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U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Request for Additional Information – ANF-1358(P) Revision 3, "The Loss of Feedwater Heating Transient in Boiling Water Reactors"

Ref. 1: Letter, James F. Mallay (FANP) to Document Control Desk (NRC), "Request for Review and Approval of ANF-1358(P) Revision 3, 'The Loss of Feedwater Heating Transient in Boiling Water Reactors'," NRC:04:046, August 19, 2004.

Ref. 2: Letter, Jerald S. Holm, (FANP) to Document Control Desk (NRC), "Request for Additional Information – ANF-1358(P) Revision 3, 'The Loss of Feedwater Heating Transient in Boiling Water Reactors'," NRC:05:026, April 15, 2005.

The NRC requested additional information to facilitate the completion of its review of the Framatome ANP topical report, ANF-1358(P) Revision 3, (Reference 1), in an e-mail on February 2, 2005. A response to this RAI was provided in Reference 2. A revision to the response in Reference 2 to question 2b is attached to this letter.

Framatome ANP considers some of the information contained in the attachments to this letter to be proprietary. The affidavit provided with the original submittal of the referenced report satisfies the requirements of 10 CFR 2.390(b) to support the withholding of this information from public disclosure.

Sincerely,

Jerald S. Holm, Director
Regulatory Affairs
Framatome ANP, Inc.

Enclosures

cc: M. C. Honcharik
Project 728

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Request for Additional Information
Framatome ANP
ANF-1358(P), Revision 3
"The Loss of Feedwater Heating Transient in Boiling Water Reactors"

Question 2b:

Loss of feedwater heating (LFWH) can be the limiting event when establishing the reload MCPR operating limit. Is the same event also generating the limiting LHGR? Describe in detail how the limiting LHGR is currently calculated, and whether the proposed approach will predict a more conservative LHGR and MCPR, compared to the currently calculated values.

Response 2b:

The LFWH event is seldom a limiting event that sets the reload MCPR operating limit. Relative to LHGR, a LFWH event does not necessarily give the limiting, i.e., worst, LHGR increase.

A Fuel Design Limit Ratio (FDLRX) is defined as the calculated LHGR over the steady-state LHGR limit.

$$FDLRX = LHGR / LHGR_{Steady\text{-}State\ Limit}$$

Under normal operation, FDLRX is maintained below 1.0 to ensure that the steady-state LHGR limit will not be exceeded. [

].

The steady-state and the AOO LHGR limits are exposure dependent. They are established for each fuel design and are based on nuclear design analyses and the fuel mechanical design criteria. Conservative power histories based on proposed LHGR limits are used in the mechanical analyses to show compliance to the fuel rod mechanical design criteria. The AOO LHGR design limit protects the fuel from cladding strain and fuel overheating.

The mechanical analyses were performed using the NRC approved methodology as described in the Topical Report EMF-85-74(P) Revision 0 Supplement 1(P)(A) and Supplement 2(P)(A), RODEX2A (BWR) Fuel Rod Thermal-Mechanical Evaluation Models, February 1998. The mechanical design criteria are contained in the NRC-approved topical, ANF-89-98(P)(A) Revision 1, Generic Mechanical Design Criteria for BWR Fuel Designs, May 1995.

The [ ] ratio is a result of performing the fuel centerline melt and the cladding transient strain analyses using the approved methodology and criteria specified in the above paragraph. First, the steady-state LHGR limit is selected. The steady-state LHGR limit normally is limited by the EOL rod internal pressure criteria. Then, the AOO LHGR limit is selected such that it is able to accommodate the increase in LHGR during a transient. The AOO LHGR limit is set as a ratio to the steady-state limit. A ratio of [ ] between the AOO and the steady state LHGR limits has been determined to be sufficient to account for the anticipated transients. Then the fuel

thermal-mechanical analyses are performed to demonstrate that the fuel centerline melt and cladding transient strain criteria are satisfied below the AOO LHGR limit. Therefore, the ratio of [ ] protects against exceeding the fuel centerline melt and cladding transient strain limits.

The bounding correlation for determining delta-CPR reported in Revision 3 (this report) gives slightly more conservative values (about 0.03 higher than the original bounding correlation for a core with 2894 rated MWth, 12.47 Mlbm/hr rated feedwater flow, and a delta feedwater temperature of 100 °F) than in the originally approved licensing topical report (Revision 1) because it includes the original data as well as additional data that covers more diverse core conditions. Additional conservatism was incorporated in defining the bounding fit coefficients. The method in the topical report for determining compliance to LHGR criteria for the LFWH event is the same as was done in the past on either a plant or cycle-specific basis. Hence, it is no more or less conservative compared to the currently calculated values.