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NOV 10 1993

U.S. Nuclear Regulatory Commission
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Gentlemen:

In the Matter of the Application of	)	Docket Nos. 50-390
Tennessee Valley Authority	)	50-391

WATTS BAR NUCLEAR PLANT (WBN) - EMERGENCY CORE COOLING SYSTEM (ECCS) EVALUATION MODEL CHANGES

This letter is notification of recent changes to WBN's ECCS evaluation model. It is intended to satisfy both the 30-day and the annual reporting requirements of 10 CFR 50.46. The last annual report of ECCS model changes for WBN was submitted in a letter dated March 17, 1993. Two recent changes in parts of the ECCS model that are used to analyze a small-break loss-of-coolant accident (SBLOCA) exceed the threshold defined in 10 CFR 50.46 for a "significant" change of more than 50°F in calculated peak cladding temperature (PCT). Therefore, TVA is reporting these significant changes within the 30-day time limit specified in 10 CFR 50.46.

There have been no additional changes in the parts of the ECCS model that are used to analyze a large-break loss-of-coolant accident (LBLOCA) since the last annual report of March 17, 1993.

The recent changes to WBN's ECCS evaluation model are described in detail in Enclosure 1. The PCT margin allocations resulting from these ECCS evaluation model changes are summarized in Enclosure 2. TVA first determined that it was necessary to report a significant change to WBN's ECCS model based on a series of letters it received from Westinghouse Electric Corporation, which has contractual responsibility for maintaining WBN's ECCS model. The last of these letters was sent to TVA on October 11, 1993.

As described in Enclosure 1, the two significant changes to WBN's ECCS evaluation model involve accounting for safety injection (SI) in the broken

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loop and corrections to the NOTRUMP computer code for drift flux flow regime map errors. TVA does not consider the other change described in Enclosure 1 (i.e., use of an improved condensation model) to be a separate significant change even though it could affect the calculated value of PCT by more than 50°F. This change was developed primarily to offset the effect of SI in the broken loop, and TVA views it as an extension of that change. Incorporation of the improved condensation model into the ECCS evaluation model is dependent on the approach that is ultimately adopted by the Westinghouse Owners Group (WOG) to resolve the issue of SI in the broken loop.

When reporting a significant change to a plant's ECCS evaluation model, 10 CFR 50.46 requires the inclusion of "a proposed schedule for providing a reanalysis or taking other action as may be needed to show compliance with 10 CFR 50.46 requirements." As a result of previous changes to WBN's ECCS model, TVA committed to a schedule for LBLOCA reanalysis in a letter dated July 28, 1993. TVA is currently evaluating the need for SBLOCA reanalysis in response to the latest ECCS model changes that are described in Enclosure 1. TVA will submit supplemental information about its plan and schedule for SBLOCA reanalysis after further discussions with Westinghouse and agreement on WOG activities to address SI in the broken loop and the offsetting use of an improved condensation model.

Enclosure 3 is a list of the commitments made in this submittal.

If you have any questions about the information provided in this letter, please telephone John Vorees at (615) 365-8819.

Very truly yours,

W. J. Museler

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Enclosures
cc: See Page 3

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ENCLOSURE 1

DESCRIPTION OF CHANGES TO EMERGENCY CORE COOLING SYSTEM (ECCS) EVALUATION MODEL

SAFETY INJECTION IN THE BROKEN LOOP

Description of Issue

Small-break loss-of-coolant accident (SBLOCA) analysis using the Westinghouse emergency core cooling system (ECCS) evaluation model has previously been based on the underlying assumption that the safety injection (SI) flow into the broken reactor coolant system (RCS) loop spilled to the containment sump. This was thought to be a conservative assumption since it appeared that taking credit for any part of the SI flow into the broken loop reaching the core would result in a lower calculated peak cladding temperature (PCT). The assumption was also thought to be conservative in view of the effect of backpressure on the spilling ECCS line for cold leg breaks. Any SI connected to the broken RCS loop would experience a higher backpressure for flow toward the reactor core than for spilling out of the break against just containment backpressure. Consequently, with some SI flow through the broken loop going to the reactor core, the total SI flow to the broken loop would be decreased compared to the SI flow rate if only spilling to the containment sump was assumed. With decreased SI flow to the broken RCS loop, SI flow to the intact loops would be proportionately increased and provide a net benefit for calculated PCT. In summary, the ECCS model assumption that SI flow to the broken loop spilled to the containment sump was viewed as very conservative. It took no credit for potentially increased SI flow rates to the intact loops and slightly faster recovery of RCS/core coolant inventory from whatever portion of SI flow into the broken loop did not spill.

However, in contradiction to the above assumption, a recently completed evaluation by Westinghouse determined that there is a significant increase in calculated PCT when SI flow into the broken RCS loop is explicitly modeled. This PCT penalty was calculated using the NOTRUMP computer code, which is used as part of Westinghouse's ECCS evaluation model for SBLOCA analysis.

Estimated Effects

No plant-specific evaluation has been performed for WBN. Westinghouse has determined that a PCT penalty of approximately 150°F is applicable to a typical Westinghouse 3-loop plant design when accounting for the effect of SI flow in the broken loop.

Technical Evaluation

The recent evaluation by Westinghouse indicated that the PCT penalty described above results from competition between the steam venting out the break and the SI flow to the broken loop, which also exits through the break. The competition between the steam and the SI flow creates higher RCS pressures for identical core steaming rates. Since the ECCS uses centrifugal pumps, higher RCS pressure decreases the delivered SI flow rates to the intact RCS loops. This SI flow reduction leads to the calculated PCT penalty. The penalty is somewhat aggravated by the use of the Moody two-phase break flow model, which is a thermal equilibrium model, to represent a clearly non-equilibrium process. However, the penalty is large enough that a change to a non-equilibrium break flow model would not be expected to offset the break flow/RCS pressure interaction which occurs due to SI flow entering into the broken loop.

For the purpose of allocating PCT margin to account for SI in the broken loop, a penalty of 150°F has been assigned based on the limited quantitative evaluation that Westinghouse has completed to date. Even if further evaluation determines that the penalty does not need to be this large, the effect of SI in the broken loop on calculated PCT almost certainly exceeds 50°F. Therefore, the change is "significant" for reporting purposes under 10 CFR 50.46(a)(3)(i).

Assessment of Safety Significance

The Westinghouse Owners Group (WOG) is reviewing this issue and possible development of a generic program for resolution. TVA expects to participate in these WOG activities and use any resulting information to assess the need for SBLOCA reanalysis at WBN. Presently, Westinghouse believes that reanalysis for this issue alone may not be needed. They have suggested that the PCT penalty imposed by SI in the broken loop can be offset on a qualitative basis with credit for the PCT benefit which results from the use of an improved condensation model. A description of this improved condensation model follows.

Note that the effects of SI in the broken loop do not change the reactor coolant pump trip symptoms developed in response to Generic Letters 83-10C and 85-12 or the SI termination criteria contained in the WOG Emergency Response Guidelines.

IMPROVED CONDENSATION MODEL

Description of Issue

Westinghouse has developed a new, conservative model of the configuration of the SI piping that is connected to the RCS cold leg in a Westinghouse-designed pressurized water reactor (PWR). This improved model is based on prototypic test data that was obtained from the COSI test facility, which is a 1/100-scale representation of the cold leg and SI injection ports in a Westinghouse PWR. COSI testing demonstrated that the current NOTRUMP condensation model under-predicts condensation of steam in the intact RCS loops during SI. When an improved condensation model based on the COSI test data is used, lower RCS pressure and larger SI flow rates are predicted for a SBLOCA event. This, in turn, leads to a calculated PCT benefit.

Estimated Effects

No plant-specific evaluation has been performed for WBN. However, Westinghouse has used the above approach to demonstrate generically that current SBLOCA analyses using NOTRUMP with its older condensation model and no SI flow into the broken loop are more conservative (i.e., calculate a higher PCT) than a case which includes SI into the broken loop and the improved condensation model. Therefore, on a qualitative basis it is justifiable to offset the negative effects of SI into the broken RCS loop with the positive effects of the improved condensation model.

Technical Evaluation

TVA expects that future discussions among NRC, Westinghouse, and WOG members will confirm the applicability of the improved condensation model in SBLOCA analysis. However, at present the test data supporting the improved condensation model have not been reviewed and approved by NRC. Also, an exact quantitative method of incorporating this new model into SBLOCA analysis and the possible need to revise the NOTRUMP computer code are yet to be determined.

For the purpose of allocating PCT margin associated with the improved condensation model, a benefit of 150°F has been assigned to offset the 150°F penalty associated with SI in the broken loop. This is thought to be conservative since the Westinghouse evaluation described above indicates that the benefit is probably greater than the penalty for SI in the broken loop. TVA expects that final implementation details for the improved condensation model will be included in the WOG activites which were recently initiated to investigate the issue of SI in the broken loop.

Assessment of Safety Significance

Use of the improved condensation model--after appropriate reviews and approvals--has no safety significance in itself since it will reduce the calculated PCT for

a SBLOCA event. However, as previously discussed, taking credit for the improved condensation model is the preferred means of offseting the PCT penalty associated with accounting for SI flow in the broken loop. Resolution of that issue, which could substantially increase calculated PCT, does have safety implications.

NOTRUMP DRIFT FLUX FLOW REGIME MAP ERRORS

Description of Issue

Westinghouse discovered errors in both WCAP-100079-P-A and related coding in NOTRUMP Subroutine DFCORRS where the improved TRAC-P1 vertical flow regime map is evaluated. For SBLOCA analysis with the NOTRUMP computer code, this flow regime map is only used during counter-current flow conditions in vertical flow links. The first error that was discovered affected Equation G-65 in WCAP-100079-P-A. The error permitted unbounded values of the parameter C_∞, which is contrary to the intent of the original source of the equation. As a result of the error, a discontinuity could exist in the flow regime map under some circumstances. The error was corrected by placing an upper limit of 1.3926 on the parameter C_∞ based on information provided in the original source. This correction made the coding in NOTRUMP consistent with the original source for the affected equation.

Further investigation of the DFCORRS subroutine uncovered an additional, closely related logic error which could lead to discontinuities under certain other circumstances. This error was also corrected and the coding in NOTRUMP made consistent with WCAP-100079-P-A.

The above errors were determined to be non-discretionary changes as described in Section 4.1.2 of WCAP-13451 and were corrected in accordance with Section 4.1.3 of WCAP-13451.

Estimated Effects

No plant-specific evaluation has been performed for WBN. However, representative plant calculations by Westinghouse have indicated that correction of the above errors would decrease PCT by somewhere between 13°F and 55°F.

Technical Evaluation

For the purpose of allocating PCT margin to address the NOTRUMP drift flux flow regime map errors, the minimum benefit of -13°F has been assigned to the change. However, the effect of the change on calculated PCT could actually exceed 50°F (i.e., a plant-specific analysis of the change could reduce PCT by as much as 55°F). Therefore, the change is "significant" for reporting purposes under 10 CFR 50.46(a)(3)(i).

Assessment of Safety Significance

Correction of the NOTRUMP drift flux flow regime map errors has no safety significance since it will reduce the calculated PCT for a SBLOCA event.

ENCLOSURE 2

SUMMARY OF PEAK CLADDING TEMPERATURE (PCT) MARGIN ALLOCATIONS RESULTING FROM CHANGES TO THE EMERGENCY CORE COOLING SYSTEM (ECCS) EVALUATION MODEL

	PCT (°F)
Large-Break Loss-of-Coolant Accident (LBLOCA):	
A. ANALYSIS OF RECORD (8/87) (Westinghouse Calc-Note No. SEC-RSA-2579-C0) (Based on BASH evaluation model, F_Q=2.40, $F\Delta_H$=1.58, SGTP=10%, and VANTAGE 5H fuel)	2126
B. PRIOR PERMANENT LBLOCA MODEL ASSESSMENTS (Refer to letters dated July 22, 1991, July 13, 1992, and March 17, 1993.)	+3
C. CURRENT LBLOCA MODEL ASSESSMENTS (8/93) (Permanent assessment of PCT margin)	0
LICENSING BASIS PCT + MARGIN ALLOCATIONS	2129
Small-Break Loss-of-Coolant Accident (SBLOCA):	
A. ANALYSIS OF RECORD (6/92) (Westinghouse Calc-Note No. SEC-SAI-3902-C0) (Based on NOTRUMP evaluation model, F_Q=2.40, $F\Delta_H$=1.58, SGTP=10%, and VANTAGE 5H fuel)	2089
B. PRIOR PERMANENT SBLOCA MODEL ASSESSMENTS (Refer to letter dated March 17, 1993.)	0
C. CURRENT SBLOCA MODEL ASSESSMENTS (8/93) (Permanent assessment of PCT margin)	
1. Safety injection in the broken loop	+150
2. Improved condensation model	-150
3. NOTRUMP drift flux flow regime map errors	-13
LICENSING BASIS PCT + MARGIN ALLOCATIONS	2076

ENCLOSURE 3

LIST OF COMMITMENTS

- TVA will submit supplemental information about its plan and schedule for small-break loss-of-coolant accident reanalysis after further discussions with Westinghouse and agreement on Westinghouse Owners Group activities to address safety injection in the broken loop and the offsetting use of an improved condensation model.