September 5, 2008

Mr. Ronnie L. Gardner
AREVA NP Inc.
3315 Old Forest Road
P.O. Box 10935
Lynchburg, VA 24506-0935

SUBJECT: THIRD REQUEST FOR ADDITIONAL INFORMATION REGARDING ANP-10278P, "U.S. EPR REALISTIC LARGE BREAK LOSS OF COOLANT ACCIDENT TOPICAL REPORT" (TAC NO. MD4978)

Dear Mr. Gardner:

By letter dated March 26, 2007 (ML070880732), AREVA NP (AREVA) submitted for U.S. Nuclear Regulatory Commission (NRC) staff review Topical Report (TR) ANP-10278P, Revision 0, "U.S. EPR Realistic Large Break Loss-of-Coolant Accident Topical Report" [ML070880739 (proprietary) and ML070880737 (non-proprietary)]. The staff has previously issued two rounds of requests for additional information (RAIs) on July 20, 2007 (ML071930475), and May 15, 2008 (ML081330106). You have responded to these requests by letters dated August 17, 2007 (ML072340458), and June 13, 2008 (ML081690569).

The NRC staff continues to review your submittal and has determined that additional information is required in order to complete the review. A draft of the RAI was provided to you on August 14, 2008 (ML082270735), and discussed with your staff on August 19 and 25, 2008. Minor modifications were made to the draft RAI as a result of those discussions. Your staff has agreed to provide us a schedule for the RAI response following a public meeting on September 10, 2008, where your approach to this RAI will be further discussed.

If you have any questions regarding this matter, I may be reached at 301-415-3361.

Sincerely,

/RA/

Getachew Tesfaye, Sr. Project Manager
EPR Projects Branch
Division of New Reactor Licensing
Office of New Reactors

Docket No. 52-020

Enclosure:
Request for Additional Information

cc: DC AREVA - EPR Mailing List

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THIRD REQUEST FOR ADDITIONAL INFORMATION (RAI)
ANP-10278P, "U.S. EPR REALISTIC LARGE BREAK LOSS OF COOLANT ACCIDENT TOPICAL REPORT" (TAC NO. MD4978)
DOCKET NO. 52-020

RAI-21 AREVA NP determines realistic-analysis uncertainty to comply with 10 CFR 50.46 via non-parametric statistics. To demonstrate compliance with the 10 CFR 50.46 requirement of high probability, the acceptance level is defined as 95/95 with respect to the probability confidence for the three acceptance criteria: peak clad temperature, maximum oxidation, and maximum hydrogen generation. The non-parametric order statistic approach taken requires a sample size of 124 cases to obtain the required 95/95 multivariate tolerance limit for the three random variables - peak clad temperature, maximum oxidation, and maximum hydrogen generation. The staff position is that EPR RLBLOCA methodology as described in Reference 1 should be updated to incorporate sample size of 124 cases instead of the present 59 sample runs.

RAI-22 GDC-35 states that emergency core cooling system evaluation must be performed for onsite power available (offsite power unavailable) and offsite power available (onsite power unavailable). The staff position is that a full set of analyses needs to be performed with the worst configuration of offsite power in order to show compliance with GDC-35.

RAI-23 AREVA has not provided sufficient documentation to support the containment model used to calculate the containment back pressure during a LBLOCA.

a. Provide justification that ICECON properly predicts appropriate containment pressure in the EPR's RLBLOCA analysis.

b. Explain how total heat transfer area is obtained and how heat transfer to the IRWST water surface is treated.

c. Explain how the "best estimate containment pressure curve" obtained as shown in Figure 3-1 is confirmed to be a best-estimate curve for LBLOCA analysis.

RAI-24 What are the range and the EPR RLBLOCA analysis values of the accumulator liquid temperature, liquid volume and initial pressure, and IRWST liquid temperatures? Provide the basis of the sampling parameter ranges. Show how the upper bound values compare with the EPR's Technical Specification values.

RAI-25 AREVA's RLBLOCA methodology does not credit operation of the MSRT (main steam relief train). If the MSRT were to operate for the smaller break sizes considered in the RLBLOCA methodology, the physical processes could be quite different from what is currently being calculated. Demonstrate that the MSRT will not operate for any of the break sizes being considered in the RLBLOCA methodology, or demonstrate that if idid operate it would have no significant effect upon the course of the transient and the resulting PCT, oxidation and hydrogen generation.

RAI-26 The core inlet flow rate shows excessive oscillation during reflood (35 to 200 seconds as shown in Reference1, Figure A-13). The effect of such oscillations is to drive water up into the core and provide an additional cooling mechanism. This could be an S-RELAP5 code characteristic rather than EPR specific issue. The staff agrees on the existence of the core flow oscillation during the reflood period of a LBLOCA, but does not agree that the magnitude of the oscillation as predicted by the S-RELAP5 code is realistic. Provide justification that S-RELAP5 is adequately capable of realistically predicting the oscillations, specifically during the reflood phase; or that S-RELAP5 conservatively predicts PCTs in spite of the oscillations. Quantify the impact on PCT due to the limitations of S-RELAP5 code to realistically analyze the core flow oscillation.

RAI-27 The S-RELAP5 analysis for the RLBLOCA indicates a relatively high system pressure increase of about 70 psi during accumulator injection phase. The staff observed that the pressure spike might come from the greatly enhanced core heat transfer and steam generation in combination with the presence of non-condensable gas. The staff agrees on the existence of a system pressure spike during the accumulator injection phase, but does not agree that the magnitude of the system pressure of 70 psi as predicted by the S-RELAP5 code is realistic. Provide sufficient justification to support the validity of the S-RELAP5 code vessel pressure prediction during the reflood phase of the RLBLOCA analysis. Quantify the impact on LOCA results due to the limitations of S-RELAP5 code to realistically analyze the associated phenomenon.

RAI-28 The Achilles test that showed a surge into the core due to nitrogen caused some momentary cooling; however later, the increased surge caused an increase in entrainment and a loss of cooling due to a lower quench level that resulted in an overall increase in PCT for the test. Explain how the code captures the detrimental effect due to nitrogen injection after the initial insurge of the liquid into the core.

RAI-29 NRC staff has determined that (Reference 2) use of probability sampling theory to satisfy the acceptance criteria for peak cladding temperature, maximum local oxidation, and core wide oxidation should be limited to break sizes falling within the appropriate phenomenologically-driven region. Provide justification of break size spectrum used in the RLBLOCA analysis for US EPR.

RAI-30 NRC staff has determined (Reference 2) that Forslund-Rohsenow heat transfer correlation has been applied outside of its range of application. Since Reference 2 methodology is used by AREVA as a basis for the EPR's RLBLOCA methodology, the staff requests AREVA to quantify the impact on the EPR RLBLOCA results.

RAI-31 The staff had expressed concerns regarding the insensitivity of downcomer nodalization on downcomer boiling following large break LOCAs (Reference 2). Staff requests that AREVA quantify the downcomer boiling impact on the EPR RLBLOCA results. It is noted that the staff had also agreed (Reference 2) that with the high containment pressures and PCTs of the order of less than 1800 °F, sufficient margin exists relative to the 10CFR50.46 criteria to not warrant further investigations. However, should PCTs increase above 1800°F and/or the containment design result in pressures below the containment design pressure in the order of 30 psia, the staff plans to establish the limitation of this RLBLOCA method regarding downcomer boiling modeling.

RAI-32 NRC staff has determined (Reference 2) that lack of a rod-to-rod radiation model in S-RELAP5 presents the potential that the uncertainty evaluation of the remaining heat transfer processes may over estimate the associated heat transfer. Staff requests AREVA to quantify the impact on the EPR RLBLOCA results.

RAI-33 The ANS/ANSI 5.1-1979 standard decay heat curve is used in the EPR's RLBLOCA analysis. Table A-6, "Summary of Major Parameters for Limiting Transient," indicates a decay heat multiplier of less than one (0.96132) is used in ranging decay heat. AREVA has not provided sufficient documentation to support the validity of use of less than 100 percent decay heat as input to the analysis. The staff also questions the use of a single multiplication factor for capturing the uncertainty of the decay heat curve in the application to realistic best-estimate analyses.

RAI-34 The limiting time-in-life for analyses of LBLOCAs requires two conditions to be analyzed to identify the limiting conditions for determining PCT They are:

1. The hot rod temperature calculation should be run at the very end-of-life when the pin pressure is highest. If a blowdown rupture occurs, then the earliest time-in-life must be found which just causes a blowdown rupture The earliest time in life that a blowdown rupture occurs will then assure the stored energy is also at a maximum, and this condition would be applied to the hot rod PCT analysis.

2. If a blowdown rupture does not occur, then analysis at the minimum gap conductance should be performed which maximizes the stored energy in the hot rod, which in turn will also maximize PCT.

The RLBLOCA methodology includes the sampling of time-in-cycle, rather than the limiting condition. Explain how the conditions described above are considered in the RLBLOCA methodology for EPR.

As part of the responses to the above RAIs, if AREVA concludes that further investigation by AREVA is necessary to mitigate a specific condition, then AREVA may propose compensatory measures that would make up for or mitigate the condition.

REFERENCES

1- "U. S. EPR Realistic Large Break Loss of Coolant Accident Topical Report," ANP-10278P REVISION 0, March 2007.

2 "Realistic Large Break LOCA Methodology for Pressurized Water Reactors," EMF-2103(P)(A) Revision 0, FANP Richland, Inc., April 2003.