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CALLAWAY PLANT
10CFR50.46 ANNUAL REPORT-ECCS EVALUATION MODEL REVISIONS

References: 1. ULNRC-2439 dated 7-19-91
2. ULNRC-2373 dated 2-28-91
3. ULNRC-2141 dated 1-19-90
4. ULNRC-2535 dated 12-18-91

Attachment 1 to this letter describes changes to Westinghouse ECCS Evaluation Models, 10CFR50.59 safety evaluations, and LOCA-related margin allocations which have been implemented for Callaway for the time period from June 1991 to June 1992. Attachment 2 provides an ECCS Evaluation Model Margin Assessment which accounts for the peak cladding temperature (PCT) changes resulting from the resolution of the issues described in Attachment 1 as they apply to Callaway. References 1-3 above transmitted prior 10CFR50.46 reports.

Attachment 1 describes the resolution of those issues which have been implemented for Callaway. In some cases this results in peak cladding temperature (PCT) margin allocations. The margin allocations for Callaway are identified in Attachment 2. Since the PCT values determined in the large and small break LOCA analyses of record, when combined with all permanent and temporary PCT margin allocations, remain less than the 2200°F regulatory limit, no reanalyses will be performed.

Should you have any questions regarding this letter, please contact us.

Very truly yours,

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Attachments

A001

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ATTACHMENT ONE

CHANGES AFFECTING CALLAWAY LARGE AND

SMALL BREAK LOCA PCT VALUES

1. BOL ROD INTERNAL PRESSURE ASSUMPTION

Large Break LOCA (LBLOCA) analyses are performed at near beginning of life (BOL) fuel rod conditions, which have been shown to be limiting in sensitivity studies. The fuel rod performance utilized in the analyses corresponds to rod internal pressure (RIP) calculations using NRC approved PAD models which provide a value for RIP that contains some conservatism in its calculation. Higher RIP typically results in earlier and greater rod burst and blockage and ultimately a PCT penalty. Recently, questions were raised concerning the calculation of BOL RIP uncertainties which contribute to the upper bound BOL RIP utilized in the LBLOCA analysis. Evaluation of the issue determined that a bounding 65 psi increase to the already conservative upper bound BOL RIP applies. Sensitivities to BOL RIP have been quantified which indicate that a penalty of 2°F should be assessed for LBLOCA analyses using the 1981 ECCS Evaluation Model (EM) with BASH as used at Callaway.

2. IFBA NON-LIMITING FUEL ROD ASSUMPTION

Recent revisions to the cladding swelling and rupture models in the Westinghouse ECCS EMs raised questions whether higher PCTs could result for fuel assemblies with Integral Fuel Burnable Absorbers (IFBAs). Previous sensitivity studies demonstrating that IFBA fuel was not limiting were questioned due to the unknown impact on those studies by the revisions to the modeling of cladding swelling and rupture behavior. Since some Callaway fuel assemblies contain IFBAs, additional analyses were performed for the Cycle 6 core recently loaded. The IFBA fuel rods were shown, by analysis, to be less limiting than the non-IFBA fuel assumed in the LBLOCA analysis documented in the Callaway FSAR. This is due to an inherent power density reduction caused by the neutron poisoning and flux depression of the absorber. IFBA power density reduction input to the ECCS Evaluation Model has been verified to be conservative relative to the Callaway Cycle 6 core. The IFBA fuel is bounded by the non-IFBA fuel assumed in the LBLOCA analysis documented in the FSAR. Thus, operation of Cycle 6 with IFBA fuel meets the requirements of 10CFR50.46 and Appendix K to 10CFR50 and no PCT penalty is assessed for either LBLOCA or SBLOCA.

3. STEAM GENERATOR FLOW AREA - SEISMIC/LOCA TUBE COLLAPSE

The issue of steam generator tube collapse under LOCA, seismic, or combined seismic and LOCA loads has been re-evaluated for Callaway due to the results of structural integrity analyses for several steam generator types. Callaway had been assessed a PCT penalty of 0°F in the 1991 10CFR50.46 report (Reference 1) which is now increased to 18.6°F. However, a plant-specific analysis has recently been completed for Wolf Creek with Model F steam generators

which, taking credit for "Leak Before Break" (LBB) methodology, has been shown to result in no steam generator tube collapse for the double-ended cold leg guillotine (DECLG) break. Similar results would be expected for Callaway.

Originally, the structural integrity analysis results for Callaway from WCAP-10043 (submitted by SLNRC 82-0047 dated 12-3-82) showed that 0% tube collapse resulted from seismic forces (SSE) and 6.2% from SSE plus LOCA for a double-ended pump suction (DEPS) break at the steam generator outlet. No data was available for the DECLG breaks but it was postulated that lower loads would result with only minor tube collapse expected. At the time, it was believed that only the DEPS break resulted in tube collapse due to the close proximity to the steam generators. Further, the PCT penalty associated with the 6.2% area reduction for the DEPS break was bounded by the PCT margin (approximately 700°F) between it and the DECLG break. Therefore, no penalty was assessed in the 1991 10CFR50.46 report (Reference 1).

Recently, analyses have been performed for several steam generator types which show that the loads are not significantly reduced for the DECLG break and tube collapse may occur. However, the DEPS break remains the more limiting break location with respect to tube collapse. As a result, the 6.2% flow area reduction from WCAP-10043 will be used as a conservative upper bound for the DECLG break.

With respect to PCT, conservative sensitivities of 3°F per percent steam generator tube plugging (%SGTP) have been documented for the BASH Evaluation Model. This results in a LBLOCA PCT penalty of 18.6°F, based on the 6.2% flow area reduction from SSE plus LOCA loads for a DEPS break.

4. <u>ECCS FLOW TECH. SPEC. CHANGE</u>

The limiting break for the Callaway licensing basis LBLOCA analysis of record is that with a discharge coefficient (C_D) of 0.6 (minimum safeguards assumptions) with a PCT of 2014°F. Assessments for changes made to the 1981 Evaluation Model with BASH, as well as other changes per Attachment 2, result in PCT penalties of 51.7°F , 20°F of which were reported previously in References 1 and 3, for a cumulative PCT of 2065.7°F.

Minimum and maximum safeguards assumptions were examined with respect to the revised CCP and SIP flows discussed in Reference 4. No changes to the RHR flow were made. For the case of maximum safeguards, total flow decreases by a negligible amount such that the current analysis remains limiting. For the case of minimum safeguards, reductions in flow result in a 7.5°F PCT penalty. This penalty is offset by taking credit for RHR delivery against a containment

backpressure of 2.7 psig, which provides a 7.5°F PCT benefit, instead of 0.0 psig as assumed in the analysis of record. This results in a 7.5°F LBLOCA PCT penalty being offset by a 7.5°F PCT benefit for a net change of 0°F (absolute change in PCT of 15°F).

The current limiting break size for the Callaway licensing-basis SBLOCA analysis is the 4-inch equivalent diameter with a PCT of 1528°F. Assessments for changes made to the NOTRUMP Evaluation Model result in PCT penalties of 306.1°F, 306°F of which were reported previously in References 1 and 3, for a cumulative PCT of 1834.1°F.

The method of evaluation for the safety injection (SI) shortfall from Reference 4 involves the calculation of the integrated SI reduction from SI initiation to PCT time based on revised flow rates. Using the revised SI flow rate at PCT time, the time to compensate for the lower integrated flow was determined. This time is assumed to coincide with an additional period of fuel cladding heat up.

The revised flows exceed the currently analyzed flows over an intermediate pressure range only, while experiencing a decrease at both the high and low pressures. As a result, the Callaway SBLOCA analyses were evaluated to ensure no shift in the break spectrum.

SI flow rates were higher for the major portion of the limiting 4-inch diameter break transient, with an overall increase in integrated SI. Therefore, no PCT penalty was assessed for the 4-inch break.

SI reductions at high pressures tend to shift the limiting break to smaller sizes since these breaks depressurize more slowly. As a result, the 3-inch break was also examined since the flow rates at the higher pressures were being adversely affected. The 3-inch break demonstrated a similar increase in integrated SI but to a slightly lesser extent such that no PCT penalty was assessed and no shift in the break spectrum is anticipated.

5. CONTAINMENT PURGE EVALUATION

A 10°F LBLOCA PCT penalty is assigned due to two containment mini-purge lines being in operation (for up to 2000 hours per year per Technical Specification 3.6.1.7.b), each with 18-inch butterfly isolation valves inside and outside containment. These valves allow a volume of the post-LOCA atmosphere to escape resulting in a lower containment pressure transient. Lower containment pressure adversely affects the core flooding rate calculation for LBLOCA resulting in increased PCT. The effect of these mini-purge valves was not incorporated into the current licensing basis LBLOCA analysis of record. Based on a pressure reduction of

approximately 0.2 psi, sensitivities were used to assign a 10°F penalty for this issue.

6. CYCLE 6 FUEL RECONSTITUTION

In order to determine the effect of reconstitution of assembly G87 in the Cycle 6 core on LBLOCA PCT, the increase in core average power due to the presence of two non-power producing stainless steel filler rods must be considered. This results in a very slight increase in peak Kw/ft and total F_q. Using Westinghouse internal sensitivities for F_q, a PCT increase of less than 0.1°F would result. For the purpose of reporting and tracking, this value will be conservatively rounded up to 0.1°F. In addition, a reduction in power of an assembly reconstituted with filler rods would increase the water density up the channel and result in increased cross flow from neighboring channels and assemblies. This effect on PCT has been determined to be less than a 1°F increase. This will be conservatively treated as a 1°F increase. These increases (1.1°F), when added to the licensing basis PCT of 2064.6°F, result in a LBLOCA PCT of 2065.7°F, which continues to meet the acceptance criteria of 10CFR50.46.

The effect of reconstitution of assembly G87 on the SBLOCA PCT was obtained by determining the increase in the clad heat-up rate during core uncovering caused by the increase in peak power of the hot rod. This was determined to be an increase of less than 0.1°F. For the purpose of reporting and tracking, this value will be rounded up to 0.1°F. This increase, when added to the licensing basis PCT of 1834.0°F, results in a SBLOCA PCT of 1834.1°F, which continues to meet the acceptance criteria of 10CFR50.46.

ATTACHMENT TWO

ECCS EVALUATION MODEL

MARGIN ASSESSMENT FOR CALLAWAY

LARGE BREAK LOCA

A. ANALYSIS OF RECORD		PCT = 2014°F
B. 1989 LOCA MODEL ASSESSMENTS (refer to ULNRC-2141 dated 1-19-90)		+ 10°F
C. 1990 LOCA MODEL ASSESSMENTS (refer to ULNRC-2373 dated 2-28-91)		+ 0°F
D. 1991 LOCA MODEL ASSESSMENTS (refer to ULNRC-2439 dated 7-19-91)		+ 100°F[1]
E. CURRENT LOCA MODEL ASSESSMENTS - JUNE 1992		
1. BOL ROD INTERNAL PRESSURE ASSUMPTION (refer to Item 1 of Attachment 1)		+ 2°F
2. IFBA NON-LIMITING FUEL ROD ASSUMPTION (refer to Item 2 of Attachment 1)		+ 0°F
F. OTHER LOCA-RELATED MARGIN ALLOCATIONS - JUNE 1992		
1. SG FLOW AREA - SEISMIC/LOCA TUBE COLLAPSE (refer to Item 3 of Attachment 1)		+ 18.6°F
G. 10CFR50.59 SAFETY EVALUATIONS - JUNE 1992		
1. ECCS FLOW TECH. SPEC. CHANGE (refer to Item 4 of Attachment 1)		+ 0°F
a. Reduction in SI and CCP flow	+7.5°F	
b. Increased RHR, taking credit for 2.7 psig containment backpressure	-7.5°F 0°F	
2. CONTAINMENT PURGE EVALUATION (refer to Item 5 of Attachment 1)		+ 10°F
3. CYCLE 6 FUEL RECONSTITUTION (refer to Item 6 of Attachment 1)		+ 1.1°F[2]
H. CURRENT LOCA MODEL ISSUES - JUNE 1992		
1. POWER DISTRIBUTION ASSUMPTION		+ 0°F[3]
LICENSING BASIS PCT + MARGIN ALLOCATIONS		= 2065.7°F

NOTES:

1. The 1991 assessments included penalties of +10°F for fuel rod model revisions and 0°F for burst and blockage. The 0°F and +100°F penalties reported in 1991 for SG flow area and LBLOCA power distribution assumption, respectively, are revised in this report per Items F.1 and H.1 above.

NOTES (cont.)

2. This penalty applies only as long as reconstituted fuel assembly G87 is in the core.

3. This is a Cycle 6 assessment only. The Westinghouse Power Shape Sensitivity Model (PSSM), discussed in WCAP-12935 (May 1991), Westinghouse ECCS Evaluation Model: Revised Large Break LOCA Power Distribution Methodology, was used to ensure that the chopped cosine power distribution remains limiting for Cycle 6. The PSSM, currently under NRC review, will also be used to ensure that the chopped cosine power distribution remains limiting for future reloads.

SMALL BREAK LOCA

A. ANALYSIS OF RECORD	PCT = 1528°F
B. 1989 LOCA MODEL ASSESSMENTS (refer to ULNRC-2141 dated 1-19-90)	+229°F
C. 1990 LOCA MODEL ASSESSMENTS (refer to ULNRC-2373 dated 2-28-91)	+ 0°F
D. 1991 LOCA MODEL ASSESSMENTS (refer to ULNRC-2439 dated 7-19-91)	+ 77°F[1]
E. CURRENT LOCA MODEL ASSESSMENTS - JUNE 1992	
1. IFBA NON-LIMITING FUEL ROD ASSUMPTION (refer to Item 2 of Attachment 1)	+ 0°F
F. 10CFR50.59 SAFETY EVALUATIONS - JUNE 1992	
1. ECCS FLOW TECH. SPEC. CHANGE (refer to Item 4 of Attachment 1)	+ 0°F
2. CYCLE 6 FUEL RECONSTITUTION (refer to Item 6 of Attachment 1)	+0.1°F[2]

LICENSING BASIS PCT + MARGIN ALLOCATION = 1834.1°F

NOTES:

1. The 1991 assessments included penalties of +37°F for fuel rod model revisions, 0°F for NOTRUMP code solution convergence, +40°F for SBLOCA rod internal pressure assumption, and 0°F for SBLOCA broken loop SI flow assumption. The SBLOCA rod internal pressure penalty of +40°F was composed of two individual aspects. For SBLOCA analyses the limiting rod internal pressure (RIP) assumption depends on whether burst is predicted to occur. A higher RIP may lead to a higher calculated PCT if burst is predicted to occur. Conversely, a lower RIP may decrease cladding creep (rod swell) away from the fuel pellets when the fuel rod internal pressure is greater than the RCS pressure. Therefore, a lower RIP could then result in a higher calculated PCT, since the cladding would be closer to the fuel pellet, for an analysis that did not predict fuel rod burst. Rod burst is not predicted to occur in the Callaway SBLOCA analysis of record (see FSAR Table 15.6-15). A 20°F PCT penalty was assessed in 1991 to account for this effect. This issue also involved an error in the cladding strain model assumed in the small break clad heatup calculation for which another +20°F PCT penalty was assessed in 1991, for a total of +40°F as reported in ULNRC-2439. Since the

NOTES (cont.):

1. time of the 1991 report, a related issue, BOL Rod Internal Pressure Uncertainty, was opened for non-IFBA fuel rods. Using a conservative combination of BOL uncertainties results in an estimated decrease of up to 65 psi in the predicted BOL RIP. Based on sensitivity analyses, a PCT penalty of +20°F was assessed. Final resolution of the rod internal pressure issue, as reported herein, incorporates the rod internal pressure portion of the original issue but not the cladding strain model error. As such, the original +40°F PCT penalty was reduced to +20°F with +20°F being reallocated for the uncertainty issue for a total of +40°F. Therefore, the total penalty reported in 1991 stays the same.

2. This penalty applies only as long as reconstituted fuel assembly G87 is in the core.