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U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

South Texas Project Electric Generating Station
Units 1 and 2
Dockets No. STN 50-498, STN 50-499
<u>10CFR50.46 Required Annual Report of ECCS Model Revisions</u>

In accordance with 10CFR50.46(a)(ii), HL&P is submitting the attached information regarding ECCS model revisions affecting South Texas Project (STP) Units 1 and 2.

The cumulative revisions to the Westinghouse Small Break LOCA ECCS Evaluation model are provided for your review. The STP Small Break LOCA analyses remain conservative when the effects of the revision are considered.

If there are any questions, please contact Mr. A. W. Harrison at (512) 972-7298 or myself at (512) 972-8530.

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Attachments: Effects of Westinghouse ECCS Evaluation Model Modifications on the South Texas Units 1 and 2 LOCA Analysis Results: Chapter 15 of the Final Safety Analysis Report

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L4/NRC/

EFFECT OF WESTINGHOUSE ECCS EVALUATION MODEL MODIFICATIONS

ON THE SOUTH TEXAS UNITS 1 & 2 LOCA ANALYSIS RESULTS

CHAPTER 15 OF THE FINAL SAFETY ANALYSIS REPORT

The October 17, 1988 revision to 10CFR50.46 required applicants and holders of operating licenses 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 were 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 2, 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 the modifications to the Westinghouse ECCS Evaluation Models on the loss-of-coolant accident (LOCA) analysis results found in Chapter 15 of the South Texas Units 1 & 2 Final Safety Analysis Report.

Large Break LOCA

The large break LOCA analysis for South Texas Units 1 & 2 were examined to assess the effect of the applicable modifications to the Westinghouse large break LOCA ECCS Evaluation Model on peak cladding temperature (PCT) results reported in Chapter 15 of the FSAR. The large break LOCA analysis results were calculated using the 1981 version of the Westinghouse large break LOCA ECCS Evaluation Model incorporating the BART analysis technology. The analysis assumed the following information important to the large break LOCA analyses:

NSSS power level of 102% of 3800 Mwt.

17x17XL STD fuel

Steam Generator Tube Plugging Level of 5% Uniform among the four steam generators.

Nuclear Peaking Factors of 2.50 for the total peaking factor and 1.52 for the Enthalpy Rise peaking factor.

The limiting break resulted from the double ended guillotine rupture of the cold leg piping with a discharge coefficient of CD = 0.6 and maximum safeguards assumptions. The calculated peak cladding temperature was 2122°F.

CODE MODIFICATION RELATED TO THE 1981 ECCS EVALUATION MODEL INCORPORATING BART ANALYSIS TECHNOLOGY:

In the 1981 version of the Westinghouse ECCS Evaluation Model which incorporates the BART analysis technology, a modification was made to delay downcomer overfilling. The delay corresponds to backfilling of the intact cold legs. Data from tests simulating cold leg injection during the post-large break LOCA reflood phase which have adequate safety injection flow to condense all of the available steam flow show a significant amount of subcooled liquid to be present in the cold leg pipe test section. This situation corresponds to the so-called maximum safety injection scenario of ECCS Evaluation Model analyses.

For maximum safety injection scenarios, the reflooding model in the Westinghouse 1981 ECCS Evaluation Model incorporating the BART analysis technology uses a WREFLOOD code version which predicts the downcomer to overfill. Flow through the vessel side of the break is computed based upon the available head of water in the downcomer in WREFLOOD using a method with incompressible flow in an open channel. A modification to the WREFLOOD computer code was made to consider the cold leg inventory which would be present in conjunction with the enhanced downcomer level in the non-faulted loops.

WREFLOOD code logic was altered to consider the filling of the cold legs together with downcomer overfilling. With this coding update, when the downcomer level exceeds its maximum value, as input to WREFLOOD, liquid flow into the intact cold leg, as well as spillage out the break, is considered. This logic modification stabilizes the overfilling of the vessel downcomer as it approaches the equilibrium level. In some cases this change could delay the downcomer overfilling process, which could in turn result in a peak cladding temperature (PCT) penalty. The magnitude of the possible PCT penalty was assessed by reanalyzing a plant which is maximum safeguards limited (CD=0.6 DECLG case) and which is most sensitive to the changes in the WREFLOOD code using the 1981 ECCS Evaluation Model without including the BART analysis technology methods. The PCT penalty of 16°F which resulted represents the maximum PCT penalty which could be exhibited for any plant due to the WREFLOOD logic change and is a conservative estimate for the BART analysis technology.

This change represents a model enhancement in terms of consistency of the approach in the WREFLOOD code and the actual response of the downcomer level. Since Appendix K to 10CFR50 does not require the explicit treatment of the mass storage feature, this modification represents an enhancement rather than an error. However, to assess the margin available for accommodating potential plant changes, a 16°F penalty in the peak cladding temperature will be tracked for this code modification.

South Texas Units 1 & 2 large break LOCA analysis results could be affected by the modifications specified above. While there may be no adverse effect on the PCT calculation for the change, a conservative estimate of 16°F will be assessed and tracked for use in determining the available margin to the limits of 10CFR50.46.

A.	Analysis calculated result	2122 °F
B.	Modifications to Westinghouse ECCS Evaluation Model	+ 16 °F
	ECCS Evaluation Model Modifications Resultant PCT	= 2138 °F

Small Break LOCA

The small break LOCA analyses for South Texas Units 1 & 2 were also examined to assess the effect of the applicable modifications to the Westinghouse ECCS Evaluation Models on peak cladding temperature (PCT) results reported in Chapter 15 of the FSAR. The small break LOCA analyses results were calculated using the 1985 version of the Westinghouse small break LOCA ECCS Evaluation Model incorporating the NOTRUMP analysis technology. The limiting size small break resulted from a 4-inch equivalent diameter break in the cold leg. The calculated peak cladding temperature was 1367°F. The analysis assumed the following information important to the small break LOCA analyses:

NSSS power level of 102% of 3800 Mwt.

17x17XL STD fuel

Steam Generator Tube Plugging Level of 5% Uniform among the four steam generators.

Nuclear Peaking Factors of 2.50 for the total peaking factor and 1.52 for the Enthalpy Rise peaking factor.

The Westinghouse small break LOCA ECCS Evaluation Model analyses for South Texas Units 1 & 2 were performed with a version of the NOTRUMP computer which existed prior to the identification of the following potentially significant modifications noted in Reference 3:

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 analyses. 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 was 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 was 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 analyses could result in an increase in the PCT of 36.6°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 LOCAL analyses. However, incorporating the correction into the analyses 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 LOCAL analyses. 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 Reference 5 was not included in the small break LOCAL analyses. 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 compiler on the Westinghouse CRAY computer system was not included in the small break LOCA analyses. Due to the different treatments of the precision of numbers between the FORTRAN compilers, 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 aborts. Implementing this modification for cases which did not abort has the potential to result in an increase in the PCT of 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 analyses. However, all of the doubly dimensioned variables used a 1 as the second dimension in all of the erroneous calls, and therefore this moditication would have no effect on the PCT.

8) The modification to correct an error in implementing equations L-28, L-52 and L-29, L-53 of Reference 5 was not included in the small break LOCA analyses. 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, L-51 of Reference 6. 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 ECCS Evaluation Model modifications on the small break LOCA analyses for South Texas Units 1 & 2 could result in a penalty in the peak cladding temperature calculation if taken into account. For conservatism in estimateing the available margin, a peak cladding temperature penalty of approximately 42°F should be added to the analysis calculation as a result of ECCS Evaluation Model changes when determining the avilable margin to the limits of 10CFR50.46.

As discussed above, modifications to the Westinghouse small break LOCA ESSC Evaluation Model could affect the small break LOCA analysis results by altering the PCT.

A.	Analysis calculated result	1367 °F
B.	Modifications to Westinghouse ECCS Evaluation Model	+ 42 °F
	ECCS Evaluation Model Modifications Resultant PCT	= 1409 °F

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2. 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.

3. 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.

4. WCAP-9561-P-A, Addendum 3 (Proprietary), WCAP-9562-A, Addendum 3 (Non-Proprietary), Young, M. Y., "Addendum to: BART-1A: A Computer Code for the Best Estimate Analysis of Reflood Transients (Special Report: Thimble Modeling in Westinghouse ECCS Evaluation Model)," 1986.

5. "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.

6. "Westinghouse Small Break ECCS Evaluation Model Using the NOTRUMP Code," WCAP-10054-P-A (Proprietary), WCAP-10081-A (Non-Proprietary), Lee, N., et. al., August 1985.

7. "Westinghouse Small Break ECCS Evaluation Model Generic Study with the NOTRUMP Code," WCAP-11145, Rupprecht, S. D., et. al., August 1985.