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To:	Paul Aitken; Eric A Blocher
Cc:	Wu, Angela
Subject:	Draft RAIs on Leak Before Break
Date:	Wednesday, May 08, 2019 1:06:00 PM
Attachments:	147.3 RAIs Surry SLR 4.7.3 LBB TLAA_ERO.docx

We will schedule a clarification call soon.

Thanks

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RAI 4.7.3-1

Regulatory Basis (applicable to all RAIs for SLRA Section 4.7.3)

In accordance with 10 CFR 54.21(c)(1), the applicant shall provide a list of time-limited aging analyses (TLAAs), as defined in 10 CFR 54.3. 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 4.7.3 addresses a TLAA on leak-before break (LBB) for the reactor coolant system (RCS) primary loop. Dominion (applicant) indicated that the LBB analysis for 80 years of operation is documented in WCAP-15550, Revision 2.

Section 4.3 of WCAP-15550, Revision 2 discusses the fracture toughness properties of the piping elbows fabricated with cast austenitic stainless steel (A351 CF8M). Section 4.3 of the WCAP report also indicates that, as discussed in NUREG/CR-4513, Revision 2, the lower-bound fracture toughness of thermally-aged CASS elbow is similar to that of stainless steel welds. The applicant used this general discussion regarding the lower-bound fracture toughness relationship as one of the bases for why the fracture toughness of the specific CASS elbows is bounding for the fracture toughness of the stainless steel welds in the primary loop.

Standard Review Plan (SRP; NUREG-0800) Section 3.6.3 provides the areas of review, acceptance criteria and review procedure for evaluations of LBB analyses. Specifically, SRP Section 3.6.3, Subparagraph III.11.A.(i) indicates that the applicant should provide the material properties used in the LBB analysis (e.g., toughness, tensile data, and long-term effects such as thermal aging).

Issue

Section 4.3 of WCAP-15550, Revision 2 does not discuss the fracture toughness data of plant-specific (or representative) primary loop stainless steel welds. The staff finds a need to confirm that the fracture toughness of the plant-specific (or representative) primary loop welds is bounded by the fracture toughness estimated for the Surry CASS elbows in accordance with NUREG/CR-4513, Revision 2. The staff also finds a similar concern related to the applicant's determination of the tensile properties of weld materials in the LBB analysis.

Even though Revision 2 of NUREG/CR-4513 uses the latest fracture toughness data of thermally-aged CASS materials, the GALL-SLR Report includes a reference to NUREG-4513/CR, Revision 1 rather than Revision 2, as referenced in GALL-SLR AMP XI.M12. Therefore, the staff needs to confirm that the use of the fracture toughness data in accordance with Revision 1 of NUREG/CR-4513 does not affect the crack stability determined in the LBB fracture mechanics analyses.

Request

1. Discuss the fracture toughness data of plant-specific (or representative) primary loop stainless steel welds to confirm that the fracture toughness data of the welds are greater than the fracture toughness estimated for the CASS elbows. Alternatively, identify relevant references (e.g., references to topical reports) for the weld fracture toughness data.

2. In addition, clarify how the limit load analysis determines the material properties of the welds (e.g., flow stresses). Alternatively, identify relevant references (e.g., references to topical reports) for the weld material properties considered in the limit load analysis.

3. Clarify whether the fracture toughness values of the CASS elbows estimated in accordance with Revision 2 of NUREG/CR-4513 are more limiting than the saturated fracture toughness (fully aged) in accordance with Revision 1 of NUREG/CR-4513 for the cold leg, crossover leg and hot leg locations. If not, please discuss whether the use of the fracture toughness value in accordance with NUREG/CR-4513, Revision 1 affects the conclusion of the crack stability analysis.

RAI 4.7.3-2

Background

SLRA Section 4.7.3 addresses a TLAA on leak-before break (LBB) for the reactor coolant system (RCS) primary loop. Dominion (applicant) indicated the LBB analysis for 80 years of operation is documented in WCAP-15550, Revision 2. Section 7 of WCAP-15550, Revision 2 includes the elastic-plastic fracture mechanics analysis based on local failure mechanism to determine crack stability as part of the LBB analysis.

Issue

Table 7-1 of WCAP-15550, Revision 2 indicates that the J_{app} value (applied J-integral) of critical location 3 (hot leg) is greater than that of critical location 6 (crossover leg). In contrast, the axial force (including pressure loading) and moment for critical location 3 are lower than those for critical location 6, respectively, as described in Figures 7-3 and 7-4. Specifically, axial force F = 1639 kips and moment M = 12918 in-kips for location 3, while F = 1870 kips and M = 15673 in-kips for location 6. Therefore, the staff needs additional information as to why the applied J-integral for location 3 is greater than that of location 6 in consideration of the load levels discussed above.

Request

Explain why the applied J-integral for location 3 is greater than that of location 6 even though the axial force and moment of location 3 are less than those of location 6, respectively. As part of the response, provide the K_t (stress intensity factor for axial tension) and K_b (stress intensity factor for bending) for each of locations 3 and 6, as the plastic zone corrections are applied (refer to Reference 7-3 of the WCAP report, which is NUREG/CR-3464, Section II-1, H. Tada paper).

RAI 4.7.3-3

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Background

SLRA Section 4.7.3 addresses a TLAA on leak-before break (LBB) for the reactor coolant system (RCS) primary loop. Dominion (applicant) indicated the LBB analysis for 80 years of operation is documented in WCAP-15550, Revision 2. Section 8 addresses the fatigue crack growth analysis to confirm that the potential fatigue crack growth does not affect the integrity of the primary loop piping and the crack stability determined in the LBB analysis.

Issue

The staff noted that the fatigue crack growth analysis does not clearly discuss the following: (1) the aspect ratio of the postulated initial crack sizes; and (2) the basis for the initial crack sizes for the fatigue analysis.

Request

Provide the following information: (1) the aspect ratio of the postulated initial crack sizes; and (2) the basis for the initial crack sizes for the fatigue analysis. As part of the response, clarify whether the initial crack depths are greater than those that are acceptable in accordance with the acceptance criteria of ASME Code, Section XI, inservice inspection requirements (e.g., Table IWB-3410-1). If not, explain why the analysis assumes initial cracks that are not large enough to be detected and repaired during the inservice inspection.

RAI 4.7.3-4

Background

SLRA Section 4.7.3 addresses a TLAA on leak-before break (LBB) for the reactor coolant system (RCS) primary loop. Dominion (applicant) indicated the LBB analysis for 80 years of operation is documented in WCAP-15550, Revision 2. Section 8 addresses the fatigue crack growth analysis to confirm that the potential fatigue crack growth does not affect the integrity of the primary loop piping and the crack stability determined in the LBB analysis.

Table 8-1 of the WCAP report lists the transients and transient cycle numbers that are used in the fatigue crack growth analysis for 80 years of operation. In comparison, Table 4.3.1-1 of the SLRA describes the 80-year transient cycle projections for the metal fatigue TLAAs based on Surry UFSAR Table 4.1-8 and Section 18.4.2.

Issue

In contrast with Table 4.3.1-1 of the SLRA, Table 8-1 of WCAP-15550, Revision 2 does not include the "Inadvertent auxiliary pressurizer spray" transient in the fatigue crack growth analysis for the LBB TLAA. Section 8.0 of the WCAP report does not clearly describe why the "Inadvertent auxiliary pressurizer spray" transient is omitted in the fatigue crack growth analysis.

Request

Describe the basis for why the fatigue crack growth analysis does not include the "Inadvertent auxiliary pressurizer spray" transient that is included in SLRA Table 4.3.1-1.

RAI 4.7.3-5

Background

SLRA Section 4.7.3 addresses a TLAA on leak-before break (LBB) for the reactor coolant system (RCS) primary loop. SLRA Section A3.7.3 provides the UFSAR supplement for the LBB TLAA.

Issue

SLRA Section A3.7.3 states that the WCAP-15550 report demonstrated compliance with LBB technology for the reactor coolant system piping for the 80-year operation. The staff notes that the LBB TLAA applies only to the reactor coolant system (RCS) primary loop piping and does not apply to the branch lines connected to the primary loop (e.g., accumulator and safety injection branch lines). In addition, the staff notes that the reference to the WCAP-15550 report in the UFSAR supplement does not include a specific revision (i.e., Revision 2) that provides the 80-year LBB analysis.

Request

1. Clarify whether the LBB TLAA applies only to the RCS primary loop piping. If so, revise the statement discussed in the SLRA Section A3.7.3 to reflect the specific scope of the LBB TLAA (i.e., LBB is only applied to the primary loop piping, but not to primary loop branch lines).

2. Revise the UFSAR supplement to include the specific revision of the WCAP-15550 report that provides the 80-year LBB analysis.

RAI 4.7.3-6

Background

SLRA Section 4.7.3 addresses a TLAA on leak-before break (LBB) for the reactor coolant system (RCS) primary loop. Dominion (applicant) indicated the LBB analysis for 80 years of operation is documented in WCAP-15550, Revision 2. Sections 7.2 and 7.3 of WCAP-15550, Revision 2 address the limit load analysis for critical locations 1, 3, 6 and 15. Section 7.3 and associated Figures 7-2 through 7-5 indicate that Z factors are applied to the load calculations for the stainless steel piping (location 1) and cast austenitic stainless steel (CASS) elbows (locations 3, 6 and 15). These locations are in the piping and elbow base materials, but not in the welds.

Issue

WCAP-15550, Revision 2 does not clearly indicate whether Z factors are applied to the axial (including pressure) and moment loads. The staff also finds a need to clarify why the applied Z factors are sufficiently high to confirm the structural integrity of the thermally aged CASS elbows.

Request

1. Clarify whether Z factors are applied to both axial (including pressure) and moment loads. If not, provide the technical basis for why the Z factors are not applied to both axial (including pressure) and moment loads.

2. Clarify why the applied Z factors are sufficiently high to confirm the structural integrity of the thermally aged CASS elbows. As part of the response, clarify whether the other conservatisms associated with the method and results of the limit load analysis (in addition to the Z factors) are sufficient to confirm the structural integrity of the CASS elbows.