Omaha Public Power District
444 South 16th Street Mall
Omaha, Nebraska 68102-2247

April 10, 2001
LIC-01-0032

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station P1-137
Washington, D.C. 20555

References:
1. Docket 50-285
2. WCAP-13027-P, "Westinghouse ECCS Evaluation Model for Analysis of CE-NSSS," dated July 1991
3. Letter from OPPD (S.K. Gambhir) to NRC (Document Control Desk), dated October 29, 1999 (LIC-99-0099)
4. Letter from OPPD (S.K. Gambhir) to NRC (Document Control Desk), dated April 28, 2000 (LIC-00-0042)

SUBJECT: Annual Report for 2000 Loss of Coolant Accident (LOCA) and Emergency Core Cooling System (ECCS) Models Pursuant to 10 CFR 50.46

In accordance with 10 CFR 50.46(a)(3)(ii), the Omaha Public Power District (OPPD) is submitting the annual 10 CFR 50.46 summary report for 2000. This summary report updates all identified changes or errors in the LOCA/ECCS codes and methods used by Westinghouse Electric Company (W) to model Fort Calhoun Station Unit No. 1 (FCS). Reference 2 describes the methodology used by W to model Combustion Engineering plants, such as FCS.

OPPD has received the W "10 CFR 50.46 Annual Notification and Reporting for 2000" for the Small and Large Break LOCA Analyses, which are subject to the reporting requirements of 10 CFR 50.46.

For 2000, there was one Small Break LOCA Analysis Peak Clad Temperature (PCT) 10 CFR 50.46 Model Assessment error of +13 °F, as described in Attachment 1, for NOTRUMP Mixture Level Tracking/Region Depletion. Attachment 2 provides the 2000 Small Break LOCA Peak Clad Temperature Margin Utilization Summary for Fort Calhoun Station. As a result of the +13 °F error, the Small Break LOCA PCT changed from the Reference 4 value of 1446 °F to 1459 °F.

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For 2000, there were two Large Break LOCA Analysis Peak Clad Temperature (PCT) 10 CFR 50.46 Model Assessment errors of +9 °F and +6 °F, as described in Attachment 3, for LOCBART Vapor Film Flow Regime Heat Transfer and LOCBART Cladding Emissivity Error. Attachment 4 provides the 2000 Large Break LOCA Peak Clad Temperature Margin Utilization Summary for Fort Calhoun Station. As a result of these two errors, the Large Break LOCA PCT changed from the References 3 and 4 value of 2094 °F to 2109 °F.

Fort Calhoun Station concluded Cycle 19 operation on March 15, 2001. For Cycle 20 operation, FCS will utilize the new LOCA/ECCS analyses performed by our new fuel vendor Framatome ANP Richland Inc. (formerly Siemens Power Corporation).

In summary, the FCS PCT values for Small and Large Break LOCAs remain less than the 10 CFR 50.46(b)(1) acceptance criterion of 2200 °F.

Please contact me if you have any questions.

Sincerely,

S.K. Gambhir
Division Manager
Nuclear Operations

SKG/RRL/rrl

Attachments

c: E.W. Merschoff, NRC Regional administrator, Region IV
L.R. Wharton, NRC Project Manager
W.C. Walker, NRC Senior Resident Inspector
Winston & Strawn

Attachment 1
10 CFR 50.46 Small Break Model Assessment

NOTRUMP - Mixture Level Tracking/Region Depletion Errors

Several closely related errors were discovered in how NOTRUMP deals with the stack mixture level transition across a node boundary in a stack of fluid nodes. First, when the mixture level attempts to transition a node boundary in a stack of fluid nodes, it can occasionally have difficulty crossing the interface (i.e., level hang). When a mixture level hang occurs at a node boundary, this leads to situations where the flow for a given time step is reset and becomes inconsistent with the matrix solution of the momentum equation for an excessive period of time. This results in local mass/energy errors being generated. In addition, it was discovered that the code was not properly updating metal node temperatures as a result of the implementation of the nodal region depletion logic which can be incurred when a fluid node empties or fills. It is noted that several aspects of the errors, namely mixture level tracking and flow resets, are not directly tied to erroneous coding; rather, they are a direct result of modeling choices made and documented in the original code development/licensing.

The nature of this error leads to a bounding 13 °F increase in the calculated PCT for all standard EM applications.

Attachment 2
Fort Calhoun Station Small Break LOCA
Peak Clad Temperature Margin Utilization Summary

	Clad Temp (°F)
LICENSING BASIS	
Analysis of Record	1444
MARGIN ALLOCATIONS (ΔPCT)	
A. Prior Permanent ECCS Model Assessments	-4
B. 10 CFR 50.59 Safety Evaluations	+6
C. 2000 10 CFR 50.46 Model Assessments (Permanent Assessments of PCT Margin)	
1. NOTRUMP Mixture Level Tracking / Region Errors	+13
LICENSING BASIS PCT + MARGIN ALLOCATIONS	**1459**

Attachment 3
10 CFR 50.46 Large Break Model Assessments

LOCBART Vapor Film Flow Regime Heat Transfer

LOCBART uses the Berenson model for film boiling, as described in WCAP-9561-P-A ("BART-A1: A Computer Code for the Best Estimate Analysis of Reflood Transients", March 1984), to compute the cladding-to-fluid heat transfer coefficient for conduction across the vapor film in the vapor film flow regime, which occurs near the quench front and is assumed to consist of both conduction and radiation components. An error was discovered in LOCBART whereby the multiplier on this correlation was programmed incorrectly, resulting in a relatively minor underprediction of the cladding-to-fluid heat transfer coefficient.

Representative plant calculations using the LOCBART code showed that this error correction generally resulted in a small-to-moderate PCT benefit for plants with burst-node-limited PCTs occurring coincident with the onset-of-entrainment in reflood and a small PCT benefit or penalty for other plants. The generic PCT assessments for this issue were derived from representative plant calculations as the bounding values for each of the two plant/transient categories (i.e., early-PCT, burst-node-limited plants and other plants) that were defined specifically for this purpose. For Fort Calhoun Station, this resulted in a +9 °F change in PCT.

LOCBART Cladding Emissivity Error

Section 2-17 of WCAP-9561-P-A ("BART-A1: A Computer Code for the Best Estimate Analysis of Reflood Transients", March 1984), Section 3.2.5 of WCAP-7437-L (LOCTA-R2 Program: Loss of Coolant Transient Analysis, January 1970), and Section 3-2 of WCAP-10484-P-A (Spacer Grid Heat Transfer Effects During Reflood, March 1991) describe expressions that are used to model radiation heat exchange between the rod, grid, and fluid during the reflood phase of the transient. It was discovered that the cladding surface emissivity values used with equations in the above references were substantially lower than values that would be expected to exist during a large break LOCA reflood transient. A review of existing documentation was inconclusive as to the exact values that were intended for use with the equations, so a constant representative value of 0.7 was used based on the value used in WCOBRA/TRAC for a similar application.

The cladding emissivity error representative plant calculations using the LOCBART code showed that these error corrections generally resulted in a small-to-moderate PCT benefit for plants with burst-node-limited PCTs occurring coincident with the onset-of-entrainment in reflood and a small benefit or penalty for other plants. The generic PCT assessments for this issue were derived from representative plant calculations as the bounding values for each of the two plant/transient categories (i.e., early-PCT, burst-node-limited plants and other plants) that were defined specifically for this purpose.

For Fort Calhoun Station, the error for this effect resulted in a +6 °F change in PCT.

Attachment 4
Fort Calhoun Station Large Break LOCA
Peak Clad Temperature Margin Utilization Summary

	Clad Temp (°F)
LICENSING BASIS	
Analysis of Record	2066
MARGIN ALLOCATIONS (ΔPCT)	
A. Prior Permanent ECCS Model Assessments	-15
B. 10 CFR 50.59 Safety Evaluations	+68
C. 2000 10 CFR 50.46 Model Assessments (Permanent Assessments of PCT Margin)	
1. LOCBART Vapor Film Flow Regime Heat Transfer Error	+9
2. Cladding Emissivity Error	+6
D. Other	
1. Quantification of Prior 0 °F Assessments	-54
2. LOCBART Zirc-Water Oxidation Error	+29
LICENSING BASIS PCT + MARGIN ALLOCATIONS	**2109**