## ArevaEPRDCPEm Resource

**From:** Carneal, Jason
**Sent:** Friday, August 28, 2009 10:25 AM
**To:** Tesfaye, Getachew
**Cc:** Jensen, Walton
**Subject:** Containment audit plan Sept 01-02 2009
**Attachments:** Containment audit plan Sept 01 2009.doc

Getachew:

Attached is the audit plan for next week's audit. It is ready for transmission to AREVA. Can you add the attached file to ADAMS as Walt is out of the office until next Monday and may not be able to sign out a memo prior to the audit? I have included Walt's suggested discussion topics as an attachment to the audit plan.

Thanks,

Jason

**Hearing Identifier:** AREVA_EPR_DC_RAIs
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**From:** Carneal, Jason

**Created By:** Jason.Carneal@nrc.gov

**Recipients:**
"Jensen, Walton" <Walton.Jensen@nrc.gov>
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AUDIT PLAN TO REVIEW SELECTED AREAS RELATED TO
U.S. EPR FSAR CHAPTER 6 AND SUPPORTING TECHNICAL REPORTS SAFETY EVALUATION

| | |
|---|---|
| APPLICANT: | AREVA NP, Inc. |
| APPLICANT CONTACT: | Ronda Pederson |
| TIME: | 9:00 pm to 4:30 pm on 9/1/2009 and<br>8:30 am to 12:00 pm on 9/2/2009 |
| LOCATION: | AREVA NP, Inc., Twinbrook Office,<br>Rockville, MD |
| REVIEWERS: | Walton Jensen (NRO, Audit Lead)<br>Christopher Jackson (NRO)<br>Getachew Tesfaye (NRO)<br>Jason Carneal (NRO)<br>Zoltan Rosztoczy (Numark Associates) |

**BACKGROUND**

AREVA NP, Inc. has submitted to the U.S. Nuclear Regulatory Commission (NRC) a Final Safety Analysis Report (FSAR) for its application of the U.S. Evolutionary Power Reactor (EPR) in December, 2007. NRC staff has initiated the design certification review on March 19, 2008. The U.S. EPR design does not rely on active containment cooling systems for post-accident containment mixing. As a result, to adequately justify the level of mixing in the containment and the level of steam condensation in the reactor coolant system credited in the post-accident analysis, the staff issued a request for additional information 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 Revision 0, "Applicability of AREVA NP Containment Response Evaluation Methodology to the U.S. EPR for Large Break LOCA Analysis Technical Report." An audit was held concerning Revision 0 of ANP-10299P on April 6 and 7, 2009 at the AREVA headquarters in Lynchburg, VA. On July 31, 2009, AREVA provided Revision 1 to ANP-10299P for NRC staff review.

In order to cover important review areas handled by the NRO Containment and Ventilation Branch, the staff is proposing an audit that will be carried out at the AREVA office in Lynchburg, VA. The review of the additional technical documents, made available by AREVA at its local office, will be facilitated by the presence of AREVA personnel at the audit. The audit is needed to resolve existing questions in accomplishing the U.S. EPR review schedule in an efficient manner.

## PURPOSE AND APPROACH

The purpose of this audit is to review additional documents and calculations provided by AREVA that pertain to the generation of ANP-10299P, "Applicability of AREVA NP Containment Response Evaluation Methodology to the U.S. EPR for Large Break LOCA Analysis Technical Report." The topics covered in the audit will include the status of the multi-node containment analysis, results of MSLB rod worth, entrainment sensitivity runs, and other selected topics of discussion as listed in Attachment B.

To achieve the review goals in an efficient manner, the staff assembled an interdisciplinary audit team. The audit team will include experts from NRC and consulting organizations. To facilitate and expedite the work, it is foreseen that the audit will be attended by representatives from AREVA who will introduce the audit topics and provide supporting documents and technical evidence to the reviewers. The staff will document the audit findings in an audit report.

## AUDIT ACTIVITIES AND SCHEDULE

The NRC staff will conduct the review over a period of one and a half business days. NRC may request an ad-hoc extension of the audit at the same location if findings during the ongoing audit reveal the need for additional time. Such an extension will be requested before the meeting is adjourned on 9/02/2009 by the NRC staff responsible for the audit.

Following the audit, each technical reviewer will prepare a separate audit report with specific findings will send the report to Walton Jensen by 09/15/2009. The NRC staff responsible for the audit will assemble and prepare a final audit report. The final report will be made available to all contributors for their concurrence by 09/24/2009. Any final notes by the contributors will be communicated to Walton Jensen no later than 09/18/2009.

A detailed agenda for the audit is presented in Attachment A. Additional potential discussion topics are listed in Attachment B. If necessary, any circumstances related to the conductance of the audit will be communicated to Walton Jensen (NRC) at 301-415-2856 or at Walton.Jensen@nrc.gov.

**Attachment A**

**Agenda**
**NRC Containment Analysis Status AUDIT**
**Pertaining to the Review of the U.S. EPR FSAR, Chapter 6**
**September 1-2, 2009**
**1700 Rockville Pike, Suite 400, Large Conference Room**
**Rockville, MD**

**Tuesday, September 1, 2009, MORNING SESSION: AUDIT - proprietary**

**09:00-09:15** Introduction ..... [NRC/AREVA]

**09:15-10:15** Status of Multi-node Containment Analysis ..... [AREVA]

**10:15-11:30** Results of MSLB Rod Worth/Entrainment Sensitivity Runs ..... [AREVA]

**11:30-13:00 Lunch**

**Tuesday, September 1, 2009, AFTERNOON SESSION: AUDIT - proprietary**

**13:00-14:30** Containment Discussion Topics Presentation and Discussion ..... [AREVA/NRC]

**14:30-14:45 Break** ..... [ALL]

**14:45-16:30** Containment Discussion Topics Presentation and Discussion ..... [AREVA/NRC]

**Wednesday, September 2, 2009, MORNING SESSION: AUDIT - proprietary**

**08:30-09:30** Containment Discussion Topics Presentation and Discussion ..... [AREVA/NRC]

**09:30-11:30** Document Review / Break-out Sessions ..... [NRC/AREVA]

**11:30-12:00** Summary, Actions, and Exit ..... [NRC/AREVA]

**12:00 Adjourn**

**Attachment B**

**Additional Potential Discussion Topics**
**Technical Report ANP-10299P Containment Functional Design**

1. At several locations in the technical report, for example page xxvii, it is stated that the mechanistic Diffusion Layer Model (DLM or DLM-FM) is used to calculate condensing heat transfer following a postulated LOCA. The staff has approved use of the DLM for safety analysis but has rejected use of DLM-FM for safety analysis. Which model will be used for US-EPR Chapter 6 safety analysis?

2. Page 9-10 describes the significant phenomena for multi-node containment analysis of the US-EPR. These include natural circulation flow patterns and potential thermal stratification as well as condensation and heat transfer which will be affected by the inter compartment flow and the dimensions of the heat structures. How can the scaling methodology being developed in Section 4 be applied to show that the data used to validate that GOTHIC 7.2b is scalable to the US-EPR? See the final paragraph of Section 4.2.2.2.3 on page 4-45.

3. The derivation for the GOTHIC reactor system model on page 8-28 needs to be extended to show how, following hot leg injection, the vessel injection fraction and vessel bypass fraction are obtained to maintain the steam flow that is computed by equation 11.

4. Are there any phenomena occurring at a certain time following LOCA, such as higher hot leg steam flow, which would affect hot leg injection differently from if the injection occurred at a much later time?

5. Describe modeling of the dome in the multi-node GOTHIC calculations. Show the results of the sample problem calculations in the dome. Are there any circulation patterns in the dome? What happened to the air that was originally in the dome? What happened to the nitrogen? What is the shape of the thermal stratification in the dome?

6. Is there a plot of the containment pressure and temperature curve of the sample problem available on a linear time scale?

7. What is the value and location of the maximum containment wall surface temperature? Is there much special variation in the wall surface temperature? Did you observe any superheated condition in the containment?

8. The equipment space contains space that is, strictly speaking, not part of the SG compartments or the pressurizer compartment. How was this space apportioned? Do the pressurizer nodes represent only the volume of the pressurizer compartment? Did you run any pressurizer compartment breaks?

9. Multi-node calculation -- “Heat transfer between the liquid and the vapor is neglected” (page 9-10). Is this assumption always conservative? Can superheated steam come in contact with liquid droplets?

10. Describe assumptions to be used in the containment analyses of other break sizes and locations. Will the timing of the reactor trip, SI and other safety actuations be included in the revised FSAR?

**Technical Report ANP-10299P LOCA M&E**

11. Clarify the effect of a hot leg nozzle gap on the mass and energy release following hot leg injection.

12. What is the significance of the change in the table on page 8-34 saying accumulator injection into the lower plenum may be applied to shorten the refill period? Define when this will be applied and when it is not applied.

13. In the calculations inflow of air into the RCS is blocked. What is expected to happen in case of an accident? Justify blocking of the air inflow.

14. All three ECCS delivery systems inject through a single line segment and nozzle into the RCS. How is the interference between the delivery system taken into account? The information presented to date is not relevant to this issue.

15. During hot leg injection the ECCS flow splits three ways. The amount of ECC delivered to the hot legs plays an important role in the containment pressure reduction and cool down. There should be an ITAAC specifying minimum hot leg delivery. Has the minimum hot leg delivery been determined? Is it a constant value? Does it depend, for example, on break size or RCS pressure?

16. Pump anti-rotation devices are not safety related. In the analysis of each case both possibilities, anti-rotation device working and anti-rotation device not working, should be considered. Whatever assumption is made, it requires justification.

17. Page 8-6 of ANP-10299P Rev 1 states that “Main feedwater system is isolated conservatively.” Justify and explain when and how this is accomplished.

18. Partial cool down of SGs on safety injection signal – Is this a safety system? Where is the description of the system? Where is the failure mode analysis of the system?

19. What safety systems do the LOCA analyses depend on? For example, partial SG cool down, MSSV, CONVECT system, etc.

20. What are the differences in the input of the Rev. 0 and Rev. 1 sample problems of ANP-10299P? It is noted that the time of hot leg injection changed. Are there any other changes?

**MSLB M&E**

21. Discussion of the smoothing process used on the mass and energy release before it is input into GOTHIC. The smoothing process is mentioned in the response to RAI 82s3 6.2.1.4-1i.

22. What safety systems do MSLB accidents depend on? For example, partial SG cool down, MSSV, CONVECT system, etc.

23. Do the MSSVs represent a safety-related system? Should this system be described in Chapter 6? The worst single failure (active or passive) needs to be identified. What is the effect of the worst single failure on the containment analysis?

24. Are there additional differences between the Chapter 6 and Chapter 15 MSLB analytical assumptions beside control rod worth and liquid carryout in the break flow?

25. Has the worst feed line break accident been analyzed? What are the results? Is there any associated recommendation for an FSAR modification?

26. Is there a difference between failure of the MSIV in the affected loop and failure of one of the other MSIV? Which failure is assumed in the MSLB analysis?

**Minimum Back Pressure**

27. Assess the need for a possible benchmark using the GOTHIC multi-node model to show that the ICECON containment results are conservative.

**CONVECT System and Safety Related Doors**

28. Provide the testing schedule for foils and dampers, including possible NRC staff interactions.

29. Discuss the failure mode analysis of the mixing dampers including their instrumentation and control, Technical Specifications for the CONVECT system, and the number of mixing dampers credited in the containment analysis.

30. If there are safety-related doors in the containment, they should be identified. Provide all significant information (purpose, location, size, failure pressure, so on) for these doors.

**Containment Heat Removal**

31. Discuss the effect of fouling on LHSI/RHR heat exchanger heat transfer including the effect of post LOCA debris and chemicals on long term cooling (a GSI-191 issue).

**RAI 226 Issues**

1. Subcompartment Analysis

2. Negative containment pressure

3. MSLB M&E