OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3 (ONS)
SUBSEQUENT LICENSE RENEWAL APPLICATION (SLRA)
REQUESTS FOR ADDITIONAL INFORMATION (RAIs)
SET #3

SAFETY REVIEW

RAI 4.7.4-1

Regulatory Basis:
Pursuant to 10 CFR 54.21(c), the SLRA must include an evaluation of time-limited aging analyses (TLAAs). The applicant shall 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 4.7.4 (Leak-Before-Break of Reactor Coolant System Piping) identifies the potential for thermal aging of the RCS piping and fatigue crack growth as the aging effects that must be addressed for SLR.

In the TLAA for the second aspect of the LBB evaluation (flaw stability analysis), the applicant stated that the flaw stability analysis performed using the lower bound NUREG/CR-6177 fracture toughness curves for the period of extended operation was updated to consider the most recent test data per NUREG/CR-4513, Revision 2. The analysis was performed on the Oconee Units 2 and 3 discharge and suction nozzles of the reactor coolant pump casings which were the most limiting material and location of the 28-inch cold leg pipe. The revised analysis appears to demonstrate the acceptability of LBB for the reactor coolant pump cast austenitic stainless steel discharge and suction nozzles for SLR for 80 years of operation.

Issue:
The applicant indicated that it dispositioned the analysis identified in the TLAA in accordance with 10 CFR 54.21(c)(1)(i) (“The analyses remains valid for the period of extended operation.”).

Request:
Since the flaw stability analysis was updated as identified in the TLAA, clarify whether the TLAA should be dispositioned in accordance with 10 CFR 54.21(c)(1)(ii) (“The analyses have been projected to the end of the period of extended operation.”).

Regulatory Basis:
Title 10 of the *Code of Federal Regulations* (10 CFR) Section 54.21(a)(3) requires the 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 (CLB) for the period of extended operation. As described in the SRP-SLR, an applicant may demonstrate compliance with 10 CFR 54.21(a)(3) by referencing the GALL-SLR Report when evaluation of the matter in the GALL-SLR Report applies to the plant.

RAI 3.5.2.2.2.1-1

Background:
Per the SRP-SLR, cracking due to expansion from reaction with aggregates could occur in inaccessible concrete areas of Groups 1-5 and 7-9 structures, and Group 6 structures. The related SRP-SLR Sections 3.5.2.2.2.1, item 2 and 3.5.2.2.2.3, item 2, associated with SRP-SLR Table items 3.5-1-043 and 3.5.1-050, respectively, recommend further evaluation to determine if a plant-specific AMP is required to manage this aging effect.

The corresponding review procedures/criteria in SRP-SLR Sections 3.5.3.2.2.1, item 2 and 3.5.3.2.2.3, item 2, state that a plant-specific evaluation or program is required to manage cracking due to reaction with aggregates if (1) reactivity tests or petrographic examinations of concrete samples identify reaction with aggregates or (2) accessible concrete exhibits visual indications of aggregate reactions, such as “map” or “patterned” cracking, alkali-silica gel exudations, surface staining, expansion causing structural deformation, relative movement or displacement, or misalignment/distortion of attached components.

The “detection of aging effects” program element of GALL-SLR report AMP XI.S6 includes guidance for inaccessible, below-grade concrete structural elements. For plants with nonaggressive groundwater/soil (pH > 5.5, chlorides < 500 ppm, and sulfates < 1,500 ppm), the program recommends: (a) evaluating the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of, or result in, degradation to such inaccessible areas and (b) examining representative samples of the exposed portions of the below-grade concrete, when excavated for any reason.

SLRA Section 3.5.2.2.2.1, item 2, related to AMR item 3.5.1-043 states, in part, “Inspection for Alkali-Silica Reaction [ASR] has been incorporated into the Structures Monitoring program. Structures Monitoring Inspections include examination for pattern cracking with darkened crack edges, water ingress, and misalignment inspections.… Review of plant OE has not identified evidence of ASR in below-grade inaccessible concrete areas of ONS groups 1–5 and 7–9 structures.”

SLRA Section 3.5.2.2.2.3, item 2, related to AMR item 3.5.1-050 states, in part, “Plant operating experience has not identified any indications of ASR for the concrete structures at ONS, except for at the Keowee dam spillway.… Inspection for ASR has been incorporated into the Structures Monitoring program.… ONS ASR operating experience is limited to the Keowee dam spillway and is not indicative of the potential for ASR in other concrete structures at ONS. Therefore, a plant-specific AMP or plant-specific enhancements to Structures Monitoring AMP for inaccessible areas are not required to manage cracking due to expansion from reaction with aggregates.”

The staff noted that ASR progression at the Keowee dam spillway is monitored by the Dam Safety Surveillance and Monitoring Plan, which is implemented to meet the guidelines of FERC and is evaluated as part of the FERC Part 12D inspection, and is outside the scope of the NRC staff’s review.

SLRA Section B2.1.33 states that the Structures Monitoring AMP is an enhanced program that will be consistent with the recommendations provided in Section XI.S6, Structures Monitoring program of NUREG-2191 with the enhancements. Additionally, SLRA Table 3.5-1 states that AMR items 3.5.1-043 and 3.5.1-050 are applicable and consistent with NUREG-2191.

Issue:

1. Based on information in SLRA Section B2.1.33 and audit of related program basis and implementing documents, it is not clear to the staff how inspection for ASR has been incorporated into the Structures Monitoring Program.

2. It is unclear to the staff how the applicant determined that a plant-specific evaluation or program is not required.

3. The staff notes that both SLRA Sections 3.5.2.2.2.1, item 2, and 3.5.2.2.2.3, item 2, appear to lack the information for how the applicant determined that there are no indications of ASR in below-grade inaccessible concrete areas of ONS structures (except for at the Keowee dam spillway). It appears that no provisions for evaluating acceptability of inaccessible areas are in the Structures Monitoring program. Therefore, it is not clear to the staff how the referenced aging effect will be adequately managed during the SPEO in inaccessible areas consistent with GALL-SLR recommendations, as claimed. Further, the SLRA does not appear to provide any supporting justification for the statement that the ONS ASR operating experience is not indicative of the potential for ASR in other concrete structures at ONS.

Request:

1. Clarify how inspection for ASR has been incorporated into the SLRA B2.1.33 Structures Monitoring Program as claimed in the SLRA.

2. Clarify, with supporting information, how it was determined that a plant-specific evaluation or program is not necessary.

3. With regard to the evaluation of applicable SLRA AMR items 3.5.1-047 and 3.5.1-050, clarify how the aging effects of cracking due to expansion from the reaction with aggregates, such as ASR, will be managed during the SPEO in inaccessible areas of concrete components for Groups 1–5 and 7–9 structures, and Group 6 structures (except the concrete components managed by the FERC Inspections of the Keowee Hydro Station) consistent with the GALL-SLR recommendations as claimed in the SLRA. Additionally, provide supporting justification for the statement in the SLRA that ONS ASR operating experience is limited to the Keowee dam spillway and is not indicative of the potential for ASR in other concrete structures at ONS.

4. Update the SLRA as necessary consistent with responses to requests above.

RAI 3.5.2.2.2.1-2

Background:
Per the SRP-SLR, increase in porosity and permeability due to leaching of calcium hydroxide and carbonation could occur in below-grade inaccessible concrete areas of Groups 1-5 and 7-9 structures, and Group 6 structures. The related SRP-SLR Sections 3.5.2.2.2.1, item 4 and 3.5.2.2.2.3, item 3 associated with SRP-SLR Table 3.5-1, Items 3.5.1-047 and 3.5.1-051, respectively, recommend further evaluation of this aging effect in inaccessible concrete areas of these groups of structures to determine if a plant-specific program or enhancement is required to manage the aging effect. The corresponding SRP-SLR review criteria in SRP-SLR Sections

3.5.2.2.2.1, item 4 and 3.5.2.2.2.3, item 3 state, in part, that a plant-specific program is not required for the reinforced concrete structures exposed to flowing water if (1) there is evidence in the accessible areas that the flowing water has not caused leaching and carbonation, or (2) evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas has no impact on the intended function of the concrete structure.

The "detection of aging effects" program element of GALL-SLR report AMP XI.S6 provides recommendations for inaccessible, below-grade concrete structural elements. For plants with nonaggressive groundwater/soil (pH > 5.5, chlorides < 500 ppm, and sulfates < 1,500 ppm), the program recommends: (a) evaluating the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of, or result in, degradation to such inaccessible areas and (b) examining representative samples of the exposed portions of the below-grade concrete, when excavated for any reason.

SLRA Sections 3.5.2.2.2.1, item 4, and 3.5.2.2.2.3, item 3, as amended by ONS SLRA Supplement 2 dated November 11, 2021 (ADAMS Accession No. ML21315A012), states that review of plant OE identified instances of aging effects related to increase in porosity and permeability due to leaching of calcium hydroxide and carbonation in accessible areas, however, the structural integrity of the components was not impacted, and the conditions will be monitored during future inspections. The applicant concluded that a plant-specific AMP is not required.

SLRA Section B2.1.33 states that the Structures Monitoring AMP is an enhanced program that will be consistent with the recommendations provided in Section XI.S6, Structures Monitoring program of NUREG-2191 with the enhancements. Additionally, SLRA Table 3.5-1 states that AMR items 3.5.1-047 and 3.5.1-051 are applicable and consistent with NUREG-2191.

Issue:

1. It is unclear from information in the SLRA what evaluation of the observed operating experience has been performed to conclude that the structural integrity of the components was not impacted regarding operating experience of increase in porosity and permeability due to leaching of calcium hydroxide and carbonation in accessible areas, and how the evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas has no impact on the intended function of the concrete structure in support of the conclusion made.

2. It appears that no provisions for evaluating acceptability of inaccessible areas are in the Structures Monitoring program. Therefore, it is not clear to the staff how the referenced aging effect will be adequately managed during the SPEO in inaccessible areas consistent with GALL-SLR recommendations, as claimed.

Request:

1. Regarding SLRA Sections 3.5.2.2.2.1, item 4, and 3.5.2.2.2.3, item 3, describe what evaluation of the observed operating experience has been performed to conclude that the structural integrity of the components was not impacted, and how the evaluation determined that the observed leaching of calcium hydroxide and carbonation in accessible areas has no impact on the intended function of the concrete structure to conclude that a plant-specific AMP is not necessary.

2. With regard to the evaluation of applicable SLRA AMR items 3.5.1-047 and 3.5.1-051, explain or clarify how the aging effects of increase in porosity and permeability, and loss of strength due to leaching of calcium hydroxide and carbonation will be managed during the SPEO in inaccessible areas of concrete components for Groups 1–5 and 7–9 structures, and Group 6 structures (except the concrete components managed by the FERC Inspections of the Keowee Hydro Station), consistent with the GALL-SLR recommendations as claimed. Update the SLRA accordingly, as necessary.

RAI 3.5.2.2.2.2-1

Background:
SLRA Section 3.5.2.2.2.2 states that the operating experience (OE) "identified no issues related to elevated temperatures affecting concrete structures. SLRA Section 3.5.2.2.2.2 also states, "The ONS spent fuel pool (SFP) cooling systems are designed to maintain the pool bulk water temperature below 150 °F for normal heat loads. The spent fuel pools have an actual operating limit of 205 °F (abnormal case). Analyses have been performed to ensure that seismic and structural integrity of the pool liner, supporting concrete, and fuel racks are not compromised at this temperature limit." The SLRA concludes that a "plant-specific aging management program to manage the effects of reduction of strength and modulus due to elevated temperature is not required."

UFSAR Section 3.8.4.4, states that the SFP walls were analyzed for thermal loads in accordance with methods presented in ACI 505. Under normal conditions, the interior wall temperature was 150 °F and the maximum calculated thermal stress was 996 psi for concrete and 11,410 psi for reinforcing steel. After prolonged outage of the cooling system, the interior wall temperature could reach 212 °F and the maximum calculated thermal stress was 1681 psi for concrete and 25,600 psi for reinforcing steel.

Calculation OSC-929 on ePortal, "Reanalysis of Unit 1+2 Fuel Pool for Poison Spent Fuel Rack Loadings," Revision 3, indicates that the maximum pool temperature is 150 °F at normal operation condition, and maximum pool temperature is 255 °F under an accident condition with poison racks.

Calculation OSC-1028 on ePortal, "Reanalysis of Unit 3 Spent Fuel Pool Liner Plate for Poison Racks," Revision 8, indicates the maximum pool temperature is 150 °F for normal operation condition, and maximum pool temperature is 255 °F for case III.

Section 3.5.2.2.2.2 of the SRP-SLR states concrete temperatures under normal operation or any other long-term period should not exceed 66 °C (150 °F) except for local areas, which are allowed to have increased temperatures not to exceed 93 °C (200 °F) and recommends a further evaluation and a plant-specific program if any portion of the safety-related and other concrete structures exceeds the specified temperature limits. It concludes that higher temperatures may be allowed if tests and/or calculations are provided to evaluate the reduction in strength and modulus of elasticity and these reductions are applied to the design calculations.

Issue:

The SLRA, UFSAR, and calculations OSC-929 and OSC-1028 present different maximum pool temperatures for abnormal cases at 205 °F, 212 °F, and 255 °F, respectively. It is unclear what the maximum pool temperatures are for abnormal cases at ONS Units 1, 2 and 3.

It is unclear how the code acceptance criteria were met for these load combinations including thermal load used for the SFP walls/supporting concrete, pool liner, and fuel racks at the maximum SFP water temperature for abnormal cases at ONS Units 1, 2 and 3.

Request:

1. Clarify the maximum pool temperatures for abnormal cases at ONS Units 1, 2 and 3.

2. Describe, with quantitative results and code allowable limits, how the structural acceptance criteria were met for the SFP walls/supporting concrete for the controlling load combinations including thermal loads at the maximum SFP water temperatures for abnormal cases at ONS Units 1, 2 and 3.

3. Describe, with quantitative results and code allowable limits, how the structural acceptance criteria were met for the pool liner for the controlling load combinations including thermal loads at the maximum SFP water temperatures for abnormal cases at ONS Units 1, 2 and 3.

4. Describe, with quantitative results and code allowable limits, how the structural acceptance criteria were met for the fuel racks for the controlling load combinations including thermal loads at the maximum SFP water temperatures for abnormal cases at ONS Units 1, 2 and 3.

5. Update SLRA Section 3.5.2.2.2.2 accordingly based on the responses above.