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APR 23 1994

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 the annual reporting requirement of 10 CFR 50.46. The ECCS model changes that are reported in this letter do not, in themselves, exceeded the threshold defined in 10 CFR 50.46 for a "significant" change of more than 50°F in calculated peak cladding temperature (PCT) for either a large-break loss-of-coolant accident (LBLOCA) or a small-break loss-of-coolant accident (SBLOCA). However, previous cumulative changes reported in WBN's last annual report, which was submitted in a letter dated November 10, 1993, were classified as "significant" for both LBLOCA analysis and SBLOCA analysis. Therefore, the currently reported ECCS model changes must be viewed as adding to the significance of the previous changes.

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. The information presented in both Enclosures 1 and 2 was provided to TVA by Westinghouse Electric Corporation, who has contractual responsibility for maintaining WBN's ECCS evaluation model.

When a "significant" change to a plant's ECCS evaluation model is reported, 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 stated above, the ECCS model changes that are

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reported in this letter are not a significant change in themselves, but they do add to previous changes that were classified as significant. TVA has already committed in a letter dated July 28, 1993, to perform LBLOCA reanalysis no later than the end of WBN's second refueling outage. This commitment has been reviewed based on the additional ECCS model changes described in Enclosure 1, and TVA has determined that there is no need to accelerate the schedule for LBLOCA reanalysis. TVA also committed to submit a plan and schedule for SBLOCA reanalysis in the letter dated November 10, 1993. TVA now intends to perform SBLOCA reanalysis prior to fuel loading of WBN Unit 1. The SBLOCA reanalysis will incorporate the cumulative ECCS evaluation model changes that are described in this and previous 10 CFR 50.46 reports.

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 (Enclosures):

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ENCLOSURE 1

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

LUCIFER ERROR CORRECTIONS

Background

The LUCIFER computer code manipulates raw input data to generate the component data bases that are used in both LBLOCA and SBLOCA analyses. Errors were found in the VESCAL subroutine of the LUCIFER code. These errors were in the geometric and mass calculations of the reactor vessel and steam generator portions of the data manipulation. All LOCA analyses which used LUCIFER code outputs were affected by these errors.

Change to ECCS Model

Westinghouse determined that correction of the errors in the LUCIFER code was a non-discretionary change as described in Section 4.1.2 of WCAP-13451. Westinghouse corrected the errors in accordance with Section 4.1.3 of WCAP-13451 in a manner that maintained the consistency of the LUCIFER code.

Estimated Effect

Representative plant calculations by Westinghouse indicate that there is a net PCT effect of -6°F for LBLOCA analysis and -16°F for SBLOCA analysis.

DOUBLE-DISK WEDGE-TYPE VALVE LEAKAGE

Background

Westinghouse evaluated a potential issue concerning the use of double-disk gate valves for isolation between the ECCS and the reactor coolant system (RCS) hot legs. The design provisions for using such a double-disk gate valve could include an inner disk pressure equalization line that creates a leakage path into the hot leg during cold leg injection following a LOCA. This condition could result in reduced core cooling during cold leg injection and, consequently, lead to an increase in PCT.

By design, a double-disk gate valve isolates flow when the downstream disk seals against its valve seat. The mechanical seating force and the hydraulic force from upstream pressure (i.e., safety injection (SI) pump discharge in the case of the ECCS) are applied to the valve sealing surfaces to keep the valve closed. Inherent to this valve design, there is a volume of fluid which is enclosed between the disks when the valve is closed. If the trapped fluid in this volume heats up, its internal pressure can exceed system pressure and force the upstream valve disk against its seat. Valve binding then occurs because both disks are forced against their seats and the valve cannot be opened. To avoid this, many double-disk gate valves have been modified to incorporate a pressure equalization line or a small hole in one of the disks to relieve any pressure increase between the disks.

Westinghouse performed generic leakage calculations which determined that the above modifications to prevent thermal binding of double-disk gate valves could result in a leakage rate of as much as 30 gpm per valve. Such leakage into the RCS hot legs increases steam binding during reflood and, consequently, increases the calculated value of PCT.

Double-disk wedge-type valves are used in WBN's ECCS, but they have been modified for pressure equalization and present a problem analogous to that described above for double-disk gate valves.

Change to ECCS Model

The effects of double-disk gate valve leakage (double-disk wedge-type valve leakage for WBN) are addressed by assigning a plant-specific PCT penalty which varies depending on a plant's ECCS configuration and capability. The penalty is only applied to LBLOCA analysis since a Westinghouse assessment of double-disk gate valve leakage during SBLOCA conditions showed a nominal benefit to the calculated value of PCT. However, on a generic basis, this PCT benefit for SBLOCA analysis is conservatively considered to be 0°F.

Estimated Effect

For WBN, Westinghouse determined that double-disk wedge-type valve leakage can divert 34 gpm of ECCS flow from the RCS cold legs to the hot legs during the ECCS injection and cold leg recirculation phases of a LBLOCA. Evaluation of this flow diversion established a PCT penalty of 40°F for LBLOCA analysis.

HOT ASSEMBLY AVERAGE ROD BURST STRAIN

Background

The computer code that is used to model fuel rod heatup for SBLOCA analysis calculates the amount of clad strain that occurs before rod burst. Historically, however, the burst strain calculation has not been applied to the hot assembly average rod. This was done on a conservative basis to minimize the rod gap and, therefore, maximize the heat transferred to the fluid channel. This, in turn, maximized the hot rod temperature. However, due to mechanisms governing the temperature excursion which results from the zircaloy-water reaction after rod burst, modeling of clad burst strain for the hot assembly average rod can result in a penalty for the hot rod by increasing the channel enthalpy at the time PCT occurs.

Change to ECCS Model

Based on the above information, Westinghouse revised SBLOCA analysis methodology to model burst strain for the hot assembly average rod. This revision was determined to be a non-discretionary change as described in Section 4.1.2 of WCAP-13451. Westinghouse made the modeling change in accordance with Section 4.1.3 of WCAP-13451.

Estimated Effect

Representative plant calculations by Westinghouse indicate that modeling clad burst strain for the hot assembly average rod increases the PCT penalty associated with fuel aging at the most limiting time-in-life conditions by approximately 10%. For WBN's SBLOCA analysis, this penalty is estimated to be 6°F. However, the increase in calculated PCT due to hot assembly average rod burst strain is offset by the effect of the "fuel rod burst strain limit," which is described next.

FUEL ROD BURST STRAIN LIMIT

Background

Westinghouse developed a revised burst strain limit model for use with the computer code WCOBRA/TRAC to perform ECCS analyses for plants with upper plenum injection. The revised model is described in WCAP-10924-P-A, Revision 1, Volume 1, Addendum 4, "Westinghouse Large Break LOCA Best Estimate Methodology: Volume 1: Model Description and Validation, Addendum 4: Model Revisions," 1991. This document has been reviewed and approved by the NRC as acceptable methodology to perform ECCS analyses in accordance with 10 CFR 50 Appendix K.

Change to ECCS Model

Westinghouse is incorporating the revised burst strain limit model into the rod heatup codes that are used in other (generally older) LBLOCA and SBLOCA analytical models, including those used for WBN. This change was determined to be a non-discretionary change as described in Section 4.1.2 of WCAP-13451. The modeling change is being made in accordance with Section 4.1.3 of WCAP-13451.

Estimated Effect

Representative plant calculations by Westinghouse indicate that the revised burst strain limit model provides a PCT benefit for SBLOCA analysis that is conservatively estimated to offset exactly the PCT penalty resulting from the previously described change for hot assembly average rod burst strain. The estimated effect on PCT for LBLOCA analysis is an unquantified benefit that ranges from negligible to moderate. However, on a generic basis, the PCT benefit for LBLOCA analysis is conservatively considered to be 0°F.

CHARGING/SI MINIFLOW ASSUMPTION

Background

Westinghouse has provided two different types of orifice for use in the miniflow lines associated with the centrifugal charging pumps (CCPs). By design, one type restricts flow to 60 gpm at a differential head of 6000 feet. The other type restricts flow to 70 gpm at a differential head of 6000 feet. Testing performed by the pump vendor determined that the actual flows through these two types of orifice are 67 gpm and 74 gpm, respectively, at a differential head of 6000 feet. Westinghouse has traditionally assumed a value of 60 gpm for CCP miniflow in the ECCS evaluation model. If actual miniflow is greater than the assumed design miniflow, as indicated by the test results, then SI flow from the CCPs to the reactor coolant system (RCS) is reduced during the injection phase following a LOCA. This, in turn, increases the expected value of PCT.

The effect of increasesd CCP miniflow is only significant for SBLOCA conditions since the CCPs provide much of the SI flow to the RCS during the initial phase (depressurization) of the SBLOCA transient. For LBLOCA conditions with very rapid depressurization of the RCS, the contribution of the CCPs to total SI flow is relatively small compared to the contributions from the SI pumps, residual heat removal pumps, and cold leg accumulators.

Change to ECCS Model

Westinghouse plans to include an updated, plant-specific CCP miniflow value in future LOCA analyses to address the two possible types of miniflow orifice and the test results described above. For now, Westinghouse has assigned a PCT penalty to each plant's SBLOCA analysis of record to account for a higher CCP miniflow than was previously assumed.

Estimated Effect

TVA has determined during preoperational testing at WBN that actual CCP miniflow is 67 gpm. This is greater than the value assumed for SBLOCA analysis, and expected SI flow to the RCS is reduced accordingly. Westinghouse estimates that the difference between assumed and actual CCP miniflow imposes a PCT penalty of 12°F for SBLOCA analysis.

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 with 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, March 17, 1993, and November 10, 1993.)	+3
C. CURRENT LBLOCA MODEL ASSESSMENTS (2/94) (Permanent assessment of PCT margin)	0
1. LUCIFER error corrections	-6
2. Double-disk wedge-type valve leakage	+40
LICENSING BASIS PCT + MARGIN ALLOCATIONS	2163
Small-Break Loss-of-Coolant Accident (SBLOCA):	
A. ANALYSIS OF RECORD (5/92) (Westinghouse Calc-Note No. SEC-SAI-3902-C0) (Based on NOTRUMP evaluation model with F_Q=2.40, $F_{\Delta H}$=1.58, SGTP=10%, and VANTAGE 5H fuel)	2089
B. PRIOR PERMANENT SBLOCA MODEL ASSESSMENTS (Refer to letters dated March 17, 1993 and November 10, 1993.)	-13
C. CURRENT SBLOCA MODEL ASSESSMENTS (2/94) (Permanent assessment of PCT margin)	
1. LUCIFER error corrections	-16
2. Hot assembly average rod burst strain	+6
3. Fuel rod burst strain limit	-6
4. Charging/SI miniflow assumption	+12
LICENSING BASIS PCT + MARGIN ALLOCATIONS	2072

ENCLOSURE 3

LIST OF COMMITMENTS

- TVA now intends to perform small-break loss-of-coolant accident (SBLOCA) reanalysis prior to fuel loading of WBN Unit 1. The SBLOCA reanalysis will incorporate the cumulative emergency core cooling system evaluation model changes that are described in this and previous 10 CFR 50.46 reports.