April 13, 2007

Mr. Ronnie Gardner
Site Operations and Regulatory Affairs Manager
AREVA NP Inc.
3315 Old Forest Road
Lynchburg, VA 24501

SUBJECT: DRAFT SAFETY EVALUATION FOR AREVA NP, INC. TOPICAL REPORT (TR) BAW-10164(P), REVISION 6, RELAP5/MOD2-B&W - AN ADVANCED COMPUTER PROGRAM FOR LIGHT WATER REACTOR LOCA [LOSS-OF-COOLANT ACCIDENT] AND NON-LOCA TRANSIENT ANALYSIS (TAC NO. MD2187)

Dear Mr. Gardner:

By letter dated March 31, 2006, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML062540326) AREVA NP, Inc. (AREVA) submitted TR BAW-10164(P), Revision 6, "RELAP5/MOD2-B&W - An Advanced Computer Program for Light Water Reactor LOCA and Non-LOCA Transient Analysis" to the U.S. Nuclear Regulatory Commission (NRC) staff for review. Enclosed for AREVA review and comment is a copy of the NRC staff's draft safety evaluation (SE) for the TR.

Pursuant to Section 2.390 of Title 10 of the *Code of Federal Regulations* (10 CFR), we have determined that the enclosed draft SE does not contain proprietary information. However, we will delay placing the draft SE in the public document room for a period of 10 working days from the date of this letter to provide you with the opportunity to comment on the proprietary aspects. If you believe that any information in the enclosure is proprietary, please identify such information line-by-line and define the basis pursuant to the criteria of 10 CFR 2.390. After 10 working days, the draft SE will be made publicly available, and an additional 10 working days are provided to you to comment on any factual errors or clarity concerns contained in the draft SE. The final SE will be issued after making any necessary changes and will be made publicly available. The NRC staff's disposition of your comments on the draft SE will be discussed in the final SE.

To facilitate the NRC staff's review of your comments, please provide a marked-up copy of the draft SE showing proposed changes and provide a summary table of the proposed changes.

If you have any questions, please contact Holly D. Cruz at 301-415-1053.

Sincerely,

/RA/

Stacey L. Rosenberg, Chief
Special Projects Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Project No. 728

Enclosure: Draft SE

April 13, 2007

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Enclosure: Draft SE

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ADAMS ACCESSION NO.: ML070610579 *No major changes to SE input NRR-043

OFFICE	PSPB/PM	PSPB/PM	PSPB/LA	SNPB/BC(A)*	PSPB/BC
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DRAFT SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

TOPICAL REPORT BAW-10164(P), REVISION 6

"RELAP5/MOD2-B&W - AN ADVANCED COMPUTER PROGRAM FOR LIGHT WATER REACTOR LOCA AND NON-LOCA TRANSIENT ANALYSIS"

AREVA NP, INC.

PROJECT NO. 728

1.0 INTRODUCTION AND BACKGROUND

AREVA NP, Inc. (AREVA) submitted Topical Report (TR) BAW-10164(P), Revision 6, "RELAP5/MOD2-B&W - An Advanced Computer Program for Light Water Reactor LOCA [Loss-of-Coolant Accident] and Non-LOCA Transient Analysis," by letter dated March 31, 2006 (Reference 1). The purpose of this revision was to include changes to incorporate the NRC-approved high thermal performance (HTP) (Reference 2) and modified HTP (BHTP) (Reference 3) critical heat flux (CHF) forms of the departure from nucleate boiling (DNB) correlation into the computer code and TR to support LOCA applications with AREVA HTP or Mark-B-HTP fuel designs.

Generalized forms (user-supplied) of the HTP, BHTP, and Babcock & Wilcox Universal (BWU) CHF correlations were also added to accommodate minor fuel design modifications or coefficient changes related to refitting or tuning these correlations with additional DNB data which might span larger data ranges. Additional minor text changes were also made in the revision to correct typographical errors in the previous version.

AREVA provided responses to the NRC staff's January 24, 2007, request for additional information (RAI) (Reference 4) in letter dated February 2, 2007 (Reference 5).

2.0 REGULATORY EVALUATION

The RELAP5/MOD2-B&W code is a general purpose code that is used for a variety of safety-related and non-safety-related transient calculations. Restrictions on the use of the code for licensing applications are contained in approved application-specific TRs. For B&W plant types, subsection 50.46 of Title 10 of the *Code of Federal Regulations* (10 CFR) licensing applications using RELAP5/MOD2-B&W are currently performed with the B&W Nuclear Technology (BWNT) LOCA Evaluation Model (EM). This model is documented in BAW-10192P-A, Rev. 0, "BWNT LOCA - BWNT Loss-of-Coolant Accident Evaluation Model for Once-Through Steam Generator Plants" (Reference 6). For certain classes of Westinghouse and Combustion Engineering plants, these are performed with the recirculating steam generator (RSG) LOCA EM documented in BAW-10168P-A, Rev. 3, "RSG LOCA - BWNT Loss-of-Coolant Accident Model for Recirculating Steam Generator Plants" (Reference 7).

The BWNT LOCA EM methodology, BAW-10192P-A, Rev. 0, for B&W plant designs states, on Page 4-24 of Volume 1, that the “LOCA analyses will use the same CHF correlation that is used for the fuel pin DNB analyses." It is this requirement that necessitated the addition of the BHTP CHF correlation into the RELAP5/MOD2-B&W code for use with the AREVA Mark-B-HTP fuel design.

3.0 TECHNICAL EVALUATION

The NRC staff reviewed the correlation form and coefficients for the BHTP CHF correlation and noted a discrepancy in the form presented in BAW-10164 as compared to the form presented in EMF-92-153(P)(A), Revision 1 and BAW-10241(P)(A), Revision 1. In response to the staff’s RAI, AREVA will correct the BAW-10164 TR to address the typographical errors in BHTP equations 2.3.3-41.6 and 2.3.3-41.13. AREVA confirmed that the computer coding was correct.

The NRC staff has determined that AREVA has properly incorporated the BHTP CHF correlation into the RELAP5/MOD2-B&W code and identified the ranges for the fluid and fuel conditions for which the correlation was approved.

AREVA added user flexibility to the RELAP5/MOD2-B&W CHF correlations to allow the user to specify specific values associated with the correlations. In addition, generic forms of the CHF correlations were added to allow a user to supply the correlation coefficients. These modifications are intended to address evolutions in future fuel designs which could result in new DNB testing that justifies changes in the coefficients used in the generic forms of the BHTP or BWU CHF correlations. The BWU and BHTP user-supplied CHF models provide flexibility to evaluate new fuel designs without having to modify the RELAP5/MOD2-B&W code. In response to the NRC staff’s RAI, AREVA clarified that future analyses with these correlations would be accompanied by a justification that will include a discussion on the selection of the values for all user-provided inputs.

LOCA analyses that utilize the user-supplied CHF models will not be applied as licensing calculations unless the CHF formulation is justified. As required by 10 CFR 50.46, changes in the evaluation model (BAW-10192P-A, Rev. 0 or BAW-10168P-A, Rev. 3) that result from the application of a new CHF correlation will be reported to the NRC.

Using a CHF correlation applicable to the specific fuel design is also consistent with the EM approach used with BAW-10168P-A, Rev. 3, for certain classes of Westinghouse and Combustion Engineering plants. Although use of the BWU or BHTP user-supplied CHF model with the BAW-10168P-A, Rev. 3 EM is not foreseen at this time, in response to the NRC staff’s RAI, AREVA clarified that calculations for future fuel designs will be performed with CHF correlations that have been justified for the intended use.

Non-LOCA licensing applications with RELAP5/MOD2-B&W are described in BAW-10193P-A, “RELAP5/MOD2-B&W for Safety Analysis of B&W-Designed Pressurized Water Reactors,” and in BAW-10169P-A, “RSG Plant Safety Analysis - B&W Safety Analysis Methodology for Recirculating Steam Generator Plants” (ADAMS Legacy Library Accession No. 8912060142) (Reference 8). When CHF calculations are required, the system results from RELAP5/MOD2-B&W are provided for use with an approved thermal hydraulic code such as

LYNXT (Reference 10). This is consistent with the SE statements for each of these non-LOCA TRs.

4.0 CONCLUSION

The NRC staff has determined that AREVA has properly incorporated the BHTP CHF correlation into the RELAP5/MOD2-B&W code and identified the ranges for the fluid and fuel conditions for which the correlation was approved. Therefore, licensees may reference the revised TR for LOCA analyses, using the BWNT LOCA EM methodology for B&W plant designs (BAW-10192P-A, Rev. 0), with the Mark-B-HTP fuel design to demonstrate compliance with 10 CFR 50.46.

The NRC staff has determined that the user-supplied CHF correlations and the user-specified specific values associated with these correlations, incorporated into the RELAP5/MOD2-B&W code, will not be used for licensing analyses without adequate justification for their use consistent with the restrictions on the use of the RELAP5/MOD2-B&W code for licensing applications as contained in approved application-specific TRs.

5.0 REFERENCES

1. Topical Report (TR) BAW-10164(P), Revision 6, “RELAP5/MOD2-B&W - An Advanced Computer Program for Light Water Reactor LOCA [Loss-of-Coolant Accident] and Non-LOCA Transient Analysis," by letter NRC:06:017 dated March 31, 2006 (Agencywide Documents Access and Management (ADAMS) Accession No. ML062540326).

2. EMF-92-153(P)(A), Revision 1, “HTP: Departure from Nucleate Boiling Correlation for High Thermal Performance Fuel,” January 2005 (ADAMS Accession No. ML051020016).

3. BAW-10241(P)(A), Revision 1, “BHTP DNB Correlation Applied with LYNXT,” July 2005 (ADAMS Accession No. ML052500092).

4. AREVA provided responses to the NRC staff’s January 24, 2007, request for additional information (RAI) (ADAMS Accession No. ML063380395).

5. Letter NRC:07:005 dated February 2, 2007 (ADAMS Accession No. ML070380124).

6. BAW-10192P-A, Rev. 0, “BWNT LOCA - BWNT Loss-of-Coolant Accident Evaluation Model for Once-Through Steam Generator Plants," June 1998 (ADAMS Legacy Library Accession No. 9808250157).

7. BAW-10168P-A Rev. 3, “RSG LOCA - BWNT Loss-of-Coolant Accident Model for Recirculating Steam Generator Plants," January 1997 (ADAMS Legacy Library Accession No. 9702100181).

8. BAW-10193P-A, “RELAP5/MOD2-B&W for Safety Analysis of B&W-Designed Pressurized Water Reactors,” January 2000 (ADAMS Accession No. ML003682985).

9. BAW-10169P-A, "RSG Plant Safety Analysis - B&W Safety Analysis Methodology for Recirculating Steam Generator Plants," November 1989 (ADAMS Legacy Library Accession No. 8912060142).

10. BAW-10156-P-A, Revision 1, "LYNXT - Core Transient Thermal-Hydraulic Program," August 1993 (ADAMS Legacy Library Accession No. 9309130194).

Principle Contributor: E. D. Throm

Date: April 13, 2007