ArevaEPRDCPEm Resource

From: Tesfaye, Getachew
Sent: Friday, January 22, 2010 8:11 AM
To: 'DUNCAN Leslie E (AREVA NP INC)'
Cc: 'GUCWA Len T (EXT)'; Carneal, Jason; ArevaEPRDCPEm Resource
Subject: FINAL Containment audit plan Jan 26 2010
Attachments: Containment audit plan Jan 26 2010.doc

Les,
Attached is the final audit plan for the January 26, 2010 audit.
Thanks,
Getachew

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 1098

Mail Envelope Properties (0A64B42AAA8FD4418CE1EB5240A6FED10DF73AE1BD)

Subject: FINAL Containment audit plan Jan 26 2010
Sent Date: 1/22/2010 8:11:26 AM
Received Date: 1/22/2010 8:11:27 AM
From: Tesfaye, Getachew

Created By: Getachew.Tesfaye@nrc.gov

Recipients:
"'GUCWA Len T (EXT)'" <Len.Gucwa.ext@areva.com>
Tracking Status: None
"Carneal, Jason" <Jason.Carneal@nrc.gov>
Tracking Status: None
"ArevaEPRDCPEm Resource" <ArevaEPRDCPEm.Resource@nrc.gov>
Tracking Status: None
"'DUNCAN Leslie E (AREVA NP INC)'" <Leslie.Duncan@areva.com>
Tracking Status: None

Post Office: HQCLSTR02.nrc.gov

Files	**Size**	**Date & Time**
MESSAGE	97	1/22/2010 8:11:27 AM
Containment audit plan Jan 26 2010.doc		69742

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

AUDIT PLAN TO REVIEW SELECTED AREAS RELATED TO
U.S. EPR FSAR CHAPTER 6 AND SUPPORTING TECHNICAL REPORTS

APPLICANT:	AREVA NP, Inc.
APPLICANT CONTACT:	Ronda Pederson
TIME:	9:00 am to 5:00 pm on 1/26/2010
LOCATION:	AREVA NP, Inc., Twinbrook Office, Rockville, MD
REVIEWERS:	Walton Jensen (NRO, Audit Lead) Shie-Jeng Peng (NRO) Getachew Tesfaye (NRO) Jason Carneal (NRO) James Steckel (NRO) Zoltan Rosztoczy (Numark Associates) Allen Notafrancesco (RES) Michael Snodderly (NRO)

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. On September 1 and 2, 2009 an audit was held at the AREVA offices in Rockville, MD to review the material submitted in Revision 1 to ANP-10299P. On December 2, 2009, AREVA submitted Revision 2 to ANP-10299P for NRC 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 Rockville, MD. 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. Specifically, the staff request that the applicant provide documentation relevant to the discussion topics provided in Attachment B. The requested documentation includes any relevant calculation documents and supporting material on which the development of ANP-10299P relies. The audit is needed to resolve existing questions in accomplishing the U.S. EPR review schedule in an efficient manner and to support the review in conformance with SRP Section 6.2.1.

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." In addition, AREVA will provide information on the proposed screening methodology used in the subcompartment analysis in support of the U.S. EPR FSAR Chapter 6 that will be submitted at a later date. The topics covered in the audit will include the screening methodology for subcompartment analysis, the multi-node containment analysis, 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 business day. If necessary, 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 01/26/2010 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 02/15/2010. 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 02/26/2010. Any final notes by the contributors will be communicated to Walton Jensen no later than 02/24/2010.

A detailed agenda for the audit is presented in Attachment A. A detailed list of discussion topics is presented 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 Audit
Pertaining to the Review of the U.S. EPR FSAR, Chapter 6
January 26, 2010
1700 Rockville Pike, Suite 400, Large Conference Room
Rockville, MD

Tuesday, January 26, 2010, MORNING SESSION: AUDIT - proprietary

09:00-09:10	Audit Entrance / Introduction	[NRC/AREVA]
09:10-12:00	Documentation Review and Discussion: Screening Methodology for Subcompartment Analysis	[NRC/AREVA]
12:00-13:00	**Lunch**	

Tuesday, January 26, 2010, AFTERNOON SESSION: AUDIT - proprietary

13:00-16:45	Documentation Review: ANP-10299P Supporting Documentation and Additional Discussion Topics	[NRC/AREVA]
16:30-16:45	NRC Internal Caucus	[NRC]
16:45-17:00	Exit Meeting	[NRC/AREVA]
17:00	**Adjourn**	

<u>**Attachment B**</u>

Containment Discussion Topics
Technical Report ANP-10299P Containment Functional Design

<u>Multi-Node Model</u>

- NRC staff request a better understanding of how the containment space was subdivided. There are many vertical and horizontal walls and the containment contains approximately 150 compartments. There are close to 140 compartments in the equipment space, which is represented by 17 nodes in the computer model. Is the representation realistic? Is there any need for modification?

- It is not clear what the pipe penetration and access nodes represent. Neither is it specified which flow path represents doors. Which doors are safety grade?

- The annular space is a certain height. It is divided into three nodes: lower, middle and upper annulus. The heights of the three nodes are given in ANP-10299P. Both, the upper and middle annulus, are connected directly to the dome by large flow paths. The middle annulus is connected with the upper annulus with a flow path of a certain area in square feet, while the direct connection of the middle annulus to the dome is a greater area in square feet. As a result, annular space is in direct communication with the dome. Is this representation of the annular space realistic? What is the justification for the uncommon modeling of the annulus?

- The area of the flow path from the upper annulus to the middle annulus is a certain value, while the flow path from the upper annulus to the dome is a different value. Should these two areas be approximately the same size as they are on the other side of the containment?

- The middle annulus nodes are very large. The two nodes together are 2.5 times the volume of the dome and are a certain height. The hydraulic diameter of the upper annulus, the middle annulus and the lower annulus are different. What is the explanation for the difference? Should the middle annulus be subdivided?

- The pipe penetration node in the model basically connects the middle annulus to the lower annulus. What does this node represent? How does it differ from a flow path? What is the benefit of this representation?

- It has been observed that the consequences of LOCAs are less favorable if the elevation of the break is higher. The highest elevation for a postulated LOCA is the top of pressurizer. For a large break it is the top of the surge line, both, the pressurizer compartment and the surge line compartment, are represented by a single node. Is this sufficient?

- The pressurizer safety relief valves blow into the annular space. Valve No. 1 blows into the middle annular compartment on one side of the containment while Valves No. 2 and 3 blow into the upper annulus on the other side of the containment. Is this correct? Have stuck open valve events been analyzed?

The area of the flow paths representing the three valves are given in ANP-10299P Revision 2. What do these flow areas represent?

- The surge line room is connected to the pressurizer compartment located above the surge line, to the reactor cavity with a small flow path, and to the blowdown heat exchanger room with an even smaller flow path. Other connections, which are to the annulus, must be doors that stay closed. How does this room drain? Does all water from the pressurizer and surge line compartments flow into the heat exchanger room?

- The blowdown heat exchanger room connects only to the surge line room and the access room. Both of these rooms are at a higher elevation than the heat exchanger room. Therefore, water should collect and build up in the heat exchanger room. Has this been observed? What is the size and shape of the heat exchanger room? Does is have any means of drainage?

- The CVCS compartment is a rather tall, large volume. It is connected to the spreading room, the piping penetration node and the middle annulus by doors which are assumed to stay closed in the safety analysis. That leaves only two additional connections: one to the Loop 1 lower equipment room, and one to the IRWST. Is the connection to the Loop 1 lower equipment room a door? Does this door remain closed in the containment's safety analysis? What is the role of the CVCS compartment in the containment heat transfer calculations? Is there any safety equipment in the CVCS compartment?

- The flow area of the flow path from the Loop 3 middle equipment room to the Loop 3/4 upper equipment room is a certain area. The corresponding flow path area in Loop 4 is a much lower area. Why is there such a large difference between the Loop 3 and Loop 4 flow areas? Why is the break placed in Loop 3? Could the results be less favorable if the break is in Loop 4?

- The elected nodalization of the containment divides the containment into two halves, two sides. There are significant differences between the two sides; they are not symmetric. See for example the pressurizer compartment, the CVCS compartment, or the flow path from the upper annulus to the dome. How was it decided which side of the containment should have the break? Has any break been analyzed at the other side of the containment?

- As part of RAI 209 the staff requested that Areva demonstrate that the noding detail of the multi-node GOTHIC simulation of the US-EPR containment is adequate to model the effects of containment stratification and to demonstrate that the noding arrangement does not produce artificial circulation patterns as discussed Section 22.10 of the GOTHIC Users Manual, NAI 8907-02 Rev. 17, January 2006. The staff could not find this information in AREVA's response and requests that it be provided for audit.

- For the multi-node GOTHIC model, how are the control functions used to calculate the mass and enthalpy that exits the break - both the steam flow and the liquid flow?

- FSAR Table 6.2.1-18 provides critical parameters for the six safety-related pressurizer doors that were credited in analysis for high energy line breaks in the pressurizer compartment. Provide this analysis and justify that the assumptions made for compartment mixing and long term containment circulation are conservative.

- When will the safety related qualification testing for the safety related pressurizer compartment doors be presented for staff review?

- When will the safety related qualification testing for the safety related containment foils and dampers be presented for staff review?

Flow Distribution and Mixing

- In the sample calculations doors open at pressure differences that are expected to pop the doors open. It appears that on the break side of the containment all doors to the annular space opened, resulting in upward flow and mixing in the annulus. Safety evaluation of the containment will be done with all non-safety doors remaining closed. Discuss the expected differences.

- At zero time there is a large inflow into the break node from the IRWST. What is the reason for this flow? Were there steady state calculations? Were there artificial circulation flow patterns observed?

- Figures 6 and 7 of RAI No. 1, Supplement 7 present water flow into the IRWST. The flow is negative, indicating that water is flowing from the tank up into the containment. Are these figures correct?

- If Figures 6 and 7 are in error, the water flow is into the IRWST, the calculated flow rate is still very low. The flow rate is a certain value and is lost in less than 2 minutes only. How is the water level maintained in the tank for 24 hours?

- The containment's representation in the GOTHIC code is asymmetric. Figure 32 seems to indicate identical flows for middle annulus rooms 3 and 4. Provide an explanation of why this is the case.

- The middle annulus rooms are connected to both the upper annulus rooms above them and also directly to the dome. The flow is directly to the dome at 5 sec. into the accident this is about the same as the flow to the upper annulus at one side of the containment and six times larger than at the other side. Thus, most of the flow bypasses the upper annulus. Is there an explanation for this unexpected flow behavior?

- Water flow from the lower annulus to the IRWST is through two drainage paths with a total flow area of 12 ft^2. These flow paths during a LOCA are expected to be blocked partially by debris. How is the blockage taken into account? As mentioned above, the calculated flow rate into the IRWST does not appear to be realistic. With realistic flow rate, could water temporarily accumulate in the annulus?

Scaling Evaluation

- From ANP-10299P Rev. 2 Tables 12-23 through 12-39, the staff notes that many of the significant pie groups did not scale well between the US-EPR containment and the HDR containment test. For each the phenomena represented by those pie groups which were not scaled well, provide the justification that GOTHIC is appropriately simulating these phenomena at the conditions predicted to occur within the US-EPR containment following an accident.

LOCA M&E

- The response to RAI 221 06.02.01-46 states that for hot leg breaks the ECCS configuration in Technical Report ANP-10299P, Section 8.1.4, will be modified to incorporate the impact of the transition to hot leg injection, which will result in a reduction of pumped ECCS to the cold legs. The ECCS configuration in the hot leg break scenario will consider that ECCS will be aligned to the hot legs at 3600 seconds and spill out the break; only the medium head safety injection (MHSI) and a portion of the low head safety injection (LHSI) will be delivered to the cold legs for core cooling. When will these modifications to ANP-10299P be done and presented to the staff? What are assumptions for the hot leg injection water? Does it mix in the RCS or is it spilled on the containment floor? Is this done in the RELAP5-BW or in the GOTHIC simulations?

- The response to RAI 221 06.02.01-46 states that for hot leg breaks the transition time between RELAP5/MOD2-BW and GOTHIC will be determined when the reactor coolant system (RCS) reaches a quasi-steady state condition which can be modeled in GOTHIC as a boiling pot but that the time will be before HLI at 3600 seconds. What criteria must be met to determine that a quasi-steady state condition occurs? What if these conditions are not met before the HLI time of 3600 seconds?

- The response to RAI 221 06.02.01-46 that the configuration for a cold leg pump discharge break limits the delivery of coolant to the loop seal piping because of a virtual weir in the U.S. EPR reactor coolant pump design that rises above the top of the cold leg piping. As a result of these weirs, the loop seals will not form as early in the CLPD scenario and the transition from RELAP5/MOD2-BW to GOTHIC for the discharge breaks can be as late as 3600 seconds coincident with the initiation of hot leg injection. Where can the staff find a scale drawing showing the RCP weir location and height relative to the cold leg piping? Provide the data and/or analyses to support the later formation of loop seals for postulated CLPD breaks. What effect would the high degree of chugging predicted by RELAP5-BW have on the ability of the weirs to prevent back flow of ECC water into the loop seals? What would be the consequences if loop seals did form at an earlier time?

- The response to RAI 221 06.02.01-46 states that as the break size decreases, the dynamics of the RCS change and input considerations such as the partial cooldown of the steam generators, loop seal formation, and hot leg injection have a significant impact on the containment response. That methods and inputs will be evaluated individually for each of break to verify a conservative pressure and temperature response. Describe how these methods and inputs are evaluated as a function of break size and justify that the process yields conservative results. Describe how partial cooldown of the steam generators, loop seal formation and hot leg injection are evaluated for small breaks. Provide and justify the noding used in the RELAP5-BW model for small break LOCA if different from that presented in ANP-10299P. Provide and justify the GOTHIC model used to calculate long term mass and energy release for SBLOCA and describe and justify the criteria that are used in switching between the RELAP5-BW and GOTHIC reactor system models.

- Section 9 of ANP-10299P Rev 2 describes the application of the LOCA mass and energy release methodology described in Section 8 to a double-ended guillotine break in the cold leg pump suction piping. Descriptions of the RELAP5-BW noding and the 1200 second time for switching between the RELAP5-BW model and the GOTHIC mass and energy model are described in Section 9. FSAR Tables 6.2.1.6, 6.2.1.7 and 6.2.1.8 list LOCA break sizes and locations that were analyzed for US-EPR. Identify which of these analyses were done using assumptions consistent with those of ANP-10299P Section 9. For those which were not, describe what assumptions were used and justify that analyses with limiting assumptions have been performed at each postulated break location.

- FSAR Section 6.2.1.3 states that the containment pressure for the containment M&E release matched the predicted GOTHIC containment pressure profile. Discuss how this was done for the portions the calculations that were performed outside of GOTHIC with RELAP5-BW.

- FSAR Section 6.2.1.3, page 6.2-19 describes the various break locations that were analyzed to include a break of the pressurizer surgeline inside the pressurizer compartment. This evaluation was stated to be used in the design of 6 safety related pressurizer doors. The methodology for evaluating the M&E for this break not included in the discussions. Describe this methodology and justify that conservative assumptions were used.

- Was the rupture of other high energy lines beside the surge line within the pressurizer compartment evaluated? If so provide and justify the methodology used in the mass and energy release calculations.

- For the cases for which the coolant pumps are assumed to be operating, confirm that they are assumed to trip by the automatic pump trip system described in FSAR Chapter 7.

<u>Main Steam Line Break</u>

- Liquid entrainment for DE break at zero power needs to be discussed. See RAI 266 06.02.01.04-5.