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Subject: Arkansas Nuclear One - Unit 1
Docket No. 50-313
License No. DPR-51
10CFR50.46 Report of an ECCS Analysis Code Error

Gentlemen:

In letter JHT/95-58 dated May 26, 1995, B&W Nuclear Technologies (BWNT) notified the Nuclear Regulatory Commission (NRC) and Arkansas Nuclear One Unit 1 (ANO-1) of an error in an NRC-approved code used for Loss-Of-Coolant-Accident (LOCA) Evaluation Model (EM) applications on BWNT-designed plants. This error is applicable to the ECCS analysis for ANO-1. The error was significant per the criterion of 10CFR50.46(a)(3)(i) since it resulted in a reduction in the calculated peak cladding temperature (PCT) in excess of 50 degrees F. The error does not represent an operational safety concern. This report is submitted as required by 10CFR50.46(a)(3)(ii). Correction of the error reduces the calculated PCT; therefore, adequate Emergency Core Cooling System (ECCS) performance during a Large Break LOCA continues to be demonstrated by compliance with the criteria contained in 10CFR50.46.

The error was discovered in the fuel pin gap conductance model in the THETA1-B code. THETA1-B performs the hot pin thermal analyses using boundary conditions from CRAFT2, REFLOD3B, and FLECSET computer codes as described in the BWNT ECCS Evaluation Model, BAW-10104 Revision 5. The error is introduced at the time of fuel pin rupture. The error does not exist in the ruptured segment. It applies to the calculation of the fuel-clad gap conductance for any unruptured, plastically-deformed cladding segment.

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The error specifically relates to the calculation of the gap heat transfer dimension. At the time of cladding rupture, the code resets the initial inside cladding diameter to the plastically-deformed inside cladding dimension. This error causes the gap dimension to decrease at the time of rupture to one that can be nearly closed. This decrease in the gap dimension increases the gap conductance by up to a factor of 10, increasing the calculated PCT. The magnitude of the increase in PCT is a function of fuel pin design, gap closure factor, and fuel pin burnup. The maximum change is calculated when the gap closure factor is zero, which is the case for closed-gap initial conditions. These conditions are encountered during the middle to high fuel pin burnup range.

Use of the smaller gap results in calculation of higher cladding temperatures in the plastically-deformed segments after cladding rupture. Correction of this error will reduce PCTs in the unruptured segments of the upper core elevations by as much as 170 degrees F for middle-of-life analyses. More modest reductions of the PCTs would be obtained for the beginning-of-life analyses. The reduction also declines as the fuel approaches the end-of-life conditions where the Linear Heat Rate (LHR) is rapidly dropping.

Since correction of this error results in a reduction in the calculated PCT, there is no safety concern for the continued operation of ANO-1. Although reduction in the PCT could allow increases in the LOCA LHR limits at the upper core elevations (4-foot through 10-foot), no significant increase in the core operating limits (rod index and axial power imbalance) is available due to the correction of this error. The limits cannot be improved because the current fuel designs are LOCA-limited primarily between the 2-foot and 4-foot core elevations. These elevations are generally either ruptured-node limited or very close to being ruptured-node limited. Since the ruptured node is not subject to the gap error, there is no potential to increase the LOCA core operating margins or decrease the overall conservatism of the limiting cases for this EM. For the current fuel cycle design, the core is Departure from Nucleate Boiling (DNB)-limited at the upper elevations. Therefore, increases in the LOCA limits for the upper core elevations would not improve the core operating limits.

Since the core operating limits remain unaffected, the LHR limits and PCTs of record are conservative and will not be reanalyzed with the corrected code version. The additional LOCA margin that may be available at the upper core elevations is unusable; therefore, there is no benefit or need to reanalyze the unruptured-node limited elevations that are subject to the code error.

BWNT has submitted a new EM (BAW-10192P), which is based on the RELAP5/MOD2-B&W code, to the NRC for review and approval for use on BWNT-designed plants. Once the review is completed and a Safety Evaluation Report is obtained, BWNT plans to perform new LOCA LHR limits calculations for future fuel designs with the RELAP5/MOD2-based EM. This new EM does not include the THETA1-B code and therefore does not contain this error.

Very truly yours,

Dwight C. Mims

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DCM/tfs

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