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Nuclear Regulatory Commission
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Subject: Arkansas Nuclear One - Unit 2
Docket No. 50-368
License No. NPF-6
Follow-up Questions Resulting from the ACRS Subcommittee's Review of ANO-2's Proposed Power Uprate

Dear Sir or Madam:

On February 13, 2002, Entergy Operations, Inc. and the NRC staff met with the Thermal Hydraulics Subcommittee of the Advisory Committee on Reactor Safeguards (ACRS) to discuss the proposed power uprate for Arkansas Nuclear One, Unit 2 (ANO-2). As a result of the meeting, the NRC staff requested additional information regarding the methods used to analyze loss of coolant accidents. The attachment contains Entergy's responses to two questions received from the staff via telex on February 15, 2002.

I declare under penalty of perjury that the foregoing is true and correct. Executed on March 1, 2002.

Sincerely,

Sherrie R. Cotton

Sherrie R. Cotton
Director Nuclear Safety Assurance

SRC/dwb
Attachment

A001

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**Follow-up Questions Resulting from the
ACRS Subcommittee's Review of ANO-2's Proposed Power Uprate**

NRC Question 1

Please clarify the nature of the CEFLASH-4AS (Small Break LOCA) computer code error reported in the Entergy letter dated June 27, 2001.

a. *Describe the error*
b. *Give the approximate range of its potential effect.*
c. *Has CE checked to see if the same error exists in the CE large break LOCA version of the computer code (CEFLASH-4A)? If so, does the error exist there too? If not, when does CE plan to check and perform any corrections, if the error is found?*

ANO Response

In a letter dated June 27, 2001 (2CAN060109), Entergy Operations, Inc. notified the NRC staff of an error in the Westinghouse CEFLASH-4AS computer code. The error, identified by Westinghouse Electric Company, affected the peak cladding temperature reported for the ANO-2 power uprate Small Break Loss-of-Coolant Accident (SBLOCA) Emergency Core Cooling System (ECCS) performance analysis. The power uprate SBLOCA analysis is contained in Section 7.1.4 of Enclosure 5 of the power uprate license application, which was submitted on December 19, 2000 (2CAN120001). The purpose of the June 27, 2001, letter was to notify the NRC staff of the error since the staff was reviewing this analysis as part of the power uprate license amendment request. Normal reporting requirements dictate including this information in the annual report in compliance with 10CFR50.46 (a)(3)(ii). The June 27, 2001, letter was not intended to replace the report required by 10CFR50.46 (a)(3)(ii).

The CEFLASH-4AS computer code is used to perform the hydraulic analysis of the reactor coolant system during the SBLOCA transient. It generates the boundary conditions for core power, pressure, two-phase mixture level, and liquid mass that are used in the hot rod heatup analysis to calculate the peak cladding temperature. It was discovered that subroutine LEAK, which performs break flow calculations, contained coding that performed operations using subscripts for arrays that exceeded the dimensions of the arrays. In particular, the critical flow tables were copied to arrays that were dimensioned smaller than the indices of the DO loops that performed the copy operations. Consequently, data in the arrays were incorrectly ordered and overwritten. In addition, values for variables in subroutine MATPRP, which calculates fuel rod material properties, were also overwritten.

The inconsistencies between the array dimensions and the subscripts were corrected so that all operations are performed with array subscripts that are consistent with the dimensions of the arrays. The code was tested for the occurrence of out-of-range subscripts to confirm that all inconsistencies were corrected.

Westinghouse performed calculations with the corrected version of CEFLASH-4AS for those Combustion Engineering designed pressurized water reactors whose SBLOCA analyses use the impacted evaluation model showed that the effect of the error on peak cladding temperature ranges from -38°F to +43°F.

As reported in the letter dated June 27, 2001, the impact of the error on the limiting break of the ANO-2 power uprate SBLOCA analysis (the 0.04 ft^2/PD) was calculated to be an increase of 24°F in peak cladding temperature. The impact was calculated using the corrected version of CEFLASH-4AS. Table 1 repeats the more detailed summary of the impact of the error on the 0.04 ft^2/PD break that was reported in the June 27, 2001 letter. As shown in the table, the results calculated for the limiting break using the corrected version of CEFLASH-4AS continue to conform to the ECCS Acceptance Criteria of 10CFR50.46 for peak cladding temperature (≤2200°F), maximum cladding oxidation (≤17%), and core-wide cladding oxidation (≤1%).

Westinghouse has checked to determine if the same error exists in the LBLOCA version of the CEFLASH computer code (CEFLASH-4A) and determined that it does not.

Table 1
Impact of the CEFLASH-4AS Error on the Results of the Limiting SBLOCA of the ANO-2 Power Uprate SBLOCA Analysis

	Peak Cladding Temperature, °F	Maximum Cladding Oxidation, %	Core-Wide Cladding Oxidation, %
Corrected Version of CEFLASH-4AS	2090	12.5	0.73
Uncorrected Version of CEFLASH-4AS (Result Reported in the Power Uprate License Application)	2066	10.78	0.67
Differential Impact	+24	+1.72	+0.06

NRC Question 2

Please confirm that the following CENPD-132 Supplement 4-P-A requirement has been considered and does not apply: "Should a Cladding Rupture Temperature greater than 950 °C be encountered in any future plant analysis, CE will submit justification for extending their models into this region." (NRC Safety Evaluation, 12/15/2000, Section 3.1, page 17)

ANO Response

The subject requirement was evaluated in the ANO-2 power uprate LBLOCA analysis and was found not to apply since the cladding rupture temperature was less than 1742°F (950°C) for every case in the power uprate LBLOCA analysis.

The rupture temperature of the limiting break (0.4 double-ended guillotine break in the pump discharge leg (0.4 DEG/PD)) can be obtained from information presented in the power uprate license application. The rupture temperature for the other breaks can be estimated from the information.

Table 7.1.3-4 of Enclosure 5 of the power uprate license application lists the time of cladding rupture for each break of the LBLOCA analysis break spectrum. Figure 7.1.3-36 presents the cladding temperature versus time for the peak cladding temperature node and the cladding rupture node for the limiting break (0.4 DEG/PD break). From Table 7.1.3-4, cladding rupture occurred at 46.7 seconds for the 0.4 DEG/PD break. From Figure 7.1.3-36, the temperature of the cladding rupture node at 46.7 seconds is approximately 1535°F, i.e., well below 1742°F.

For the other breaks of the break spectrum, only the temperature of the peak cladding temperature node, and not that of the cladding rupture node, is presented. However, as shown by Figure 7.1.3-36, the temperatures of the two nodes are similar up to the time of cladding rupture. Review of the temperatures of the peak cladding temperature nodes for the other break sizes (Figures 7.1.3-9, 18, 27, and 55) at the cladding rupture times listed in Table 7.1.3-4 shows that in all cases the cladding temperatures at the time of cladding rupture are well below 1600°F.

Additionally, an error checking feature included in the 1999 EM versions of the CEFLASH-4A and STRIKIN-II computer codes (the two codes that contain the NUREG-0630 cladding rupture models) facilitates compliance with the subject requirement on the rupture temperature. Specifically, the 1999 EM versions of CEFLASH-4A and STRIKIN-II compare the cladding rupture temperature to 1742°F and print an error message if the rupture temperature exceeds 1742°F.