August 17, 2006

Mr. Ronnie Gardner
3315 Old Forest Road
Lynchburg, VA 24501

SUBJECT: AREVA NP, INC. (FORMERLY FRAMATOME) REQUEST FOR ADDITIONAL INFORMATION FOLLOWUP RE: TOPICAL REPORT EMF-2103(P), REVISION 1, "REALISTIC LARGE BREAK LOCA METHODOLOGY FOR PRESSURIZED WATER REACTORS" (TAC NO. MC4259)

Dear Mr. Gardner:

By letter dated August 9, 2004, AREVA NP, Inc. (AREVA), submitted for U.S. Nuclear Regulatory Commission (NRC) staff review Topical Report (TR) EMF-2103(P), Revision 1, "Realistic Large Break LOCA [loss-of-coolant accident] Methodology for Pressurized Water Reactors." The NRC staff prepared a request for additional information (RAI) with regard to the number of emergency core cooling system performance evaluation model runs that need to be performed to demonstrate a high probability that the criteria of Section 50.46(b)of Title 10 of the *Code of Federal Regulations* (10 CFR) will not be exceeded.

The NRC staff discussed the needed calculations with AREVA by telecon in June 2006. As a result of the telephone conversations, enclosed is a simplified supporting explanation of the number of calculations to be performed to demonstrate that the three criteria, peak cladding temperature, maximum local oxidation, and core wide oxidation specified in 10 CFR 50.46(b) have been met to a high probability.

The references cited in the enclosure, which provide the detailed derivations of the applicable equations, have all been supplied to AREVA previously.

It has been clearly shown in the enclosure and cited references that use of non-parametric order statistics methodology necessitates 124 calculations be performed to obtain the 95/95 values of three parameters. All future submittals applying the order statistics methodology must be based on this number of calculations to be acceptable.

Sincerely,

/RA/
Sean E. Peters, Project Manager
Special Projects Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Project No. 728

Enclosure: RAI Followup

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Enclosure: RAI Followup

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ADAMS ACCESSION NO.: ML062150349 **NRR-106**

OFFICE	PSPB/PM	PSPB/LA	Tech Branch	PSPB/BC
NAME	SPeters	DBaxley	FAkstulewicz	SRosenberg
DATE	8/16/06	8/15/06	07/20/06	8/17/06

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REQUEST FOR ADDITIONAL INFORMATION FOLLOWUP

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

TOPICAL REPORT EMF-2103(P), REVISION 1

"REALISTIC LARGE BREAK LOCA METHODOLOGY

FOR PRESSURIZED WATER REACTORS"

AREVA NP, INC. (AREVA)

PROJECT NO. 728

Order Statistics and Number of Cases

Use of the non-parametric order statistic approach to determine the bounding value for a parameter has been described extensively in the references cited at the end of this discussion. All of the references that discuss the statistical aspects, References 2-5, agree on the following.

The general form of the relationship between the confidence level, probability, number of required calculations, and number of parameters being assessed is given by Equation 40 for two-sided tolerance intervals or Equation 41 for the one-sided tolerance interval per Reference 3.

$$\beta = 1 - I(\gamma, 2s, N - 2s + 1), \text{ two-sided,} \quad (1)$$

$$\beta = 1 - I(\gamma, s, N - s + 1), \text{ one-sided.} \quad (2)$$

In the case of a single parameter, Equation 2 reduces to:

$$\beta = 1 - \gamma^N \quad (3)$$

where β is the confidence level, γ is the probability, and N is the number of cases necessary to achieve the probability at the confidence level.

In the case of multiple parameters, looking at only the one-sided upper tolerance interval, one must use Equation 41 from Reference 2. The solution of the equation is not trivial and requires mathematical software such as *Mathmatica* to solve. For the general form of the equation,

$$\beta = 1 - I(\gamma, s, N - s + 1), \quad (4)$$

in which $I(\gamma, s, N - s + 1)$ is the Incomplete Beta function, an asymptotic solution can be found in Reference 1, and can be reduced to:

$$\beta = 1 - \gamma^N - N(1 - \gamma)\gamma^N \quad (5)$$

ENCLOSURE

in the case of two parameters. The solution for N, with the confidence level of 95 percent and the probability level of 95 percent, is 93. Thus, the one-sided upper tolerance interval requires 93 cases to determine the 95/95 values of two parameters.

Carrying the solution further for 2 parameters:

β/γ	0.9	0.95	0.99
0.9	37	76	388
0.95	46	93	473
0.99	64	130	661

Solution beyond the simple one or two parameter cases can not be done by hand. Use of software such as *Mathmatica* to solve the Incomplete Beta function will return the requirement of 124 cases to determine the 95/95 values of three parameters.

All of the statistic references cited, and previously provided, make it abundantly clear that to obtain the 95/95 values of two or three parameters one can not use 59 cases. A larger number of cases is required. Attempts to rely on 59 cases to obtain the values of more than a single parameter are simply wrong and unsupportable.

In the future, all applications of the order statistics methodology to more than a single parameter will be evaluated based on the above information. Results will not be acceptable without the appropriate population to support the level of certainty being sought.

References:

1. Doman, B. G. S., *An Asymptotic Expansion for the Incomplete Beta Function*, Mathematics of Computation, 65:215, July 1996, Pages 1283-1288.

2. Guba, A., Makai, M, and Pal, L., *Statistical Aspects of Best-Estimate Method-I*, Reliability Engineering and System Safety, Vol. 80, Pages 217-232 (2003).

3. Pal, L. and Makai, M., *Remarks on Statistical Aspects of Safety Analysis of Complex Systems*, arXiv:physics/0308086v1, August 23, 2003.

4. Pal, L. and Makai, M., *Statistical Considerations on Safety Analysis*, arXiv:physics/0511140v1, November 16, 2005.

5. Orechwa, Y., *Some Statistical Considerations in the Application of Best-Estimate Methods for Compliance with 10CFR50.46*, NRR/DSS/SNPB, May 30, 2006.