AUDIT PLAN TO REVIEW SELECTED AREAS RELATED TO
U.S. EPR FSAR TIER 2, SECTION 4.2

APPLICANT:	AREVA NP, Inc.
APPLICANT CONTACT:	Ronda Pederson
TIME:	11:00 am to 3:00 pm on 01/15/2010
LOCATION:	AREVA NP, Inc. 3315 Old Forest Road Lynchburg, VA and AREVA NP, Inc. 2101 Horn Rapids Road Richland, WA
REVIEWERS:	Fred Forsaty (NRO, Audit Lead) Shanlai Lu (NRO) Fred Forsaty (NRO) Getachew Tesfaye (NRO) Carl Beyer (PNNL), Richland site Nicholas Klymyshyn (PNNL), Richland site

BACKGROUND

AREVA NP, Inc. (AREVA) has submitted by a letter dated December 11, 2007 to the U.S. Nuclear Regulatory Commission (NRC) a Final Safety Analysis Report (FSAR) for its application of the U.S. EPR design, accessible by Agencywide Documents Access and Management System (ADAMS) Accession No. ML073520305. NRC initiated the design certification review on March 19, 2008. During the review of the U.S. EPR design certification application, NRC staff identified the need for additional information concerning the employed seismic-LOCA analysis methodology. NRC staff issued a request for additional information (RAI) no. 318 on January 5, 2010 to request information related to the seismic-LOCA methodology. The staff determined that an audit was necessary in order to review supporting documentation related to the seismic-LOCA analysis used in the U.S. EPR design.

In order to cover important review areas handled by the Office of New Reactors (NRO) Reactor Systems, Code Performance and Review Branch (SRSB), the staff is proposing an audit that will be carried out concurrently at AREVA facilities in Lynchburg, VA and Richland, WA. The review of additional technical documents, made available by AREVA at its local offices, will be facilitated by the presence of AREVA personnel at the audit.

AREVA personnel will present technical topics to NRC staff and provide necessary technical information to NRC staff during documentation review. The audit is needed to support the resolution of issues and accomplishing the U.S. EPR review schedule in an efficient manner, particularly in reference to Standard Review Plan (SRP) Section 4.2.

PURPOSE AND APPROACH

The purpose of this audit is to review several issues identified by the staff regarding the seismic-LOCA analysis employed in the U.S. EPR design. The topics covered in the audit will include the overall seismic-LOCA methodology, calculation of the maximum impact loads, and calculation of the 95/95 lower bound impact loads. A detailed agenda is provided in Attachment A. Detailed discussion topics suggested by NRC staff are provided 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. NRC staff will attend the audit at the Lynchburg, VA facility, and the contractors will attend the meeting simultaneously at the Richland, WA facility. 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. 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 01/08/2010 by the NRC staff responsible for the audit.

Following the audit, each technical reviewer and consulting organization will prepare a separate audit report with specific findings and will send the report to Fred Forsaty by 01/22/2010. 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 02/5/2010. Any final notes by the contributors will be communicated to Fred Forsaty no later than 02/03/2010.

A proposed agenda for the audit is presented in Attachment A. If necessary, any circumstances related to the conductance of the audit will be communicated to Fred Forsaty (NRC) at 301-415-8523 or at Fred.Forsaty@nrc.gov.

Attachment A

Agenda
NRC Fuel Seismic-LOCA Methodology Audit
Pertaining to the Review of the U.S. EPR FSAR, Chapter 15
January 15, 2010
AREVA NP, Inc., 3315 Old Forest Road,
Lynchburg, VA
and
AREVA NP, Inc., 2101 Horn Rapids Road
Richland, WA

Friday, January 08, 2010, AFTERNOON SESSION: AUDIT – proprietary

11:00-11:15	Entrance / Opening Statements	[NRC/AREVA]
11:15-11:45	Overview: Seismic LOCA Analysis	[AREVA]
11:45-14:30	Discussion Topics and Documentation Review	[NRC/AREVA]
14:30-14:45	NRC Internal Caucus	[NRC]
14:45-15:00	Summary and Exit Meeting	[NRC/AREVA]
15:00	**Adjourn**	

Attachment B

DISCUSSION TOPICS

RAI 318, Question 04.02-16:

Section 4.2.1.4 of the DCD references BAW-10133PA-01 as a representation of the seismic-LOCA analysis methodology and states that plastic deformation is not experienced for maximum loads. In addition, Section 5.3.4.1 of ANP-10285P provides the maximum impact loads and 95/95 lower bound impact loads that demonstrate the impact loads remain below those for plastic deformation. However, neither Section 4.2 nor the mechanical design topical report, ANP-10285P, documents the implementation of this methodology for the EPR fuel assembly. For example, the implementation of the seismic-LOCA methodology laid out in BAW-10133PA-01 involves the determination of various stiffness and damping constants specific to the EPR fuel assembly design based on pluck and shaker tests as well as dynamic crush and lateral impact tests to determine lower impact loads. The stiffness and damping values are the inputs to the calculations that determine the peak impact load.

Provide a summary of the methodology and the numbers at each step that would give enough confidence that the methodology has been followed correctly. The model inputs and a description of how they were determined needs to be provided. Provide the model outputs and show how they were combined into the peak impact force. If this information has already been submitted, identify where the seismic-LOCA evaluation of the EPR fuel assembly design is documented. If this has not already been formally documented, provide documentation to demonstrate that the methodology of BAW-10133PA-01 was followed for the EPR fuel assembly design.

Additional Discussion Topics Identified by NRC staff:

AREVA uses the CASAC code to calculate the SSE+LOCA response of the fuel assemblies in the core. The input parameters to the CASAC code are determined from experimental tests. NRC staff are interested in reviewing the documentation that supports their choice of input parameters. NRC staff also would like to discuss the degree of variation AREVA witnessed in their testing. Data from other vendors indicates there could be a sizeable uncertainty band around some of these input quantities, and NRC staff would like to determine if AREVA has witnessed similar results and how they dealt with it in their calculations.

The following is a list of specific questions NRC staff have to date regarding these issues:

Topic 1: CASAC program

1.1) Briefly describe the CASAC program and how it works. Identify the major input and output quantities.

1.2) Are dynamic analyses of the core calculated in two horizontal directions or one?

1.3) Describe how the SSE and LOCA time history inputs were determined.

1.4) Are SSE+LOCA conditions combined in a single dynamic analysis? If so, provide a description as to how they are combined.

Topic 2: Grid spacer strength P(crit)

2.1) Describe the experimental procedure used to determine grid spacer crush strength. Were short segments of cladding tubes used in the grid spacer or were the cells empty?

Topic 3: Grid spacer impact stiffness

3.1) Describe how grid spacer impact stiffness is implemented in CASAC.

3.2) Describe the experimental procedure used to determine grid spacer impact stiffness. Was a range of impact velocities used in the experiments? How does the impact velocity of the testing compare to the impact velocities predicted in the SSE and LOCA dynamic core response calculations?

3.3) Is grid spacer impact stiffness modeled as a constant?

3.4) How many repeated tests were used to determine grid spacer impact stiffness? What is the spread of collected stiffness data (highest and lowest)? Was an average value used in the dynamic models? Was a sensitivity study performed to determine SSE and LOCA results based on high and low impact stiffness values?

Topic 4: Fuel assembly frequency

4.1) Does the CASAC program make use of fuel assembly mode shapes in its calculations of core response? If so, explain how. (If not, ignore 4.2-4.4)

4.2) Is the first mode frequency of the fuel assembly defined as a constant or as an amplitude-dependant function?

4.3) Describe the test procedure for determining first mode frequency. What amplitude of fuel assembly perturbation was used? How does the amplitude compare to the displacement amplitudes calculated in the SSE+LOCA dynamic calculations?

4.4) How much variation is witnessed in the test data used to determine first mode fuel assembly frequency? Have any sensitivity studies been performed to test the effect of first mode frequency variation on the SSE+LOCA calculations?

Topic 5: Fuel assembly damping

5.1) How is fuel assembly damping represented in CASAC? Is the damping ratio defined as a constant or as an amplitude-dependant function?

5.2) Describe the test procedure for determining fuel assembly damping. How does the amplitude of the testing compare to the amplitude of fuel assembly deflection in the core dynamic analysis?

5.3) How much variation is witnessed in the test data used to determine damping? Have any sensitivity studies been performed to test the effect of damping variation on the SSE+LOCA calculations?