June 3, 2002

Mr. James F. Mallay
Director, Regulatory Affairs
Framatome ANP, Richland, Inc.
2101 Horn Rapids Road
Richland, WA 99352

SUBJECT: POTENTIAL NON-CONSERVATIVE MODELING OF DOWNCOMER BOILING IN THE APPROVED FRAMATOME ANP EMERGENCY CORE COOLING SYSTEM EVALUATION MODEL FOR APPLICATION TO CERTAIN WESTINGHOUSE AND COMBUSTION ENGINEERING DESIGNED PRESSURIZED WATER REACTORS

Dear Mr. Mallay:

The NRC staff has been evaluating potential non-conservative modeling of the downcomer region and downcomer boiling in the approved 10 CFR Part 50, Appendix K loss-of-coolant accident evaluation models (EMs) when they are applied to certain types of Westinghouse designed pressurized water reactors. Based on a meeting with Framatome ANP on April 16, 2002, the NRC staff identified serious concerns with the use of existing approved EMs regarding modeling of the downcomer region and downcomer boiling. The NRC staff is requesting Framatome ANP to review the enclosure to this letter and take the necessary steps for prompt resolution.

The staff requests that discussions be held after receipt of this letter to establish an appropriate schedule for submittal of the requested information.

Sincerely,

/RA/

Stephen Dembek, Chief, Section 2
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Project No. 693

Enclosure: Request for Information

June 3, 2002

Mr. James F. Mallay
Director, Regulatory Affairs
Framatome ANP, Richland, Inc.
2101 Horn Rapids Road
Richland, WA 99352

SUBJECT: POTENTIAL NON-CONSERVATIVE MODELING OF DOWNCOMER BOILING IN THE APPROVED FRAMATOME ANP EMERGENCY CORE COOLING SYSTEM EVALUATION MODEL FOR APPLICATION TO CERTAIN WESTINGHOUSE AND COMBUSTION ENGINEERING DESIGNED PRESSURIZED WATER REACTORS

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POTENTIAL NON-CONSERVATIVE MODELING OF DOWNCOMER AND DOWNCOMER BOILING IN THE APPROVED B&W EMERGENCY CORE COOLING SYSTEM (ECCS) EVALUATION MODEL APPLIED TO CERTAIN WESTINGHOUSE AND COMBUSTION ENGINEERING DESIGNED PRESSURIZED WATER REACTORS (PWRS)

REQUEST FOR INFORMATION

The NRC staff has been evaluating potential non-conservative modeling of the downcomer region and downcomer boiling in approved 10 CFR Part 50, Appendix K loss-of-coolant accident (LOCA) evaluation models (EMs) when they are applied to certain types of Westinghouse (W) designed PWRs. Based on a meeting with Framatome ANP (Framatome) on April 16, 2002, the staff has questions regarding the modeling of the downcomer and downcomer boiling in currently approved Framatome EMs that are applied to certain types of W and Combustion Engineering (CE) designed PWRs. The staff requests that, on an expedited basis, Framatome respond to the issues and questions discussed in this enclosure and describe why the currently approved Appendix K models remain acceptable for use in licensing applications.

The staff met with Framatome on April 16, 2002, to discuss issues related to a fuel transition license amendment request submittal (Reference 1). At this meeting, Framatome discussed the following proposed departures from their approved Appendix K EM (References 2-5):

- Core peaking for LOCA evaluation
- Energy deposition
- Average core energy representation
- Minimum containment backpressure
- REFLOD3B carryout rate fraction
- End of transient justification
- Oxide calculations
- SBLOCA noding

In discussing the above items, Framatome informed the staff that the REFLOD3B calculation terminates when the downcomer and lower plenum reach saturated conditions, and that the approved Framatome Appendix K EM does not include any two phase model to calculate the effects of downcomer boiling. Additionally, Framatome reported that the calculation terminates due to code numerical issues at a time prior to calculated core quench. Based on the discussions at this meeting, the staff believes that there are potential concerns with the use of the Framatome EMs. Sensitivity studies have shown downcomer boiling to be of greater concern for low backpressure containments (i.e., ice condenser and subatmospheric containment designs) and for plants with low safety injection flowrates (i.e., three loop plants).

The downcomer boiling behavior appears to originate from the choice of downcomer noding and fluid flow modeling in combination with heat transfer from the reactor vessel, thermal shield, and core structures. The NRC staff has questions regarding continued application of the

current approved version of this EM because the Framatome Appendix K EM substantially underestimates the timing and impacts of downcomer boiling and also fails to conclusively terminate. Specifically, the staff questions how the currently approved Framatome Appendix K EM (References 2-5) complies with the following requirements of 10 CFR 50, Appendix K:

- 10 CFR Part 50, Appendix K, Section II.2 requires that, "for each computer program, solution convergence shall be demonstrated by studies of system modeling or noding and calculational time steps." This requirement is not satisfied because the REFLOD3B code fails at some time prior to core quench. Framatome should discuss how and why this code fails, and demonstrate why the EM solution converges under these conditions and is acceptable for the entire duration of its expected calculational period (entire duration of the refill and reflood portions of the LOCA transient).

- 10 CFR Part 50, Appendix K, Section II.3 requires that, "appropriate sensitivity studies shall be performed for each evaluation model, to evaluate the effect on the calculated results of variations in noding, phenomena assumed in the calculation to predominate, including pump operation or locking, and values of parameters over their applicable ranges. For items to which results are shown to be sensitive, the choices made shall be justified." Based on current knowledge of downcomer boiling and its impacts on peak clad temperature (PCT) and oxidation, sensitivity studies of downcomer and downcomer boiling modeling must be performed.

Based on the above information, Framatome must address the potential impact of downcomer boiling in the currently approved Appendix K EM for two and three loop W and CE type PWRs with low backpressure containment designs or low safety injection flowrates. The NRC staff requests that Framatome provide an assessment of this issue and its implication for their approved EMs. In addition, if changes to the approved methodology are necessary, Framatome should provide a plan and schedule for actions to ensure continued compliance with the requirements of 10 CFR 50.46 and 10 CFR Part 50, Appendix K, and provide the required limitation on the use of the EM until such time as these issues are resolved.

REFERENCES

1. Meeting Summary - Discussion of the Framatome Fuel Transition Program at North Anna Power Station, ADAMS ML021200194, April 30, 2002.

2. BAW-10168P-A, Revision 3, "BWNT Loss-of-Coolant Accident Evaluation Model for Recirculating Steam Generator Plants," December 1996.

3. BAW-10164P-A, Revision 3, "RELAP5/MOD2-B&W - An Advanced Computer Program for Light Water Reactor LOCA and Non-LOCA Transient Analysis," July 1996.

4. BAW-10171P-A, Revision 3, "REFLOD3B - Model for Multinode Core Reflooding Analysis," December 1995.

5. BAW-10166P-A, Revision 4, "BEACH - Best Estimate Analysis Core Heat Transfer, A Computer Program for Reflood Heat Transfer During LOCA," February 1996.