Enclosure 5 to AEP-NRC-2018-64

Response to Request for Additional Information (RAI-1 through RAI-6): Westinghouse letter LTR-SDA-II-18-41-NP, Revision 1, "Responses to NRC Question on the Expanded Scope Leak-Before-Break Evaluations for D.C. Cook Units 1 and 2," from E. D. Johnson to P. Brusamonti, dated September 18, 2018 (Non-Proprietary)

Westinghouse

To: Pete Brusamonti

Date: September 18, 2018

From: Eric D. Johnson
Ext: 412-374-4584
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Our ref: LTR-SDA-II-18-41-NP
Revision 1

Subject: Responses to NRC Question on the Expanded Scope Leak-Before-Break Evaluations for D.C. Cook Units 1 and 2

References: (as noted in Attachment 1)

A License Amendment Request (LAR) was submitted to the U.S. Nuclear Regulatory Commission (NRC) for the application of Leak-Before-Break (LBB) evaluations to the Accumulator piping, Safety Injection (SI) piping, and Residual Heat Removal (RHR) piping at the Donald C. Cook Nuclear Plant (CNP), Unit 1. The NRC staff reviewers have determined that additional information is necessary in order to complete its review and have issued a series of Requests for Additional Information (RAIs) which relate to the analytical methodology, processing of analysis inputs, assumptions applied in the evaluation, demonstration of specific criteria and requirements, or other technical aspects of the submitted reports.

The purpose of this letter is to provide a response to each of the six RAIs. These responses are intended for transmittal to the NRC for supporting the completion of the LAR review and acceptance.

It is noted that the current LAR review and RAIs are specific to CNP Unit 1, but since the LBB evaluations for these piping systems enveloped both CNP Units 1 and 2, the responses to these RAIs are also applicable to CNP Unit 2.

Revision 1 of this letter is being issued to update Reference 11 to the latest revision.

If you have any questions please call the undersigned.

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Attachment 1

Responses to RAIs on the Expanded Scope Leak-Before-Break (LBB) Evaluation for D.C. Cook Units 1 and 2

Responses to RAIs on the Expanded Scope Leak-Before-Break (LBB) Evaluation for D.C. Cook Units 1 and 2

Introduction

This attachment provides responses to each of the six Requests for Additional Information (RAIs) which have been issued by the U.S. Nuclear Regulatory Commission (NRC) in Reference 1 following their initial review of the License Amendment Request (LAR) for the application of Leak-Before-Break (LBB) evaluations to the Accumulator piping, Safety Injection (SI) piping, and Residual Heat Removal (RHR) piping at the D.C. Cook Nuclear Plant (CNP), Unit 1.

References

1. "Request for Additional Information Regarding License Amendment Request for Application of Leak-Before-Break Evaluations for Accumulator, Safety Injection, and Residual Heat Removal Piping, Donald C. Cook Nuclear Plant, Unit No. 1, Docket No. 50-315," US Nuclear Regulatory Commission (electronically attached in PRIME).

2. Westinghouse Reports, WCAP-18295-P (Proprietary) and WCAP-18295-NP (Non-proprietary), "Technical Justification for Eliminating Accumulator Line Rupture as the Structural Design Basis for D.C. Cook Units 1 and 2, Using Leak-Before-Break Methodology," January 2018.

3. Westinghouse Reports, WCAP-18302-P (Proprietary) and WCAP-18302-NP (Non-proprietary), "Technical Justification for Eliminating Residual Heat Removal Line Rupture as the Structural Design Basis for D.C. Cook Units 1 and 2, Using Leak-Before-Break Methodology," January 2018.

4. Westinghouse Reports, WCAP-18309-P (Proprietary) and WCAP-18309-NP (Non-proprietary), "Technical Justification for Eliminating Safety Injection Line Rupture as the Structural Design Basis for D.C. Cook Units 1 and 2, Using Leak-Before-Break Methodology," January 2018.

5. Standard Review Plan: Public Comments Solicited; 3.6.3 Leak-Before-Break Evaluation Procedures; Federal Register/Vol. 52, No. 167/Friday August 28, 1987/Notices, pp. 32626-32633.

6. NUREG-0800, Revision 1, Standard Review Plan: 3.6.3 Leak-Before-Break Evaluation Procedures, March 2007.

7. "Point Beach Nuclear Plant, Units 1 and 2 – Review of Leak-Before-Break Evaluation for the Accumulator Line Piping as Provided by 10 CFR 50 Part 50, Appendix A, GDC 4 (TAC NOS. MA7834 and MA7835)," US Nuclear Regulatory Commission, November 7, 2000.
(the Safety Evaluation Report is included in Westinghouse WCAP-15107-P-A, Revision 1)

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11. Westinghouse Reports, WCAP-18394-P, Revision 1 (Proprietary) and WCAP-18394-NP, Revision 1 (Non-proprietary), "Fatigue Crack Growth Evaluations of D.C. Cook Units 1 and 2 RHR, Accumulator, and Safety Injection Lines Supporting Expanded Scope Leak-Before-Break," September 2018.

RAIs and Responses

RAI-1

Two weld locations in pipe Segment III of the accumulator lines have lower maximum faulted stresses than 5 weld locations in pipe Segments I and II as shown in Table 5-1 of WCAP-18295. However, Table 6-1 of WCAP-18295 shows that the 2 weld locations in Segment III have much larger leakage flaw sizes than the 5 weld locations in pipe Segments I and II.

Since it would be expected that weld locations having high faulted stresses would lead to a larger leakage flaw size than the weld locations with lower faulted stresses, explain why the 2 weld locations in pipe Segment III have larger leakage flaw sizes than the 5 weld locations in pipe Segments I and II.

Westinghouse Response to RAI-1:

The critical weld locations for the Accumulator line LBB evaluation are chosen based on the highest faulted load conditions, as described in Section 5.1 of Reference 2. The leakage flaw size evaluations (Section 6.3 of Reference 2) consider the normal operation load conditions. As such, the faulted stress values in Table 5-1 of Reference 2 are not indicative of the leakage flaw size. The normal operating stresses for the critical weld locations in Segment III of the Accumulator line piping are considerably lower than the critical weld locations in Segments I and II, as shown in the following table:

Segment	Weld Location Node	Normal Operation Stress (psi)
I	2-SI-59-10-307	14,198
II	2-SI-58-9-160Y	10,576
	2-SI-58-9-162	10,731
	2-SI-58-6-184N	14,821
	2-SI-58-6-184F	14,951
III	2-SI-56-3-458F	2,561
	2-SI-56-3-456	2,246

Note: Normal operation stress values are taken from Tables 3-3 through 3-10 of Reference 2 for the critical weld location nodes.

For the critical weld locations in Segment III, the consideration of significantly lower normal operating loads necessitates a much greater leakage flaw length in order to establish the flaw opening area which produces the evaluation leak rate of 8 gpm. Additionally, the operating pressure in Segment III is significantly lower than the other weld locations – 644 psig for Segment III as compared to 2345 psig for Segment I and 2235 psig for Segment II. The lower operating pressure results in a much lower pressure differential driving the leakage rate. This condition also necessitates a greater leakage flaw length order to establish the flaw opening area which produces the evaluation leak rate of 8 gpm.

RAI-2

Table 7-1 of WCAP-18295 shows that the 2 weld locations (2-SI-56-3-458F and 2-SI-56-3-456) in pipe Segment III have an exact margin of 2.0 between the critical crack size and leakage crack size. The weld locations in Segments I and II have much higher margins between the critical crack size and leakage crack size. The footnote to Table 7-1 states that the calculation for welds, 2-SI-56-3-458F and 2-SI-56-3-456, is based on the methodology in Section 7.2, which is the J-integral method. The critical crack size for the weld locations in pipe Segments I and II was calculated based on the limit load method.

a) Explain why the critical crack size for welds 2-SI-56-3-458F and 2-SI-56-3-456 were calculated based on the J-integral method, whereas the critical crack size for the rest of welds were calculated based on the limit load methods.

b) Section 7.2 of WCAP-18295 discusses the J-integral method in general, but does not present any details of the critical crack size calculation using the J-integral method. Provide the details of critical crack size calculation for welds 2-SI-56-3-458F and 2-SI-56-3-456, such as the Ramberg-Osgood parameter and exponent, load combinations, J applied, and J resistance.

Westinghouse Response to RAI-2:

As identified above for RAI-1, the Accumulator line leakage flaw sizes for the critical weld locations in Segment III are considerably larger than the leakage flaw sizes for critical weld locations in Segments I and II. Due to these larger leakage flaw sizes for the welds in Segment III, it was not possible to establish the required margin of 2.0 (References 5 and 6) between the leakage flaw size and the critical flaw size using the conservative limit load method for calculating the critical flaw size. The J-integral flaw evaluation methodology was utilized at the locations in Segment III to demonstrate the required margin of 2.0 between the leakage flaw size and the critical flaw size. Consistent methodology has been accepted by the NRC on past LBB review applications, as documented in the Safety Evaluation Report for the Point Beach Accumulator Line LBB (Reference 7).

The details of the J-integral evaluation in Section 7.2 of WCAP-18295 (Reference 2) were kept brief for the purpose of limiting proprietary information and the need for additional bracketing and redaction from the non-proprietary version of the report. Details of those evaluations are provided as follows:

Critical crack size calculation:

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Ramberg-Osgood parameter and exponent:

A J-integral evaluation requires the use of Ramberg-Osgood parameters which establish the non-linear, elastic-plastic characteristics of the material being evaluated. For the locations being analyzed using the J-integral methodology (welds 2-SI-56-3-458F and 2-SI-56-3-456), the faulted total stresses are significantly less than the material yield stress as shown in the following table:

Segment	Weld Location Node	Maximum Faulted Stress (psi)	Material Yield Stress (psi)
III	2-SI-56-3-458F	6,974	28,960
	2-SI-56-3-456	6,975	28,960

Note: Maximum faulted stress values are taken from Table 5-1 of Reference 2 for the critical weld location nodes and material yield stress is taken from Table 4-1 of Reference 2 for the 120°F operating temperature.

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Load combinations:

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J-applied:

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J-resistance:

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RAI-3

Section 8 of WCAP-18295, WCAP-18302, and WCAP-18309 states that fatigue crack growth is not required based on the NRC Standard Review Plan (SRP). It is noted that in the LBB applications for the primary loop piping in 1999, and pressurizer surge line in 2000, the licensee performed fatigue crack growth calculation for the primary loop piping and pressurizer surge piping as shown in WCAP-15131, and WCAP-15434.

Consistent with SRP, Section 3.6.3.III.11.C.v, demonstrate that the crack growth is stable and the final crack size is limited such that a double-ended pipe break will not occur. Alternatively, explain why fatigue crack growth analysis is not required for the accumulator, residual heat removal, and safety injection lines.

Westinghouse Response to RAI-3:

A separate report, WCAP-18394 (Reference 11), has been issued to document fatigue crack growth evaluations for the D.C. Cook Units 1 and 2 Accumulator lines, RHR lines, and SI lines.

RAI-4

By letter dated November 8, 2000 (see original RAI, Reference 1), the NRC approved the LBB application for the pressurizer surge line for CNP Unit Nos. 1 and 2. In the corresponding safety evaluation, in accordance with SRP 3.6.3, the NRC staff reviewed the load combinations, including torsional moments, on the pressurizer surge line piping.

Consistent with SRP, Section 3.6.3.III.11.C.ii, explain how torsional moments were considered in the load combinations in WCAP-18295, WCAP-18302, and WCAP-18309 when calculating the critical crack size.

Westinghouse Response to RAI-4:

As discussed in Section 3.1 of the respective WCAP reports (References 2, 3, and 4), the torsional moment is conservatively included in the total applied bending moment load. The total applied bending moment for each loading combinations are calculated by the following equation:

$$M = \sqrt{M_x{}^2 + M_y{}^2 + M_z{}^2}$$

where,

M_x = X component of moment, torsion

M_y = Y component of bending moment

M_z = Z component of bending moment

This method of combining torsional moment loads into the total applied bending moment using the square root of the sum of the squares is consistent with SRP, Section 3.6.3.III.11.C.v (Reference 6). The evaluations in these WCAP reports follow this moment combination methodology for both normal operating load conditions (leakage flaw size) and faulted load conditions (critical flaw size).

RAI-5

The NRC has approved the license renewal application for CNP Unit No. 1. In Section 3.3 of Enclosure 2 to the LAR, the licensee stated that the LBB analysis does not include any time dependencies, and the LBB application would not impact CNP Unit No. 1 license renewal.

Provide justification why the LBB analysis has no impact on CNP license renewal. Specifically, explain why the fatigue crack growth of postulated flaws in the subject piping was not performed for the period of extended operation.

Westinghouse Response to RAI-5:

By inclusion of fatigue crack growth evaluations in response to RAI-3, the application of LBB for these auxiliary piping systems does now include associated time dependencies. As documented in WCAP-18394 (Reference 11), the fatigue crack growth evaluations for each piping system bound the transient projections for the 60-year period of extended operation.

RAI-6

By letter dated December 20, 2002 (see original RAI, Reference 1), the NRC approved a measurement uncertainty recapture power uprate for CNP Unit 1. The staff notes that pipe loads may be increased after implementing the power uprate.

Discuss whether the pipe loads used in the LBB analysis for the subject piping include the effects of power uprate. If not, explain.

Westinghouse Response to RAI-6:

The effects due to implementation of the measurement uncertainty recapture (MUR) power uprate for CNP Unit 1 were previously evaluated for each of the piping systems. It was determined that the operating parameters considered in the piping stress calculations for each system either bound the MUR operating parameters or would result in a negligible impact to the pipe loading conditions. As such, the piping loads used in the LBB analyses are representative of the MUR uprating operation.

Approval Information
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