AREVA

March 26, 2009
NRC:09:021

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

Response to a Third Request for Additional Information Regarding ANP-10286P, "U.S. EPR Rod Ejection Accident Methodology Topical Report"

Ref. 1: Letter, Ronnie L. Gardner (AREVA NP Inc.) to Document Control Desk (NRC), "Request for Review and Approval of ANP-10286P, 'U.S. EPR Rod Ejection Accident Methodology Topical Report'," NRC:07:065, November 20, 2007.

Ref. 2: Letter, Getachew Tesfaye (NRC) to Ronnie L. Gardner (AREVA NP Inc.), "Third Request for Additional Information Regarding ANP-10286P, 'U.S. EPR Rod Ejection Accident Methodology Topical Report'," February 27, 2009.

AREVA NP Inc. (AREVA NP) requested the NRC's review and approval of topical report ANP-10286P, "U.S. EPR Rod Ejection Accident Methodology Topical Report" in Reference 1. The NRC provided a third Request for Additional Information (RAI) regarding this topical report in Reference 2. The response to the RAI is enclosed with this letter, ANP-10286Q3P, "Response to a Request for Additional Information – ANP-10286P, 'U.S. EPR Rod Ejection Accident Methodology Topical Report'."

AREVA NP considers some of the material contained in the attachments to this letter to be proprietary. As required by 10 CFR 2.390(b), an affidavit is enclosed to support the withholding of the information from public disclosure. Proprietary and non-proprietary versions of the response are attached.

If you have any questions related to this submittal, please contact Ms. Sandra M. Sloan, Regulatory Affairs Manager for New Plants. She may be reached by telephone at 434-832-2369 or by e-mail at sandra.sloan@areva.com.

Sincerely,

Ronnie L. Gardner

Ronnie L. Gardner, Manager
Corporate Regulatory Affairs
AREVA NP Inc.

Enclosure

cc: G. Tesfaye
Docket No. 52-020

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NRO

AFFIDAVIT

COMMONWEALTH OF VIRGINIA)
) ss.
CITY OF LYNCHBURG)

1. My name is Gayle F. Elliott. I am Manager, Product Licensing, for AREVA NP Inc. and as such I am authorized to execute this Affidavit.

2. I am familiar with the criteria applied by AREVA NP to determine whether certain AREVA NP information is proprietary. I am familiar with the policies established by AREVA NP to ensure the proper application of these criteria.

3. I am familiar with the AREVA NP information contained in ANP-10286Q3P, Revision 000, entitled, "Response to a Request for Additional Information – ANP-10286P, 'U.S. EPR Rod Ejection Accident Methodology Report'," dated March 2009 and referred to herein as "Document." Information contained in this Document has been classified by AREVA NP as proprietary in accordance with the policies established by AREVA NP for the control and protection of proprietary and confidential information.

4. This Document contains information of a proprietary and confidential nature and is of the type customarily held in confidence by AREVA NP and not made available to the public. Based on my experience, I am aware that other companies regard information of the kind contained in this Document as proprietary and confidential.

5. This Document has been made available to the U.S. Nuclear Regulatory Commission in confidence with the request that the information contained in this Document be withheld from public disclosure. The request for withholding of proprietary information is made in accordance with 10 CFR 2.390. The information for which withholding from disclosure is

requested qualifies under 10 CFR 2.390(a)(4) "Trade secrets and commercial or financial information."

6. The following criteria are customarily applied by AREVA NP to determine whether information should be classified as proprietary:

(a) The information reveals details of AREVA NP's research and development plans and programs or their results.

(b) Use of the information by a competitor would permit the competitor to significantly reduce its expenditures, in time or resources, to design, produce, or market a similar product or service.

(c) The information includes test data or analytical techniques concerning a process, methodology, or component, the application of which results in a competitive advantage for AREVA NP.

(d) The information reveals certain distinguishing aspects of a process, methodology, or component, the exclusive use of which provides a competitive advantage for AREVA NP in product optimization or marketability.

(e) The information is vital to a competitive advantage held by AREVA NP, would be helpful to competitors to AREVA NP, and would likely cause substantial harm to the competitive position of AREVA NP.

The information in the Document is considered proprietary for the reasons set forth in paragraphs 6(b) and 6(c) above.

7. In accordance with AREVA NP's policies governing the protection and control of information, proprietary information contained in this Document have been made available, on a limited basis, to others outside AREVA NP only as required and under suitable agreement providing for nondisclosure and limited use of the information.

8. AREVA NP policy requires that proprietary information be kept in a secured file or area and distributed on a need-to-know basis.

9. The foregoing statements are true and correct to the best of my knowledge, information, and belief.

SUBSCRIBED before me this 25th day of March 2009.

Sherry L. McFaden
NOTARY PUBLIC, COMMONWEALTH OF VIRGINIA
MY COMMISSION EXPIRES: 10/31/10
Reg. # 7079129

SHERRY L. MCFADEN
Notary Public
Commonwealth of Virginia
7079129
My Commission Expires Oct 31, 2010

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RAI-33. [*Intentionally deleted.*]

RAI-34:

Figure 8-41 provides the transient post-to-pre-ejection power ratio versus static post-to-pre-ejection power ratio plot, and the rod failure census.

a. *Why is the static ratio always larger than the transient ratio?*
b. *Does this imply a built-in conservatism [and if yes, what is it]?*
c. *Provide a qualitative discussion of the methodology used to determine the number of failed rods for transients terminated by 5 seconds.*

Response to RAI-34:

a. The reactivity feedback (Doppler and moderator) is frozen at the pre-ejection conditions, while the transient calculation includes thermal reactivity feedback at all conditions including the time period during the ejection of the control rod. Therefore, the static value of the power ratio is always larger than the transient value. The power ratios are addressed in the Response to RAI-28, Reference 34-1.

b. The use of the static ratios does not add additional conservatism relative to the use of the transient ratios. There is additional conservatism included due to the determination of the relationship of static ratio to transient ratio. This is described in the Response to RAI-34c.

c. [ ] fuel rods (chosen from those represented in the Rod Ejection Topical Report, Figure 8-41) are chosen to have their transient power histories individually analyzed by LYNXT for each condition (e.g., beginning-of-cycle (BOC), hot full power (HFP)). The highest corresponding transient ratio data point (corresponding to a particular fuel assembly) for a given static ratio data point is chosen to be conservative. The power histories are augmented by applicable uncertainty components as described in the Rod Ejection Topical Report, Table 7-2 throughout the entire transient as analyzed by LYNXT.

   For example, for the BOC HFP case, the total two dimensional uncertainty plus an additional design allowance results in a total multiplier of [ ] on the peak fuel rod power, which is included throughout the entire transient. Each of the [ ] transient power histories is analyzed using LYNXT to determine a corresponding multiplier on the fuel rod power which causes the fuel rod to reach the departure from nucleate boiling ratio (DNBR) design limit. The multipliers are then applied to the corresponding static pre-ejection and post-ejection peaking factors ($F_{\Delta H}$ and F_Q) in order to generate a set of failure criteria to be applied to all fuel rods in the static census analysis. This process and example peaking factors are also provided in the Response to RAI-28, Reference 34-1. The LYNXT analysis calculated power multipliers resulted in 0.3 percent of fuel rods failed for the BOC HFP case. If the uncertainties and allowances were removed to simulate best estimate values, no failures would be calculated for this example.

   The primary conservatisms in the control rod ejection methodology, which result in a conservative number of failed fuel rods are:

   1) The power response versus time for the reference has the following conservatisms:

      a) The deterministic choice of the highest ejected control rod worth or peaking versus a statistical evaluation of the range of potential ejected control rod worths.

b) The 15% uncertainty applied to the ejected control rod worth (Rod Ejection Topical Report, Table 7-3).

c) The uncertainties applied to Doppler and moderator temperature reactivity coefficients (DTC and MTC) and delayed neutron fraction beta effective (β-eff).

d) The reference cycle has additional biases on ejected rod worth, DTC, MTC, and β–eff that will be less limiting for the actual cycles.

2) The peaking factor uncertainties defined in the Rod Ejection Topical Report, Table 7-2.

3) The choice of the assemblies with the highest values of [ ] for the DNBR evaluation.

Reference:

34-1, ANP-10286Q2P, Response to Second Request for Additional Information - ANP-10286P "U.S. EPR Rod Ejection Accident Methodology Topical Report."

RAI-35:

Provide a discussion of the analysis regarding the number of rods failed in the quasi-static analysis using S-RELAP and LYNXT for transients lasting longer than approximately 5 seconds.

Response to RAI-35:

The analysis for the number of rods failed in the steady state analysis is analogous to the transient analysis except that [ ] fuel rods reduce to a single fuel rod because all rod powers include the full Doppler and moderator feedback effects. The fuel rod with the peak steady state power (F_{dh}) and corresponding normalized axial shape is analyzed using LYNXT for the DNBR performance. The fuel rod power is augmented by applicable uncertainty components as described in Table 7-2.

For example, for the BOC HFP case, the total two dimensional uncertainty plus an additional design allowance results in a total multiplier of [ ] which is multiplied times the peak pin power. The power distribution (radial and axial) for the fuel assembly is analyzed with LYNXT in a static solution mode to determine a corresponding multiplier on the fuel rod power, which causes the fuel rod to reach the DNBR design limit. The thermal hydraulic boundary conditions for system pressure, core inlet temperature, and inlet mass flux are from the S-RELAP calculation at the time of interest during the transient (this is described in the Response to RAI-26 in Reference 35-1). The multiplier is then applied to the steady state post-ejection peaking factors ($F_{\Delta H}$ and F_Q) in order to generate failure criteria to be applied to fuel rods in the steady state census analysis. The LYNXT analysis calculated multiplier resulted in 7.2 percent of fuel rods failed. If the uncertainties and allowances were removed to simulate best estimate values, less than 0.6 percent of fuel rods would be calculated to fail for this example.

The primary conservatisms in the control rod ejection methodology which result in a conservative number of failed fuel rods for transients lasting longer than approximately five seconds are the same as the first two described in the Response to RAI-34.

Reference:

35-1, ANP-10286Q2P, Response to Second Request for Additional Information - ANP-10286P "U.S. EPR Rod Ejection Accident Methodology Topical Report."