

NRC Staff's Licensing Perspectives on Alkali-Silica Reaction (ASR) Effects on Concrete for SLR

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Overview

- Background
- NRC Guidance for SLR
- Key Expectations

Background on ASR

- ASR is a more common form of Alkali-Aggregate Reaction
- ...slow chemical reaction that could occur in hardened concrete when **moisture is present**, in which **alkalis** predominantly from the cement combine with certain **reactive forms of silica** that may be present in aggregates
- The reaction produces a gel that can absorb water and expand to cause cracking and deformation that has potential to affect structural performance

NRC Guidance for SLR

- Standard Review Plan for Subsequent License Renewal (SRP-SLR) and Generic Aging Lessons Learned Report for Subsequent License Renewal (GALL-SLR) include modified aging management review (AMR) line items and further evaluation (FE) guidance for the aging effect of *Cracking due to Expansion from Reaction with Aggregates* (e.g., ASR)
- The modified guidance incorporated industry operating experience on ASR (NRC IN 2011-20, “Concrete Degradation by Alkali Silica Reaction”), from which it is evident that the aging effect should not be determined to be “not applicable” based on aggregates passing ASTM screening tests at the time of construction

NRC Guidance for SLR

- SRP-SLR Table 3.5-1, Items 12, 19 address concrete ASR for Containment (inaccessible, accessible areas)

New, Modified, Deleted, Edited Item	ID	Type	Component	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation Recommended	GALL-SLR Item
M	019	BWR/PWR	Concrete (accessible areas): dome; wall; basemat; ring girders; buttresses, containment; concrete fill-in annulus	Cracking due to expansion from reaction with aggregates	AMP XI.S2, "ASME Section XI, Subsection IWL," and/or AMP XI.S6, "Structures Monitoring"	No	II.A1.CP-33 II.A2.CP-58 II.B1.2.CP-59 II.B2.2.CP-59 II.B3.1.CP-66 II.B3.2.CP-60
M	012	BWR/PWR	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses, containment; concrete fill-in annulus	Cracking due to expansion from reaction with aggregates	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.1.8)	II.A1.CP-67 II.A2.CP-104 II.B1.2.CP-99 II.B2.2.CP-99 II.B3.1.CP-83 II.B3.2.CP-121

- *Further Evaluation*: SRP Sections 3.5.2.2.1.8 and 3.5.3.2.1.8

NRC Guidance for SLR

- SRP-SLR: Table 3.5-1, Items 43, 54 & 50, 96 address ASR for Groups 1-5, 7-9; and Group 6 structures, respectively

M	043	BWR/PWR	All Groups except Group 6: concrete (inaccessible areas): all	Cracking due to expansion from reaction with aggregates	Plant-specific aging management program	Yes (SRP-SLR Section 3.5.2.2.2.1.2)	III.A1.TP-204 III.A2.TP-204 III.A3.TP-204 III.A4.TP-204 III.A5.TP-204 III.A7.TP-204 III.A8.TP-204 III.A9.TP-204
M	054	BWR/PWR	All groups except 6: concrete (accessible areas): all	Cracking due to expansion from reaction with aggregates	AMP XI.S6, "Structures Monitoring"	No	III.A1.TP-25 III.A2.TP-25 III.A3.TP-25 III.A4.TP-25 III.A5.TP-25 III.A6.TP-25 III.A7.TP-25 III.A8.TP-25 III.A9.TP-25

- Further Evaluation:* SRP-SLR Sections 3.5.2.2.2.1.2 and 3.5.2.2.2.3.2

NRC Guidance for SLR

From SRP-SLR Section 3.5.3.2.1.8:

“Further evaluation is recommended ...A plant-specific AMP is necessary 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....”**

Expectation:

Plant-Specific
AMP(s) Needed if
there is
Plant-Specific
Operating
Experience of ASR

Key Expectations for SLR

(with respect to SRP/GALL-SLR guidance)

No plant-specific OE (including visual symptoms) of ASR identified at site



No Plant-Specific AMP is needed; however, monitor accessible areas for common visual indications of ASR by visual inspection in applicable GALL AMP

If plant-specific OE exists (e.g. visual, reactivity tests or petrography)



Submit plant-specific AMP meeting acceptance criteria in Appendix A.1 of SRP-SLR such that the aging effect will be adequately managed

QUESTIONS?

