleable Iron	Air – Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-77	3.3.1- 078	A
			Air – Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-77	3.3.1- 078	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B2.1.4)	VII.I.A-79	3.3.1- 009	A
			Condensation (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-405a	3.3.1- 132	A
			Raw Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VII.C1.A-532	3.3.1- 193	A
				Loss of Material	Selective Leaching (B2.1.21)	None	None	H
				Loss of Material, Flow Blockage	Open-Cycle Cooling Water System (B2.1.11)	VII.C1.AP-194	3.3.1- 037	B

SLRA Table 3.3.2-48 (page 3-925) is revised as follows:

Table 3.3.2-48 Auxiliary Systems – Condenser Circulating Water System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG-2192 Table 1	Notes
Piping	Structural Integrity	Malleable Iron	Air – Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-77	3.3.1- 078	A
			Air – Outdoor (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-77	3.3.1- 078	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B2.1.4)	VII.I.A-79	3.3.1- 009	A
			Condensation (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-405a	3.3.1- 132	A
			Raw Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VII.C1.A-532	3.3.1- 193	A
				Loss of Material	Open-Cycle Cooling Water System (B2.1.11)	VII.C1.AP-194	3.3.1- 037	B, 1
					Selective Leaching (B2.1.21)	None	None	H
			Waste Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VII.E5.A-785	3.3.1- 193	A
				Loss of Material	Selective Leaching (B2.1.21)	None	None	H
					Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.24)	VII.E5.AP-281	3.3.1- 091	A, 1

SLRA Table 3.3.2-49 (page 3-945) is revised as follows:

Table 3.3.2-49 Auxiliary Systems – Low Pressure Service Water System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Pressure Boundary	Malleable Iron	Air – Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-77	3.3.1- 078	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B2.1.4)	VII.I.A-79	3.3.1- 009	A
			Condensation (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-405a	3.3.1- 132	A
			Raw Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VII.C1.A-532	3.3.1- 193	A
				Loss of Material	Selective Leaching (B2.1.21)	None	None	H
				Loss of Material, Flow Blockage	Open-Cycle Cooling Water System (B2.1.11)	VII.C1.AP-194	3.3.1- 037	B

SLRA Table 3.3.2-49 (page 3-947) is revised as follows:

Table 3.3.2-49 Auxiliary Systems – Low Pressure Service Water System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Structural Integrity	Malleable Iron	Air – Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-77	3.3.1- 078	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B2.1.4)	VII.I.A-79	3.3.1- 009	A
			Condensation (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-405a	3.3.1- 132	A
			Raw Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VII.C1.A-532	3.3.1- 193	A
				Loss of Material	Open-Cycle Cooling Water System (B2.1.11)	VII.C1.AP-194	3.3.1- 037	B, 1
					Selective Leaching (B2.1.21)	None	None	H

SLRA Table 3.3.2-59 (page 3-1029) is revised as follows:

Table 3.3.2-59 Auxiliary Systems – Liquid Waste Disposal System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Structural Integrity	Malleable Iron	Air – Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VII.I.A-77	3.3.1- 078	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B2.1.4)	VII.I.A-79	3.3.1- 009	A
			Waste Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VII.E5.A-785	3.3.1- 193	A
				Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.24)	VII.E5.AP-281	3.3.1- 091	A, 3
					Selective Leaching (B2.1.21)	None	None	H

SLRA Section 3.4.2.1.1 (page 3-1046) is revised as follows:

3.4.2.1.1 Condensate System

Materials

Components in the Condensate System are constructed of the following materials:

* Copper Alloy
* Copper Alloy (>15% Zn)
* Ductile Iron
* Glass
* Gray Cast Iron
* Malleable Iron
* Stainless Steel
* Steel
* Steel w. Nickel Plating
* Steel with Internal Coating/Lining

SLRA Section 3.4.2.1.2 (page 3-1048) is revised as follows:

3.4.2.1.2 Feedwater System

Materials

Components in the Feedwater System are constructed of the following materials:

* Copper Alloy (>15% Zn)
* Galvanized Steel
* Glass
* Malleable Iron
* Polymeric
* Stainless Steel
* Steel
* Steel (with Stainless Steel Cladding)

SLRA Section 3.4.2.1.3 (page 3-1050) is revised as follows:

3.4.2.1.3 Heater Drain System

Materials

Components in the Heater Drain System are constructed of the following materials:

* Copper Alloy
* Copper Alloy (>15% Zn)
* Glass
* Gray Cast Iron
* **Malleable Iron**
* Stainless Steel
* Steel

SLRA Section 3.4.2.1.7 (page 3-1058) is revised as follows:

3.4.2.1.7 Auxiliary Steam System

Materials

Components in the Auxiliary Steam System are constructed of the following materials:

* Copper Alloy
* Glass
* Gray Cast Iron
* **Malleable Iron**
* Stainless Steel
* Steel

SLRA Section 3.4.2.1.10 (page 3-1063) is revised as follows:

3.4.2.1.10 Plant Heating System

Materials

Components in the Plant Heating System are constructed of the following materials:

* Copper Alloy
* Gray Cast Iron
* **Malleable Iron**
* Stainless Steel
* Steel

SLRA Table 3.4.2-1 (pages 3-1116 and 3-1117) is revised as follows:

Table 3.4.2-1 Steam and Power Conversion System – Condensate System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Heat Exchanger (condensate booster pump oil cooler) Head	Structural Integrity	Copper Alloy ~~(>15% Zn)~~	Air – Indoor Uncontrolled (External)	Cracking	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VIII.H.S-454	3.4.1- 106	A
			Closed Cycle Cooling Water (Internal)	Cracking	Closed Treated Water System (B2.1.12)	VII.C2.A-473a	3.3.1- 160	A
				Loss of Material	Closed Treated Water System (B2.1.12)	VIII.E.SP-8	3.4.1- 027	A
					~~Selective Leaching (B2.1.21)~~	~~VIII.F.SP-29~~	~~3.4.1- 033~~	~~A~~

SLRA Table 3.4.2-1 (page 3-1124) is revised as follows:

Table 3.4.2-1 Steam and Power Conversion System – Condensate System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Pressure Boundary	Malleable Iron	Air – Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VIII.H.S-29	3.4.1- 034	A
			Treated Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VIII.E.S-432	3.4.1- 081	A
				Loss of Material	One-Time Inspection (B2.1.20)	VIII.E.SP-73	3.4.1- 014	A
					Water Chemistry (B2.1.2)	VIII.E.SP-73	3.4.1- 014	A
					Selective Leaching (B2.1.21)	None	None	H

SLRA Table 3.4.2-1 (page 3-1125) is revised as follows:

Table 3.4.2-1 Steam and Power Conversion System – Condensate System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Structural Integrity	Malleable Iron	Air – Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VIII.H.S-29	3.4.1- 034	A
			Treated Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VIII.E.S-432	3.4.1- 081	A
				Loss of Material	One-Time Inspection (B2.1.20)	VIII.E.SP-73	3.4.1- 014	A
					Water Chemistry (B2.1.2)	VIII.E.SP-73	3.4.1- 014	A
					Selective Leaching (B2.1.21)	None	None	H

SLRA Table 3.4.2-2 (page 3-1153) is revised as follows:

Table 3.4.2-2 Steam and Power Conversion System – Feedwater System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Structural Integrity	Malleable Iron	Air – Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VIII.H.S-29	3.4.1- 034	A
			Treated Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VIII.E.S-432	3.4.1- 081	A
				Loss of Material	One-Time Inspection (B2.1.20)	VIII.E.SP-73	3.4.1- 014	A
					Water Chemistry (B2.1.2)	VIII.E.SP-73	3.4.1- 014	A
					Selective Leaching (B2.1.21)	None	None	H

SLRA Table 3.4.2-3 (pages 3-1167 and 3-1168) is revised as follows:

Table 3.4.2-3 Steam and Power Conversion System – Heater Drain System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Heat Exchanger (condensate booster pump oil cooler) Head	Structural Integrity	Copper Alloy ~~(>15% Zn)~~	Air – Indoor Uncontrolled (External)	Cracking	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VIII.H.S-454	3.4.1- 106	C
			Closed Cycle Cooling Water (Internal)	Cracking	Closed Treated Water System (B2.1.12)	VII.C2.A-473a	3.3.1- 160	A
				Loss of Material	Closed Treated Water System (B2.1.12)	VIII.E.SP-8	3.4.1- 027	C
					~~Selective Leaching (B2.1.21)~~	~~VIII.F.SP-29~~	~~3.4.1- 033~~	~~C~~

SLRA Table 3.4.2-3 (page 3-1171) is revised as follows:

Table 3.4.2-3 Steam and Power Conversion System – Heater Drain System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Structural Integrity	Malleable Iron	Air – Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VIII.H.S-29	3.4.1- 034	A
			Treated Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VIII.E.S-432	3.4.1- 081	A
				Loss of Material	One-Time Inspection (B2.1.20)	VIII.E.SP-73	3.4.1- 014	A
					Water Chemistry (B2.1.2)	VIII.E.SP-73	3.4.1- 014	A
					Selective Leaching (B2.1.21)	None	None	H

SLRA Table 3.4.2-7 (page 3-1210) is revised as follows:

Table 3.4.2-7 Steam and Power Conversion System – Auxiliary Steam System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Structural Integrity	Malleable Iron	Air – Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VIII.H.S-29	3.4.1- 034	A
			Treated Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VIII.A.S-432	3.4.1- 081	A
				Loss of Material	One-Time Inspection (B2.1.20)	VIII.B1.SP-74	3.4.1- 014	A
					Water Chemistry (B2.1.2)	VIII.B1.SP-74	3.4.1- 014	A
					Selective Leaching (B2.1.21)	None	None	H

SLRA Table 3.4.2-10 (page 3-1235) is revised as follows:

Table 3.4.2-10 Steam and Power Conversion System – Plant Heating System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Pressure Boundary	Malleable Iron	Air – Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VIII.H.S-29	3.4.1- 034	A
			Treated Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VIII.A.S-432	3.4.1- 081	A
				Loss of Material	One-Time Inspection (B2.1.20)	VIII.B1.SP-74	3.4.1- 014	A
					Water Chemistry (B2.1.2)	VIII.B1.SP-74	3.4.1- 014	A
					Selective Leaching (B2.1.21)	None	None	H

SLRA Table 3.4.2-10 (page 3-1235) is revised as follows:

Table 3.4.2-10 Steam and Power Conversion System – Plant Heating System – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG - 2192 Table 1	Notes
Piping	Structural Integrity	Malleable Iron	Air – Indoor Uncontrolled (External)	Loss of Material	External Surfaces Monitoring of Mechanical Components (B2.1.23)	VIII.H.S-29	3.4.1- 034	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B2.1.4)	VIII.H.S-30	3.4.1- 004	A
			Treated Water (Internal)	Long-Term Loss of Material	One-Time Inspection (B2.1.20)	VIII.A.S-432	3.4.1- 081	A
				Loss of Material	One-Time Inspection (B2.1.20)	VIII.B1.SP-74	3.4.1- 014	A
					Water Chemistry (B2.1.2)	VIII.B1.SP-74	3.4.1- 014	A
					Selective Leaching (B2.1.21)	None	None	H

SLRA Appendix A2.21 (pages A-22 and A-23) is revised as follows:

A2.21 Selective Leaching

Program Description

The *Selective Leaching* AMP is a new condition monitoring program that will monitor components constructed of materials which are susceptible to selective leaching. Susceptible materials are gray cast iron, ductile iron, **malleable iron,** and copper alloys containing greater than 15% zinc or greater than 8% aluminum (aluminum bronze). The *Selective Leaching* program includes a one-time inspection for susceptible components exposed to ~~closed cycle cooling water and~~ **a** treated water environment~~s~~ since plant-specific OE has not revealed evidence of significant selective leaching in ~~these environments~~ **treated water**, as well as opportunistic and periodic inspections for susceptible components exposed to raw water, waste water, and soil (which may include groundwater) environments. **The *Selective Leaching* AMP also includes a one-time inspection for gray cast iron components exposed to a closed cycle cooling water environment. Opportunistic and periodic inspections will be performed for malleable iron and ductile iron components exposed to closed cycle cooling water.**

Visual inspections supplemented by mechanical examination techniques such as chipping or scraping (for ductile**, malleable,** and gray cast iron components) will be conducted on a representative sample of susceptible components. In addition, periodic destructive examinations of components for physical properties (i.e., degree of dealloying, depth of dealloying, wall thickness, and chemical composition) will be conducted for components exposed to raw water, waste water, and soil environments**, and for malleable and ductile iron components exposed to closed cycle cooling water**. Inspections and tests will be conducted to determine whether loss of material due to selective leaching will affect the ability of the components to perform their intended function for the SPEO. Inspections will be conducted in accordance with plant-specific procedures including inspection parameters such as lighting, distance, offset and surface conditions as appropriate. When the acceptance criteria are not met such that it is determined that the affected component should be replaced prior to the end of the SPEO, additional inspections will be performed.

SLRA Table A6.0-1 (page A-86) is revised as follows:

Table A6.0-1: Subsequent License Renewal Commitments

#	Program	Commitment	AMP	Implementation
21	*Selective Leaching* program	The *Selective Leaching* AMP is a new condition monitoring program that will monitor components constructed of materials which are susceptible to selective leaching. The *Selective Leaching* program includes a one-time inspection for susceptible components exposed to ~~closed-cycle cooling water and~~ a treated water environment~~s~~, as well as opportunistic and periodic inspections for susceptible components exposed to raw water, waste water, and soil (which may include groundwater) environments. **The *Selective Leaching* AMP also includes a one-time inspection for gray cast iron components exposed to a closed cycle cooling water environment. Opportunistic and periodic inspections will be performed for malleable iron and ductile iron components exposed to closed cycle cooling water.** Industry and plant-specific OE will be considered in the development and implementation of this program.	B2.1.21	Program will be implemented no later than 10 years prior to the SPEO. The one-time inspections and initial periodic inspections are required to be performed within the 10 years prior to the SPEO, and no later than 6 months prior to the SPEO, or no later than the last refueling outage prior to the SPEO.

SLRA Appendix B2.1.21 (page B-154) is revised as follows:

B2.1.21 SELECTIVE LEACHING

Program Description

The *Selective Leaching* AMP is a new condition monitoring program that includes a one-time inspection for components exposed to ~~closed cycle cooling water and~~ **a** treated water environment~~s~~ since plant-specific OE has not revealed evidence of significant selective leaching in ~~these environments~~ **treated water**, as well as opportunistic and periodic inspections for components exposed to raw water, waste water, and soil environments. **The *Selective Leaching* AMP also includes a one-time inspection for gray cast iron components exposed to a closed cycle cooling water environment since plant-specific OE has not revealed evidence of significant selective leaching of gray cast iron in closed cycle cooling water. Opportunistic and periodic inspections will be performed for malleable iron and ductile iron components exposed to closed cycle cooling water.**

Visual inspections supplemented by mechanical examination techniques such as chipping or scraping (for ductile**, malleable,** and gray cast iron components) will be conducted. Periodic destructive examinations of components for physical properties (i.e., degree of dealloying, depth of dealloying, through wall thickness, and chemical composition) will be conducted for components exposed to raw water, waste water, and soil environments**, and for malleable and ductile iron components exposed to closed cycle cooling water**. Inspections and tests will be conducted to determine whether selective leaching is occurring and whether loss of material will affect the ability of the components to perform their intended function for the SPEO.

Components in the scope of the *Selective Leaching* AMP include piping and piping components, valve bodies, pump casings, and other components that are constructed of susceptible materials and exposed to environments conducive to selective leaching. Materials susceptible to selective leaching which are in the scope of this program are gray cast iron, ductile iron, **malleable iron,** and copper alloys containing greater than fifteen percent zinc, or greater than eight percent aluminum (aluminum bronze). Environments that promote susceptibility to selective leaching include raw water, closed cycle cooling water, treated water, waste water, and soil.

For the one-time and periodic/opportunistic portions of the program, visual inspections supplemented by mechanical examination techniques such as chipping or scraping (for ductile**, malleable,** and gray cast iron components) will be conducted on a representative sample of components of each material and environment combination of components. **A representative sample of components will be inspected from the combined population of ductile iron and malleable iron components in each environment due to the similarities in the microstructures of these two materials.** Other than for ductile iron and gray cast iron components exposed to soil, a representative sample consists of three percent of each material and environment population per unit or a maximum of seven components per population per unit for periodic inspections or ten components per population for one-time inspections. Ductile iron and gray cast iron components exposed to soil within the scope of the program are limited to common buried fire header components, identified with no unit-specific designators. Therefore, this equipment will be addressed as a single unit. A representative
SLRA Appendix B2.1.21 (page B-155) is revised as follows:

B2.1.21 SELECTIVE LEACHING

Program Description (cont'd)

Inspections are conducted in accordance with plant-specific procedures including inspection parameters such as lighting, distance, offset and surface conditions as appropriate. Results will be evaluated against acceptance criteria to confirm that the sampling bases (e.g., selection, size, frequency) will maintain the intended functions of components throughout the SPEO based on the projected rate and extent of degradation. The acceptance criteria are: (a) for copper-based alloys, no noticeable change in color from the normal yellow color to the reddish copper color or green copper oxide; (b) for gray cast iron**, malleable iron,** and ductile iron, the absence of a surface layer that can be easily removed by chipping or scraping or identified in the destructive examinations, (c) the presence of no more than a superficial layer of dealloying, as determined by removal of the dealloyed material by mechanical removal, and (d) the components meet system design requirements such as minimum wall thickness, when extended to the end of the SPEO.

SLRA Appendix B2.1.21 (page B-156) is revised as follows:

B2.1.21 SELECTIVE LEACHING

Operating Experience

2. For SLR, a ten year review of Oconee OE has been performed to identify occurrences of selective leaching. This review identified no evidence that loss of material due to selective leaching will adversely impact the performance of intended functions during the SPEO other than **operating experience** example**s 3 and 4** provided below ~~in a raw water environment~~. ~~No failures~~ **Other than degradation of malleable iron recirculating cooling water system pipe fittings described in operating experience example 4, no significant degradation** due to selective leaching ~~were~~ **was** identified for components constructed of susceptible materials and exposed to closed cycle cooling water or treated water environments.

   OE example 2 provides objective evidence that significant degradation due to selective leaching is not occurring in susceptible materials exposed to ~~closed cycle cooling water or~~ treated water **or in susceptible materials other than malleable iron exposed to closed cycle cooling water** ~~environments~~ at Oconee**.**~~, and t~~**T**herefore, the use of one-time inspection for selective leaching in these ~~environments~~ **sample populations** is appropriate for the SPEO.

SLRA Appendix B2.1.21 (page B-157) is revised as follows:

B2.1.21 SELECTIVE LEACHING

Operating Experience

4. **In October 2020, a nonsafety-related ¾-inch recirculating cooling water system elbow broke during performance of maintenance on a Unit 1 heater drain pump motor. The failure occurred while the elbow was subject to abnormal loading of a cantilevered pipe that was disconnected for maintenance. The elbow was sent to the Duke metallurgical laboratory for analysis. The analysis determined that the failed elbow was constructed of gray cast iron. Gray cast iron is not an approved material for small diameter pipe fittings in the recirculating cooling water system [Reference: 1]. Destructive examination of the elbow was performed, and several areas of localized selective leaching were identified. The penetration depth of the dealloyed material was less than 0.040 inch after approximately 47 years in service. Loss of material is not considered the cause of the failure since the average wall thickness measured near the fracture was 0.143 inch with a minimum of 0.108 inch at a pit. This failure is considered a legacy issue caused by the installation of an elbow of an unapproved material with the failure instigated by abnormal loading which occurred while the pipe was disassembled for maintenance.**

   Based on the measured penetration depth of graphitic corrosion, a conservative linear degradation rate of 0.001 inch per year is assumed for gray cast iron components in a closed cycle cooling water environment. If this conservative corrosion rate is assumed, localized selective leaching with a penetration depth of up to 0.080 inch could occur by the end of the subsequent period of extended operation. The gray cast iron components exposed to closed cycle cooling water managed by this program are limited to pump casings, heat exchanger heads, and valve bodies which are thicker walled, heavier castings. As such, selective leaching of gray cast iron components exposed to closed cycle-cooling water is not expected to impact **the performance of component intended functions through the end of the subsequent period of extended operation and, therefore, one-time inspections are appropriate. One-time inspections of a representative sample of these components will be performed to confirm that the assumed selective leaching rate is conservative. If one-time inspections identify selective leaching is occurring at a more accelerated rate such that impact on component intended functions could occur, then periodic inspections will be implemented.**

   An extent of condition review was performed to determine if an unapproved material was used for other similar fittings in the recirculating cooling water system. The extent of condition review consisted of the removal of nine similar small diameter (¾-inch to 1-inch) recirculating cooling water system pipe fittings for metallurgical evaluation by an outside laboratory. Each of the nine fittings was sectioned to expose the interior surface of the sample and specimens were selected and excised for further evaluation. Each of the specimens exhibited microstructures consistent with malleable iron which is an approved material for recirculating cooling water system pipe fittings 2-inch in diameter or less.

Internal surface degradation potentially indicative of graphitic corrosion (i.e., dark corrosion product with no significant change to component shape or dimension) was present in the cross-sectioned malleable iron pipe fittings. Subsequent reexamination of the fittings performed in October 2021 confirmed that the degradation is consistent with graphitic corrosion. The corrosion product closely matches the original shape and contours of the fittings and the corrosion products contained residual temper graphite as is expected with graphitic corrosion. In addition, the innermost layers of these corrosion products could be cut with a scalpel consistent with published characteristics of graphitic corrosion.

Each of the nine pipe fittings exhibited some degree of degradation consistent with graphitic corrosion. The locations with the greatest wall loss were under deposit pitting-type indications. Relatively minor degradation was present in eight of the nine pipe fittings with an estimated degradation rate of 0.001 inch to 0.002 inch per year. A deeper pit was present in one of the fittings indicating an accelerated degradation rate of approximately 0.0035 inch per year. Metallurgical examination of the fitting that experienced accelerated degradation identified the presence of casting defects (shrinkage porosity) and an abnormal microstructure having radial “stringers” of temper graphite. The presence of voids in the casting due to shrinkage porosity allow for electrolyte penetration thereby exacerbating degradation. The abnormal microstructure creates more of a continuous network of temper graphite within the malleable iron and a decreased anode (iron) to cathode (graphite) ratio further contributing to accelerated corrosion.

As stated above, the locations with the greatest wall loss were under internal deposits or tubercles. The recirculating water cooling system operating history indicates the occurrence of under deposit microbiological activity. Microbiological activity in the recirculating cooling water system has been attributed to prior use of nitrite-based corrosion inhibitor which served as a food source for bacteria within the system. Graphitic corrosion is often driven by localized electrochemical corrosion mechanisms including microbiological influenced corrosion.

Although the operating experience described above shows that graphitic corrosion of malleable iron exposed to closed cycle cooling water is typically slow acting (0.001 inch to 0.002 inch per year), the potential exists for graphitic corrosion to impact intended functions prior to the end of the subsequent period of extended operation due to the lower margins in thinner walled pipe fittings and local factors that could contribute to accelerated degradation. As such, the *Selective Leaching* AMP will perform periodic inspections of malleable iron components exposed to closed cycle cooling water. Due to the similarities between malleable iron and ductile iron microstructures, components constructed of ductile iron and exposed to closed cycle cooling water will also be subject to periodic inspection. Periodic inspections will be performed of a representative sample of components from the combined population of ductile iron and malleable iron components.

ENCLOSURE 1

OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3
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ATTACHMENT 2
RAI B3.1-1

Enclosure 1, Attachment 2

RAI B3.1-1:

Regulatory Basis
Pursuant to 10 CFR 54.21(a)(3), the SLRA must demonstrate that the effects of aging for each structure and component identified in 10 CFR 54.21(a)(1) will be adequately managed so that the intended function(s) will be maintained consistent with the current licensing basis for the subsequent period of extended operation.

Background
SLRA Section B3.1 states that the program assures that the number of occurrences of each critical transient remains within the limits of the fatigue analyses. The SLRA also indicates that the design transients and associated design cycles are listed in Oconee UFSAR Tables 5-2 (for reactor coolant system other than pressurizer surge line) and 5-23 (for pressurizer surge line).

Issue
Enhancement 3 of the program states that the program will be enhanced to expand existing corrective action guidance associated with exceeding a cycle counting surveillance limit. The staff finds a need to clarify the meaning of the cycle surveillance limit. In addition, the staff needs to clarify whether the cycle counting surveillance limit includes the cycle limits associated with the analytical flaw evaluation (SLRA Section 4.3.5), weld overlay fatigue analysis (SLRA Section 4.3.6), cumulative usage factors and environmental cumulative usage factors in addition to the design transient cycles.

Request
Describe the meaning of the cycle counting surveillance limit addressed in Enhancement 3 of the Fatigue Monitoring program. As part of the response, clarify whether the surveillance limit includes the cycle and design limits associated with the analytical flaw evaluation (SLRA Section 4.3.5), weld overlay fatigue analyses (SLRA Section 4.3.6), cumulative usage factors and environmental cumulative usage factors in addition to the design transient cycles. If not, explain why the surveillance limit does not include the cycle or design limits associated with the analytical flaw evaluation, weld overlay fatigue analyses, cumulative usage factors and environmental cumulative usage factors.

Response to RAI B3.1-1:

The ONS Fatigue Monitoring program monitors and tracks the applicable plant transients and compares them to the associated design cycles. The fatigue analyses that calculate the cumulative usage factors and environmental cumulative usage factors for the applicable plant components utilize the design cycles as a part of those analyses. The tracking of transient cycles would ensure that the design cycles utilized in the fatigue analyses would not be exceeded. The cycle counting surveillance limit addressed in SLRA Section B3.1, Enhancement 3, requires that if any transient exceeds 80% of its allowable design cycles or if the minimum time to reach the allowable is less than three years, then the issue shall be entered into the corrective action program.

As described above, the fatigue analyses utilize design cycles as part of the calculations. This includes the cycles and design limits associated with the analytical flaw evaluations, weld overlay fatigue analyses, cumulative usage factors and environmental cumulative usage factors. SLRA Section B3.1, Enhancement 3, which addresses additional guidance when exceeding a cycle counting surveillance limit, applies to each of the above-mentioned fatigue analyses.

SLRA Revisions:

SLRA Appendix B3.1 (Page B-281) is revised as follows:

Design Basis Management

The program verifies the continued acceptability of existing design analyses through cycle counting. The program records, monitors, and tracks the overall cumulative number of plant transients. The program assures that the number of occurrences of each critical transient remains within the limits of the fatigue analyses, which in turn ensures that the analyses remain valid. Oconee UFSAR Table 5-2 and Table 5-23 provide a listing of design transients and associated design cycles. The program monitors actual operating conditions to ensure that fatigue analyses remain valid for the SPEO. The program requires that when ~~a cumulative usage factor or environmentally-assisted cumulative usage fatigue value~~ **any transient event total** exceeds 80 percent of the applicable allowable limit or if the minimum time for any transient event total occurrence projection to reach the allowable is less than three years, then the issue shall be entered into the corrective action program.

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ATTACHMENT 3
RAI B3.1-2

Enclosure 1, Attachment 3

RAI B3.1-2:

Regulatory Basis
Pursuant to 10 CFR 54.21(a)(3), the SLRA must demonstrate that the effects of aging for each structure and component identified in 10 CFR 54.21(a)(1) will be adequately managed so that the intended function(s) will be maintained consistent with the current licensing basis for the subsequent period of extended operation.

Background
SLRA Section B3.1 provides the evaluation of the operating experience related to the Fatigue Monitoring program.

Issue
The applicant's evaluation of the operating experience does not address an evaluation of the following NRC generic communication: Regulatory Issue Summary (RIS) 2011-14, "Metal Fatigue Analysis Performed by Computer Software." RIS 2011-14, in part, addresses the concern that the fatigue calculations of the WESTEMS software package may involve the algebraic summation of three orthogonal moment vectors, which is not consistent with ASME Code, Section III, Subsection NB, Subarticle NB-3650. RIS 2011-14 also states that the NRC encourages addressees to review the documents discussed above and to consider actions, as appropriate, to ensure compliance with the requirements for ASME Code fatigue calculations and QA programs, as described in 10 CFR 50.55a and Appendix B to 10 CFR Part 50, respectively.

Request
Provide the operating experience evaluation regarding RIS 2011-14, including the applicability of the RIS to the Oconee plant.

Response to RAI B3.1-2:

RIS 2011-14, "Metal Fatigue Analysis Performed by Computer Software," was evaluated in the Duke Energy corrective action system. The evaluation determined the need for communication to various corporate groups for awareness. Oconee Nuclear Station does not utilize the WESTEMS software package as part of the *Fatigue Monitoring* program. Therefore, the conclusion of the evaluation for RIS 2011-14 states that there are no actions or NRC response required.

SLRA Revisions:

None

ENCLOSURE 1

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ATTACHMENT 4
RAI 3.5.2.2.2.5-1

Enclosure 1, Attachment 4

RAI 3.5.2.2.2.5-1:

Regulatory Basis
Pursuant to 10 CFR 54.21(a)(3), the SLRA must demonstrate that the effects of aging for each structure and component identified in 10 CFR 54.21(a)(1) will be adequately managed so that the intended function(s) will be maintained consistent with the current licensing basis for the subsequent period of extended operation.

Background
SLRA Section 3.5.2.2.2.5 states that the evaluations of fatigue for component support members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3 component supports are TLAAs as defined in 10 CFR 54.3, and are addressed in SLRA Section 4.3, "Metal Fatigue." The component support groups are the following: (1) Group B1.1: supports for ASME Code Class 1 piping and components; (2) Group B1.2: supports for ASME Class 2 and 3 piping and components; (3) Group B1.3: supports for ASME Class MC (metal containment) components.

Issue
However, SLRA Sections 3.5.2.2.2.5 and 4.3 do not clearly identify the component supports, anchor bolts, and welds evaluated in the fatigue TLAAs and the dispositions of the fatigue TLAAs.

Request
Identify the component supports, anchor bolts and welds in Groups B1.1, B1.2, and B1.3 that are evaluated in the fatigue TLAAs. In addition, describe the fatigue TLAAs, including the TLAA dispositions, for the component supports, anchor bolts, and welds.

Response to RAI 3.5.2.2.2.5-1:

NUREG-2191 (GALL SLR) provides alignments for component supports in Section III and alignments for the major Reactor Coolant System component supports (ex., Reactor Vessel) in Section IV. The ONS current licensing basis contains fatigue analysis for the Reactor Vessel Support Skirt, Steam Generator Base Support, and Pressurizer Support Plate Assemblies components that are a TLAA. These components were screened in with the "Reactor Vessel, Reactor Internals, and Reactor Coolant System" portion of the SLRA.

The Reactor Vessel Support Skirt component is screened under the Reactor Vessel group. As listed in SLRA Table 3.1.2-1, the Reactor Vessel Support Skirt aligns to NUREG-2191 Item IV.A1.R-70. Further evaluation for cumulative fatigue damage for the Reactor Vessel Support Skirt is provided in Section 3.1.2.2.1 and the cumulative fatigue damage TLAA is evaluated in Section 4.3.2.1.

The Steam Generator Base Support component is screened under the Steam Generator group. As listed in SLRA Table 3.1.2-3, the Steam Generator Base Support aligns to NUREG-2191 Item IV.A2.R-70. Further evaluation for cumulative fatigue damage for the Steam Generator Base Support is provided in Section 3.1.2.2.1 and the cumulative fatigue damage TLAA is evaluated in Section 4.3.2.3.

The Pressurizer Support Plate Assemblies component is screened under the Reactor Coolant System group. As listed in SLRA Table 3.1.2-4, the Pressurizer Support Plate Assemblies aligns to NUREG-2191 Item IV.C2.R-18. Further evaluation for cumulative fatigue damage for the Pressurizer

Support Plate Assemblies is provided in Section 3.1.2.2.1 and the cumulative fatigue damage TLAA is evaluated in Section 4.3.2.5.

All the support components that contain a fatigue analysis in the ONS current licensing basis are evaluated in the Reactor Vessel and Reactor Coolant System group. The ONS current licensing basis contains no fatigue analysis for Group B1.1 component supports screened under the Component Support group. Therefore, a TLAA is not required to be evaluated in accordance with 10 CFR 54.21(c) for these components.

The ONS current licensing basis contains no fatigue analysis for Groups B1.2 and B1.3 component supports, which are screened under the Component Support group. Therefore, a TLAA is not required to be evaluated in accordance with 10 CFR 54.21(c) for these components.

SLRA Revisions:

SLRA Section 3.5.2.1.22 (page 3-1303) is revised as follows:

Aging Management Programs

The aging effects for components in the Component Supports are managed by the following AMPs:

* ASME Section XI, Subsection IWF (B2.1.30)
* Boric Acid Corrosion (B2.1.4)
* Structures Monitoring (B2.1.33)
* ~~TLAA~~
* Water Chemistry (B2.1.2)

SLRA Section 3.5.2.2.2.5 (page 3-1319) is revised as follows:

3.5.2.2.2.5 Cumulative Fatigue Damage

NUREG-2192

Evaluations involving time-dependent fatigue, cyclical loading, or cyclical displacement of component support members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3 component supports are TLAAs as defined in 10 CFR 54.3 only if a CLB fatigue analysis exists. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c). The evaluation of this TLAA is addressed in Section 4.3, "Metal Fatigue Analysis," and/or Section 4.7, "Other Plant- Specific Time-Limited Aging Analyses," of this SRP-SLR. For plant-specific cumulative usage factor calculations, the method used is appropriately defined and discussed in the applicable TLAAs.

Evaluation

[3.5.1-053] – ~~The evaluation of fatigue for component support members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3 component supports are TLAAs as defined in 10 CFR 54.3, and is addressed in SLRA Section 4.3, "Metal Fatigue".~~ **This Item Number is not applicable to ONS. The ONS current licensing basis contains no fatigue analysis for Groups B1.1, B1.2, and B1.3 component supports, which are screened under the Component Support group. Therefore, a TLAA is not required to be evaluated in accordance with 10 CFR 54.21(c) for these components.**

SLRA Table 3.5.1 (page 3-1338) is revised as follows:

Table 3.5.1 Summary of Aging Management Programs for Containments, Structures and Component Supports Evaluated in Chapters II and III of the GALL-SLR Report

Item Number	Component	Aging Effect/Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
3.5.1-051	Groups 6: concrete (inaccessible areas): exterior above- and below-grade; foundation; interior slab	Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Plant-specific aging management program, or AMP XI.S6, "Structures Monitoring" enhanced as necessary	Yes (SRP-SLR 3.5.2.2.2.3.3)	Consistent with NUREG-2191. See further evaluation in Section 3.5.2.2.2.3.
3.5.1-052	Groups 7, 8 - steel components: tank liner	Cracking due to SCC; Loss of material due to pitting and crevice corrosion	Plant-specific AMP	Yes (SRP-SLR 3.5.2.2.2.4)	Not applicable. ONS has no stainless steel tank liners in the scope of subsequent license renewal. The associated NUREG-2191 aging items are not used.
3.5.1-053	Support members; welds; bolted connections; support anchorage to building structure	Cumulative fatigue damage due to cyclic loading (Only if CLB fatigue analysis exists)	TLAA, SRP-SLR Section 4.3 "Metal Fatigue," and/or Section 4.7 "Other Plant-Specific Time-Limited Aging Analyses"	Yes (SRP-SLR Section 3.5.2.2.2.5)	~~Consistent with NUREG-2191. The evaluation of fatigue for component support members, anchor bolts, and welds for Groups B1.1, B1.2, and B1.3 component supports is a TLAA as defined in 10 CFR 54.3, and is addressed in SLRA Section 4.3.~~ **Not applicable. There are no support members; welds; bolted connections; or support anchorages to building structure subject to cumulative fatigue damage due to cycle loading in Component Supports.** See further evaluation in Section 3.5.2.2.2.5.

SLRA Table 3.5.2-22 (page 3-1444) is revised as follows:

Table 3.5.2-22 Containments, Structures, and Component Supports – Component Supports – Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG-2192 Table 1	Notes
ASME Piping: Sliding surfaces	SS	Lubrite; Fluorogold; Lubrofluor	Air – Indoor Uncontrolled (External)	Loss of Mechanical Function	ASME Section XI, Subsection IWF (B2.1.30)	III.B1.2.TP-45	3.5.1- 075	A
ASME Piping: Spring hangers, guides and stops	SS	Steel	Air – Indoor Uncontrolled (External)	Loss of Mechanical Function	ASME Section XI, Subsection IWF (B2.1.30)	III.B1.2.T-28	3.5.1- 057	A
			Air – Outdoor (External)	Loss of Mechanical Function	ASME Section XI, Subsection IWF (B2.1.30)	III.B1.2.T-28	3.5.1- 057	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B2.1.4)	III.B1.2.T-25	3.5.1- 089	A,5
ASME Piping: Support members	SS	Stainless Steel	Treated Borated Water (External)	Loss of Material	ASME Section XI, Subsection IWF (B2.1.30)	III.B1.1.TP-10	3.5.1- 090	A,4
					Water Chemistry (B2.1.2)	III.B1.1.TP-10	3.5.1- 090	A,4
		Steel	Air – Indoor Uncontrolled (External)	~~Cumulative Fatigue Damage (Only if CLB fatigue analysis exists)~~	~~TLAA~~	~~III.B1.2.T-26~~	~~3.5.1- 053~~	~~A~~
						~~III.B1.3.T-26~~	~~3.5.1- 053~~	~~A~~
				Loss of Material	ASME Section XI, Subsection IWF (B2.1.30)	III.B1.2.T-24	3.5.1- 091	A

SLRA Table 3.5.2-22 (page 3-1448) is revised as follows:

Table 3.5.2-22 Containments, Structures, and Component Supports - Component Supports - Aging Management Evaluation

Component Type	Intended Function	Material	Environment	Aging Effect	Aging Management Program	NUREG-2191 Item	NUREG-2192 Table 1	Notes
RCS Support: Support members	SS	Steel	Air – Indoor Uncontrolled (External)	~~Cumulative Fatigue Damage (Only if CLB fatigue analysis exists)~~	~~TLAA~~	~~III.B1.1.T-26~~	~~3.5.1- 053~~	~~A~~
				Loss of Material	ASME Section XI, Subsection IWF (B2.1.30)	III.B1.1.T-24	3.5.1- 091	A
			Air with Borated Water Leakage (External)	Loss of Material	Boric Acid Corrosion (B2.1.4)	III.B1.1.T-25	3.5.1- 089	A,5

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ATTACHMENT 5
RAI 4.3.2-1

Enclosure 1, Attachment 5

RAI 4.3.2-1

Regulatory Basis
Pursuant to 10 CFR 54.21(c), the SLRA must include an evaluation of time-limited aging analyses (TLAAs). The applicant must demonstrate that (i) the analyses remain valid for the period of extended operation, (ii) the analyses have been projected to the end of the period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

Background
SLRA Section 4.3.2.2 addresses the fatigue TLAA for the reactor vessel internals (RVIs) as part of the Class 1 metal fatigue evaluations. The applicant indicated that the fatigue analysis addressed in the section is the low-cycle (design transient) fatigue analysis for the replacement bolts that fasten the lower end of the reactor vessel thermal shield to the lower grid assembly. SLRA Section 4.3.2.2 does not address a low-cycle fatigue analysis for the other RVIs.

Issue
The following reference provides the staff-approved, existing fatigue analyses for the applicant's RVIs for 60 years of operation (Reference: BAW-2248A, Demonstration of the Management of Aging Effects for the Reactor Vessel Internals, March 2000, ADAMS Accession No. ML003708443). Section 3.4 of the staff's safety evaluation for BAW-2248A, as contained in BAW-2248A, indicates that Section 4.5 of the BAW-2248A report addresses the low-cycle fatigue TLAA for the RVIs, including the fatigue TLAA for thermal shield replacement bolts.

Specifically, Section 4.5.1 of BAW-2248A states that the "[reactor vessel] internals designers did, however, consider the reactor coolant system functional design requirements when performing their structural design." The section also states that meeting these requirements in the original design meant that the RVIs were implicitly designed for low cycle fatigue based on the projected reactor coolant system design transients. Therefore, BAW-2248 identifies the implicit fatigue analysis as a time-limited aging analysis for the Babcock and Wilcox-designed RVIs.

Accordingly, Section 5.1.5 of BAW-2248A addresses the fatigue in the RVIs and related transient cycle count assumptions. The section states that, since the original RVIs design implicitly considered the reactor coolant system transient cycle assumptions, validation of these assumptions for 60 years of operation will assure the original design intent of the RVIs is maintained. The section also states that, since the design transients applicable for 40 years of operation remain valid for 60 years of operation with no increase in the number of transients anticipated, fatigue of the RVIs, implicit in the original design, is acceptable for 60 years of operation in accordance with 10 CFR 54.21(c)(1)(i).
In relation to the implicit fatigue TLAA, License Renewal Action Item 11 in the staff's safety evaluation for the BAW-2248A report specifies that a license renewal applicant must address the plant-specific plans to continue monitoring and tracking design transient occurrences for the RVIs, which include the thermal shield replacement bolts and the other RAIs.

As discussed above, SLRA Section 4.3.2.2 only addresses the low-cycle fatigue TLAA for the thermal shield replacement bolts, excluding the fatigue TLAA for the other RVIs. Therefore, the fatigue TLAA in SLRA Section 4.3.2.2 is not consistent with BAW-2248A and Action Item 11 of the BAW- 2248A report. Action Item 11 addresses the monitoring activity to ensure that the implicit fatigue TLAA remains valid for the RVIs including the thermal shield replacement bolts. The action item states that the applicant must address the plant-specific plans to continue monitoring and tracking design transient occurrences.

The staff needs additional information to resolve this potential inconsistency between the implicit fatigue TLAA for RVIs identified in BAW-2248A and the staff's safety evaluation for BAW-2248A (including Action Item 11) and the absence of such a TLAA from SLRA Section 4.3.2.2.

In addition, the following reference indicates that the current licensing basis fatigue analysis for RVI bolts is based on the design cycles (18000 cycles each) of the "power loading 8 to 100 percent power" and "power unloading 100 to 8 percent power" design transients (Reference: Table 6 of Framatome Technologies Engineering Information Record 1234566-02, "Fatigue Trackable Component & Transients," May 30, 1996). The staff found a need to clarify whether the fatigue analysis for RVI bolts (including bolts other than thermal shield replacement bolts) is a TLAA.

Request

1. Resolve the potential inconsistency between the implicit fatigue TLAA for RVIs, which is identified in BAW-2248A and the staff's safety evaluation for BAW-2248A (including Action Item 11), and the absence of such a TLAA in SLRA Section 4.3.2.2.

2. Clarify whether the fatigue analysis for RVI bolts (including bolts other than thermal shield replacement bolts), which is addressed in the engineering information record discussed above, is a TLAA. If so, provide the summary and disposition of the TLAA.

Response to RAI 4.3.2-1:

Request 1:

As described in BAW-2248A Sections 2.0 and 4.5, B&W reactor vessel internals were designed and constructed prior to the development of ASME Code requirements for core support structures. However, the structural design did consider the reactor coolant system functional design requirements. Meeting these requirements in the original design meant that the reactor vessel internals were implicitly designed for low cycle fatigue based on the projected reactor coolant system design transients. Transient cycle count assumptions used implicitly in the design of the reactor vessel internals has been identified as a TLAA for SLR.

Revisions to SLRA Section 4.3.2.2, included below, identify that transient cycle count assumptions used implicitly in the design of the reactor vessel internals is a TLAA and provide the TLAA evaluation. The revision also identifies that the TLAA will be managed using the Fatigue Monitoring AMP and dispositioned in accordance with 10 CFR 54.21(c)(iii).

Request 2:

It is confirmed that the explicit fatigue analysis for reactor vessel internals (RVI) bolts, as referred to above, applies only to the thermal shield replacement bolts. The TLAA identification process, described in SLRA Section 4.1, included a comprehensive search of the Oconee current licensing basis for those calculations and analyses that meet the 10 CFR 54.3 definition of a TLAA. Results from the TLAA identification, relative to the RVI bolting, is discussed in detail in ANP-3899NP, Sections 1.0 and 4.0, and describes that the thermal shield replacement bolting is the only applicable RVI bolting TLAA that is based on transient cycle count assumptions. The CUF of the thermal shield replacement bolts reported in ANP-3898P, Section 4.3.3, is based on consideration of Power Loading and Power

Unloading cycles and flow-induced vibration. The current design cycles for each of the Power Loading 8% to 100% Power and Power Unloading 100% to 8% Power design transients is 18,000 cycles. These transients are not logged, since the actual number of plant loadings will be on the order of 1000 events in the plant lifetime and are therefore considered to have an insignificant impact on the fatigue analysis.

SLRA Revisions:

SLRA Section 4.3.2.2 (Page 4-57) is revised as follows:

4.3.2.2 Reactor Vessel Internals

TLAA Description:

As described in BAW-2248A [Reference 4.3-4], Sections 2.0 and 4.5.1, the reactor vessel internals were designed and constructed prior to the development of ASME Code requirements for core support structures. Because of the lack of specific ASME design rules for core support structures at the time of design and construction of the Oconee reactor vessel internals, Section III of the ASME code was used as a guideline for the design criteria for the reactor vessel internals. Qualification of the internals was accomplished by both analytical and test methods. **However, the internals designers did consider the reactor coolant system functional design requirements when performing their structural design. Meeting these requirements in the original design meant that the reactor vessel internals were implicitly designed for low cycle fatigue based on the projected reactor coolant system design transients.** The only specific fatigue analyses performed in the original design were those that addressed flow-induced vibration reported in BAW-10051, Revision 1 [Reference 4.3-7], Section 4.7.1.2, Reactor Vessel Internals Flow Induced Vibration Endurance Limits, herein, addresses this Oconee reactor internals TLAA issue. **In modifications following original design, the projected design transients were used to calculate the ability of the replacement bolting items to withstand cyclic operation without fatigue failure.**

After operations began, Inservice Inspection (ISI) at the three Oconee nuclear plants during 1981 and 1982 revealed failed bolts in the joint fastening the lower end of the reactor vessel thermal shield to the lower grid assembly. These bolts were made of A-286 material. The failed bolts were replaced with X-750 bolting and fatigue analyses were performed for the replacement bolts as reported in BAW-1843PA [Reference 4.3-5]. This topical report summarizes fatigue analyses performed to the ASME code (Section III, Subsection NG) including both high cycle fatigue (flow-induced vibration) and low cycle fatigue (design transients).

The **transient cycle count assumptions used implicitly in the design of the reactor vessel internals and used in the** ASME Section III fatigue evaluations for **the** internal**s** replacement bolting were evaluated in BAW-2248A [Reference 4.3-4] for 60-years and are addressed here **as TLAA** for SLR. ~~The low cycle fatigue (design transients) of the replacement bolting is the only reactor internals component discussed in this section.~~

TLAA Evaluation:

The transient cycles for the reactor internals**, including** replacement bolting, were projected for 80 years of operation as discussed in Section 4.3.1 and the count found to be adequate for the SPEO. As reported in Table 4.3.1-1, the 40-year design cycles (CLB cycles) are postulated to

SLRA Section 4.3.2.2 (Page 4-58) is revised as follows:

4.3.2.2 Reactor Vessel Internals

bound 80 years of plant operation. The Fatigue Monitoring AMP (B3.1) will continue to monitor all design transients. The program will assure that appropriate actions are taken to ensure that **the transient cycle count assumptions used implicitly in the design of the reactor vessel internals are not exceeded, and that** the design CUF values **for the replacement bolting** remain less than unity.

The contribution of flow-induced vibration to the total CUF for replacement bolting, as first reported in BAW-1843PA, was extended to 80-years consistent with the methodology used for the 60-year evaluation using Crandall's method, and is reported in Proprietary Report ANP-3899P, Revision 0 and in Non-Proprietary Report ANP-3899NP, Revision 0 [References 4.3-6 and 4.3-7 respectively]. With consideration of contributions from thermal fatigue and flow induced vibration the total CUF of reactor vessel internals replacement bolting remains less than unity during the SPEO.

Therefore, the fatigue analyses for the reactor internals replacement bolting are projected to have adequate margin in order to remain valid for the SPEO. In order to ensure the design cycles remain bounding for the reactor internals replacement bolting, the Fatigue Monitoring AMP (B3.1) will track cycles for significant fatigue transients listed in Table 4.3.1-1 and ensure corrective action is taken prior to potentially exceeding fatigue design limits.

TLAA Disposition: 10 CFR 54.21(c)(1)(iii):

The effects of fatigue on the intended functions of the reactor vessel internals**, including replacement** bolting**,** have been projected to the end of the SPEO and adequate margin exists. The Fatigue Monitoring AMP (B3.1) will continue to monitor reactor coolant system design transients for the SPEO. Therefore, This TLAA is dispositioned in accordance with 10 CFR 54.21(c)(iii).

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ATTACHMENT 6
RAI 4.3.3-1

Enclosure 1, Attachment 6

RAI 4.3.3-1

Regulatory Basis
Pursuant to 10 CFR 54.21(c), the SLRA must include an evaluation of time-limited aging analyses (TLAAs). The applicant must demonstrate that (i) the analyses remain valid for the period of extended operation, (ii) the analyses have been projected to the end of the period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

Background
SLRA Section 4.3.3 addresses the fatigue TLAA for the non-Class 1 piping systems. In the section, Table 4.3.3-2 provides 80-year thermal cycle projections for the piping systems and the conservative cycle assumptions used in the cycle projections. Specifically, SLRA Table 4.3.3-2 describes the specific cycle numbers associated heatup, cooldown or other relevant cycles, or cycle number per a specific time period (e.g., monthly cycles).

Issue
However, the applicant did not describe how the conservative cycle basis of the cycle projections was determined. The staff needs additional information to clarify the basis of the cycle projections. In addition, the applicant did not describe the number of emergency feedwater actuation cycles per year, which is referenced in SLRA Table 4.3.3-2.

Request
1. Describe how the applicant determined the cycle projection basis for the non-Class 1 piping systems. As part of the response, discuss relevant references that were used to determine the conservative projection basis (e.g., by using the operating procedures, manuals or test requirements for the piping systems).
2. Provide the number of emergency feedwater actuation cycles per year, which is used in the cycle projections, and the basis for the yearly cycle estimate.

Response to RAI 4.3.3-1:

Request 1:

Cycle projections for non-Class 1 piping systems were determined by performing an initial screening of flow diagrams to determine if any of the piping experienced operating temperatures above 200°F for carbon steel or 270°F for stainless steel. Systems below these operating temperatures are screened out as the temperature does not vary significantly for thermal fatigue to be a concern in accordance with industry fatigue management guidelines. System operating characteristics were then determined from a review of design specifications, historical plant data, operating procedures, and specific system level knowledge to quantify system transients such as heat-up/cooldown operations, testing, reactor trips, sampling, and swapping of trains. Transients such as heatups, cooldowns, reactor trips, and HPI actuations which are tracked for the life of the plant, were assumed to occur at their previous rates. Since the nuclear units have become more consistent over time with fewer transients this assumption is conservative. Additional conservatism was built into the projected number of thermal transients for each system by adding a 15% margin factor.

Request 2:

Cycle projections for non-Class 1 piping systems conservatively estimated 20 emergency feedwater actuations per year. The 20 cycles per year is a bounding estimate based on the historical number of emergency feedwater actuations per year. A 15% margin factor is then applied to this number to yield 23 emergency feedwater actuations per year, or a total of 1840 estimated cycles in 80 years of operation.

SLRA Revisions:

None

ENCLOSURE 1

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ATTACHMENT 7
RAI 4.3.3-2

Enclosure 1, Attachment 7

RAI 4.3.3-2:

Regulatory Basis

Pursuant to 10 CFR 54.21(c), the SLRA must include an evaluation of time-limited aging analyses (TLAAs). The applicant must demonstrate that (i) the analyses remain valid for the period of extended operation, (ii) the analyses have been projected to the end of the period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

Background

SLRA Section 4.3.3 indicates that none of the non-Class 1 piping lines in the scope for SLR exceed the allowable number of thermal cycles specified in the ANSI B31.1 Code and, therefore, the stress range reduction factors applied to the piping systems remain valid in all locations. In comparison, SLRA Table 4.3.3-2, Note 1 indicates that the pressurizer sampling piping stress range reduction factor has been reduced from 1.0 to 0.7 to allow a total of 45,000 cycles for the piping.

Issue

SLRA Section 4.3.3 does not clearly address whether the updated stress reduction factor for the pressurizer sampling system (from 1.0 to 0.7) is adequately used in the stress analysis for the piping system and whether the related stress analysis is acceptable.

Request

Clarify whether the thermal expansion stress (S_E) of the pressurizer sampling piping meets the acceptance criteria (i.e., the stress does not exceed the allowable stress range (S_A), as modified by applying the stress reduction factor of 0.7 for the piping). If not, provide justification for why the applicant’s stress analysis results with the updated stress reduction factor are acceptable, including relevant references (e.g., edition and provisions of a code).

Response to RAI 4.3.3-2:

The pressurizer sampling piping meets the code requirements of the 1967 Edition of USAS B31.1 for all three units. The Oconee analysis describes the calculated thermal expansion stress as less than the value of the allowable stress range (S_A) with a stress range reduction factor of 0.7 for Unit 1.

For Units 2 and 3, the Oconee analyses combine the primary and thermal expansion stresses to utilize excess margin in the primary stress allowable (S_h) to offset extra thermal expansion stress for a stress range reduction factor of 0.7. Combination of these additive stresses is allowed by Paragraph 102.3.2 (d) of B31.1. Therefore, the total calculated combined stress for the Unit 2 and 3 sampling piping systems is less than the primary plus thermal expansion allowable stress, thus meeting the B31.1 code requirement.

SLRA Revisions:

None

ENCLOSURE 1

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ATTACHMENT 8
RAI 4.3.3-3

Enclosure 1, Attachment 8

RAI 4.3.3-3:

Regulatory Basis
Pursuant to 10 CFR 54.21(c), the SLRA must include an evaluation of time-limited aging analyses (TLAAs). The applicant must demonstrate that (i) the analyses remain valid for the period of extended operation, (ii) the analyses have been projected to the end of the period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

Background
SLRA Section B3.1 indicates that the high energy line break (HELB) analyses do not exclude break locations based on fatigue so that the Fatigue Monitoring program does not apply to HELB.

Issue
The applicant's discussion in SLRA Section B3.1 does not clearly describe whether the implicit fatigue analysis (SLRA 4.3.3) for the non-Class 1 piping systems, which involves a stress range reduction factor, may have a potential impact on the HELB location postulation.
The following reference indicates that the applicant's HELB location postulation includes a criterion using the allowable stress range for thermal expansion (SA) compared to the thermal expansion stress (Reference: Letter for the Proposed License Amendment Request to Revise the Oconee Nuclear Station Current Licensing Basis for High Energy Line Breaks Outside of the Containment Building, Section 3.4.1, August 28, 2019, ADAMS Accession No. ML19240A814). SA needs to be adjusted by the stress range reduction factor that is based on the implicit fatigue analysis (SLRA Section 4.3.3) for the non-Class 1 piping systems.

Therefore, the staff found a need to clarify whether the implicit fatigue analysis, which involves a stress range reduction factor, is used associated with the HELB location postulation. In addition, the staff finds a need to clarify whether the HELB location postulation does not use cumulative usage factors as an input for the break location determination.

Request
1. Clarify whether the implicit fatigue analysis (SLRA Section 4.3.3) for the non-Class 1 piping systems, which involves a stress range reduction factor, provides an input for the HELB location determination. If so, identify the HELB analysis as a TLAA and provide the disposition of the TLAA with a relevant revision to SLRA Table 4.1.4-2 (TLAA identification) as appropriate.

2. Clarify whether the pressurizer sampling piping is within the scope of the HELB analysis. If so, clarify whether the non-Class 1, implicit fatigue analysis (SLRA Section 4.3.3) for pressurizer sampling piping may have an impact on the HELB location determination.

3. Clarify whether the HELB location postulation uses cumulative usage factors to provide an input for the break location determination. If so, identify the HELB analysis as a TLAA and provide the disposition of the TLAA and its basis.

Response to RAI 4.3.3-3:

Background

Oconee license amendment numbers 421, 423, and 422, which revises the current licensing basis (CLB) for high energy line breaks (HELBs) outside of containment, was effective as of March 15, 2021 (ADAMS Accession No. ML21006A098). The license amendment requires the implementation of required plant modifications by Fall 2026, Fall 2025, and Spring 2026 for Units 1, 2, and 3, respectively. The Oconee Subsequent License Renewal Application submittal dated June 7, 2021 (ADAMS accession No. ML21158A194) was developed from the CLB information that pre-dated the issuance of the HELB license amendment.

In accordance with 10CFR54.21(b), CLB changes during the NRC review of the application that materially affect the application are to be submitted in an amendment each year and at least 3 months before the scheduled completion of the NRC review. In lieu of providing the evaluation of subject CLB as a time-limited aging analyses (TLAA) in the SLRA annual update, that evaluation is provided herein. Since structures and components (SCs) required by the subject CLB change will be installed in the plant at future dates, the impact of these new SCs on the SLRA are not included with this response. These impacts will be addressed when implemented into the plant and will be addressed either in accordance with the requirements of 10CFR54.21(b) (if during the NRC review of the application) or 10CFR54.37(b) (if following the issuance of the renewed license).

Request 1:

The implicit fatigue analysis for the non-Class 1 piping systems provides an input for the HELB location determination. The criteria for identifying high energy piping break locations are as follows:

- HELBs of any type are not postulated on high energy piping that has a nominal size of 1” or less.
- HELBs and critical cracks are not postulated on high energy lines that operate at high energy conditions less than approximately 2% of the total system operating time.
- HELBs and critical cracks are not postulated on high energy lines that operate at high energy conditions less than 1% of the total plant (unit) operating time (normal plant conditions).
- HELBs are postulated at the terminal ends of high energy piping runs.
- There is no American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, Section III, Division 1-Class 1 equivalent piping outside of the containment building.
- For ASME B&PV, Section III-Class 2 and Class 3 equivalent piping that is seismically analyzed, HELBs are postulated at axial locations where the calculated longitudinal stress for the applicable load cases (internal pressure, dead weight (gravity), thermal, and seismic (operating basis earthquake - OBE) conditions) exceeds 0.8(Sh + Sa).
- For ASME B&PV, Section III-Class 2 and Class 3 equivalent piping that is seismically analyzed, critical cracks are postulated at axial locations where the calculated stress for the applicable load cases exceed 0.4(Sh + Sa). Applicable load cases include internal pressure, dead weight (gravity), thermal, and seismic (OBE). Critical cracks are not postulated at locations of terminal ends or intermediate breaks.
- For branch connections where the branch line is included in the seismic stress analysis of the run piping, the stress criteria for seismically analyzed piping lines is used to determine HELBs.
- Breaks and critical cracks at closed valves are postulated as follows. The postulation of terminal end breaks at the first normally closed valve(s) separating portions of a system maintained

pressurized during normal operations and portions of a system not maintained pressurized depends on whether the system has a seismic analysis that is continuous across the valve. For systems or portions of systems that are not seismically analyzed, breaks are postulated to occur at all piping girth welds in the system including those that attach to normally closed valves. For systems or portions of systems that are seismically analyzed, and the analysis is continuous across the normally closed valve, such that stresses can be accurately determined, break and crack locations are determined based on comparison to the intermediate break and crack stress thresholds.

- For piping that is not rigorously analyzed or does not include seismic loadings, HELBs are postulated at intermediate break locations as provided in Branch Technical Position (BTP) Mechanical Engineering Branch (MEB) 3-1, Section B.1.c.(2)(b)(i).
- For branches where both the main and branch runs are unanalyzed or where the stress at the branch connection is not accurately known, break locations are postulated on the branch and run sides of the connection.
- For piping that is not rigorously analyzed or does not include seismic loadings, critical cracks are not postulated since the effects of postulated HELBs on these piping runs will bound the effects from critical cracks.
- Actual stresses used for comparison to the break and crack thresholds are calculated in accordance with the ONS piping code of record, USAS B31.1.0 (1967 Edition). Allowable stress values S_a and S_h are determined in accordance with USAS B31.1.0 or the USAS B31.7 (February 1968 draft edition with errata) code as appropriate.
- Moderate energy line breaks are not postulated. The HELB requirements for ONS Nuclear Station only require compliance to the Giambusso/Schwencer letters. The requirements contained therein do not include postulation of moderate energy line breaks.
- High energy piping lines with an internal pressure at atmospheric or below (< 0 psig) are excluded from damage assessments due to insufficient energy to create pipe whip or jet impingement forces.
- For the Main Steam penetrations into the containment structure, Main Steam HELBs are postulated to occur at the outside face of the concrete containment structure.
- For the Main Feedwater penetrations into the containment structure, Main Feedwater HELBs are postulated to occur on the outside of the containment structure side of the Main Feedwater terminal/rupture/guard pipe restraint.
- For all other ASME B&PV, Section III-Class 2 equivalent piping penetrations into the containment structure, HELBs are postulated to occur at the outside face of the concrete containment structure.

The allowable stress range (S_a) is utilized in the selection of longitudinal breaks and critical cracks. Since S_a involves a stress range reduction factor that depends on the number of thermal cycles, it involves an implicit fatigue analysis. Therefore, the HELB analysis is a TLAA. Accordingly, SLRA Table 4.1.4-2 is revised.

The HELB analysis identifies the following as high energy systems:

- Auxiliary Steam System
- Condensate System
- Extraction Steam System
- Feedwater System
- Heater Drain System
- Heater Vent System
- High Pressure Injection System

- Main Steam System
- Moisture Separator Reheater Drain System
- Plant Heating System
- Reverse Osmosis System
- Steam Drain System
- Steam Seal Header System

For Subsequent License Renewal, the Extraction Steam System is evaluated as the High Pressure Turbine Exhaust and Low Pressure Turbine Extraction systems, the Moisture Separator Reheater Drain System is evaluated within the Heater Drain System. The Reverse Osmosis System is evaluated with the Spent Fuel Cooling System. However, since the Reverse Osmosis System is a high energy system for pressure only, the stress range reduction factor is not used as an input in the selection of HELB locations. Table 4.3.3-2 of the Oconee SLRA indicates the 80 year thermal cycles for all other high energy systems are less than 7,000 cycles. The non-Class 1, implicit fatigue analysis does not impact the selection of HELB locations in these systems as the value of S_a used in the selection of HELB locations based on stress criteria is unchanged. Therefore, the HELB analysis has been projected to the end of the SPEO in accordance with 10CFR54.21(c)(1)(ii). Accordingly, SLRA Section 4.3.3 is revised to document the disposition of the HELB analysis TLAA.

Request 2:

The pressurizer sampling piping is not within the scope of the HELB analysis. The pressurizer sampling piping located outside of containment is less than 1 inch nominal pipe size. HELBs of any type (circumferential breaks, longitudinal breaks, or critical cracks) are not postulated on high energy piping that has a nominal pipe size of 1 inch or less. Therefore, the non-Class 1, implicit fatigue analysis of the pressurizer sampling piping does not impact the determination of HELB locations.

Request 3:

The HELB analysis does not postulate HELB locations based on cumulative usage factor. The HELB analysis evaluated high energy piping located outside of containment for Class 2 and 3 equivalent piping. There is no Class 1 equivalent piping outside of the containment building.

SLRA Revisions:

SLRA Table 4.1.4-2 (page 4-7) is revised as follows:

Table 4.1.4-2: Review of Time-Limited Aging Analyses Listed in NUREG-2192, Table 4.1-2

NUREG-2192, Table 4.1-2 - Generic Time-Limited Aging Analyses	Applies to ONS	SLRA Section
METAL FATIGUE		
Metal Fatigue of Class 1 Components	Yes	4.3.2
Metal Fatigue of Non-Class 1 Components	Yes	4.3.3
Environmentally Assisted Fatigue	Yes	4.3.4
High Energy Line Break Analyses	~~No~~ **Yes** (Note 1)	~~NA~~ **4.3.3**

SLRA Table 4.1.4-2 (page 4-8) is revised as follows:

Table 4.1.4-2: Review of Time-Limited Aging Analyses Listed in NUREG-2192, Table 4.1-2

NUREG-2192, Table 4.1-2 - Generic Time-Limited Aging Analyses	Applies to ONS	SLRA Section
Cycle-Dependent Fracture Mechanics or Flaw Evaluations	Yes	4.3.5
Cycle-Dependent Fatigue Waivers	Yes	4.3.2.9
Environmental Qualification of Electric Equipment	Yes	4.4
Concrete Containment Tendon Prestress	Yes	4.5
Containment Liner Plate, Metal Containments, and Penetrations Fatigue	Yes	4.6

Note 1: A review of the ONS CLB was performed, which included **HELB analyses inside containment and outside containment. HELB analysis inside containment includes** HELB postulation for low pressure injection/decay heat removal piping. For Units 1, 2, and 3, thermal aging was addressed through the lower-bound, unaged J-R curve for submerged arc welds and gas-tungsten arc welds from NUREG/CR-6428. It was also found that an explicit fatigue analysis was not necessary since the stresses at the critical locations are too low to justify a need for a quantitative fatigue crack growth analysis. Therefore, the leak before break analyses for the Units 1, 2, and 3 low pressure injection/decay heat removal piping are not TLAA. **No other HELB analyses inside containment are related to fatigue analyses. However, the selection of break locations in the HELB outside containment analyses are based on an implicit fatigue analyses and are a TLAA.**

SLRA Section 4.3.3 (page 4-65) is revised as follows:

4.3.3 NON-CLASS 1 PIPING FATIGUE ANALYSES

TLAA Description:

within the systems managed by this TLAA, that are designed in accordance with ASME Code, Section VIII, Division 2 requirements.

The stress range reduction factor is utilized as an input in high energy line break (HELB) analyses for the selection of break locations in high energy systems. Therefore, the HELB analysis involves an implicit fatigue analysis and are also TLAAs that require evaluation for subsequent license renewal.

SLRA Section 4.3.3 (page 4-66) is revised as follows:

4.3.3 NON-CLASS 1 PIPING FATIGUE ANALYSES

TLAA Evaluation:

instrument air, low pressure injection, low pressure service water, low pressure turbine extraction, main steam, plant heating, reactor coolant, standby shutdown facility air intake and exhaust, standby shutdown facility diesel lube oil, steam drain, steam seal, and vacuum.

Table 4.3.3-2 provides a summary description of which systems will experience thermal cycles during various modes of operation, along with the 80-year projected number of cycles that will occur. There are no portions of non-class 1 piping in scope for SLR that exceed the allowable number of thermal cycles; therefore, the stress range reduction factors applied to the piping systems remain valid in all locations.

Evaluation of HELB Analyses TLAA

The HELB Analyses TLAA, which utilizes the non-class 1 piping fatigue analyses as input, is evaluated in the discussion below.

In the license amendment dated March 15, 2021 (ADAMS Accession No. ML21006A098), the ONS CLB for HELBs outside containment was revised. The CLB change which was effective with the issuance of the license amendment, required changes to the plant to be implemented by Fall 2026, Fall 2025, and Spring 2026 for Units 1, 2, and 3, respectively. The criteria used in identifying HELB locations were as follows:

a. **HELBs of any type are not postulated on high energy piping that has a nominal size of (1) inch or less.**

b. **HELBs and critical cracks are not postulated on high energy lines that operate at high energy conditions less than approximately 2% of the total system operating time.**

c. **HELBs and critical cracks are not postulated on high energy lines that operate at high energy conditions less than 1% of the total plant (unit) operating time (Normal Plant Conditions).**

d. **HELBs are postulated at the terminal ends of high energy piping runs.**

e. **There is no American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, Section III, Division 1 – Class 1 equivalent piping outside of the containment building.**

f. **For ASME B&PV Section III – Class 2 and Class 3 equivalent piping that is seismically analyzed, HELBs are postulated at axial locations, where the calculated longitudinal stress for the applicable load case (internal pressure, dead weight (gravity), thermal, and seismic (OBE) conditions) exceeds 0.8(S_a +S_h).**

g. **For ASME B&PV Section III – Class 2 and Class 3 equivalent piping that is seismically analyzed, critical cracks are postulated at axial locations where the calculated stress for the applicable load cases exceed 0.4(S_a +S_h). Applicable load cases include internal pressure, dead weight (gravity), thermal, and seismic (OBE). Critical cracks are not postulated at locations of terminal ends or intermediate breaks.**

h. **For branch connections where the branch line is included in the seismic stress analysis of the run piping, the stress criteria for seismically analyzed piping lines is used to determine HELBs.**

i. **Breaks and critical cracks at closed valves are postulated as follows. The postulation of terminal end breaks at the first normally closed valve(s) separating portions of a system maintained pressurized during normal operations and portions of a system not maintained pressurized depends on whether the system has a seismic analysis that is continuous across the valve. For systems or portions of systems that are not seismically analyzed, breaks are postulated to occur at all piping girth welds in the system including those that attach to normally closed valves. For systems or portions of systems that are seismically analyzed, and the analysis is continuous across the normally closed valve, such that stresses can be accurately determined, break and crack locations are determined based on comparison to the intermediate break and crack stress thresholds.**

j. **For piping that is not rigorously analyzed or does not include seismic loadings, HELBs are postulated at intermediate break locations as provided in BTP MEB 3-1, Section B.1.c.(2)(b)(i).**

k. **For branches where both the main and branch runs are unanalyzed or where the stress at the branch connection is not accurately known, break locations are postulated on the branch and run sides of the connection.**

l. **For piping that is not rigorously analyzed or does not include seismic loadings, critical cracks are not postulated since the effects of postulated HELBs on these piping runs will bound the effects from critical cracks.**

m. **Actual stresses used for comparison to the break and crack thresholds are calculated in accordance with the ONS piping code of record, USAS B31.1.0 (1967 Edition). Allowable stress values S_a and S_h are determined in accordance with USAS B31.1.0 or the USAS B31.7 (February 1968 draft edition with errata) code as appropriate.**

n. **Moderate energy line breaks are not postulated. The HELB requirements for ONS only require compliance to the Giambusso/Schwencer letters. The requirements contained therein do not include postulation of moderate energy line breaks.**

o. **High energy piping lines with an internal pressure at atmospheric or below (less than or equal to 0 psig) are excluded from damage assessments due to insufficient energy to create pipe whip of jet impingement forces.**

p. **For the Main Steam penetrations into the containment structure, Main Steam HELBs are postulated to occur at the outside face of the concrete containment structure.**

q. **For the Main Feedwater penetrations into the containment structure, Main Feedwater HELBs are postulated to occur on the outside of the containment structure side of the Main Feedwater terminal/rupture/guard pipe restraint.**

r. **For all other ASME B&PV Section III – Class 2 equivalent piping penetrations into the containment structure, HELBs are postulated to occur at the outside face of the concrete containment structure.**

The term S_a used in criteria f and g above represents the maximum allowable stress range for thermal expansion based on the number of equivalent full temperature cycles and a corresponding stress range reduction factor. The evaluations for required stress range reduction factors are considered an implicit fatigue analysis as they are based on the number of fatigue cycles anticipated for the life of the component. Table 4.3.3-2 provides the results of the evaluation that was performed to determine a conservative number of projected fatigue cycles for 80 years of plant operation for piping systems in the scope of SLR that were designed to the B31.1 piping code. Break locations in high energy systems that are selected based on stress criteria using S_a as an input are based on fatigue cycles that correspond to a stress range reduction factor of 1.0. These projections indicate that the fatigue cycle limits for these piping systems will not be exceeded for the 80 year SPEO. Therefore, the implicit fatigue analyses and the postulated breaks locations in the HELB analyses also remain valid for the SPEO.

SLRA Section 4.3.3 (page 4-71) is revised as follows:

4.3.3 NON-CLASS 1 PIPING FATIGUE ANALYSES

TLAA Disposition: 10 CFR 54.21(c)(1)(ii):

There are no portions of non-class 1 piping in scope for SLR that exceed the allowable number of thermal cycles; therefore, the stress range reduction factors applied to the piping systems remain valid in all locations. The plant analyses has been projected to the end of the SPEO. Therefore, this TLAA is dispositioned in accordance with 10 CFR 54.21(c)(1)(ii).

As the stress range reduction factors remain valid for high energy systems in the HELB analyses, the selection of HELB locations also remains valid for the SPEO. The HELB analyses have been projected to the end of the SPEO. This TLAA is also dispositioned in accordance with 10 CFR 54.21(c)(1)(ii).

SLRA Appendix A4.3.3 (page A-62) is revised as follows:

A4.3.3 Non-Class 1 Piping Fatigue Analysis

For the Oconee non-Class 1 mechanical systems within the scope of SLR, only the piping components have been explicitly designed to consider thermal transient cycle count assumptions that must be revalidated for the extended period of operation. These piping systems are designed to ANSI B31.7 Class II and Class III and ANSI B31.1 requirements where a stress range reduction factor is used based on the number of expected thermal cycles during the period of plant operation. If the total number of expected thermal cycles for a piping system is less than 7,000, then a stress range reduction factor of 1.0 is applied. If the total number of expected thermal cycles for a piping system is greater than 7,000, a stress range reduction factor less than 1.0 is applied to reduce the ~~alternating~~ allowable stress range in the piping design. From review of the design basis and projected 80 year cycles, no portions of non-Class 1 piping exceed the allowable number of thermal cycles. The stress range reduction factors applied to the non-Class 1 piping systems design will remain valid for the extended period of operation in accordance with 10 CFR 54.21 (c)(1)(ii). **The postulation of break locations in high energy systems outside of containment, which uses the stress range reduction factor as an input, will also remain valid for the extended period of operation in accordance with 10 CFR 54.21 (c)(1)(ii).**

ENCLOSURE 1

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ATTACHMENT 9
RAI 4.3.1-1

Enclosure 1, Attachment 9

RAI 4.3.1-1:

Regulatory Basis
Pursuant to 10 CFR 54.21(c), the SLRA must include an evaluation of time-limited aging analyses (TLAAs). The applicant must demonstrate that (i) the analyses remain valid for the period of extended operation, (ii) the analyses have been projected to the end of the period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

Background
SLRA Section 4.3.1 indicates that the fatigue analyses are based upon numbers and amplitudes of thermal and pressure transients in UFSAR Table 5-2, "Transient Cycles for RCS [reactor coolant system] Components Except Pressurizer Surge Line" and UFSAR Table 5-23, "Operating Design Transient Cycles for Pressurizer Surge Line." Specifically, SLRA Table 4.3.1-1 describes the 80-year projected transient cycles in comparison with the design transient cycles that are described in UFSAR Tables 5-2 and 5-23.

In its review, the staff noted that the following transients in UFSAR Table 5-2 are not listed in SLRA Table 4.3.1-1: (1) Transient 3, power loading 8 to 100 percent power; (2) Transient 4, power unloading 100 to 8 percent power; (3) Transient 5, 10 percent step load increase; (4) Transient 6, 10 percent step load decrease; (5) Transient 12, hydrotests; (6) Transient 18, loss of feedwater heater; (7) Transient 19, feed and bleed operations; and (8) Transient 20, miscellaneous transients.

Issue
The SLRA does not clearly discuss why the transients discussed above are excluded from SLRA Table 4.3.1-1 that addresses the transient cycle projection and monitoring for 80-year operation.

Request
1. Justify the exclusion of the following transients from SLRA Table 4.3.1-1 for 80-year transient cycle projections and monitoring: (1) Transient 3, power loading 8 to 100 percent power; (2) Transient 4, power unloading 100 to 8 percent power; (3) Transient 5, 10 percent step load increase; (4) Transient 6, 10 percent step load decrease; (5) Transient 12, hydrotests; (6) Transient 18, loss of feedwater heater; (7) Transient 19, feed and bleed operations; and (8) Transient 20, miscellaneous transients. If a relevant reference is available regarding the transient exclusion, provide the reference, too.

2. If the exclusions of the transients are based on the large allowable transient cycles or insignificant fatigue effect for 80-year operation, discuss (1) why the allowable cycle numbers are large enough to exclude the transients in comparison with the actual cycles and (2) why the fatigue effects of the transients are insignificant.

Response to RAI 4.3.1-1:

Request 1:

The ONS SLRA Table 4.3.1-1 lists the UFSAR transient cycles that tracked per the CLB for 60-years of operation. In a letter dated March 29, 1999, "Forwards supplemental response to NRC RAI 5.4.1-5 to provide additional information on ONS thermal fatigue management program and topics discussed in

990318 telcon" (ML15113A785), Duke energy provided Table 2, which summarized the UFSAR transient events that were excluded from logging (i.e., excluded from thermal fatigue cycle counting). The individual transients identified for exclusion and the reason for exclusion were:

Transient 3 (power loading 8 to 100 percent power), Transient 4 (power unloading 100 to 8 percent power), Transient 5 (10 percent step load increase), Transient 6 (10 percent power decrease), Transient 19 (feed and bleed operations), and Transient 20 (miscellaneous transients) were excluded due to a large number allowable transient cycles.

Transient 12A (Hydrotest RCS) is no longer performed at ONS.

Transient 12B (Hydrotest Secondary) causes no RCS fatigue and therefore is excluded from logging. Transient 18 (loss of feedwater heater) is excluded based on minimal RCS fatigue.

Request 2:

ONS UFSAR Table 5-2, Transient Cycles for RCS Components Except Pressurizer Surge Line, documents the design cycles for each of the reactor coolant system transients. Transients 3 and 4 have an allowable of 18,000 design cycles. Transients 5 and 6 have an allowable of 8,000 design cycles. Transient 19 has an allowable of 4,000 design cycles and Transient 20 contains three miscellaneous cycles with the following allowable design cycles: 20A has an allowable of 30,000 design cycles, 20B has an allowable of 20,000 cycles, and 20C has an allowable of $4x10^6$ design cycles.

The 60-year design cycles that are monitored and tracked by the Fatigue Monitoring Program are listed in SLRA Table 4.3.1-1 and their expected cyclic events are also projected to 80-years of operation. The 80-year projection are below the 60-year design cycles for each of the applicable monitored transients.

Similarly, the six transients listed above are expected to have fewer occurrences. The exclusion of these events will remain valid for 80-years of operation since the reduced numbers of occurrences of these events would still be divided by the large allowable cyclic values and result in insignificant cumulative fatigue usage, consistent with the basis for the original exclusion. Therefore, due to the 80-year projections in Table 4.3.1-1 and the large number of allowable design cycles for Transients 3, 4, 5, 6, 19, and 20, there is reasonable assurance that these transients will continue to not contribute significantly to fatigue and will not exceed their design allowable with current plant operations.

Transient 18, loss of feedwater heater, has an allowable of 620 design cycles and was excluded from tracking for 60-years due to minimal RCS fatigue caused by this transient. Due to the relatively large number of design transients and the fact that there is minimal RCS fatigue caused by this transient, there is reasonable assurance that the design transients for Transient 18 would not be exceeded with current plant operations.

SLRA Revisions:

None

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ATTACHMENT 10
RAI 4.3.1-2

Enclosure 1, Attachment 10

RAI 4.3.1-2:

Regulatory Basis
Pursuant to 10 CFR 54.21(c), the SLRA must include an evaluation of time-limited aging analyses (TLAAs). The applicant must demonstrate that (i) the analyses remain valid for the period of extended operation, (ii) the analyses have been projected to the end of the period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

Background
SLRA Table 4.3.1-1, Note 1 and the related discussion in SLRA Section 4.3.4 indicate that the pressurizer surge line, main steam penetrations, and main feedwater penetrations have a reduced set of transient cycles in comparison with the design transient cycles listed in SLRA Table 4.3.1-1.

Issue
SLRA Sections 4.3.1 and 4.3.4 do not clearly provide the following information: (1) the reduced set of the transient cycles for the pressurizer surge line, main steam penetrations, and main feedwater penetrations and (2) whether the Fatigue Monitoring program will monitor actual cycles against the reduced set of the transient cycles.

Request
1. Provide the reduced set of transient cycles discussed in SLRA Table 4.3.1-1, Note 1 for the pressurizer surge line, main steam penetrations, and main feedwater penetrations. As part of the response, discuss why these transient cycles can reasonably represent the transient cycles for the pressurizer surge line, main steam penetrations, and main feedwater penetrations (e.g., compared to 80-year projected cycles).

2. Clarify whether the Fatigue Monitoring program will perform monitoring to ensure that the actual transient cycles do not exceed the reduced cycles addressed in SLRA Table 4.3.1-1, Note 1. If not, justify why the absence of such monitoring is acceptable to ensure that the actual cycles do not exceed the reduced set of cycles.

Response to RAI 4.3.1-2:

Request 1:

The pressurizer surge line, main steam penetrations, main feedwater penetrations all contain a reduced set of analyzed transient cycles for 60 years of operation as described in SLRA Table 4.3.1-1. For 80-years of operation the pressurizer surge line was evaluated to the requirements of ASME Code, Section XI Appendix L. The Appendix L interval of 10 years was evaluated as the allowable operating period for the pressurizer surge line. The ASME Code, Section XI, Appendix L inspections will be conducted by the Inservice Inspection (ASME Section XI Inservice Inspection, Subsection IWB, IWC, and IWD program (ONS SLRA, Appendix B2.1.1)) program. The inspection locations for the pressurizer surge line are the elbow check “B”, butt weld PSL-6 and PSL-7 as defined in ONS-SLR-TLAA-0306P/NP, Table 4.3.4-3. Each location in the population will be volumetrically inspected using the code required techniques once prior to establishing the Inspection Interval schedule for Units 1, 2, and

3 ASME Code, Section XI, Appendix L locations. Table 1 below shows the transient cycles used in the evaluation for the pressurizer surge line.

Table 1: Transient Cycles for Surge Line

Transient Number	Transient Description (ASME Category)	Design Cycles	Projected Cycles	60-Year Envelope	Analyzed 10-yr Cycles
1A4	Heatup from 70F to 8% Full Power (Type 4)	≤ 51	51	51	9
1A5	Heatup from 120F to 8% Full Power (Type 5)	≤ 260	147	147	25
1B1	Cooldown from 8% Full Power (Type 1)	60	0	0	9
1B2	Cooldown from 8% Full Power (Type 2)	300	149	149	25
2A	Power Change 0 to 15%	1440	260	1440	240
2B	Power Change 15 to 0%	1440	177	1440	240
3	Power Loading 8% to 100% Power	18000	n/a	6000	1000
4	Power Unloading 100% to 8% Power	18000	n/a	6000	1000
7	Step Load Reduction (100% to 8% Power)	310	67	300	50
8A	Reactor Trip, Type A (Loss of RC Flow)	80	14	120	20
8B	Reactor Trip, Type B (High RC Temperature)	172	32	180	30
8C	Reactor Trip, Type C (High RC Pressure)	90	36	120	20
8D	Reactor Trip, Type D (Misc. Other Trips)	70	87	120	20
9	Rapid Depressurization	40	2	60	10
10	Change of RC Flow Rate (Loss of RCP)	412	15	420	70

Notes: Transients #20 are excluded because they do not have any significant stress cycling in the surge line.
Transients #22 are excluded because ONS projects that HPI tests will no longer be performed.

The reduced set of transient cycles for the Main Steam and Main Feedwater Penetrations is contained in SLRA Table 4.6.3-1 on page 4-102 and reproduced below. All allowable cycles in Table 4.6.3-1 are less than the design transients, but greater than the cycles projected for 80 years of operation in SLRA Table 4.3.1-1.

Table 4.6.3-1: ONS Main Steam and Main Feedwater Containment Penetrations

Name	Governing Transient	40-Year Design Allowable Cycles	Refined Allowable Cycles	Current Count[2]	Projected for 80 years[1]
Main Steam Reactor Building Penetrations	1A Heatup[3]	360	262	125	189
	1B Cooldown[3]	360	262	131	197
	Total Reactor Trips[4]	412	262	135	194
Main Feedwater Reactor Building Penetrations	1A Heatup[3]	360	249	125	189
	1B Cooldown[3]	360	249	131	197

Note 1: The projected 80 year cycles are from Table 4.3.1-1
Note 2: The current count is the maximum accrued cycles from each Oconee unit
Note 3: These governing transients include seismic loads
Note 4: The total number of reactor trips comes from the addition of transients 8A, 8B, 8C, and 8D from Table 4.3.1-1

Request 2:

As described in SLRA Section B3.1, Enhancement 1, the Fatigue Monitoring program will be enhanced to require monitoring and tracking of transient cycles associated with the ASME Code, Section XI, Appendix L locations. Therefore, the Fatigue Monitoring program will track the reduced set of cycles for the pressurizer surge line. The Main Steam and Main Feedwater penetration cycles in Table 4.6.3-1 are less than the design transients, but greater than the cycles projected for 80 years of operation in SLRA Table 4.3.1-1. The reduced set of allowable transient cycles for the Main Steam and Main Feedwater penetrations will be monitored and tracked in the Fatigue Monitoring program and will be subject to the same cycle counting surveillance limits described in SLRA Section B3.1.

SLRA Revisions:

None

ENCLOSURE 1

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ATTACHMENT 11
RAI 4.3.1-3

Enclosure 1, Attachment 11

RAI 4.3.1-3:

Regulatory Basis
Pursuant to 10 CFR 54.21(c), the SLRA must include an evaluation of time-limited aging analyses (TLAAs). The applicant must demonstrate that (i) the analyses remain valid for the period of extended operation, (ii) the analyses have been projected to the end of the period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

Background
UFSAR Table 5-2, Note 2 indicates that, in order to analytically demonstrate a usage factor of less than 1.0, certain welds associated with the emergency high pressure injection (HPI) nozzles have been qualified for fewer than the design number of cycles of two transients as follows. Specifically, the sum of the cycles of the “manual actuation of HPI system after reactor trip” transient (Transient 8) and the cycles of “rapid depressurizations” transient (Transient 9) cannot exceed 29 cycles.

Similarly, Note 7 of UFSAR Table 5-2 explains that the reactor vessel closure head assemblies are limited to 5000 cycles of “power loading and unloading” transient (Transients 3 and 4) and 15 cycles of “hydrotests” transient (Transient 12).

Issue
In contrast, SLRA Table 4.3.1-1 does not include the design transients that have the reduced set of transient cycles that are specified in Notes 2 and 7 of UFSAR Table 5-2. The staff needs to resolve this potential inconsistency.

Request
1. Clarify whether the reduced transient cycles specified in Notes 2 and 7 of UFSAR Table 5-2 are also applied to SLRA Table 4.3.1-1 that describes the design cycles and cycle projections for subsequent license renewal fatigue monitoring.

2. If there are additional components for which reduced transient cycles are applied (other than HPI nozzles and the reactor vessel closure head assemblies), identify the components and the reduced transient cycles. The response to this request may exclude the discussion on the pressurizer surge line, main steam penetrations and main feedwater penetrations, which are addressed in a separate RAI.

3. Clarify whether the Fatigue Monitoring program will perform monitoring to ensure that the actual transient cycles do not exceed the reduced cycles addressed in request items 1 and 2 above. If not, justify why the Fatigue Monitoring program does not monitor the reduced transient cycles (such as reduced cycles for Transients 8 and 9 and Transients 3, 4 and 12).

Response to RAI 4.3.1-3:

Request 1:

The current ONS UFSAR Table 5-2, Notes 2 and 7, describe the Allowed Operating Transient Cycles (AOTC) basis for tracking the HPI and reactor vessel head components that are designed to less than the 60-year design transients as of 2004. The notes in this table have been updated to reflect additional OE and EAF considerations for these components as part of subsequent license renewal. The UFSAR change was effective on May 22, 2021 and will be reflected in UFSAR Revision 29. The UFSAR change states, in part:

> "Table 5-2 Note 2 should be revised to state, "Some components are evaluated to less than the design number of cycles and are tracked within the ONS Thermal Fatigue Management Program. The number of actual events are expected to remain below the analyzed number of events throughout the current 60-year plant life." To be consistent, a similar note should be added to Table 5-23."

For clarity, the Thermal Fatigue Management Program referenced in the above UFSAR change is the Fatigue Monitoring Program for subsequent license renewal.

In conclusion, the UFSAR Table 5-2 and 5-23 notes have been modified to simply reference the ONS Fatigue Monitoring Program for tracking and managing all components that are designed to less than the full number of design cycles. The expected number of operating cycles for 80 years, which are expected to be bounded by the design cycle numbers, is contained in Table 4.3.1-1 of the SLRA.

Request 2:

The ONS components that contain a reduced set of allowable transient cycles, with exception to the components listed above, are the CRDM welds and a portion of the Full Structural Weld Overlays (FSWO) population. The CRDM welds are discussed in RAI 4.3.4-4. The FSWOs that contain a reduced number of transient cycles are discussed in RAI 4.3.1-4.

Request 3:

The Fatigue Monitoring Program tracks those components with reduced transient cycles, just as it tracks those components qualified to the allowed design cycle events. The tracking is performed in the same manner for each of the described components above. The Fatigue Monitoring Program will ensure both the design cycles, as well as, the reduced set of allowed cycles will not be exceeded during the subsequent license renewal period of extended operation for any tracked component. Surveillance limits are set for the program, and if exceeded a corrective action will be initiated.

RAI 4.3.1-1 discusses why the Fatigue Monitoring Program is not required to monitor operating transient cycles for Transient 3 (Power Loading), Transient 4 (Power Unloading), and Transient 12 (Hydrotests).

Transient 8 (Reactor Trips) and Transient 9 (Rapid Depressurization) are monitored and tracked within the Fatigue Monitoring Program as described in the first paragraph in Item 3 above.

SLRA Revisions:

None

ENCLOSURE 1

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ATTACHMENT 12
RAI 4.3.1-4

Enclosure 1, Attachment 12

RAI 4.3.1-4:

Regulatory Basis

Pursuant to 10 CFR 54.21(c), the SLRA must include an evaluation of time-limited aging analyses (TLAAs). The applicant must demonstrate that (i) the analyses remain valid for the period of extended operation, (ii) the analyses have been projected to the end of the period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

Background

SLRA Section 4.3.5 addresses the analytical evaluation of flaws for the 80-year operation. The section indicates that the flaws identified for initial license renewal have been re-evaluated or the component containing the flaw has been replaced. SLRA Section 4.3.5 also explains that these reanalyzed flaws are now acceptable for their full controlling design basis transient cycles as discussed in Section 4.3.1.

Issue

In comparison, UFSAR Table 5-2, Note 1 indicates that certain components have flaw tolerance evaluations (as addressed in UFSAR Sections 5.2.2 and 5.2.3.12.4) and that these evaluations assume a reduced number of heatup and cooldown cycles. Therefore, the staff finds a need to further confirm that the analytical evaluations of the flaws discussed in SLRA Section 4.3.5 use the design transient cycles identified in SLRA Section 4.3.1 without using a reduced set of transient cycles. The staff needs a similar confirmation for the weld overlay fatigue analysis discussed in SLRA Section 4.3.6.

Request

1. Clarify whether the analytical evaluations of the flaws discussed in SLRA Section 4.3.5 use the design transients and cycles identified in SLRA Section 4.3.1 without assuming a reduced set of transient cycles. If not, identify the reduced set of transient cycles and discuss why the reduced cycles can reasonably represent the transient cycles for the flaws.

2. Clarify whether the transients and cycles used in SLRA Section 4.3.6 (weld overlay fatigue analysis) are consistent with the design transients and cycles identified in SLRA Table 4.3.1-1. If not, identify the reduced set of transient cycles and discuss why the reduced cycles can reasonably represent the transient cycles for the weld overlays.

3. Clarify whether a certain fraction of the design cycles is used for the flaw evaluation or weld overlay fatigue analysis (e.g., the 60-year design cycles were divided by 6 to estimate the cycles for the 10-year inspection interval cycles). If so, clarify whether the inspection frequency for the flaws and weld overlays is consistent with the time period corresponding to the certain fraction of the design cycles in order to ensure the component integrity.

4. Clarify whether the Fatigue Monitoring program will ensure that the actual transient cycles do not exceed the transient cycles that are assumed in the flaw evaluations and weld overlay fatigue analysis. If not, provide the justification.

Response to RAI 4.3.1-4:

Request 1:

SLRA Section 4.3.5 describes that the results of the SLR review of applicable flaw growth analyses identified for initial license renewal found that all flaws, where reduced numbers of acceptable cycles did require management under the Thermal Fatigue Management Program (known as the Fatigue Monitoring AMP for SLR), have since been re-evaluated, or the component containing the flaw was replaced. The Inservice Inspection record review for the time period since initial license renewal identified only one additional indication, which was in a High Pressure Injection piping weld in Unit 1. This flaw evaluation determined that the flaw would be acceptable for the full controlling design basis transient cycles identified in SLRA Section 4.3.1. It is confirmed that the analytical evaluations of the flaws discussed in the SLRA Section 4.3.5 use the design transients and cycles identified in SLRA Section 4.3.1 with no assumption of a reduced set of transient cycles for 80 years.

Request 2:

There are eight full structural weld overlays (FSWOs) on each of the three Oconee Units for a total of 24 FSWOs. For the purposes of this discussion, the transient cycles used in the weld overlay fatigue analyses for all 24 of the FSWO components belong in one of three categories:

a. Fifteen of the FSWO components are qualified to the full 60-year set of design transient cycles
    i. Pressurizer Spray (Units 1, 2, and 3)
    ii. Three Safety/Relief Valves (Units 1, 2, and 3)
    iii. Hot Leg Surge Nozzle (Unit 1)
    iv. Cold Leg Letdown FSWO with long radii elbows, (Units 1 and 2)
b. Four of the FSWO components were designed with 60-year design cycles but are qualified to less than 60 years of operation
    i. Hot Leg Decay Heat (Units 1, 2 and 3) circumferential flaws are qualified for 60 years, but the axial flaws are qualified for 33 years
    ii. Cold Leg Letdown FSWO (Unit 3) with short radius elbow - the circumferential flaw is qualified for 60 years, but the axial flaw is qualified for 18 years
c. Five of the FSWO components are qualified with an approach that divided the 60-year set of design cycles by a factor of 6 and applied the resulting cycles to the fatigue analyses for the following weld overlays:
    i. Hot Leg Surge Nozzle (Units 2 and 3)
    ii. Pressurizer Surge Nozzle (circumferential flaw only) (Units 1, 2, and 3)

Based on the 80-year projections for operating cycles as provided in SLRA Table 4.3.1-1, the projected cycles for the FSWOs qualified using 60-year design cycles, as described above, are clearly bounded.

In addition, all of the FSWOs accumulate actual cycles at a rate below that implied by the design cycle rate. As such, the nine FSWOs described above in categories “b” and “c” are expected to have a service life beyond that implied by a 10-year, 18-year or 33-year design period. Therefore, it is reasonable to conclude that the reduced design cycles used in the qualification of these FSWOs will bound, or represent, the expected number of accumulated transient cycles.

Request 3:

All of the analytical flaw evaluations as discussed in SLRA Section 4.3.5 are qualified for their full controlling design basis transient cycles as described in the response to RAI 4.3.1-4, Item 1, above. The design cycles used in the fatigue analyses for the FSWOs, including those locations that were qualified to a reduced number of cycles, are described in the response to RAI 4.3.1-4, Item 2, above.

At the time when five FSWOs were qualified to 1/6 of the 60-year design cycles and four FSWOs were qualified to less than 60 years of operation, it was concluded that the qualified service life for these components was adequate. This was based, in part, on the fact that the Oconee Units are accumulating operational cycles at a rate lower than the 60-year design cycle rate. This is demonstrated in SLRA Table 4.3.1-1, which clearly shows that Oconee will accumulate less than 55% of the 60 year design cycles projected to 80 years of operation, with the exception of the 8D Reactor Trips, which are projected to be less than 84% of allowable. Therefore, using 1/6 of the design cycles results in an actual service life well over 10 years.

Based on a review of the Augmented Inservice Inspection Program for the 5th Interval, it was determined that 25% of the 24 FSWOs are volumetrically examined per the requirements of ASME Code Case N-770-5. This Code Case added the 25% sample of the FSWOs (two per Unit) to the Augmented Inservice Inspection Program, primarily based on those FSWOs with the highest service temperature.

To reconcile the design cycle and periodic inspection considerations and to ensure component integrity for 80 years, an enhancement to the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD AMP will revise program documents to: (a) specify volumetric inspections for each inspection interval for those FSWO components qualified to 1/6 of the 60-year design cycles (i.e., Units 2 and 3 Hot Leg Surge Nozzles and Units 1, 2, and 3 Pressurizer Surge Nozzles); and (b) specify volumetric inspections at a frequency that ensures the qualified life is not exceeded between inspections for those FSWO components qualified to less than 60 years of operation (i.e., Units 1, 2, and 3 Hot Leg Decay Heat FSWOs and Unit 3 Cold Leg Letdown FSWO).

Request 4:

The Fatigue Monitoring AMP tracks cycles for those components qualified to the full set of design transient cycles so that their cycles will be maintained below design cycle limits. This includes the analytical flaw evaluations described in the response to RAI 4.3.1-4, Item 1, above; and includes the fifteen FSWOs that are qualified to the full 60-year set of design transient cycles described in the response to RAI 4.3.1-4, Item 2, above.

The Fatigue Monitoring AMP also provides guidance for tracking cycles relative to fatigue crack growth calculations for which reduced cyclic limits apply. For those five FSWO components qualified to 1/6 of the 60-year design cycles, their cycles are tracked to ensure that their actual operating cycles remain below the 1/6 design cycle values. This tracking also ensures that these five FSWOs are not operated beyond their design set of allowed transient cycles.

Regarding the four FSWO components qualified for less than 60 years of operation, the Units 1, 2 and 3 Decay Heat FSWOs and Unit 3 Letdown FSWOs were installed in Fall 2009, Fall 2011, Fall 2007 and Fall 2010, respectively. In addition, the Unit 3 Decay Heat FSWO was inspected under ASME Code Case N-770-5 during Spring 2018, with no identified indications. Therefore, the service life for these four FSWOs is currently Fall 2043, Fall 2045, Spring 2051, and Fall 2028, respectively. The Fatigue Monitoring AMP tracking of cycles relative to these four FSWOs will also ensure that they are not operated beyond their design set of allowed transient cycles.

Therefore, the Fatigue Monitoring AMP will ensure that either the full set of design cycles, or the reduced set of allowed cycles, as applicable for the specific FSWO, will not be exceeded during subsequent period of extended operation for any tracked component.

Conclusion:

Revisions to SLRA Sections A2.1, A6.0, and B2.1.1, included below, describe that an enhancement of the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD AMP will revise program documents to: (a) specify volumetric inspections for each inspection interval for those FSWO components qualified to 1/6 of the 60-year design cycles (i.e., Units 2 and 3 Hot Leg Surge Nozzles and Units 1, 2, and 3 Pressurizer Surge Nozzles); and (b) specify volumetric inspections at a frequency that ensures the qualified life is not exceeded between inspections for those FSWO components qualified to less than 60 years of operation (i.e., Units 1, 2, and 3 Hot Leg Decay Heat FSWOs and Unit 3 Cold Leg Letdown FSWO).

SLRA Revisions:

SLRA Appendix A2.1 (page A-4) is revised as follows:

A2.1 ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD

Enhancements

The *ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD* AMP will be enhanced to:

1. Revise procedures to require inspections to be performed for components associated with the sentinel locations assessed under ASME Code, Section XI, Non-Mandatory Appendix L for the following:

    - Reactor coolant system pressurizer surge line piping (hot leg elbow).
    - High pressure injection piping, stop valve-to-check valve (usage bounds high pressure injection nozzle).

2. **Revise program documents to: (a) specify volumetric inspections for each inspection interval for those FSWO components qualified to 1/6 of the 60-year design cycles (i.e., Units 2 and 3 Hot Leg Surge Nozzles and Units 1, 2, and 3 Pressurizer Surge Nozzles); and (b) specify volumetric inspections at a frequency that ensures the qualified life is not exceeded between inspections for those FSWO components qualified to less than 60 years of operation (i.e., Units 1, 2, and 3 Hot Leg Decay Heat FSWOs and Unit 3 Cold Leg Letdown (FSWO).**

SLRA Table A6.0-1 (page A-73) is revised as follows:

Table A6.0-1: Subsequent License Renewal Commitments

#	Program	Commitment	AMP	Implementation
1	*ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD* program	The *ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD* AMP is an existing program that will be enhanced to: 1. Revise procedures to require inspections to be performed for components associated with sentinel locations assessed under ASME Code, Section XI, Non-Mandatory Appendix L for the following: • Reactor coolant system pressurizer surge line piping (hot leg elbow). • High pressure injection piping, stop valve-to-check valve (usage bounds high pressure injection nozzle). **2. Revise program documents to: (a) specify volumetric inspections for each inspection interval for those FSWO components qualified to 1/6 of the 60-year design cycles (i.e., Units 2 and 3 Hot Leg Surge Nozzles and Units 1, 2, and 3 Pressurizer Surge Nozzles); and (b) specify volumetric inspections at a frequency that ensures the qualified life is not exceeded between inspections for those FSWO components qualified to less than 60 years of operation (i.e., Units 1, 2, and 3 Hot Leg Decay Heat FSWOs and Unit 3 Cold Leg Letdown (FSWO).**	B2.1.1	Program enhancements for SLR will be implemented six months prior to the SPEO.

SLRA Appendix B2.1.1 (pages B-23 and B-24) is revised as follows:

Enhancements

Prior to the SPEO, the following enhancement(s) will be implemented in the following program element: Detection of Aging Effects (Element 4).

1. Procedures will be revised to require inspections to be performed for components associated with sentinel locations assessed in accordance with ASME Code, Section XI, Non-Mandatory Appendix L:

   a. Reactor coolant system pressurizer surge line piping (hot leg elbow).
   b. High pressure injection piping, stop valve-to-check valve (usage bounds high pressure injection nozzle).

2. Revise program documents to: (a) specify volumetric inspections for each inspection interval for those FSWO components qualified to 1/6 of the 60-year design cycles (i.e., Units 2 and 3 Hot Leg Surge Nozzles and Units 1, 2, and 3 Pressurizer Surge Nozzles); and (b) specify volumetric inspections at a frequency that ensures the qualified life is not exceeded between inspections for those FSWO components qualified to less than 60 years of operation (i.e., Units 1, 2, and 3 Hot Leg Decay Heat FSWOs and Unit 3 Cold Leg Letdown (FSWO).

ENCLOSURE 1

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ATTACHMENT 13
RAI 4.3.4-1

Enclosure 1, Attachment 13

RAI 4.3.4-1:

Regulatory Basis

Pursuant to 10 CFR 54.21(c), the SLRA must include an evaluation of time-limited aging analyses (TLAAs). The applicant must demonstrate that (i) the analyses remain valid for the period of extended operation, (ii) the analyses have been projected to the end of the period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

Background

SLRA Section 4.3.4, as supplemented by the SLR-ONS-TLAA-0306NP report, discusses the environmentally-assisted fatigue (EAF) screening process to determine the leading EAF locations. The section indicates that, to reduce excess conservatism for stainless steel location due to the very large maximum F_{en} (environmental fatigue correction factor), an estimated F_{en} is calculated as the average of the value based on a qualitative estimate of strain rate and the value based on the worst possible strain rate.

Issue

The staff needs to clarify the meanings of (1) the qualitative estimate of strain rate and (2) the worst possible strain rate.

Request

1. Clarify the meanings of (1) the qualitative estimate of strain rate and (2) the worst possible strain rate in the discussion on the reduction of the excessive conservatism.
2. For the other materials (e.g., carbon steel and nickel alloy), discuss how the strain rate is determined in the F_{en} calculations.

Response to RAI 4.3.4-1:

Request 1:

The EAF screening was performed following guidance in EPRI report 1024995, “Environmentally Assisted Fatigue Screening: Process and Technical Basis for Identifying EAF Limiting Locations.” As per page 3-6 of EPRI report 1024995, a qualitative “best estimate” of strain rate is determined based on experience with similar systems and transients rather than calculating specific quantitative strain rates. The “worst possible” estimate of strain rate is the saturation value of strain rate that results in the highest possible contribution to the F_{en} value (see response to item 2). The estimated F_{en} was then calculated based on an average of the F_{en} values associated with (1) the best estimate strain rate and (2) the saturation strain rate value.

Request 2:

For each material, there is a saturation value of strain rate (typically < 0.001 %/sec for carbon and low-alloy steel and < 0.0004 %/sec for stainless steels and nickel-based alloys) below which the F_{en} value does not increase further. The saturation value for carbon steel and nickel alloy materials was used, as applicable in the F_{en} calculations.

SLRA Revisions:

None

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ATTACHMENT 14
RAI 4.3.4-2

Enclosure 1, Attachment 14

RAI 4.3.4-2:

Regulatory Basis
Pursuant to 10 CFR 54.21(c), the SLRA must include an evaluation of TLAAs. The applicant must demonstrate that (i) the analyses remain valid for the period of extended operation, (ii) the analyses have been projected to the end of the period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

Background
SLRA Section 4.3.4, as supplemented by the SLR-ONS-TLAA-306NP report, indicates that, for locations where the conservatively determined screening CUF_{en} (environmental cumulative usage factor) exceeded 1.0, further evaluations were performed in accordance with NUREG/CR-6909, Revision 1.

Issue
The SLRA does not clearly discuss how the conservatism associated with the screening CUF_{en} calculation has been removed in the further evaluations.

Request
Discuss how the conservatism associated with the screening CUF_{en} calculation has been removed to refine the calculations in the further evaluations.

Response to RAI 4.3.4-2:

The SLR-ONS-TLAA-306NP report states, in part, *"Furthermore, conservatism added as part of initial screening for F_{en} values for stainless steel were removed as part of the analysis for 80-years of operation."* Since only some conservatisms were removed, it would be more accurate if the word *"conservatism"* in this statement were to be replaced with the words *"some conservatisms."*

For EAF screening, the maximum F_{en} value was calculated by adjusting the parameters used to calculate F_{en} (strain rate, dissolved oxygen, temperature) to obtain a conservative F_{en} value for a given thermal zone. For ONS EAF Screening, the maximum temperature and the average of best estimate and saturated strain rate was used. See response to RAI 4.3.4-1.

When EAF Screening calculations resulted in a CUF_{en} value greater than 1.0, the conservativisms used in the screening CUF_{en} calculations were reduced by refining the computation of the F_{en} and, if necessary, CUF values used in the analyses.

CUF values were reduced in some instances by reducing the number of operating cycles through the use of projected cycles for 80-years of operation based on the rate of cycle accumulation or where the component was replaced after many years of service. F_{en} values were reduced by use of service temperatures in lieu of maximum design temperature and use of a F_{en} value of 1 where load pair alternating stresses were below the threshold value.

Therefore, ONS reduced some conservatisms by use of projected operating cycles or refining F_{en} values based on more accurate service temperatures and strain rates.

SLRA Revisions:

None

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ATTACHMENT 15
RAI 4.3.4-3
[NON-PROPRIETARY]

Enclosure 1, Attachment 15
[Non-Proprietary]

Note: Text that is within brackets is proprietary to Framatome, Inc.

RAI 4.3.4-3:

Regulatory Basis
Pursuant to 10 CFR 54.21(c), the SLRA must include an evaluation of TLAAs. The applicant must demonstrate that (i) the analyses remain valid for the period of extended operation, (ii) the analyses have been projected to the end of the period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

Background
SLRA Section 4.3.4, as supplemented by the SLR-ONS-TLAA-306NP report, indicates that the high pressure injection (HPI) piping stop valve-to-check valve location is bounding for the HPI nozzle that is identified in NUREG/CR-6260 as one of the leading locations for EAF in Babcock and Wilcox designed plants.

Issue
The staff needs the F_{en} (environmental fatigue correction factor) and CUF_{en} values of these piping locations for 80 years to confirm the adequacy of the applicant's evaluation.

Request
1. Provide the F_{en} and CUF_{en} values of the HPI stop valve-to-check valve weld and HPI nozzle to confirm that the HPI stop valve-to-check valve weld is bounding for the HPI nozzle in the EAF analysis. In addition, describe the fabrication materials of these welds.

2. If periodic inspections are performed on these welds (e.g., inspections on nickel alloy locations), describe the inspection method, frequency and results to confirm that the inspection results are consistent with the fatigue analysis (e.g., absence of fatigue cracking).

Response to RAI 4.3.4-3:

Request 1:

The HPI stop valve-to-check valve is immediately upstream of the HPI Nozzles A1, A2, B1, and B2 on all 3 ONS Units. The higher usage for the HPI stop valve-to-check valve is on the HPI Emergency Lines B1/B2; the usage on makeup lines A1/A2 is less due to less severe thermal transients. The piping from the HPI nozzle safe end to the stop check valve was replaced on all four lines and all 3 Oconee Units during the 1997-1998 timeframe following the leak on Nozzle 2A1. The adjusted approximate environmental cumulative usage factor discounting the period prior to 1998 yields a usage factor of 3.38. This usage factor was calculated using the general equation for the fatigue life correction factor (F_{en}) from NUREG/CR-5704. The F_{en} value for the HPI stop valve-to-check valve is **[ ]**$_{b,c,d,e}$. Due to the large estimated environmental cumulative usage factor, there was no expected benefit from evaluating this location using NUREG/CR-6909, Revision 1. The fatigue usage at this location bounds that of the HPI nozzle pipe to safe end weld, the limiting location for all the HPI nozzle components.

The HPI piping nozzle is a NUREG/CR-6260 location for which a detailed analysis was performed as part of 60-year license renewal. Following the 2013 November leak on the ONS Unit 1 1B2 HPI piping to nozzle safe end, the nozzle was reanalyzed using as-found weld geometry; this analysis used ASME 1983 Code rules and F_{en} expressions from NUREG/CR-5704. This resulted in an adjusted approximate environmental cumulative usage factor discounting the period prior to 1998 yields a usage factor of 2.38. The F_{en} value for the HPI nozzle pipe-to-safe end weld is **[ ]**$_{b,c,d,e}$.

All the valve-to-valve butt welds on all four HPI lines for all three Oconee Units is fabricated with 316 stainless steel weld material.

The HPI nozzles on all three Units are fabricated from SA 105 Grade 2 carbon steel material. The stainless steel HPI safe ends are fabricated from SA 312, 336 or 479 material, welded to the carbon steel HPI nozzles with dissimilar metal butt welds of either 82/182 or 52/152 weld material. The safe ends are attached to the 312 stainless steel piping with 316 stainless steel butt welds.

Request 2:

The HPI stop valve-to-check valve is a site-committed location for NRC Bulletin 88-08. The location cannot be fully inspected with UT and is supplemented by an RT exam. As documented in the Oconee Nuclear Station – Augmented Inservice Inspection NDE Plan – General Requirements and Units Detail Listing, the Thermal Fatigue IEB 88-08 Exams (Item Number Series: G4.1) are performed once per inservice inspection interval, but not to exceed every other outage.

The Unit 1 HPI stop valve-to-check valve examinations were last performed during the O1R30 refueling outage in the Fall of 2018. The results of these examinations show that they were accepted with no relevant indications for both the UT and RT examinations.

The Unit 2 HPI stop valve-to-check valve examinations were last performed during the O2R29 refueling outage in the Fall of 2019. The results of the examinations were acceptable with no relevant indications for both the UT and RT exams.

The Unit 3 HPI stop valve-to-check valve examinations were last performed during O3R30 refueling outage in the Spring of 2020. The results of the examinations were acceptable with no relevant indications for both the UT and RT examinations.

The HPI Nozzle Safe End examination is performed as part of the Generic Letter 85-20 Exams (Item Number Series: G2.1) as part of the Augmented Inservice Inspection program. The HPI Nozzle-to-Safe End welds are inspected as part of the ASME Code Case N-770-5 exams (Item Number Series: G12.1). As documented in the Oconee Nuclear Station – Augmented Inservice Inspection NDE Plan – General Requirements and Units Detail Listing, the examinations on the HPI Nozzle Safe End examinations are performed every other refueling outage. The HPI Nozzle-to-Safe End welds examination is performed every other inspection period, not to exceed 7 years.

The last examinations on the ONS Unit 1 HPI nozzles were performed as part of the O1R30 refueling outage in the Fall of 2018. The HPI Nozzle inspections (G2.1) inspections were all acceptable with no relevant indications with the exception of 1B2 thermal sleeve RT examination. This examination reported that the gap length between the outer sleeve and safe end had a gap increase greater than 1/8 of an inch. This was evaluated by engineering and found acceptable. The HPI Nozzle-to-Safe End welds (G12.1) examinations reported that there were no service-induced flaw indications reported on any of the four dissimilar metal welds. No fabrication flaws exceeding the acceptance standards of ASME Code, Section XI, IWB-3514 (2007 Edition with Addenda through 2008) were detected.

The Unit 2 HPI Nozzle examinations (G2.1) were last performed in the O2R29 refueling outage in the Fall of 2019. All examinations were acceptable with no relevant indications. The Unit 2 HPI Nozzle-to-Safe End Welds (G12.1) were last examined during the 2EOC27 refueling outage in the Fall of 2015. The UT examination yielded no service induced indications and the examination was acceptable.
The Unit 3 HPI Nozzle examinations (G2.1) were last performed in the O3R30 refueling outage in the Spring of 2020. The results of the examinations were acceptable with no relevant indications. The Unit 3 HPI Nozzle-to-Safe End welds were last examined during the 3EOC28 refueling outage in the Spring of 2016. There was one relevant indication on the 3-RC-212-53V, HPI Safe End-to-Nozzle Alloy 600 dissimilar metal weld. The indication was previously identified in the Spring of 2014 and was evaluated during the 3EOC27 refueling outage as a fabrication related embedded flaw. The flaw was evaluated again in the 3EOC28 refueling outage to the requirements of ASME Code, Section XI, IWB-3640 and was found to be acceptable.

SLRA Revisions:

None

Associated Enclosures:

See Enclosure 2, Attachment 1 for Affidavit.

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ATTACHMENT 16
RAI 4.3.4-4

Enclosure 1, Attachment 16

RAI 4.3.4-4:

Regulatory Basis

Pursuant to 10 CFR 54.21(c), the SLRA must include an evaluation of TLAAs. The applicant must demonstrate that (i) the analyses remain valid for the period of extended operation, (ii) the analyses have been projected to the end of the period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

Background

Table 4.3.4-1 of SLRA Section 4.3.4, as supplemented by the SLR-ONS-TLAA-306NP report, addresses the leading EAF locations. The table indicates that the control rod drive mechanism (CRDM) weld is part of the reactor vessel closure head (RVCH) replacement. The table also indicates that the 80-year CUF of the CRDM weld is based on reduced “power loading/unloading” cycles. The table further states that the “power loading/unloading” transients are excluded from the Fatigue Monitoring program, which will require reconsideration if the applicant implements flexible power operation (i.e., operation involving load-following).

Issue

Given the reduced “power loading/unloading” cycles used in the CUF_{en} calculation, the staff notes that the transients may need to be monitored by the Fatigue Monitoring program to ensure that the projection basis with the reduced cycles remains valid. However, these transients are excluded from the fatigue monitoring. The staff also needs to clearly identify the specific CRDM weld discussed in Table 4.3.4-1 of SLRA Section 4.3.4.

Request

1. Describe which weld of the CRDM is specifically referenced in Table 4.3.4-1 of SLRA Section 4.3.4 (e.g., reactor vessel head penetration nozzle weld or CRDM housing weld above the reactor vessel head closure).

2. Describe the reduced cycles and 80-year projected cycles for the CRDM welds to confirm that the reduced cycles are comparable to the 80-year projected cycles.

3. Provide justification for excluding the “power loading/unloading” transients from the fatigue monitoring even though the reduced cycles are used in the CUF_{en} calculation for the CRDM weld. If it cannot be justified, include the power loading/unloading transients in the scope of the Fatigue Monitoring program to ensure the cycle projection basis remains valid.

4. If any components or piping other than the CRDM welds in the EAF analysis use reduced cycles compared to the design cycles in UFSAR Tables 5-2 and 5-23, identify (1) such components and piping and (2) the reduced transient cycles for the components and piping. In addition, provide justification for using the reduced cycles in the EAF analysis and clarify whether the Fatigue Monitoring program will be used to ensure that the actual cycles do not exceed the reduced cycles used in the EAF analysis.

Response to RAI 4.3.4-4:

Request 1:

As described in SLRA Section 4.3.2.1, the reactor vessel closure heads were replaced on all three Oconee Units between 2003 and 2004. The replacement closure heads were designed and fabricated by B&W Canada, which includes the updated stress report. The analysis included the Alloy 690 J-groove replacement closure head penetration welds between the CRDM nozzle housings and the replacement closure head, including the highest stress CRDM “hillside” location. Therefore, the CRDM weld is the Alloy 690 J-groove weld between the CRDM housing and the replacement closure head.

Request 2:

The Unit Loading/Unloading (Transients 3 and 4) cycles documented in the original B&W Canada design report are 12,000 Unit Loading and Unloading events. These cycles are greater than the 5,000 Unit Loading and Unloading design events documented in the replacement closure head design specification. The Updated Final Safety Analysis Report (UFSAR) Table 5-2 (Revision 28) has 18,000 cycles for the Unit Loading and Unloading event, but also includes Note 7 to that Table which documents that some components of the replacement closure head were designed to as few as 5,000 Unit Loading and Unloading events.

The original 5,000 Unit Loading and Unloading cycles for the CRDM J-groove welds were further reduced to 4,100 events during the initial 2015 scoping evaluation for subsequent license renewal environmentally assisted fatigue. This evaluation was used as a bases for the most recent subsequent license renewal environmentally assisted fatigue analysis of this component which also retained the reduced 4,100 cycles for Unit Loading and Unloading events, resulting in an environmental cumulative usage factor of 0.94.

Request 3:

The 5,000 cycles used to qualify the CRDM J-groove welds for the Unit Loading and Unloading (Transients 3 and 4) events meet the requirements of the Reactor Vessel Design Specification for the closure head. The fact that some Reactor Vessel components are designed to cyclic values less than those described in the UFSAR Table 5-2 is documented in Note 7.

In addition, the identified Unit Loading and Unloading transient events (Transients 3 and 4) are excluded from transient logging as documented in Table 2 to ONS Revised Responses to NRC Request for Additional Information, dated March 29, 1999 (ML15113A785). These events are specifically excluded due to having a “large allowable.” The ONS units are operated as Base Load Units, so Transient 3 and 4 events are rare, and even 4,100 events are much larger than the units expect to experience during 80 years of operation. Therefore, this consideration is also valid for the subsequent period of extended operation.

Request 4:

The components that are part of the environmentally assisted fatigue analysis and contain a reduced set of allowable cycles are the CRDM welds, the HPI nozzles, and the pressurizer surge line. The HPI nozzles allowable cycles are discussed in detail as part of RAI 4.3.1-3. The pressurizer surge line allowable cycles are discussed in detail as part of RAI 4.3.1-2.

SLRA Revisions:

None

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ATTACHMENT 17
RAI 4.3.4-5
[NON-PROPRIETARY]

Enclosure 1, Attachment 17
[Non-Proprietary]

Note: Text that is within brackets is proprietary to BWXT Canada Ltd.

RAI 4.3.4-5:

Regulatory Basis
Pursuant to 10 CFR 54.21(c), the SLRA must include an evaluation of TLAAs. The applicant must demonstrate that (i) the analyses remain valid for the period of extended operation, (ii) the analyses have been projected to the end of the period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

Background
The following reference provides the fatigue analysis and cumulative usage for the steam generator tube-to-tubesheet welds (Reference: Calculation Number OSC 11520, Revision 0, Replacement Once through Steam Generators Tube-to-Tubesheet Weld Stress analysis). Table 1.1 of the reference indicates that the projected cumulative usage factor of the welds is slightly less than the design limit (1.0).

Issue
However, the reference above and SLRA Section 4.3.4, as supplemented by SLR-ONS-TLAA-0306NP, do not clearly address the EAF analysis for the steam generator tube-to-tubesheet welds. Therefore, the staff needs additional information regarding the EAF analysis for these welds.

Request
1. Clarify whether the steam generator tube-to-tubesheet welds have been evaluated in the EAF analysis. If so, provide the projected 80-year CUF and CUF_{en} values.

2. If these tube-to-tubesheet welds are bounded by a leading location in terms of EAF analysis, identify the leading location.

3. Discuss how the applicant will manage the aging effect of cumulative fatigue damage for the tube-to-tubesheet welds.

Response to RAI 4.3.4-5:

Request 1:

The steam generator tube-to-tubesheet welds have not been evaluated for environmentally-assisted fatigue (EAF). **[**

]$_{a,b,c,d}$. Since the weld root is not exposed to reactor coolant, an EAF analysis for this location is not required. Since the weld outer surface, which is exposed to reactor coolant but **[**
]$_{abcd}$ an EAF analysis for this location is not required.

The figure below identifies **[** **]$_{a,b,c,d}$** for the steam generator tube-to-tubesheet welds. **[**

] a,b,c,d

[

] a,b,c,d

Request 2:

Since an EAF analysis for the steam generator tube-to-tubesheet weld is not required, identification of the leading location relative to the tube-to-tubesheet weld is not applicable. However, leading locations for the steam generators were identified during EAF screening, which was performed for all ASME Code, Section III components with existing CUF values to ensure that any additional plant-specific component locations in the reactor coolant pressure boundary that may be more limiting than those considered in NUREG/CR-6260, were addressed. The EAF screening process grouped replacement steam generator and replacement reactor vessel head locations in the same thermal zone, since these locations experience the same thermal transients. For the purpose of EAF screening, a thermal zone is a collection of components which undergo essentially the same group of thermal and pressure transients during plant operation. Typically, components in the same flow path are included in the same thermal zone. The EAF screening process is further described in Oconee calculation ONS-SLR-TLAA-0306P/NP.

The limiting location in terms of EAF for the steam generators is the control rod drive mechanism (CRDM) weld in the reactor vessel closure head. Considering that the reactor vessel closure head is not original equipment, the next highest limiting location in terms of EAF is the reactor vessel bottom mounted instrumentation (BMI) weld.

ONS-SLR-TLAA-0306P/NP, Table 7.3.4-1, reports that the cumulative usage factor adjusted for environmental effects (CUF_{en}) for the CRDM weld is 0.772, and that the CUF_{en} for the BMI weld is 0.744.

Request 3:

Oconee SLRA Supplement 3 dated December 15, 2021 (ML21349A005), describes how the aging effect of cumulative fatigue damage will be adequately managed for the replacement steam generator tube-to-tubesheet welds for the subsequent period of operation.

SLRA Revisions:

None

Associated Enclosures:

See Enclosure 2, Attachment 2 for Affidavit.

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ATTACHMENT 18
RAI 4.3.4-6
[Non-Proprietary]

Enclosure 1, Attachment 18
[Non-Proprietary]

Note: Text that is within brackets is proprietary to Framatome, Inc.

RAI 4.3.4-6:

Regulatory Basis
Pursuant to 10 CFR 54.21I, the SLRA must include an evaluation of TLAAs. The applicant must demonstrate that (i) the analyses remain valid for the period of extended operation, (ii) the analyses have been projected to the end of the period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation
Background The following reference indicates that the 80-year CUF_{en} for the venturi exceeds the fatigue design limit (1.0) but the CUF_{en} is acceptable because it is not a reactor coolant pressure boundary component that requires an EAF analysis (Reference: Section 8.5 of ANP-3898NP, Revision 0, "Framatome Reactor Vessel and RCP TLAA and Aging Management Review Input to the ONS SLRA").

Issue
However, the related discussion in the reference above does not clearly discuss how the applicant will manage the aging effect of cumulative fatigue damage for the venturi.

Request
1. Describe the intended function of the venturi and how the applicant will manage the aging effect of fatigue for the venturi. As part of the response, discuss periodic inspections (e.g., visual, surface or volumetric examination) that will be performed to confirm the integrity of the venturi.

2. Discuss any conservatism associated with the CUF_{en} calculation for the venturi. In addition, provide the 80-year CUF value for the venturi as baseline information.

3. Clarify whether the applicant's aging management review (AMR) results adequately identify the aging management for the venturi.

Response to RAI 4.3.4-6:

Request 1:

Oconee SLRA Supplement 2 dated November 11, 2021 (ML21315A012), provides the intended function of the core flood nozzle flow restrictor (i.e., venturi) and describes how the aging effect of fatigue will be managed. The Oconee ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD AMP is credited for confirming the integrity of the venturi with VT-3 inspections that are performed once each inspection interval. The most recent inspections were completed during Fall 2012, Fall 2013, and Spring 2014 for Units 1, 2, and 3, respectively. No recordable indications were identified.

Request 2:

As reported in ANP-3898P, Revision 0, Table 8-1, the CUF_{en} calculation for the venturi utilizes a bounding environmentally-assisted fatigue penalty factor (F_{en}) of [ ] b,c,d,e The CUF_{en} includes the following conservatisms as reported in ANP-3898NP, Revision 0, Section 8.4:

a. In NUREG/CR-6909, Revision 1, when calculating T* in Appendix A, the upper bound limit of equation for T is 325°C (617°F). For the purposes of calculating a F_{en}, this temperature is considered bounding for locations exposed to LWR coolant.

b. Since the strain rate is unknown for the stress intensity ranges, the slowest strain rate used in NUREG/CR-6909, Revision 1, is considered for conservatism.

c. A sulfur content of 0.015 wt.% is assumed. This value is taken from NUREG/CR-6909, Revision 1, as the bounding value.

As reported in ANP-3898P, Revision 0, Table 8-1, the in-air CUF for the venturi is [ ] b,c,d,e

Request 3:

Oconee SLRA Supplement 2 dated November 11, 2021 (ML21315A012), describes how the aging effect of fatigue will be adequately managed for the venturi for the subsequent period of operation.

SLRA Revisions:

None

Associated Enclosures:

See Enclosure 2, Attachment 1 for Affidavit.

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ATTACHMENT 19
RAI 4.3.4-7

Enclosure 1, Attachment 19

RAI 4.3.4-7:

Regulatory Basis
Pursuant to 10 CFR 54.21(c), the SLRA must include an evaluation of TLAAs. The applicant must demonstrate that (i) the analyses remain valid for the period of extended operation, (ii) the analyses have been projected to the end of the period of extended operation, or (iii) the effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

Background
Table 4.3.4-1 of SLRA Section 4.3.4, as supplemented by the SLR-ONS-TLAA-306NP report, described the leading EAF locations for thermal zones. For the following thermal zones, the fabrication material for the leading EAF locations is only stainless steel: (1) pressurizer lower head and surge line; (2) pressurizer spray; (3) high pressure injection; (4) decay heat removal system; and (5) core flood.

Issue
The SLRA does not clearly discuss why the thermal zones mentioned above do not identify any leading EAF locations that are fabricated of materials other than stainless steel.

Request
1. Justify why the following thermal zones do not identify any leading EAF locations that are fabricated of materials other than stainless steel (e.g., carbon steel and nickel alloy): (1) pressurizer lower head and surge line; (2) pressurizer spray; (3) high pressure injection; (4) decay heat removal system; and (5) core flood.

2. If the applicant determined that the leading EAF locations fabricated of stainless steel bound the locations fabricated of other materials in each thermal zone, provide the basis of the determination (e.g., comparison of the F_{en} and CUF_{en} values between the highest CUF_{en} locations fabricated of the different materials in each thermal zone).

Response to RAI 4.3.4-7:

Request 1:

Screening to identify leading (i.e., Sentinel) locations was performed for any locations with fatigue usage factors that are wetted by primary coolant in the primary pressure boundary systems. For each of the above thermal zones, carbon steel (CS), low alloy steel (LAS), and Ni-Cr (nickel alloy) materials, in addition to stainless steel, were considered in the evaluations.

Answer for each of the thermal zones referenced above are as follows:

(1) Pressurizer lower head and surge line

For the pressurizer vessel, including the lower head, fatigue usage factors for materials other than stainless steel were considered, including the pressurizer heater forging to shell and lower head (CS), and the pressurizer heater cover plate (LAS). For these components, previously-determined fatigue usage factors using the ASME fatigue curves and the Fen formulations of NUREG/CR-6583 were multiplied by conservatively defined factors that account for both the maximum effects of the NUREG/CR-6909 Revision 1 fatigue curves and Fen formulations, and the CUF_{en} results were found to be approximately half that of the limiting stainless steel location.

For the surge line piping, all locations are austenitic stainless steel, and the limiting locations were evaluated using ASME Section XI, Appendix L inspection and flaw tolerance methods.

The pressurizer surge nozzle and the hot leg surge nozzle are located at the terminal ends of the stainless steel surge piping and contain multiple different material types. However, for these nozzles, the wetted locations are all either stainless steel, due to the presence of cladding protecting the ferritic components, or nickel alloy weld material. Stainless steel and nickel alloy material both use the same fatigue curve, but nickel alloy has a lower Fen than stainless steel. Fatigue usage factors for the surge nozzle were bounded by the maximum value in the stainless steel surge piping.

(2) Pressurizer spray

For the Pressurizer Spray Line piping, all locations are austenitic stainless steel.

At the terminal end of the spray piping, the pressurizer spray nozzle, which is comprised of multiple different material types, was evaluated for fatigue. The nozzle's wetted locations are all either stainless steel, due to the presence of cladding, or nickel alloy weld material. Stainless steel and nickel alloy material both use the same fatigue curve, but nickel alloy has a lower F_{en} than stainless steel. Fatigue usage factors for the spray nozzle were bounded by the maximum value in the stainless steel spray piping.

The RCS Cold Leg spray nozzle is at the other end of the spray piping. It is fabricated from austenitic stainless steel. It was determined to satisfy the ASME Code requirements for exemption from a detailed fatigue analysis.

(3) High pressure injection

For the High Pressure Injection (HPI) piping, all locations are austenitic stainless steel. The limiting location was determined to be at the piping weld between the stop valve and check valve. This location was evaluated using ASME Section XI, Appendix L inspection and flaw tolerance methods.

The HPI Nozzle (NUREG/CR-6260 location) is located at the terminal end of the HPI piping and was evaluated for EAF in accordance with NUREG/CR-6909 Revision 1. For this nozzle, the wetted locations are all either stainless steel, due to the presence of stainless steel cladding, or nickel alloy weld material on the ferritic components. Stainless steel and nickel alloy material both use the same fatigue curve, but nickel alloy has a lower F_{en} than stainless steel. The fatigue usage factor for the HPI nozzle was bounded by the maximum value in the stainless steel spray piping weld between the stop valve and check valve.

(4) Decay heat removal system

For the Decay Heat piping, all locations are austenitic stainless steel.
At the terminal end of the Decay Heat piping, the Decay Heat nozzle was also evaluated for fatigue. For this nozzle, the wetted locations are all either stainless steel, due to the presence of stainless steel cladding, or nickel alloy weld buttering on the ferritic components. Both of these materials use the same

fatigue curve, but nickel alloy has a lower F_{en} than stainless steel. The maximum fatigue usage factor for the Decay Heat nozzle was bounded by the maximum value in the stainless steel spray piping.

(5) Core flood

For the Core Flood piping, all locations are austenitic stainless steel.

The Core Flood Nozzle is included within the RC Transients thermal zone and is identified as a limiting EAF location within that thermal zone.

Request 2:

For the purpose of EAF screening, one material was not assumed to automatically bound another. Evaluations were performed considering different materials, as discussed above for each thermal zone. In the case of CS and LAS materials, NUREG/CR-6909 Revision 1 fatigue curves differ from those used by the ASME Code and so a direct comparison of CUF and F_{en} values would require re-analysis of fatigue usage. As noted in the response to item 1, fatigue usage factors using the ASME fatigue curves and the F_{en} formulations of NUREG/CR-6583 were multiplied by conservatively defined factors that account for both the maximum effects of the NUREG/CR-6909 Revision 1 fatigue curves and Fen formulations to provide a like for like comparison.

SLRA Revisions:

None

ENCLOSURE 1

OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3
SUBSEQUENT LICENSE RENEWAL APPLICATION
RESPONSES TO REQUESTS FOR ADDITIONAL INFORMATION
SET #1 SAFETY REVIEW AND SECOND ROUND REQUEST FOR
ADDITIONAL INFORMATION B2.1.27-1A

ATTACHMENT 20
RAI B2.1.27-1a

Enclosure 1, Attachment 20

RAI B2.1.27-1a:

Regulatory Basis
Title 10 of the Code of Federal Regulations (10 CFR) 54.21(a)(3) 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 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 regarding the matters described below.

Background:
As amended by letter October 22, 2021 (ADAMS Accession No. ML21295A035), the SLRA states that the Open-Cycle Cooling Water System program will manage the following internally-coated components exposed to raw water: (1) main condenser water boxes and tube sheets cited in SLRA Table 3.4.2-1; (2) main turbine oil tank oil cooler heat exchanger head cited in SLRA Table 3.3.2-30; and (3) main condenser discharge piping cited in SLRA Table 3.3.2-48. In addition, the October 22, 2021, submittal states the following with respect to the raw water environment at Oconee:

> The internal environment for this equipment is raw water from Lake Keowee. Water from Lake Keowee is non-aggressive, and a review of operating experience shows that leaks due to microbiologically influenced corrosion [MIC] are rare. A total of five piping segments in raw water systems have experienced leaks at Oconee over the past 10 years where MIC was identified as a contributing cause or potential contributing cause and they are all stagnant or intermittent flow lines.

GALL-SLR Report AMP XI.M42, “Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks,” states AMP XI.M20, “Open-Cycle Cooling Water System,” is an acceptable alternative to the inspections recommended in AMP XI.M42 for internal coatings when six conditions are met. One of the conditions is that the internal environment would not promote MIC of the base metal. As an alternative to meeting these six conditions, the “scope of program” program element of AMP XI.M42 states an applicant may elect to manage the aging effects for internal coatings/linings using AMP XI.M20 as long as the following are met: (a) the recommendations of AMP XI.M42 are incorporated into AMP XI.M20; (b) exceptions or enhancements associated with the recommendations in AMP XI.M42 are included in AMP XI.M20; and (c) the FSAR supplement for AMP XI.M42 as shown in the GALL-SLR Report Table XI-01, “FSAR Supplement Summaries for GALL-SLR Report Chapter XI Aging Management Programs,” is included in the application with a reference to AMP XI.M20.

Issue:
Based on its review of the October 22, 2021, submittal, it is unclear to the staff how the raw water environment at Oconee would not promote MIC of the base metal. The staff notes that at least 5 leaks

have occurred over the past 10 years where MIC was a contributing cause or potential contributing cause.

Request:
Provide additional information demonstrating how the raw water environment at Oconee would not promote MIC of the base metal for internally-coated components within the scope of the Open-Cycle Cooling Water System program. Alternatively, revise the application as appropriate to reflect that the recommendations associated with AMP XI.M42 will be incorporated into the Open-Cycle Cooling Water System program for internally-coated components (or provide an alternative basis demonstrating the adequacy of the Open-Cycle Cooling Water System program to manage the subject components).

Response to RAI B2.1.27-1a:

As amended by the letter dated October 22, 2021 (ADAMS Accession No. ML21295A035), the SLRA states that the Open-Cycle Cooling Water System program will manage the following internally-coated components exposed to raw water:

- main turbine oil tank oil cooler heat exchanger head
- main condenser outlet waterbox and outlet waterbox tubesheet
- main condenser discharge piping

As stated in the amendment, a review of Oconee site-specific OE identified five leaks in piping segments of raw water systems over the past 10 years where microbiologically influenced corrosion (MIC) was determined to be a contributing cause or a potential contributing cause. Specifically, the five leaks occurred in Low Pressure Service Water System piping subject to either stagnant flow or intermittent flow conditions. The main turbine oil tank cooler, which is supplied by the Low Pressure Service Water System, is subject to continuous flow conditions and has not experienced leakage due to MIC. In addition, none of the identified leaks occurred in the Condenser Circulating Water System which supplies the main condenser. The main condenser outlet waterbox, outlet waterbox tubesheet, and discharge piping are subject to continuous flow conditions.

Industry OE, as reflected in NRC Information Notices (IN) 85-30, IN 94-79, and IN 2007-06 has found that MIC is a concern in locations in service water systems subject to stagnant or intermittent flow conditions. Industry OE finds that continuous flow conditions prevent the attachment and growth of microbial films.

The main turbine oil tank cooler is subject to a continuous flow of 3,000 gallons per minute (gpm) with a fluid velocity of greater than 6 feet per second. The main condenser outlet waterboxes, outlet waterbox tubesheet, and discharge piping are subject to a flow of 113,000 gpm with a fluid velocity of greater than 6 feet per second.

The operating conditions for the Oconee main turbine oil tank oil cooler heat exchanger head, main condenser outlet waterbox and outlet waterbox tubesheet, and the main condenser discharge piping do not promote MIC. Review of site OE supports this conclusion.

Main Turbine Oil Tank Oil Cooler Heat Exchanger Head

The main turbine oil tank oil cooler heat exchanger heads perform a leakage boundary (structural integrity) function. There are no downstream components with an (a)(1) or (a)(3) function that can be affected by a loss of the coating.

The subject coating is Belzona material used primarily to repair localized areas of the heat exchanger heads which were degraded. The remaining surfaces of the heat exchanger heads are uncoated base metal exposed to the raw water environment. The entire wetted surface of the heads on one heat exchanger (1B) was elected to be coated with Belzona.

Visual inspections of the heat exchanger heads, including the condition of the Belzona coatings, are currently performed on a 24-month frequency. The preventive maintenance activities are conducted by engineering. Indications of coating degradation or defects such as surface wear, under-coating corrosion, detached coating, or thinning are documented on the heat exchanger inspection checklist and evaluated by engineering. A review of the last 10 years of inspection results for the heat exchangers did not identify any failures of the intended function. The inspection frequency has proven effective in maintaining the component intended function. The existing inspection activities provide reasonable assurance that age-related degradation of the coatings will be detected, and corrective actions taken such that the intended function of the components will be maintained.

An exception is taken from applying the coating inspection recommendations of GALL-SLR Report AMP XI.M42, “Internal Coatings/Linings for In -Scope Piping, Piping Components, Heat Exchangers, and Tanks” to the Oconee Open-Cycle Cooling Water System program. The coating inspections will continue to be performed to the existing site inspection requirements which have been proven to be effective for aging management.

Main Condenser Outlet Waterbox, Outlet Waterbox Tubesheet, and Discharge Piping

The main condenser inlet waterbox and inlet waterbox tubesheet have a pressure boundary function and are managed by the Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks program. The main condenser outlet waterbox, outlet waterbox tubesheet, and discharge piping perform a leakage boundary (structural integrity) function and are managed by the Open-Cycle Cooling Water System program. There are no downstream components with an (a)(1) or (a)(3) function that can be affected by a loss of the coating.

The main condenser outlet waterbox and outlet waterbox tubesheet are visually inspected on a 24 month frequency to monitor the condition of the coatings. The discharge piping is visually inspected on a 4-year frequency to monitor the condition of the coating. The preventative maintenance activities are performed in accordance with site procedures by experienced civil engineers. The inspection procedures contain acceptance criteria and corrective actions commensurate with the function of the component. The inspection acceptance criteria are no visual indications of coating defects that expose the base metal. Inspection results are evaluated by engineering and corrective actions are identified. The last 10 years of inspection results were reviewed and did not identify any failures of the intended function of the main condenser outlet waterbox, outlet waterbox tubesheet, or discharge piping. If degraded coatings are identified they are repaired, and the base metal is evaluated for corrosion. The current inspection activities provide reasonable assurance that age-related degradation of the coatings will be detected, and corrective actions taken such that the intended function of the main condenser outlet waterbox, outlet waterbox tubesheet, and discharge piping will be maintained.

An exception is taken from applying the coating inspection recommendations of GALL-SLR Report AMP XI.M42, "Internal Coatings/Linings for In -Scope Piping, Piping Components, Heat Exchangers, and Tanks" to the Oconee Open-Cycle Cooling Water System program. The coating inspections will continue to be performed to the existing inspection requirements which have been proven to be effective for aging management.

SLRA Revisions:

SLRA Section B2.1.27 (page B-193) is revised as follows:

B2.1.27 INTERNAL COATINGS/LININGS FOR IN-SCOPE PIPING, PIPING COMPONENTS, HEAT EXCHANGERS, AND TANKS

Exception 3 to NUREG-2191

Program Element Affected: Scope of Program (Element 1)

3. NUREG-2191 recommends that when an alternative aging management program is used to manage the aging effects for internal coatings/linings the recommendations of the XI.M42 Internal Coatings/Linings for In-Scope Piping, Piping Components, Heat Exchangers, and Tanks program are incorporated into the alternative program. Also, exceptions or enhancements associated with the recommendations in the XI.M42 program are recommended to be included in the alternative program. In addition, NUREG-2191 recommends that the FSAR supplement for the XI.M42 program in the application includes a reference to the alternative program.

   The alternative program used to manage the internal coatings for the main condenser outlet waterbox, outlet waterbox tubesheet, and discharge piping is the Open-Cycle Cooling Water System program. The Open-Cycle Cooling Water System program will adequately manage the effects of aging on the coatings for these components without incorporation of the recommendations of XI.M42, including any exceptions or enhancements. The Open-Cycle Cooling Water System program is not referenced in the FSAR supplement for the XI.M42 program.

   Justification for Exception 3

   The main turbine oil tank cooler heat exchanger heads perform a leakage boundary (structural integrity) function. There are no downstream components with (a)(1) or (a)(3) functions that can be affected by a loss of the coating. The Belzona coatings are applied primarily as repairs on localized areas of the components surface leaving the remaining base metal exposed to the raw water environment. The entire wetted surface of the heads on one heat exchanger (1B) was elected to be coated with Belzona.

   The main turbine oil tank cooler heat exchanger heads are visually inspected on a 24 month frequency, including the condition of the Belzona coatings. The preventive maintenance activities are conducted by engineering. Indications of coating degradation or defects such as surface wear, under-coating corrosion, detached coating, or thinning are documented on the heat exchanger inspection checklist and evaluated by engineering. A review of the last 10 years of inspection results for the heat exchangers did not identify any failures of the intended function. The inspection frequency has proven effective in maintaining the component intended function. The existing inspection activities provide reasonable assurance that age-related degradation of the coatings will be detected, and corrective actions taken such that the intended function of the components will be maintained.

The main condenser outlet waterbox, outlet waterbox tubesheet, and discharge piping perform a leakage boundary (structural integrity) function. There are no downstream components with (a)(1) or (a)(3) functions that can be affected by a loss of the coating.

The main condenser outlet waterbox and outlet waterbox tubesheet are visually inspected on a 24 month frequency to monitor the condition of the coatings. The discharge piping is visually inspected on a 4 year frequency to monitor the condition of the coating. The preventative maintenance activities are performed in accordance with site procedures by experienced civil engineers. The inspection procedures contain acceptance criteria and corrective actions commensurate with the function of the component. The inspection acceptance criteria is no visual indications of coating defects that expose the base metal. Inspection results are evaluated by engineering and corrective actions are identified. The last 10 years of inspection results were reviewed and did not identify any failures of the intended function of the main condenser outlet waterbox, outlet waterbox tubesheet, or the discharge piping. If degraded coatings are identified they are repaired, and the base metal is evaluated for corrosion. The current inspection activities provide reasonable assurance that age-related degradation of the coatings will be detected, and corrective actions taken such that the intended function of the main condenser outlet waterbox, outlet waterbox tubesheet, and discharge piping will be maintained.

ENCLOSURE 2

OCONEE NUCLEAR STATION
SUBSEQUENT LICENSE RENEWAL APPLICATION
RESPONSES TO NRC REQUEST FOR ADDITIONAL INFORMATION SET 1 AND SECOND ROUND REQUEST FOR ADDITIONAL INFORMATION B2.1.27-1A

AFFIDAVITS

Attachment	Affidavit
1	Affidavit for Framatome, Inc.
2	Affidavit for BWXT Canada Ltd.

A F F I D A V I T

1. My name is Philip A. Opsal. I am Manager, Product Licensing for Framatome Inc. (formally known as AREVA Inc.), and as such I am authorized to execute this Affidavit.

2. I am familiar with the criteria applied by Framatome to determine whether certain Framatome information is proprietary. I am familiar with the policies established by Framatome to ensure the proper application of these criteria.

3. I am familiar with the Framatome information contained in the following documents referred to herein as "Documents":

- Framatome Document ANP-3898P, Revision 0, "Framatome Reactor Vessel and RCP TLAA and Aging Management Review Input to the ONS SLRA"
- Framatome Document ANP-3899P, Revision 0, "Framatome Reactor Vessel Internals TLAA Input to the ONS SLRA"

Information contained in these Documents has been classified by Framatome as proprietary in accordance with the policies established by Framatome for the control and protection of proprietary and confidential information.

4. These Documents contain information of a proprietary and confidential nature and is of the type customarily held in confidence by Framatome and not made available to the public. Based on my experience, I am aware that other companies regard information of the kind contained in these Documents as proprietary and confidential.

5. These Documents have been made available to the U.S. Nuclear Regulatory Commission in confidence with the request that the information contained in these Documents be withheld from public disclosure. The request for withholding of proprietary information is

made in accordance with 10 CFR 2.390. The information for which withholding from disclosure is requested qualifies under 10 CFR 2.390(a)(4) "Trade secrets and commercial or financial information."

6. The following criteria are customarily applied by Framatome to determine whether information should be classified as proprietary:

(a) The information reveals details of Framatome's research and development plans and programs or their results.

(b) Use of the information by a competitor would permit the competitor to significantly reduce its expenditures, in time or resources, to design, produce, or market a similar product or service.

(c) The information includes test data or analytical techniques concerning a process, methodology, or component, the application of which results in a competitive advantage for Framatome.

(d) The information reveals certain distinguishing aspects of a process, methodology, or component, the exclusive use of which provides a competitive advantage for Framatome in product optimization or marketability.

(e) The information is vital to a competitive advantage held by Framatome, would be helpful to competitors to Framatome, and would likely cause substantial harm to the competitive position of Framatome.

The information in these Documents is considered proprietary for the reasons set forth in paragraphs 6(b), 6(c), 6(d) and 6(e) above.

7. In accordance with Framatome's policies governing the protection and control of information, proprietary information contained in these Documents has been made available, on a limited basis, to others outside Framatome only as required and under suitable agreement providing for nondisclosure and limited use of the information.

8. Framatome policy requires that proprietary information be kept in a secured file or area and distributed on a need-to-know basis.

9. The foregoing statements are true and correct to the best of my knowledge, information, and belief.

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

Executed on May 6, 2021.

Philip A. Opsal

PROVINCE OF ONTARIO

REGIONAL MUNICIPALITY OF WATERLOO

AFFIDAVIT OF MARIO GOGIC

I, Mario Gogic, of the City of Guelph, in the Province of Ontario, being sworn, make oath and say as follows:

1. I am the Manager, Component Engineering of BWXT Canada Ltd. ("BWXT"), and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rulemaking proceedings, and am authorized to apply for its withholding on behalf of BWXT.

2. I am making this Affidavit in conformance with the provisions of 10CFR Section 2.390 of the Commission's regulations and in conjunction with the BWXT Canada Ltd. Application for Withholding accompanying this Affidavit.

3. I have personal knowledge of the criteria and procedures utilized by BWXT in designating information as a trade secret, proprietary or as confidential commercial or financial information.

4. Pursuant to the provisions of paragraph (b)(4) of Section 2.390 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

    (i) The information sought to be withheld from public disclosure is owned and has been held in confidence by BWXT.

    (ii) The information is of a type customarily held in confidence by BWXT and not customarily disclosed to the public. BWXT has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes BWXT policy and provides the rational basis required.

    Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follow:

    (a) The information reveals the distinguishing aspects of a process, component, structure, tool, method, etc., where prevention of its use by any of BWXT's competitors without license from BWXT constitutes a competitive economic advantage over other companies.

    (b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce its expenditure of resources or improve its competitive position in the design, manufacture, shipment, installation, quality assurance, or licensing of a similar product.

(d) It contains patentable ideas, for which patent protection may be desirable.

There are sound policy reasons behind the BWXT system which include the following:

- The use of such information by BWXT gives BWXT a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect BWXT's competitive advantage.

- It is information which is marketable in many ways. The extent to which such information is available to competitors diminishes the B&W ability to sell products and services involving the use of such information.

- Use by a competitor of BWXT would put BWXT at a competitive disadvantage by reducing the competitor's expenditure of resources at BWXT's expense.

- BWXT's capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10CFR Section 2.390, it is to be received in confidence by the Commission.

(iv) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(v) The proprietary information sought to be withheld in this submittal is that which is identified in BWXT Canada report 318A-SR-02, Revision 0, "Replacement Once Through Steam Generators Tube-To-Tubesheet Weld Stress Analysis Report.", as summarized in RAI 4.3.4-5.
The information which is proprietary in the proprietary version is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (d) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary. These lower case letters refer to the types of

information BWXT customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(d) of this affidavit pursuant to 10 CFR 2.390(b)(1).

SWORN BEFORE ME in the)
City of Guelph in the)
Province of Ontario, this)
14th day of December, 2021.)

MARIO GOGIC

A Commissioner, etc.
Jon R. Johnson