November 20, 2009

Mrs. Sandra Sloan
AREVA NP Inc.
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SUBJECT: AUDIT REPORT FOR JULY 14 AND 15, 2009, REVIEW OF SELECTED AREAS RELATED TO U.S. EPR FSAR CHAPTER 6 AND SUPPORTING TECHNICAL/TOPICAL REPORTS SAFETY EVALUATION

Dear Mrs. Sloan:

AREVA NP, Inc. (AREVA), submitted to the U.S. Nuclear Regulatory Commission (NRC) a Final Safety Analysis Report (FSAR) for its application of the U.S. EPR in December, 2007 (Agencywide Documents Access and Management System [ADAMS] ML073520305). NRC staff initiated the design certification review on March 19, 2008. During the review, the staff issued a request for additional information (RAI) which required long lead items to properly address the issue at the beginning of Phase 1. On January 28, 2009, AREVA provided a response to the RAI in the submittal of ANP-10299P, "Applicability of AREVA Containment Response Evaluation Methodology to the U.S. EPR for Large Break LOCA Analysis Technical Report" (ADAMS ML090330151). The subsequent review of the U.S. EPR containment design and RAI responses identified several issues that required further discussion.

In order to cover important review areas handled by the NRO Containment and Ventilation Branch, the staff proposed an audit that was carried out at the AREVA office in Lynchburg, VA on July 14 and 15, 2009. The review of the additional technical documents, made available by AREVA at its local office, was facilitated by the presence of AREVA personnel at the audit. The audit report is contained in the enclosure to this letter.

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:
Audit Report

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

Docket No. 52-020
Enclosure:
Audit Report

cc: DC AREVA – EPR Mailing List

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ADAMS Accession Number: ML092160060 **NRO-002**

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DATE	08/04/09	09/08/09	09/08/09	09/16/09	11/20/09

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APPLICANT: AREVA NP, INC.

PROJECT: EPR DESIGN CERTIFICATION

SUBJECT: SUMMARY OF JULY 14 AND 15, 2009, REVIEW OF SELECTED AREAS RELATED TO U.S. EPR FSAR CHAPTER 6 AND SUPPORTING TECHNICAL/TOPICAL REPORTS SAFETY EVALUATION.

BACKGROUND

AREVA NP, Inc. (AREVA), submitted to the U.S. Nuclear Regulatory Commission (NRC) a Final Safety Analysis Report (FSAR) for its application of the U.S. EPR in December, 2007 (Agencywide Documents Access and Management System [ADAMS] ML073520305). NRC staff initiated the design certification review on March 19, 2008. During the review, the staff issued a request for additional information (RAI) which required long lead items to properly address the issue at the beginning of Phase 1. On January 28, 2009, AREVA provided a response to the RAI in the submittal of ANP-10299P, "Applicability of AREVA Containment Response Evaluation Methodology to the U.S. EPR for Large Break Loss of Coolant Accident (LOCA) Analysis Technical Report" (ADAMS ML090330151). The subsequent review of the U.S. EPR containment design and RAI responses identified several issues that required further discussion.

In order to cover important review areas handled by the Office of New Reactors (NRO) Containment and Ventilation Branch, the staff proposed an audit that was carried out at the AREVA office in Lynchburg, VA on July 14 and 15, 2009. The review of the additional technical documents, made available by AREVA at its local office, was facilitated by the presence of AREVA personnel at the audit. The audit was performed to resolve existing questions in accomplishing the U.S. EPR review schedule in an efficient manner.

AUDIT APPROACH

During this audit, the staff reviewed additional documents and calculations provided by AREVA that pertain to Main Steam Line Break (MSLB) Mass and Energy (M&E) release and other topics pertinent to the review of Chapter 6 of the U.S. EPR FSAR. The topics covered in the audit included MSLB M&E release calculations, functional containment design and multi-node GOTHIC models, containment back pressure for the emergency core cooling system (ECCS), LOCA M&E, and heat removal systems. The modified agenda for this audit is given in Attachment A.

To achieve the review goals in an efficient manner, the staff assembled an audit team comprised of experts from NRC. Representatives from AREVA introduced the audit topics and provided supporting documents and technical evidence to the reviewers on each topic during the audit. The attendee list for the meeting is presented in Attachment B.

AUDIT SUMMARY

AREVA representatives began the audit with a presentation on the current approach and the status of completed work to date. AREVA personnel mentioned that not all pertinent documents had been through internal quality assurance procedures and were, therefore, not available for the audit.

ENCLOSURE

Subsequent discussions were guided by a list of topics that was compiled by NRC staff and included as part of the audit plan. The list of potential discussion topics is included in Attachment C. The discussions were related to technical issues identified in former RAI questions, namely RAI 82, question (Q) 6.2.1.1-1.a1; RAI 82, Q6.2.1.5b; RAI 82, Q6.2.1.1.3-1; RAI 104, Q14.3.1-a.2; RAI 221, Q6.2.1.4-1.e; RAI 221, Q6.2.1.4-1.i; RAI 221, Q6.2.1.5-1.a; RAI 221, Q6.2.1-43; RAI 221, Q6.2.1; RAI, Q6.2.1.3-1c and RAI 221, Q6.2.1.

A set of new RAIs will be issued by NRC as a follow-up to this audit.

Main steam line break mass and energy (MSLB M&E) release

NRC staff will issue an RAI requesting a comparison of the heat transfer modes predicted by RELAP5-BW with nucleate boiling and to justify any discrepancies.

AREVA assumes entrainment of liquid from the break based on the liquid fraction in the RELAP5-BW node describing the steam separators. AREVA referred to BAW-10169PA (ADAMS ML091470336) and BAW-10193PA (ADAMS ML003683007) but did not provide any justifying documentation. For the EPR Chapter 15 MSLB analysis, AREVA assumes no liquid entrainment. NRC staff will issue an RAI asking AREVA to justify their assumptions.

In Chapter 15, AREVA calculates that the core returns to power for a spectrum of MSLB sizes and initial conditions. However, in Chapter 6, AREVA does not calculate return to power for any break size. In addition to differing break locations for the analyses performed for Chapter 6 versus the analyses contained in Chapter 15, the Chapter 6 containment analysis performed by AREVA assumes a control rod worth of a certain value, while the Chapter 15 analysis assumes a control rod worth of a much different value. NRC staff will issue an RAI asking AREVA to justify the different assumptions made in the Chapter 6 and Chapter 15 analyses.

In the response to RAI 82, Supplement 3, Question 6.2.1.4-1i submitted on May 22, 2009 (ADAMS ML091420588), AREVA stated a smoothing process was used on the M&E input data for GOTHIC. AREVA stated that this smoothing process would be described in more detail at the next meeting, including providing both release curves. This discussion may result in an RAI question.

AREVA informed NRC of an error in steam generator mass calculations due to faulty input to the code. Calculations performed with the correct input resulted in lower containment pressures for MSLB. AREVA plans to recalculate all containment analyses by December 18, 2009, using the multi-node model. AREVA is working to put main feed-water line break (MFWLB) analyses in the FSAR as requested by NRC.

Multi-node GOTHIC model

AREVA provided a noding diagram of their multi-node model. The nodding in the multi-node GOTHIC model is lumped parameter, with the exception of the meshed dome. AREVA plans to test two mesh schemes to look for convergence. NRC staff intends to ask AREVA for their input data through an additional RAI. AREVA plans to submit the multi-node model to NRC by the end of August, 2009, in the revised technical report ANP-10299P and to discuss it in the next meeting.

Loss of coolant accident mass and energy (LOCA M&E) release

In response to RAI 82, Supplement 3, Question 6.2.1.3.-1c submitted on May 22, 2009 (ADAMS ML091420588), AREVA now achieves a much smoother core flow but could not provide a specific explanation for these results. NRC staff will issue an RAI concerning this issue.

Minimum Back Pressure

NRC suggested that AREVA show that the methodology employed for the analysis of back pressure is conservative for the U.S. EPR by comparing the results with the new multi-node GOTHIC model which could be run as a best-estimate. AREVA will consider the suggestion and discuss this with NRC at the next meeting. This may lead to a new RAI.

CONVECT System (Foils and Dampers)

AREVA intends to add a respective section to the FSAR in December, 2009. NRC indicated that AREVA should address all the items in the Regulatory Guide (RG) 1.206 and that no more RAIs would be sent on the CONVECT system until NRC has reviewed the FSAR revisions.

Other topics discussed

Other issues that were on the agenda included numerical diffusion in GOTHIC, conservatism of ICECON, fouling of heat exchangers and large break loss of coolant accident (LBLOCA) accumulator temperature. AREVA explained these issues are currently being addressed, and that discussions could be supported at the next meeting. With regard to subcompartment and negative containment pressure, AREVA is still evaluating when these topics can be discussed in detail with NRC personnel.

AUDIT FINDINGS

The July 14 and 15, 2009, containment audit was performed successfully at AREVA headquarters in Lynchburg, VA. The information presented by the applicant provided the staff with a better understanding of several issues that were raised in previous RAI.

With regard to the overall schedule, the audit had three main outcomes:

1) New RAIs will be issued by NRC on several technical issues that were discussed during the meeting (refer to the audit summary above).

2) The discussion of some issues that were on the agenda for this audit (subcompartment, negative containment pressure, etc.) have been deferred to the next meeting as AREVA is still working on the issues and was not prepared to present their results at this meeting. The next meeting is tentatively scheduled for the first week of September, 2009.

3) Open items concerning heat removal systems (CONVECT system, etc.) will be addressed by AREVA as part of the new FSAR modifications currently planned for submission in December 2009.

Attachment A

Agenda
NRC Containment AUDIT
Main Steam Line Break Mass and Energy Release and Other Topics
Pertaining to the Review of the U.S. EPR FSAR, Chapter 6
July 14-15, 2009
AREVA NP, Inc., Old Forest Road, Lynchburg, VA

Tuesday, July 14, 2009, AFTERNOON SESSION: AUDIT - proprietary

1:00-1:15 PM	Introduction	[NRC/AREVA]
1:15-2:15 PM	MSLB M&E's (60 min)	[AREVA]
2:15-3:00 PM	Discussion: Functional Design / Multi-node model (45 min.)	[NRC/AREVA]
3:00-3:15 PM	Break (15 min)	[ALL]
3:15-4:15 PM	Discussion: LOCA M&E (60 min)	[NRC/AREVA]
4:15-5:00 PM	Document Review / Break-out Sessions (45 min)	[NRC/AREVA]

Wednesday, July 15, 2009, MORNING SESSION: AUDIT - proprietary

9:00-10:00 AM	Discussion: Containment Back-Pressure for ECCS (60 min)	[NRC/AREVA]
10:00-10:45 AM	Discussion: Heat Removal Systems (45 min)	[NRC/AREVA]
10:45-11:00 AM	Break (15 min)	[ALL]
11:00-12:00 PM	Discussion of Remaining Open Items (60 min)	[NRC/AREVA]
12:00-12:15 PM	Summary and Next Steps (15 min)	[NRC/AREVA]
12:15-12:30 PM	Actions / Exit (15 min)	[NRC/AREVA]
12:30 PM	Adjourn	

Attachment B

Attendee List –
NRC Containment AUDIT
Main Steam Line Break Mass and Energy Release and Other Topics
Pertaining to the Review of the U.S. EPR FSAR, Chapter 6
July 14-15, 2009
AREVA NP, Inc., Old Forest Road, Lynchburg, VA

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Attachment C

Potential EPR Containment Discussion Topics

MSLB M&E

1. Technical Report ANP-10299, page 8-36 statements on MSLB with entrainment M&E. Reference: RAI 221-39,40 08/31/09.
2. Entrainment in 20 percent power case. Reference: RAI 6.2.1.4-1.e.
3. Response to RAI 82 6.2.1.1-1a1 indicates that lower MSLB pressures are now obtained for the same accidents. What is the cause?
4. Justification for conservative SG and metal heat removal compare to nucleate boiling heat transfer. Reference: Potential Open Items, January 2009.
5. Decay heat model ANS71x1.0 vs. ANS 79,94,04 + 2 sigma Reference: Potential Open Items, January 2009.
6. Return to power calculated for Chapter 15, effect on containment M&E Reference: Potential Open Items, January 2009.
7. Additional explanation for steam flow rate compared to Moody model for 4 x 1.4 ft2 breaks. Why did flow increase at 5 sec? Reference: RAI 6.2.1.4-1.i
8. Chapter 15 states 1.72 ft^2 break instead of 1.4 ft^2 in Chapter 6.2. Reference: Potential Open Items, January 2009.

Functional Design

1. Multinode Model – LOCA, MSLB, small breaks, containment circulation patterns, IRWST pool boiling, condensing heat transfer models, opening of all or some foils and dampers, EQ envelope. Reference: RAI 209 12/18/09.
2. Closed compartments. Reference: RAI 221-44 12/17/09.
3. Analyses of MFW line breaks. Reference: Potential Open Items, January 2009.

Minimum Back Pressure

1. Heat transfer to heat structures, 1.7 Uchida vs. BTP 6-2.
2. Experimental data comparison presented in 06.02.01.05-1.a.
3. 1.7 Uchida needs to be approved on a case-by-case basis
    a. How did the test facilities compare to EPR LOCA? Possible RAI.
    b. Compare ICECON with 1.7 Uchida to new multi-node GOTHIC with DLM. All other assumptions should be the same, M&E, containment volume, IRWST condensation, mixing of spilled ECCS water with containment atmosphere. Possible RAI.
4. Multi node GOTHIC predicts 2 psi lower than single node GOTHIC, but single node ICECON is 4 psi lower than single node GOTHIC. Why is this so? Reference: RAI 82 6.02.01.05-1h.

5. Supplement 3 response to RAI 82 6.02.01.05b was unclear (122°F or 131°F).

LOCA M&E

1. Changes from FSAR, resulting from RAI 221-43 08/27/09.
2. In response to RAI 82 supplement 3, Question 6.2.1.3-1c. The core flow is much smoother than in the previous documentation. Why?
3. Decay heat: ANS71x1.1 vs. ANS79,94,04 + 2sigma. Reference: Potential Open Items, January 2009.
4. Evaluation of hot leg nozzle gaps. Reference: RAI 221-26 12/17/09.
5. Core heat transfer in RELAP5-BW vs. nucleate boiling in SRP 6.2.1.3. Reference: RAI 221-27 08/27/09.
6. Carryout rate fraction vs. core flooding rate RELAP5 vs. FLECHT RAI 221-29 08/21/09.
7. Metal heat transfer in RELAP5-BW. Reference: RAI 221-28 12/17/09.
8. SG heat transfer. Reference: RAI 221-30 12/17/09.
9. Justification for 1200 seconds. Reference: RAI 221-34 12/17/09.
10. Discussion concerning 5 percent of total ECCS flow carried out of core in GOTHIC and four-way split of flow in hot legs. Is this conservative? Reference: RAI 221-35 12/17/09.
11. Explain M&E curve in ANP-100299. Reference: RAI 221-37 07/31/09.
12. Transient HL injection rates. Reference: RAI 221-38c.
13. Flow split for hot leg injection ITAAC and TS. Reference: RAI 221-38b 12/18/09.
14. Other break sizes and locations. Reference: RAI 221-46 08/27/09.

Heat Removal Systems

1. Design of doors is not yet specified, response to RAI 82 6.2.1.1.3-1. When will this be completed and submitted to NRC? Reference: RAI 221-21 12/17/09.
2. Open areas and flow losses. Reference: RAI 221-20 09/30/09.
3. Testing LOCA, MSLB, FWLB, seismic forces on foils, doors and dampers. See also RG 1.206 Item C.I.6.2.2.4. What is the schedule?
4. Instrumentation description: Sensor location not yet specified. Reference: RAI 221-17. No date given.
5. Control room readouts. See RG 1.206 Item C.I.6.2.2.5.
6. Failure modes and effects analysis. See RG 1.206 Item C.I.6.2.2.3.
7. EQ testing. Reference: RAI 221 -18 9/30/2009.
8. Testing for reverse pressure events foils and dampers outside of the SG compartment. Reference: RAI 157 07/28/09.
9. CONVECT system ITAACs. Reference: RAI 104 14.3.1-a.2 12/18/09 See also RG 1.206 Item C.I.6.2.2.4.
10. CONVECT system TS. Reference: RAI 221-24 12/17/09.
11. RHR HX heat exchanger surface fouling needs to be justified. Reference: Potential Open Items, January 2009.

DC AREVA - EPR Mailing List (Revised 05/13/2009)

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