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April 8, 2003

U. S. Nuclear Regulatory Commission
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Ameren UE

Ladies and Gentlemen

ULNRC-04834

DOCKET NUMBER 50-483
CALLAWAY PLANT UNIT 1
UNION ELECTRIC CO.
FACILITY OPERATING LICENSE NPF-30
10 CFR 50.46 THIRTY DAY REPORT
ECCS EVALUATION MODEL REVISIONS

Attachment 1 to this letter describes changes to the Westinghouse ECCS Large Break and Small Break Loss of Coolant Accident (LOCA) Evaluation Models which have been implemented for Callaway during the time period from October 2002 to March 2003. 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 1-17, listed below, include prior 10 CFR 50.46 reports.

The Small Break LOCA table included in Attachment 2 remains unchanged from that submitted in Reference 17 and is enclosed here for completeness only.

Based on the criteria and reporting requirements of 10CFR50.46(a)(3)(ii), as clarified in Section 5.1 of WCAP-13451, "Westinghouse Methodology for Implementation of 10 CFR 50.46 Reporting," the cumulative changes since the last Large Break LOCA 30-day report, Reference 14, require a new 30-day report. Attachment 1, Item 3 describes a change that resulted in a +40°F PCT penalty that was more than offset by a -40°F PCT benefit. There is no net change in reported PCT.

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The regulation also requires a "proposed schedule for providing a reanalysis or taking other action as may be needed to show compliance with Section 50.46 requirements." The new Large Break LOCA PCT assessments reported herein offset each other and the Large Break LOCA PCT value determined in the analysis of record, when combined with all PCT margin allocations, remains below the 2200°F regulatory limit. As such, no reanalysis is currently planned by AmerenUE to address the specific issues raised in Attachment 1. AmerenUE does plan to reanalyze Large Break and Small Break LOCA for the replacement steam generators to be installed during Refuel 14 (fall 2005). Should you have any questions regarding this letter, please contact us.

Very truly yours,

David Shafer
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TEH/KAM/GGY/mlo
Attachments

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References:
1) ULNRC-2141 dated 1-19-90
2) ULNRC-2373 dated 2-28-91
3) ULNRC-2439 dated 7-19-91
4) ULNRC-2664 dated 7-16-92
5) ULNRC-2822 dated 7-15-93
6) ULNRC-2892 dated 10-22-93
7) ULNRC-3087 dated 10-19-94
8) ULNRC-3101 dated 11-23-94
9) ULNRC-3295 dated 11-22-95
10) ULNRC-3499 dated 11-27-96
11) ULNRC-3552 dated 3-21-97
12) ULNRC-3761 dated 3-6-98
13) ULNRC-3975 dated 3-5-99
14) ULNRC-4146 dated 11-4-99
15) ULNRC-4338 dated 11-2-00
16) ULNRC-4551 dated 11-2-01
17) ULNRC-4751 dated 10-14-02

ATTACHMENT ONE

CHANGES TO THE WESTINGHOUSE

ECCS EVALUATION MODEL

AND PCT PENALTY ASSESSMENTS

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* **New PCT penalty assessment**

1. BASH-EM TRANSIENT TERMINATION

A method has been developed to extend BASH-EM transients beyond the point at which downcomer boiling is predicted to occur in BASH, by correlating the boiling-induced reduction in downcomer driving head to a corresponding reduction in the core inlet flooding rate. This approach, which is referred to as the LOCBART transient extension method, is used to ensure adequate termination of the fuel rod cladding temperature and oxidation transients predicted by LOCBART, as required to demonstrate compliance with the pertinent acceptance criteria of 10 CFR 50.46. In accordance with Reference 1 below, the LOCBART transient extension method is being submitted to the NRC for review and approval, and 10 CFR 50.46 assessments have been completed to ensure adequate transient termination for the BASH-EM analyses within Westinghouse Pittsburgh cognizance. This represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451, "Westinghouse Methodology for Implementation of 10 CFR 50.46 Reporting," October 1992.

The estimated effect of this issue was determined on a plant-specific basis. For cases where transient termination can be demonstrated prior to downcomer boiling, no further action is considered necessary. For other cases, transient termination has been demonstrated by applying the LOCBART transient extension method and the effects of downcomer boiling are considered to be implicit in the analysis results. In all cases, it was concluded that the pertinent acceptance criteria of 10 CFR 50.46 are satisfied.

A recent BASH-EM analysis was performed for a 4-loop dry atmospheric containment plant of similar design to Callaway and demonstrated transient termination with substantial margin to the 10 CFR 50.46 acceptance limits. Based on these analysis results and the general similarity between this plant and Callaway, it is expected that a BASH-EM reanalysis for Callaway would also demonstrate transient termination with substantial margin to the 10 CFR 50.46 acceptance limits. As a result, it is judged that no further action is required to demonstrate transient termination for the Callaway BASH-EM analysis.

Reference 1:

Letter from S. Dembek (USNRC) to H. Sepp (Westinghouse), "Potential Non-Conservative Modeling of Downcomer Boiling in the Approved Westinghouse 1981 Evaluation Model Using BASH," March 27, 2002.

2. LOCBART RADIATION TO LIQUID LOGIC

A review of the LOCBART cladding-to-fluid heat transfer logic found that radiation to liquid could occur after the core inlet flooding rate dropped below 1 in/s, if the channel blockage fraction was simultaneously equal to zero. This logic was modified by deleting the check for a channel blockage fraction greater than zero in Subroutine HTSORT such that radiation to liquid is now ignored whenever the core inlet flooding rate is less than (or equal to) 1 in/s. This represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

A review of existing analyses within Westinghouse Pittsburgh cognizance determined that the situation described above does not occur for most PWR licensing calculations, in which case the subject modification has no effect on existing analysis results. For analyses where this situation did occur, representative plant calculations using the LOCBART code showed that the revised logic generally produced a small-to-moderate increase in peak cladding temperature, and plant-specific assessments were derived from the representative calculations in a conservative manner. No plant-specific PCT assessment was required for Callaway.

3. LOCBART ZIRLO™ CLADDING SPECIFIC HEAT MODEL

The ZIRLO™ cladding specific heat model in LOCBART has been revised to reflect data collected at the Thermophysical Properties Research Laboratory. This change was made to resolve differences between the model and data that could produce an increase in peak cladding temperature for some transients. This represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Representative plant calculations using the LOCBART code showed that this change results in a moderate PCT penalty for early-reflood-PCT plants (such as Callaway), a small-to-moderate PCT penalty for mid-reflood-PCT plants, and a negligible PCT effect for late-reflood-PCT plants. Additional BASH-EM sensitivity calculations indicated that the reduction in initial pellet average temperatures due to PAD Version 4.0 provides a PCT benefit that more than offsets any PCT penalty due to the change in specific heat. This PCT benefit was applied (listed on Attachment 2 as "PAD 4.0 Initial Pellet Temperatures") as a separate, offsetting credit. A +40°F PCT penalty, offset by a -40°F PCT benefit, is listed on Attachment 2.

4. BASHER CALCULATION OF FLOW LINK INPUTS

BASHER is used to generate the plant-specific input models for BASH. Some minor errors were discovered in the calculation of elevation and length terms for the flow link that connects the upper head and upper plenum. As discussed below, it was determined that correcting these errors would have a negligible effect on results, so BASHER updates will be deferred to a future code release. When corrected, these changes will represent a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

A sample BASH calculation demonstrated that these changes have a negligible effect on the core inlet flooding rate, which is consistent with the expected result given the minimal importance of the affected flow path during a PWR reflood transient. These changes will be deferred to a future code release and are treated as having a 0°F PCT effect for 10 CFR 50.46 reporting purposes.

5. LOCBART PELLET-TO-CLADDING GAP CONDUCTANCE MODEL

An error was discovered in a generic LOCBART input value used with the pellet-to-cladding gap conductance model. This error affected calculations performed using fuel rod initial conditions from PAD Version 4.0 and led to an underprediction of the gap heat transfer coefficients. The input guidance was corrected to reflect the appropriate value. This represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Representative plant calculations using the LOCBART code demonstrated that this change leads to a small-to-moderate PCT benefit that will conservatively be treated as a 0°F PCT change for 10 CFR 50.46 reporting purposes.

6. LOCBART TIME STEP SELECTION LOGIC

LOCBART was updated to resolve some inconsistencies in the time step selection logic, pertaining to the use of the fluid vs. fuel rod time step. This represents a closely-related group of Non-Discretionary Changes in accordance with the Section 4.1.2 of WCAP-13451.

Representative plant calculations using the LOCBART code demonstrated that this change produces a negligible effect on results that will be treated as a 0°F PCT effect for 10 CFR 50.46 reporting purposes.

7. LOCBART CLADDING SURFACE HEAT TRANSFER LOGIC

Some recent LOCBART calculations showed anomalous behavior in the cladding surface heat transfer coefficients, when the local void fraction was high and the cladding surface temperature had decreased to the temperature at which a return to nuclear boiling is permitted to occur. This behavior was resolved by adding a void fraction criterion to the return-to-nucleate boiling logic in Subroutine HTSORT. This represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

A sample LOCBART calculation demonstrated that this change produces a negligible effect on results that will be treated as a 0°F PCT effect for 10 CFR 50.46 reporting purposes.

8. LOCBART ZIRLO™ CLADDING CREEP CONSTANTS

LOCBART was updated to correct two of the constants in the high-temperature creep model for ZIRLO™ cladding which were found to disagree with the basis documentation. This represents a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

The changes identified above lead to a small change in the creep rate over a limited range of temperatures, which is considered to have a negligible effect on results and will be treated as a 0°F PCT effect for 10 CFR 50.46 reporting purposes.

9. SBLOCTA TIME STEP SELECTION LOGIC

SBLOCTA was updated to resolve some inconsistencies in the time step selection logic, pertaining to the use of the fluid vs. fuel rod time step. This represents a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

Representative plant calculations using the SBLOCTA code demonstrated that this change produces a small PCT benefit for cases modeling Zircaloy-4 cladding that are predicted to burst, and a negligible effect on results for other cases. Accordingly, this change will be treated as a 0°F PCT effect for 10 CFR 50.46 reporting purposes.

10. SBLOCTA ZIRLO™ CLADDING SPECIFIC HEAT MODEL

For consistency with the change made to LOCBART (as described previously) the ZIRLO™ cladding specific heat model in SBLOCTA has been revised to reflect data collected at the Thermophysical Properties Research Laboratory. This represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Sensitivity calculations using the SBLOCTA code demonstrated that this change produces a negligible effect on results that will be treated as a 0°F PCT effect for 10 CFR 50.46 reporting purposes.

11. SIMPLIFIED ISOTHERMAL SOLUTION FOR SBLOCTA SUBROUTINE RATE

As discussed in Reference 2 below, LOCBART was revised in 1999 to correct a logic error that caused the Baker-Just metal-water reaction calculations to be performed three times per time step. During the review of the corresponding code logic, it was determined that the complicated solution technique described in Section 3.3.2 of Reference 3 below could be replaced with a simplified isothermal solution, with only a minimal effect on results. This change was made in LOCBART per Reference 4 below and has also been implemented in SBLOCTA which uses similar logic. This represents a Discretionary Change that will be implemented on a forward-fit basis in accordance with Section 4.1.1 of WCAP-13451.

Representative plant calculations using the SBLOCTA code demonstrated that this change produces a negligible effect on results that will be treated as a 0°F PCT effect for 10 CFR 50.46 reporting purposes.

References:

2. Westinghouse Letter NSBU-NRC-00-5970, "1999 Annual Notification of Changes to the Westinghouse Small Break LOCA and Large Break LOCA ECCS Evaluation Models, Pursuant 10 CFR 50.46 (a)(3)(ii)", May 12, 2000.

3. WCAP-8301, "LOCTA-IV Program: Loss-of-Coolant Transient Analysis", June 1974.

4. Westinghouse Letter LTR-NRC-01-6, "U.S. Nuclear Regulatory Commission, 10 CFR 50.46 Annual Notification and Reporting for 2000", March 13, 2001.

12. GENERAL CODE MAINTENANCE

Various changes in code input and output format have been made to enhance usability and help preclude errors in analyses. This includes both input changes (e.g., more relevant input variables defined and more common input values used as defaults) and input diagnostics designed to preclude unreasonable values from being used as well as various changes to code output which have no effect on calculated results. In addition, various blocks of coding were rewritten to eliminate inactive coding, optimize the active coding, and improve commenting, both for enhanced usability and to facilitate code debugging when necessary. These represent Discretionary Changes that will be implemented on a forward-fit basis in accordance with Section 4.1.1 of WCAP-13451. The nature of these changes leads to an estimated PCT impact of 0°F.

ATTACHMENT TWO

ECCS EVALUATION MODEL

MARGIN ASSESSMENT FOR CALLAWAY

LARGE BREAK LOCA

A.	ANALYSIS OF RECORD (AOR)	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)	+ 10°F
E.	1992 LOCA MODEL ASSESSMENTS, MARGIN ALLOCATIONS, AND SAFETY EVALUATIONS (refer to ULNRC-2664 dated 7-16-92 and ULNRC-2892 dated 10-22-93)	+ 29°F
F.	1993 LOCA MODEL ASSESSMENTS (refer to ULNRC-2822 dated 7-15-93 and ULNRC-2892 dated 10-22-93)	- 65°F
G.	1994 LOCA MODEL ASSESSMENTS (refer to ULNRC-3087 dated 10-19-94 and ULNRC-3101 dated 11-23-94)	- 6°F
H.	1995 LOCA MODEL ASSESSMENTS (refer to ULNRC-3295 dated 11-22-95)	+ 39°F
I.	1996 LOCA MODEL ASSESSMENTS (refer to ULNRC-3499 dated 11-27-96)	+ 0°F
J.	1997 LOCA MODEL ASSESSMENTS (refer to ULNRC-3552 dated 3-21-97)	+ 15°F
K.	1998 LOCA MODEL ASSESSMENTS (refer to ULNRC-3761 dated 3-6-98)	+ 0°F
L.	1999 SAFETY EVALUATIONS (refer to ULNRC-3975 dated 3-5-99)	+ 30°F[5]

LARGE BREAK LOCA (cont.)

M.	1999 LOCA MODEL ASSESSMENTS, MARGIN ALLOCATIONS, AND SAFETY EVALUATIONS	
	1. LOCBART ZIRC-WATER OXIDATION ERROR (This PCT assessment is tracked separately since it will change depending on future margin allocations.)	+197°F
	2. NET CHANGE OF OTHER ALLOCATIONS (refer to ULNRC-4146 dated 11-4-99)	-139°F[8]
N.	2000 LOCA MODEL ASSESSMENTS AND MARGIN ALLOCATIONS (refer to ULNRC-4338 dated 11-2-00)	- 14°F
O.	2001 LOCA MODEL ASSESSMENTS (refer to ULNRC-4551 dated 11-2-01)	- 10°F
P.	2002 LOCA MODEL ASSESSMENTS (refer to ULNRC-4751 dated 10-14-02)	+ 0°F
Q.	CURRENT LOCA MODEL ASSESSMENTS - March 2003	
	1. LOCBART ZIRLO™ Cladding Specific Heat Model	+ 40°F
	2. PAD 4.0 Initial Pellet Temperatures	- 40°F
	LICENSING BASIS PCT + MARGIN ALLOCATIONS	2110°F
	ABSOLUTE MAGNITUDE OF MARGIN ALLOCATIONS SINCE LAST LBLOCA 30-DAY REPORT	0°F

SMALL BREAK LOCA

A.	ANALYSIS OF RECORD (AOR)	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)	+ 0°F[1]
E.	1992 LOCA MODEL ASSESSMENTS AND SAFETY EVALUATIONS (refer to ULNRC-2664 dated 7-16-92)	+ 0°F
F.	1993 LOCA MODEL ASSESSMENTS (refer to ULNRC-2892 dated 10-22-93)	- 13°F[2]
G.	1993 SAFETY EVALUATIONS (refer to ULNRC-2822 dated 7-15-93)	+ 0°F[3]
H.	BURST AND BLOCKAGE/TIME IN LIFE (This PCT assessment is tracked separately since it will change depending on future margin allocations.)	+ 0°F[1]
I.	1994 LOCA MODEL ASSESSMENTS (refer to ULNRC-3087 dated 10-19-94 and ULNRC-3101 dated 11-23-94)	-282°F[4]
J.	1995 LOCA MODEL ASSESSMENTS (refer to ULNRC-3295 dated 11-22-95)	+ 0°F

SMALL BREAK LOCA (cont.)

K.	1996 LOCA MODEL ASSESSMENTS - (refer to ULNRC-3499 dated 11-27-96)	+30°F[6]
L.	1997 LOCA MODEL ASSESSMENTS - (refer to ULNRC-3552 dated 3-21-97)	+ 0°F
M.	1998 LOCA MODEL ASSESSMENTS - (refer to ULNRC-3761 dated 3-6-98)	+ 0°F
N.	1999 SAFETY EVALUATIONS* (refer to ULNRC-3975 dated 3-5-99)	+120°F[7] + 22°F[6] + 40°F[5]
O.	1999 LOCA MODEL ASSESSMENTS (refer to ULNRC-4146 dated 11-4-99)	+ 0°F
P.	2000 LOCA MODEL ASSESSMENTS - (refer to ULNRC-4338 dated 11-2-00)	+ 13°F
Q.	2001 LOCA MODEL ASSESSMENTS - (refer to ULNRC-4551 dated 11-2-01)	+ 0°F
R.	2002 LOCA MODEL ASSESSMENTS - (refer to ULNRC4751 dated 10-14-02)	+ 0°F
S.	CURRENT LOCA MODEL ASSESSMENTS - March 2003	+ 0°F

LICENSING BASIS PCT + MARGIN ALLOCATIONS	1687°F
ABSOLUTE MAGNITUDE OF MARGIN ALLOCATIONS SINCE LAST SBLOCA 30-DAY REPORT (ULNRC-3101)	43°F*

* Prior changes to plant input parameters evaluated per 10 CFR 50.59 (such as the March 1999 safety evaluations) are not tracked against the 10 CFR 50.46 reporting requirements related to a significant change (i.e., > 50°F). As a result of the 10 CFR 50.59 rule change, future changes of this type will be reportable under 10 CFR 50.46.

NOTES:

1. See Attachment 1 to ULNRC-3101. The 1991 assessments have been eliminated as a result of the new SBLOCTA calculation. The Small Break Burst and Blockage penalty is a function of the base PCT plus margin allocations and has been reduced to 0°F since the total PCT has been reduced to a value below that at which burst would occur.

2. Addendum 2 to WCAP-10054 has been submitted to NRC. It references the improved condensation model (COSI) described in WCAP-11767 and provides justification for application of this model to small break LOCA calculations. Union Electric tracks the Peak Cladding Temperature (PCT) change reported in ULNRC-2892 (+150°F/-150°F) as a permanent change to Callaway's calculated PCT. See WCAP-10054, Addendum 2, "Addendum to the Westinghouse Small Break ECCS Evaluation Model Using the NOTRUMP Code: Safety Injection into the Broken Loop and COSI Condensation Model," August 1994.

3. +4.0°F Cycle 6 crud deposition penalty has been deleted. A PCT penalty of 0°F has been assessed for 4 mils of crud, provided BOL conditions remain limiting. In the event that the SBLOCA cumulative PCT becomes ≥ 1700°F, this issue must be reassessed.

4. Based on the limiting case clad heatup reanalysis with axial offset reduced from 30% to 20%, as discussed in ULNRC-3101.

5. Based on a safety evaluation for a 5°F reduction in full-power T_{avg} (from 588.4°F to 583.4°F), a +30°F PCT penalty is established for LBLOCA and a +40°F PCT penalty is established for SBLOCA.

6. The 1996 safety evaluation reported a +10°F PCT penalty for a feedwater temperature reduction from 446°F to 410°F. This is replaced by a new safety evaluation. The 1996 assessment is reduced from +40°F to +30°F and a new +22°F PCT penalty is established for SBLOCA associated with a feedwater temperature reduction from 446°F to 390°F.

7. See Amendment No. 128 dated October 2, 1998.

8. Included in this value is an estimated PCT benefit of 100°F associated with reducing the F_Q limit from the AOR value of 2.5 to a value of 2.45 for core average burnups between 0 and 8000 MWd/MTU. After a burnup of 8000 MWd/MTU, the F_Q limit returns to 2.5 with no PCT penalty. This applies for the current operating cycle.