



March 25, 2014  
NRC:14:011

U.S. Nuclear Regulatory Commission  
Document Control Desk  
11555 Rockville Pike  
Rockville, MD 20852

**Request for Review and Approval of ANP-10332P, Revision 0, "AURORA-B: An Evaluation Model for Boiling Water Reactors; Application to Loss of Coolant Accident Scenarios"**

- Ref. 1: Letter, Ronnie L. Gardner (AREVA NP Inc.) to H. D. Cruz (NRC), "Request for Review and Approval of ANP-10300P, Revision 0, 'AURORA-B: An Evaluation Model for Boiling Water Reactors; Application to Transient Accident Scenarios'," NRC:09:134, December 23, 2009.
- Ref. 2: Letter, Ronnie L. Gardner (AREVA NP Inc.) to H. D. Cruz (NRC), "Realistic Thermal-Mechanical Fuel Rod Methodology for Boiling Water Reactors Supplement 1: Qualification of RODEX4 for Recrystallized Zircaloy-2 Cladding," NRC:09:133, December 22, 2009.
- Ref. 3: BAW-10247PA, Revision 0, "Realistic Thermal-Mechanical Fuel Rod Methodology for Boiling Water Reactors," AREVA NP, February 2008

AREVA Inc. (AREVA) requests the NRC's review and approval of the topical report ANP-10332P, Revision 0, "AURORA-B: An Evaluation Model for Boiling Water Reactors; Application to Loss of Coolant Accident Scenarios," dated February 2014, for referencing in licensing actions.

This report presents a methodology for the evaluation of a loss-of-coolant accident for boiling water reactors (BWRs). The methodology builds on the AURORA-B AOO Methodology currently under review by the NRC (Reference 1,) and consists of the thermal-hydraulic system code S-RELAP5 and the NRC approved advanced fuel performance code RODEX4 (Reference 3.) This methodology implements improvements in analysis capabilities that enhance safety to the public. Some specific improvements are the treating of fuel swelling, rupture, and relocation as well as explicit accounting for exposure dependent fuel thermal conductivity degradation. Section 2.4 of the report provides a roadmap of the document to demonstrate compliance with the 10 CFR 50.46 criteria and Section 6.2 details the compliance to Appendix K requirements.

This topical report is part of AREVA's response to NRC Information Notice 2009-23: Nuclear Fuel Thermal Conductivity Degradation. This information notice states that previous fuel performance codes did not model the impact of irradiation on fuel thermal conductivity adequately. The RODEX4 fuel performance code in BAW-10247PA, Revision 0, "Realistic Thermal-Mechanical Fuel Rod Methodology for Boiling Water Reactors," (Reference 3,) contains a nuclear fuel thermal conductivity model which accurately reflects the impact of irradiation. Also, the Supplement 1 to BAW-10247PA, "Realistic Thermal-Mechanical Fuel Rod Methodology for Boiling Water Reactors Supplement 1: Qualification of RODEX4 for Recrystallized Zircaloy-2 Cladding," (Reference 2,) is currently under review by the NRC, and will extend capabilities to include a hydrogen up-take model upon approval.

The inclusion of this model will result in the full capability of the AURORA-B LOCA methodology to demonstrate compliance with the anticipated requirements of the new 10 CFR 50.46c regulation, as described

**AREVA INC.**

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in Section 2.5.1. The updated S-RELAP5 Models and Correlations Code Theory Manual (FS1-0009406 Revision 3) will be provided for information in a follow-on transmittal to support review of this Topical Report.


AREVA considers some of the material contained in the enclosed documents 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 report are found in Enclosures 1 and 2, respectively. Enclosure 3 is the notarized Affidavit.

In support of the Office of Nuclear Reactor Regulation's prioritization efforts, the prioritization scheme matrix is included in Attachment A.

There are no commitments contained within the enclosures to this letter.

If you have any questions related to this submittal please contact Mr. Alan B. Meginnis, Product Licensing Manager, by telephone at (509) 375-8266, or by e-mail at Alan.Meginnis@areva.com.

Sincerely,



Pedro Salas, Director  
Regulatory Affairs  
AREVA Inc.

Attachments:

- A. NRC Prioritization Matrix

Enclosures:

1. Proprietary Version of ANP-10332P, Revision 0, "AURORA-B: An Evaluation Model for Boiling Water Reactors; Application to Loss of Coolant Accident Scenarios"
2. Non-Proprietary Version of ANP-10332NP, Revision 0, "AURORA-B: An Evaluation Model for Boiling Water Reactors; Application to Loss of Coolant Accident Scenarios"
3. Notarized Affidavit

cc: J. G. Rowley  
Project 728

**ATTACHMENT A:  
NRC Prioritization Matrix**

<b>TR Prioritization Scheme Matrix for Metric and Resources</b>			
<b>Title: ANP-10332P, Revision 0, "AURORA-B Evaluation Model for Boiling Water Reactors; Application to Loss of Coolant Accident Scenarios"</b>			
<b>Expect submitting FY</b>	<b>TAC</b>	<b>PM</b>	<b>Today's Date: 3/25/2014</b>
<b>Technical Review Division(s)</b>		<b>Technical Review Branch(s)</b>	
<b>Factors</b>	<b>Select the Criteria That the TR Satisfies</b>	<b>Points can be Assigned for Each Criteria</b>	<b>Assigned Points</b>
<b>TR Classification</b> (Select one only)	Resolve Generic Safety Issue (GSI).	6	3
	Emergent NRC Technical Issue.	3	
	New technology improves safety.	2	
	TR Revision reflecting current requirements or analytical methods.	2	
	Standard TR.	1	
<b>TR Applicability</b> (Select one only)	Potential industry-wide applications.	3	2
	Potentially applicable to entire groups of licensees.	2	
	Intended for only partial groups of licensees.	1	
<b>TR Implementation Certainty</b> (Select one only)	Industry-wide Implementation expected.	3	1
	Expected implementation by an entire group of licensees (BWROG, PWROG, BWRVIP, etc.) who sponsored the TR.	2	
	Docketed intent by U.S. plant(s) but no formal LAR schedule yet.	1	
	No U.S. plant(s) have indicated strong intent on docket to implement yet.	0	
<b>Tie to a LAR</b> (Select if applicable)	A SE is requested by a certain date (less than two years) to support a licensing activity or renewal date (note it in Comments).	3	0
<b>Review Progress</b> (Points are cumulative as applicable)	Accepted for review.	0.3	0
	RAI issued.	0.5	0
	RAI responded.	1.2	0
	SE drafted.	2.0	0
<b>Management (LT/ET) discretion adjustment</b>		-3 to +3	
<b>Total Points (Add the total points from each factor and total here):</b>			<b>6</b>
<b>Comments:</b> <p>The 3 points for "TR Classification" is justified as the Methodology in ANP-10332P implements the RODEX4 models in the BWR LOCA Analysis for the first time which resolves the Exposure Depended Fuel Thermal Conductivity Related issue for BWR LOCA Analyses. Additionally it is expected that new methodology attributes of this method will be required to demonstrate compliance with the upcoming 10 CFR 50.46c regulation requirements.</p> <p>The 2 points for "TR Applicability" are justified because AREVA could apply this methodology in a fuel transition for all BWRs except BWR 2s.</p> <p>The 1 point for "TR Implementation Certainty" is justified as all US BWRs will be required to meet the criteria of 10 CFR 50.46c after it is published. This new methodology will be required for AREVA analyses to demonstrate compliance with the new requirements of the new regulation.</p>			

## AFFIDAVIT

STATE OF WASHINGTON     )  
                                      ) ss.  
COUNTY OF BENTON        )

1.       My name is Alan B. Meginnis. I am Manager, Product Licensing, for AREVA Inc. and as such I am authorized to execute this Affidavit.

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

3.       I am familiar with the AREVA information contained in the report ANP-10332P, Revision 0, "AURORA-B: An Evaluation Model for Boiling Water Reactors; Application to Loss of Coolant Accident Scenarios," dated February 2014 and referred to herein as "Document." Information contained in this Document has been classified by AREVA as proprietary in accordance with the policies established by AREVA 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 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 to determine whether information should be classified as proprietary:

- (a) The information reveals details of AREVA'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.
- (d) The information reveals certain distinguishing aspects of a process, methodology, or component, the exclusive use of which provides a competitive advantage for AREVA in product optimization or marketability.
- (e) The information is vital to a competitive advantage held by AREVA, would be helpful to competitors to AREVA, and would likely cause substantial harm to the competitive position of AREVA.

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

7. In accordance with AREVA'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 only as required and under suitable agreement providing for nondisclosure and limited use of the information.

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

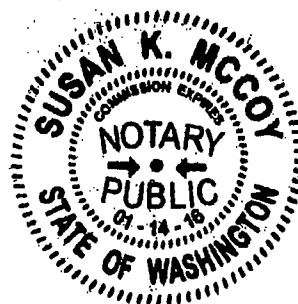
9. The foregoing statements are true and correct to the best of my knowledge,  
information, and belief.

du G Men

SUBSCRIBED before me this 28<sup>th</sup>  
day of February, 2014.

Susan K. McCoy

Susan K. McCoy  
NOTARY PUBLIC, STATE OF WASHINGTON  
MY COMMISSION EXPIRES: 1/14/2016



bcc: NRC:14:011  
T. C. Attard  
R. L. Baxter  
F. Burtak  
S. E. Cole  
F. Curca Tivig  
R. J. Desteese  
B. M. Dunn  
G. F. Elliott  
R. S. Freeman  
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N. L. Garner  
K. R. Greene  
R. G. Grummer  
D. P. Jordheim  
R. J. Land  
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T. N. Wills



# NRC CORRESPONDENCE CONCURRENCE SHEET

(Note: LE should fill in Regulatory Considerations)

Due Date: 03/12/14		Preparer: Alan Meginnis	
Letter No.: NRC:14-014			
Subject: Request for Review and Approval of ANP-10332P, Revision 0, "AURORA-B: An Evaluation Model for Boiling Water Reactors; Application to Loss of Coolant Accident Scenarios"			
<b>REGULATORY CONSIDERATIONS</b>			
Affidavit	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Posting Requirements	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Licensing Verification	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	FSAR Impact	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
New Commitments	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Legal Consultation	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
LIC-109 Review	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Engineering Technical Review	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
LIC-500 Review	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
<b>CONCURRENCE</b>			
A concurrence signature reflects that the signatory has assured that the submittal is appropriate and consistent with AREVA Policy, applicable commitments are approved for implementation and supporting documentation for submittal completeness and accuracy has been prepared.			
Name	Role	Signature	Date
Tiffany Wills	Administrative Assistant	<i>Tiffany Wills</i>	3/12/14
Tiffany Wills	Technical Editor	<i>Tiffany Wills</i>	3/12/14
Gayle Elliott	Peer Reviewer	<i>Gayle Elliott</i>	3/17/14
Robert Schnepf	Technical Reviewer	<i>Robert Schnepf</i>	3/6/14
Len Gucwa	EPR Only	N/A	N/A
Alan Meginnis	Letter Author		
Katherine Anderson	Director Assistant		

Spell Checked: ☒ Yes ☐ No

Attachment(s) Enclosed: ☒ Yes ☐ No





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New Commitments	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Legal Consultation	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
If yes, Date:		Engineering Technical Review	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
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<b>CONCURRENCE</b>			
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Name	Role	Signature	Date
Tiffany Wills	Administrative Assistant	<i>[Signature]</i>	3/16/14
Tiffany Wills	Technical Editor	<i>[Signature]</i>	3/16/14
Gayle Elliott	Peer Reviewer		
Robert Schnepf	Technical Reviewer		
Len Gucwa	EPR Only	N/A	N/A
Alan Meginnis	Letter Author	<i>[Signature]</i>	3/6/14
Katherine Anderson	Director Assistant		

Spell Checked: ☒ Yes ☐ No

Attachment(s) Enclosed: ☒ Yes ☐ No