FRAMATOME ANP

Proj 693

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Document Control Desk
ATTN: Chief, Planning, Program and Management Support Branch
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

**Response to Informal Request on BAW-10231P, "COPERNIC Fuel Rod Design Code"**

Ref.: 1. Letter, Stewart Bailey (NRC) to T. A. Coleman (Framatome ANP), "Request for Additional Information – Framatome Topical Report BAW-10231P (TAC NO. MA6792), August 1, 2000.

Ref.: 2. Letter, Letter, T. A. Coleman (Framatome ANP) to U. S. Nuclear Regulatory Commission, GR0-021.doc, February 5, 2001.

Ref.: 3. Letter, Stewart Bailey (NRC) to T. A. Coleman (Framatome ANP), "Request for Additional Information – Chapter 13 of Framatome Topical Report BAW-10231P (TAC NO. MA9783), May 14, 2001.

Ref.: 4. Letter, James F. Mallay (Framatome ANP) to Document Control Desk (NRC), "Partial Response to RAI," NRC:01:033, July 27, 2001.

On several occasions the NRC has asked Framatome ANP to provide additional information to assist in the NRC's review of BAW-10231P, "COPERNIC Fuel Rod Design Code." Reference 1 transmitted a request for additional information (RAI) on the $UO_2$ applications of this report. Reference 2 contained Framatome's response to that RAI. Reference 3 provided an RAI that addressed primarily the MOX applications for COPERNIC. However, two of the questions in that RAI referred to $UO_2$ applications. Reference 4 contained our response to those two questions.

In addition to information provided in References 2 and 4, Framatome ANP provided an informal response to an NRC question concerning time in life for LOCA initialization. Attached to this letter is a formal, referenceable response to that question.

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Based on discussions with the NRC, Framatome understands that this letter and attachment will provide an adequate basis for completing the SER for the application of BAW-10231P to $UO_2$.

Very truly yours,

Gerald L Holm for

James F. Mallay, Director
Regulatory Affairs

/lmk

Attachment

cc: J. S. Cushing
D. G. Holland
Project 693

ATTACHMENT

Supplement to RAI #25 on BAW-10231P

Question:

Figures 12-21, -22, -23, -24, -25, and, -26 in BAW-10231P show a trend of increasing volumetric average fuel temperatures with burnups for LOCA initial conditions. This raises a concern that the LOCA PCT may not be limiting in BOL. FCF needs to address the trend of increasing fuel temperatures with burnups to allay this concern. Please evaluate the LOCA PCT results for these figures as compared to the PCT limit of 2200 degree F.

Response:

The NRC-approved BWNT LOCA EM (BAW-10192P-A) and RSG LOCA EM (BAW-10168P-A) are the calculational frameworks used to demonstrate compliance to the five criteria of 10CFR50.46 for B&W-designed plants and Westinghouse- and CE-designed plants, respectively. The detailed methods used to show compliance are prescribed in 10 CFR 50 Appendix K. Relative to fuel temperature trends, Appendix K Section I.A.1 gives the requirements for the initial stored energy in the fuel. It states:

> "The steady-state temperature distribution and stored energy in the fuel before the hypothetical accident shall be calculated for the burn-up that yields the highest calculated cladding temperature (or, optionally, the highest calculated stored energy). To accomplish this, the thermal conductivity of the $UO_2$ shall be evaluated as a function of burn-up and temperature, taking into consideration differences in initial density, and the thermal conductance of the gap between the $UO_2$ and the cladding shall be evaluated as a function of the burn-up taking into consideration fuel densification and expansion, the composition and pressure of the gases within the fuel rod, the initial cold gap dimension with its tolerances, and cladding creep."

An NRC-approved steady-state fuel code like TACO3 (BAW-10162) or COPERNIC simply provides a set of inputs (namely fuel temperatures, hot and cold fuel pin dimensions, pin gas pressure, and pin gas composition) that are derived from the parameters listed in the Appendix K requirements. These inputs are then used in the analyses that show compliance to 10 CFR 50.46 for the limits of fuel operation covering currently approved burnups for Mark-B and Mark-BW fuel types.

LBLOCA analyses performed for the B&W-designed plants with BAW-10192P-A typically complete five analyses at BOL, five analyses at a limiting MOL burnup (typically at 40, but ranging from 20 to 55 GWd/mtU) and at least one analysis at the EOL condition based on inputs from the TACO3 code. The time-in-life conditions at which the potential limiting PCT analyses are performed are strongly influenced by the fuel stored energy and pin pressure predicted by the steady-state fuel code. After the COPERNIC code is approved, it can be used to generate steady-state LOCA initialization inputs at several times in life to provide fuel pin parameters that will determine how the PCT varies with burnup. This method is used to define an allowed linear heat rate limit versus burnup curve that will maintain the calculated PCTs below the 2200 F limit for the entire fuel pin burnup range.

The LBLOCA analyses performed with BAW-10168P-A for the Westinghouse or CE plants define a $K_{burnup}$ curve that is used to restrict the total peaking as a function of time in life to ensure that the PCT predicted by analyses performed near the beginning of life remains limiting. The $K_{burnup}$ curve is set based on LBLOCA analyses performed at limiting fuel pin burnups that cover the licensed fuel pin burnup range. This burnup curve may need to be redefined when the specific NRC-approved steady-state fuel code used for the fuel reload licensing contract is changed (i.e. TACO3 to COPERNIC).