June 29, 1995

MEMORANDUM TO: Robert A. Hermann, Section Chief
Materials and Chemical Engineering Branch
Division of Engineering

FROM: Laurence E. Phillips, Section Chief
Reactor Systems Branch
Division of Systems Safety and Analysis

SUBJECT: DSSA SER INPUT REGARDING CONFIRMATION OF THE CORE SHROUD SE FOR DRESDEN UNIT 3 AND QUAD CITIES UNIT 1 (TAC NOS. M91298 AND M91299)

On July 21, 1994, the staff issued a Safety Evaluation (SE) on core shroud cracking at Dresden, Unit 3, and Quad Cities, Unit 1. In the staff's SE, the staff concluded that the cracked shrouds will satisfy ASME Code margins against weld failure for 15 months of operation above cold shutdown. A full cycle of operation was not allowed due to the uncertainties identified by the staff in the Commonwealth Edison Company (ComEd) analyses. The staff requested that confirmatory analyses be provided to the NRC by December 15, 1994. By letters dated September 2, November 15, and December 14, 1994, ComEd submitted information requested in the SE dated July 21, 1994, and subsequent requests for information for Dresden, Units 2 and 3, and Quad Cities, Units 1 and 2.

The Reactor Systems Branch (SRXB) has reviewed the licensee's September 2, and subsequent submittals. Our evaluation is provided in the attached Safety Evaluation Report (SER). This SER provides our input to the review being conducted by the Division of Engineering regarding the structural and materials aspects of power operation for 15 months above cold shutdown.

Docket Nos.: 50-237, 50-249, 50-254, 50-265

Attachments: As noted

cc: M. Virgilio
R. Jones

Contact: K. Kavanagh, SRXB/DSSA, 415-3743

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DRESDEN UNITS 2 & 3 AND QUAD CITIES UNITS 1 & 2

VERIFICATION OF STAFF SER DATED 7/21/94

SRXB EVALUATION

1.0 INTRODUCTION

The NRC staff issued the "Resolution of Core Shroud Cracking At Dresden, Unit 3, and Quad Cities, Unit 1," safety evaluation (SE) on July 21, 1994. In the SE, the staff requested Commonwealth Edison (ComEd), the licensee, to provide the following confirmatory analyses to the NRC by December 15, 1994:

1. a computerized 3-dimensional asymmetric depressurization analysis for the recirculation line break, including assumptions and entry level conditions,

2. the WHAM calculations for the recirculation line break, including assumptions and entry level conditions, and

3. a detailed analysis of shroud movement, assuming a 360° through-wall crack, following postulated events, including all assumptions, entry level conditions, calculational techniques, and conservatisms. In your evaluation of seismic consideration, the analysis should be based on the most limiting seismic input motion (i.e., Golden Gate Park, time history, and El Centro, and Housner).

The staff also requested additional information in the "Request for Additional Information Concerning Generic Letter 94-03, 'Intergranular Stress Corrosion Cracking of Core Shrouds in Boiling Water Reactors'," dated November 14, 1994. ComEd responded to both requests in letters dated September 2, November 15, and December 14, 1994. The Reactor Systems Branch (SRXB) has reviewed portions of the ComEd submittals, and provided an evaluation of the licensee's findings in the following discussion.

2.0 EVALUATION

2.1 Recirculation Line Break Blowdown Loads

For the reactor recirculation line break (RLB) loss-of-coolant (LOCA), the blowdown and acoustic loads associated with the RLB have been calculated. As stated in the staff's SE dated July 21, 1994, the staff found that there was significant uncertainty with the RLB blowdown loads calculated using potential flow theory, and concluded that the blowdown loads were not conservative based on the licensee's June 17, 1994 submittal. A scoping calculation utilizing TRAC was performed by the staff which provided loads and tipping moments that were approximately twice as large as the loads calculated by the licensee in the original submittal dated June 17, 1994.

Based on this conclusion, the licensee provided a computerized 3-dimensional asymmetrical depressurization analysis for the RLB in the letter dated

September 2, 1994. The licensee used a TRACG calculation to evaluate the blowdown loads. The most important phenomena in determining the blowdown loads are single phase pressure drops and the break flow. The calculations used 120% of the nominal break flow which effectively multiplies the nominal load by 1.44. The licensee also performed a nodalization sensitivity study and used conservative loss coefficients to model the jet pumps. The behavior of the RLB is generally consistent with experimental integral facility test data and the independent assessment of the blowdown loads by the NRC staff. Therefore, the staff concludes that the RLB blowdown loads calculated in the September 2, 1994 submittal are acceptable.

2.2 WHAM Calculations For the Recirculation Line Break

As stated in the SE dated July 21, 1994, the acoustic loads provided by ComEd are calculated by the WHAM computer code and backed up by several different hand calculations to conclude that the short duration acoustic load from the RLB event would result in minimal movement of the shroud in the event of a postulated 360° through-wall crack. In the SE, the staff concurred with the licensee that the acoustic loads need not be included in determining the structural response of the shroud even though the WHAM models and assumptions were not provided to the staff. However, the staff requested that the licensee provide the WHAM models in order to validate the magnitude of the acoustic loads since these loads may be pertinent for other structural evaluation such as permanent repair options.

Since the issuance of the July 21, 1994 SE, ComEd has submitted its proposed core shroud repair for Dresden, Units 2 and 3, and Quad Cities, Units 1 and 2, to the staff. The staff issued the "Quad Cities Nuclear Power Station, Units 1 and 2, Safety Evaluation Regarding Core Shroud Repair," on June 8, 1995. In that SE, the staff evaluated ComEd's analysis of the dynamic nature of the RLB, the design basis earthquake, and the main steam line break (MSLB) LOCA loads on the repaired core shroud structure. The licensee demonstrated that the RLB LOCA lateral loading fluctuates with time, but the initial acoustic loading has an input frequency much greater than the shroud frequency content such that there is very little response due to the initial acoustic loading. Additionally, ComEd determined that the portion of the RLB loading following the acoustic portion is relatively constant which would result in a static load with no amplification, and that the RLB loads were bounded by the MSLB loads for the design of the stabilizers. Based on this analysis, the staff concluded that the WHAM models and assumptions were not required to validate the magnitude of the acoustic loads.

2.3 Main Steam Line Break TRACG Analysis

The MSLB LOCA results in the most limiting reactor vessel depressurization and yields the largest vertical pressure differences. This large upward load on the shroud could impact the ability of the control rods to insert and the ability of the core spray system to perform its safety function, if upward

shroud motion occurred. The staff has found that uncertainties exist in the calculation of the differential pressures (dP) due to break flow, two phase losses, and the TRACG separator model. During the October 14, 1994 meeting between ComEd and the NRC, the staff requested ComEd to provide the main steam line break (MSLB) TRACG analysis and its effect on the core shroud. Specifically, the staff requested that the following information be provided:

1. All assumptions used in the calculations.

2. Entry level conditions.

3. Correlations to other calculation techniques and the justification for their use for the plant specific calculation for Dresden and Quad Cities.

4. Conservatism used in the calculations.

5. Identify all uncertainties and inaccuracies in the TRACG calculation.

The licensee provided the results, including items 1 through 4, of the TRACG analysis for the MSLB in the letter dated November 15, 1994. Since the licensee did not fully address item number 5, the staff performed a confirmatory limit load analysis to demonstrate structural integrity of the welds for the 15 months of operation above cold shutdown. The staff's analysis confirmed that acceptable margin existed such that upward shroud motion is not expected during a MSLB LOCA. The staff also notes that the frequency of the MSLB is extremely low. Based on these findings, the staff confirms that operation of Dresden, Unit 3, and Quad Cities, Unit 1, for 15 months above cold shutdown is acceptable.

CONCLUSION

The staff has evaluated the licensee's response to the staff's RAIs and open items from the July 21, 1994 SE. The licensee adequately addressed most of the staff's concerns. The staff concluded that the licensee's analyses were consistent with experimental integral facility test data and the staff's confirmatory analyses and within the allowable ASME code margins. Therefore, the staff has concluded that operation of Dresden, Unit 3, and Quad Cities, Unit 1, for 15 months above cold shutdown is acceptable.

Principal Contributor: K. Kavanagh
Dated: 6/28/95