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Attention: Brian Benney

Our ref: LTR-NRC-05-46

August 4, 2005

TRANSMITTAL OF INFORMATION

Subject: Clarification of WCAP-10325-P-A

This letter provides a non-proprietary version of the previously transmitted letter LTR-NRC-05-38, June 22, 2005. The purpose of this letter is to provide more details of the Westinghouse LOCA Mass and Energy release model.

Westinghouse intends to continue to perform the LOCA Mass and Energy Release analysis as described in the attachment and has been done since the model was implemented. We are providing this information to you for clarification in our documentation. We request a letter from the staff in response indicating your concurrence with the acceptability of this approach.

Questions concerning this letter or the Reference 1 Westinghouse LOCA mass and energy release model should be directed to Ms. Susan I. Dederer, Acting Manager of the Containment Radiological and Analysis group at 412-374-5387 or to me at 412-374-4643.

Very truly yours,

J. A. Gresham, Manager
Regulatory Compliance and Plant Licensing

cc: Ed Throm
Girija Shukla

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WESTINGHOUSE LOCA MASS AND ENERGY RELEASE MODEL FOR CONTAINMENT DESIGN MARCH 1979 MODEL WCAP-10325-P-A CLARIFICATION OF SOME MODEL FEATURES

The Westinghouse LOCA mass and energy (M&E) release model described in WCAP-10325-P-A (Reference 1) was approved in February 1987 (Reference 2) and has been used to calculate the LOCA mass and energy releases for almost all Westinghouse designed PWRs and some non-Westinghouse designed PWRs. This model contains several feature changes when compared to the model of Reference 3. Reference 1 also includes a discussion of some identified conservatisms that remain in the model. As a result of a Westinghouse review of the Reference 1 models, the need to clarify two model features was identified. These are the assumptions placed on the steam generator exit steam enthalpy during the post-reflood period and the assumed power level used in the LOCA M&E analysis. Since these two model features are applied differently than presented in Reference 1 and as approved in Reference 2, this discussion was deemed necessary.

Steam Generator Exit Steam Enthalpy

Reference 1, Section 2.0 "Reflood", Sub-Section 2.2.3, "Steam Generator Fluid Exit Condition" *as well as the response to Question 1.4 in Appendix A of Reference 1 describes a change from the Reference 3 model to limit the SG tube side exit steam enthalpy to saturated steam as opposed to the Reference 3 model which calculated super-heated steam based on the SG secondary side temperature. This model change was justified based on some FLECHT test results that showed that the fluid leaving the steam generator primary side during reflood was not superheated to the temperature of the secondary side.* This assumption was described in Section 2.3 and Section 5.1 of Reference 1 as also being extended to the FROTH computer code even though the impact of this assumption on the peak containment pressure is slight. From Table 5 in Reference 1, the results show that the minimum safeguards case experienced a penalty of 0.08 psi when saturated releases were modeled and the non-limiting maximum safeguards case had a penalty of 0.32 psi. The FROTH code is described in detail in Reference 3 and is used to address the post-reflood period from the end of reflood until the intact steam generator(s) is calculated to equilibrate at the containment design pressure.

The Westinghouse review noted that the WREFLOOD code is generating saturated releases but the FROTH code is using the assumption from Reference 3 that the SG tube exit steam enthalpy can become superheated if warranted by the fluid and heat transfer conditions. While this condition does not conform to the model as presented in Reference 1 or as described again in Reference 2, the overall release rate of the steam generator(s) energy (i.e., down to atmospheric pressure at one hour) remains conservative. The release of super-heated steam during this phase is expected due to this rapid removal of the secondary side energy. The analysis description of super-heated releases during post-reflood phase has been stated in the SAR and licensing submittal documentation supplied to licensees since the 1980s; for example, in two sections of the licensing submittals:

> **LOCA M&E Release Phases**
> For the pump suction break, a two-phase mixture exits the core, passes through the hot legs, and is superheated in the steam generators prior to exiting the break as steam. After the broken loop steam generator cools, the break flow becomes two phase.
>
> **Post-Reflood Mass and Energy Release Data**
> The FROTH code calculates the heat release rates resulting from a two-phase mixture present in the steam generator tubes. The mass and energy releases that occur during this phase are typically superheated due to the depressurization and equilibration of the broken loop and intact loop steam generators.

Power Level

Reference 1, Section 5.1, "Model Conservatisms" under Item 1 "*.....core power is assumed to be 102% of the license power level. For other plants where the 3800 MWt rating will not be exceeded, the ESDR (Engineered Designed Safeguards Rating) will be used. This power level is based on the upper limit rating of the components in the plant and is about 4.5 percent greater than the license rating.*" The reactor core power of 3800 megawatts thermal was an upper limit that was defined by the U.S. Atomic Energy Commission in Regulatory Guide 1.49, Revision 1, which was later lifted. For plants with a core power less than 3800 MWt, the LOCA mass and energy release analyses have been performed at the licensed core power or the planned uprated core power, with allowance for calorimetric error, even if these power levels were less than the ESDR power level. Thus, by interpretation, these analyses could be considered to be inconsistent with respect to the core power discussed in Reference 1.

With the passing of the 3800 MWt limit, it is the understanding of Westinghouse that analyses at the planned uprated core power or the licensed core power, regardless of power level, is an acceptable method, as long as the plant-specific calorimetric uncertainty is also included. While this condition does not conform to the model as presented in Reference 1 or as described again in Reference 2, Westinghouse has stated in the input assumptions of SAR and licensing submittal documentation supplied to licensees since the 1980s, that the core power, with allowance for calorimetric error, forms the bases for the analysis.

Model Conservatisms and Current Position

As noted in Chapter 5.1 of Reference 1, a significant amount of conservatism exists in the methodology:

1. Core power includes allowance for calorimetric error
2. RCS fluid temperatures are maximized by including uncertainty
3. RCS fluid volumes include uncertainty and account for thermal expansion
4. Steam generator secondary side fluid mass is increased by 10% to maximize available energy
5. Stored metal energy is maximized
6. Decay heat is maximized (two sigma uncertainty has been added for conservatism)
7. Core-stored energy is maximized

The current model extracts the secondary side energy down to atmospheric conditions within 1 hour. Prior investigations and current work have indicated that this is a very conservative model constraint.

Therefore, any change in the mass and energy releases and the corresponding containment response due to modifying the exit steam enthalpy during the post-reflood period are small compared to the overall conservatism in the methodology. Analyzing a power level above which the plant would operate is an excessive conservatism not needed with the current conservative methodology. The current model retains sufficient conservatism such that there is assurance that plants operating with the model as described will remain within the specified licensing basis.

Conclusion

Westinghouse has identified two inconsistencies associated with the Reference 1 LOCA mass and energy release model. Although the analysis description of the post-reflood super-heated releases and the assumed power level has been presented in the SAR and licensing submittal documentation supplied to licensees since the 1980s, further clarification of the Westinghouse model is provided in this letter. Furthermore, these differences have been determined as being very small relative to the overall conservatism of the analysis. The Reference 1 model, with the noted differences, retains sufficient conservatism such that there is assurance that plants operating under an analysis containing the identified differences will remain within the specified licensing basis.

Questions concerning this letter or the Reference 1 Westinghouse LOCA mass and energy release model should be directed to Mr. James A. Gresham, Manager of the Westinghouse Regulatory Compliance Group or Ms. Susan I. Dederer, Acting Manager of the Containment Radiological and Analysis group.

References

1. "Westinghouse LOCA Mass and Energy Release Model for Containment Design - March 1979 Version," WCAP-10325-P-A, May 1983 (Proprietary), WCAP-10326-A (Non-proprietary).

2. Letter from Mr. Charles E Rossi (NRC) to Mr. William J. Johnson (W), "Acceptance for Referencing of Licensing Topical Report WCAP-10325, 'Westinghouse LOCA Mass and Energy Release Model for Containment Design (Proprietary) - March 1979 Version'," February 17, 1987.

3. "Westinghouse Mass and Energy Release Data for Containment Design," WCAP-8264-P-A, Rev. 1, August 1975 (Proprietary), WCAP-8312-A, Rev. 2 (Non-proprietary).