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Gentlemen:

DOCKET NUMBER 50-483
CALLAWAY PLANT
10CFR50.46 ANNUAL REPORT-ECCS EVALUATION MODEL REVISIONS

References: 1. NS-NRC-89-3463, "10CFR50.46 Annual Notification for 1989 of Modifications in the Westinghouse ECCS evaluation Models," Letter from W. J. Johnson (Westinghouse) to T. E. Murley (NRC), Dated October 5, 1989.

2. NS-NRC-89-3464, "Correction of Errors and Modifications to the NOTRUMP Code in the Westinghouse Small Break LOCA ECCS Evaluation Model Which Are Potentially Significant," Letter from W. J. Johnson (Westinghouse) to T. E. Murley (NRC), Dated October 5, 1989.

This letter provides the annual report of emergency core cooling system (ECCS) model revisions as they apply to Callaway Plant. In References 1 and 2 Westinghouse Electric Corporation provided information regarding modifications to their ECCS evaluation models to NRC Staff. References 1 and 2 describe the generic effects of the model revisions for both large and small break loss of coolant accidents (LOCA).

The attachment to this letter provides information regarding the effect of the ECCS evaluation model modifications on the Callaway FSAR Chapter 15.6.5 LOCA analysis. For large break LOCA the peak clad temperature (PCT) increases by 10°F to 2024°F. For small break LOCA, a conservative estimate of an increase of 42°F yields a resultant PCT of 1570°F. The attachment to this letter and Reference 2 also discuss modifications to the small break LOCA model which are expected to result in a decrease in the PCT. These modifications are considered potentially

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significant under the reporting requirements of 10CFR50.46. Westinghouse is conducting an investigation of the NOTRUMP Model because of the unexpected sensitivity of PCT to these changes. Westinghouse believes this investigation will be completed in the second quarter of 1990. Union Electric will provide a follow-up report based on the results of the Westinghouse investigation.

Westinghouse has also identified internal safety evaluations which are being performed on the Callaway FSAR Chapter 15 LOCA analysis which do not require reporting under 10CFR50.46. No impact is expected on the revised large break LOCA PCT of 2024°F as reported in the attachment to this letter. Some increase is expected in the small break PCT of 1570°F as reported in the attachment, but it is expected to be small in relationship to the margin of 630°F to the regulatory limit of 2200°F. These evaluations will be reported in the annual report of safety evaluations submitted per the requirements of 10CFR50.59. In addition they will be incorporated into an upcoming FSAR update per the requirements of 10CFR50.71(e).

If there are any questions with respect to this information please contact us.

Very truly yours,

Donald F. Schnell

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DS/sla

Attachment

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EFFECT OF WESTINGHOUSE ECCS EVALUATION MODEL MODIFICATIONS ON THE CALLAWAY FINAL SAFETY ANALYSIS REPORT CHAPTER 15 LOCA ANALYSIS RESULTS

The October 17, 1988 revision to 10CFR50.46 required applicants and holders of operating license or construction permits to notify the Nuclear Regulatory Commission (NRC) of errors and changes in the ECCS Evaluation Models on an annual basis, when the errors and changes are not significant. Reference 1 defines a significant error or change as one which results in a calculated peak fuel cladding temperature different by more than 50°F from the temperature calculated for the limiting transient using the last acceptable model, or is a cumulation of changes and errors such that the sum of the absolute magnitudes of the respective temperature changes is greater than 50°F.

In Reference 1, information regarding modifications to the Westinghouse large break and small break LOCA ECCS Evaluation Models was submitted to the NRC. The following presents an assessment of the effect of modifications to the Westinghouse ECCS Evaluation Models on the FSAR Chapter 15 loss-of-coolant accident (LOCA) analysis results for Callaway.

LARGE BREAK LOCA

The large break LOCA analysis for Callaway was examined to assess the effect of the applicable modifications to the Westinghouse large break LOCA ECCS Evaluation Model on peak cladding temperature (PCT) results. The large break LOCA analysis results were calculated using the 1981 version of the Westinghouse large break LOCA ECCS Evaluation Model (incorporating the BASH analysis technology). The analysis assumed the following information important to the large break LOCA analysis; core power of 3565 MWth, 17x17 VANTAGE-5 fuel, FQT=2.5, F-delta-H=1.65, and 15% steam generator tube plugging.

For Callaway, the limiting break resulted from the double-ended guillotine rupture of the cold leg piping with a discharge coefficient of CD = 0.6. The calculated peak cladding temperature was 2014°F.

The following modifications to the Westinghouse ECCS Evaluation Models discussed in Reference 1 apply to the large break LOCA analysis results for Callaway:

Several improvements were made to the BASH computer code to treat special analysis cases which are related to the tracking of fluid interfaces.

1) A modification, to prevent the code from aborting, was made to the heat transfer model for the special situation when the quench front region moves to the

bottom of the BASH core channel. The quench heat supplied to the fluid node below the bottom of the active fuel was set to zero.

2) A modification, to prevent the code from aborting, was made to allow negative initial movement of the liquid/two-phase and liquid-vapor interfaces. The coding was generalized to prevent mass imbalance in the special case where the liquid/two-phase interface reaches the bottom of the BASH core channel.

3) Modifications, to prevent the code from aborting, were made to increase the dimensions of certain arrays for special applications.

4) A modification was made to write additional variables to the tape of information to be provided to LOCBART.

5) Typographical errors in the coding of some convective heat transfer terms were corrected, but the corrections have no effect on the BASH analysis results since the related terms are always set equal to zero.

6) A modification was made to the BASH coding to reset the cold leg conditions, in a conservative manner, when the accumulators empty. The BASH model is initialized at the bottom of core recovery with the intact cold legs and lower plenum full of liquid. Flow into the downcomer then equals the accumulator flow. The modification removed most of the intact cold leg water at the accumulator empty time by resetting the intact cold leg conditions to a high quality two phase mixture.

In a typical BASH calculation, the downcomer is nearly full when the accumulators empty. The delay time, prior to the intact cold leg water reaching saturation, is sufficient to allow the downcomer to fill from the addition of safety injection fluid before the water in the cold legs reaches saturations. When the intact cold leg water reached saturation it merely flows out of the break. The cold leg water therefore, does not affect the reflood transient.

However, in a special case, a substantial time was required to fill the downcomer after the accumulators emptied. The fluid in the intact cold legs reached saturation before the downcomer filled. This artificially perturbed the transient response by incorrectly altering the downcomer fluid conditions and caused the code to abort.

The Callaway LOCA analysis results could be affected by the modifications specified in the items above. While there is no adverse effect on the PCT calculation for the majority of the changes discussed above, a conservative estimate of 10°F will be

assessed and tracked for use in determining the available margin to the limits of 10CFR50.46.

As discussed above, modifications to the Westinghouse large break LOCA ECCS Evaluation Model could affect the result by altering the PCT.

A.	Analysis calculated result	2014	°F
B.	Modifications to Westinghouse ECCS Evaluation Model	+ 10	°F
	Resultant PCT	2024	°F

SMALL BREAK LOCA

The small break LOCA analysis for Callaway was examined to assess the Effect of the applicable modifications to the Westinghouse small break LOCA ECCS Evaluation Model on peak cladding temperature (PCT) results. The small break LOCA analysis results were calculated using the 1985 version of the Westinghouse small break LOCA ECCS Evaluation Model incorporating the NOTRUMP analysis technology. For Callaway, the limiting size small break resulted from a 4 inch equivalent diameter break in the cold leg. The calculated peak cladding temperature was 1528°F. The analysis assumed the following information important to the small break LOCA analysis; core power of 3565 MWth, 17x17 VANTAGE-5 fuel, FQT=2.5, F-delta-H=1.65, and 15% steam generator tube plugging.

The Callaway small break LOCA analysis was performed with a version of the NOTRUMP computer code which did not incorporate several potentially significant modifications noted in References 1 and 2. These modifications are as follow:

1) The modification to preclude changing the region designation (upper, lower) for a node in a stack which does not contain the mixture-vapor interface was not incorporated in the small break LOCA analysis. The purpose of the modification was to enhance tracking of the mixture-vapor interface in a stacked series of fluid nodes and to preclude a node in a stack, which does not contain the mixture-vapor interface, from changing the region designation. The update does not affect the fluid conditions in the nodes representing the reactor coolant system, only the designation of the region of the node. The region designation does not typically affect the calculations, except for the nodes representing the core fluid volume (core nodes). In core nodes which are designated as containing vapor regions, the use of the steam cooling heat transfer correlation is forced on the calculation in compliance with the requirements of Appendix K to 10CFR50, even if the node conditions would indicate otherwise. This modification could affect the heat transfer calculation

if the region designation was improperly reflected, but is expected to result in a small decrease in the PCT if the correction were taken into account..

2) The modification to correct typographical errors in the equations which calculate the heat transfer rate derivatives for subcooled, saturated, and superheated natural convection conditions for the upper region of interior fluid nodes were not included in the small break LOCA analyses. The heat transfer rate derivatives for subcooled saturated, and superheated natural convection conditions for the upper region of interior fluid nodes used the lower region heat transfer area instead of the upper region heat transfer area, which could, in rare instances, affect the amount of heat that could be transferred to the fluid. Incorporating the modification into the small break LOCA analysis results in an increase in the PCT of 36.8°F.

3) The modification to correct typographical errors in equations which calculate the derivatives of the natural convection mode of heat transfer in the subroutine HEAT were not included in the small break LOCA analysis. However, incorporating the correction into the analysis would have no effect on the analysis results.

4) The modification to correct a typographical error in an equation which calculates the internal energy for nodes associated with the reactor coolant pump model when the associated reactor coolant pump flow links are found to be in critical flow was not included in the small break LOCA analysis. Since the small break LOCA Evaluation Model calculations did not encounter critical flow in the reactor coolant pump flow links, including this modification would have no effect on the analysis results.

5) The modification to correct an error in the implementation of equation 5-33 of the NOTRUMP (1) code was not included in the small break LOCA analysis. Equation 5-33 describes the calculation of the flow link friction parameter c_k for single phase flow in a non-critical flow link "k". In the erroneous implementation, equation 5-33 was replaced by equation 5-34 which is used for all flow conditions. This modification could affect the small break LOCA calculation, but is expected to result in a decrease in the PCT if the correction were taken into account through a new analysis.

6) The modification made to prevent code aborts resulting from implementation of a new FORTRAN complier on the

Westinghouse CRAY computer system was not included in the small break LOCA analysis. Due to the different treatments of the precision of numbers between the FORTRAN compliers, the subtraction of two large, but close numbers resulted in zero. The zero value was used in the denominator of a derivative equation, which resulted in the code abort. Implementing this modification for cases which did not abort has the potential to increase the PCT approximately 4.8°F.

7) The modification to properly call some double-dimensioned variables in subroutines INIT and TRANSNT was not included in the small break LOCA analysis. However, all of the doubly dimensioned variables used a "1" as the second dimension in all of the erroneous calls, and therefore this modification would have no Effect on the PCT.

8) The modification to correct an error in implementing equation pairs L-28, L-52 and L-29, L-53 of the NOTRUMP (1) code was not included in the small break LOCA analysis. The two pairs of equations respectively describe the partial derivatives of F^K with respect to pressure and specific enthalpy. F^K is an interpolation parameter that is defined by equations L-27 and L-51 of the NOTRUMP (1) code. This modification could affect the small break LOCA calculation, but is expected to result in a decrease in the PCT if the correction were taken into account through a new analysis.

Modifications were also made to the small break LOCTA-IV computer code used in the small break LOCA ECCS Evaluation Model. Since the small break LOCTA-IV code modifications could, at most, result in a very small benefit the effect of modification to the small break LOCTA-IV code modifications do not need to be assessed or tracked.

The effect of the potentially significant ECCS Evaluation Model modifications on the Callaway small break LOCA analyses could result in a penalty in the peak cladding temperature calculation if taken into account. For conservatism in estimating the available margin, a peak cladding temperature penalty of approximately 42°F should be added to the analysis calculations as a result of ECCS Evaluation Model changes when determining the available margin to the limits of 10CFR50.46.

A.	Analysis calculated result	1528 °F
B.	Westinghouse ECCS Evaluation Model Mod.	+ 42 °F
	Resultant PCT	1570 °F

CONCLUSIONS

An evaluation of the effect of modification to the Westinghouse ECCS Evaluation Model as reported in Reference 1 was performed for both the large break LOCA and small break LOCA analyses for the Callaway FSAR Chapter 15.6.5 results. It was determined that compliance with the requirements of 10CFR50.46 would be maintained when the effects of the ECCS Evaluation Model modifications applicable to Callaway were combined with the current plant analysis results.

(1) "NOTRUMP-A Nodal Transient Small Break and General Network Code," WCAP-10079-P-A (Proprietary), WCAP-10080-A (Non-Proprietary), Meyer, P.E., et.al., August 1985.