June 3, 2014

MEMORANDUM TO: John Segala, Chief
Licensing Branch 1
Division of New Reactor Licensing
Office of New Reactors

FROM: Michael Eudy, Project Manager ***/RA/***
Licensing Branch 1
Division of New Reactor Licensing
Office of New Reactors

SUBJECT: JULY 8 – 10, 2013, AUDIT OF U.S. EPR DESIGN CERTIFICATION APPLICATION SEISMIC MARGIN ASSESSMENT

By letter dated December 11, 2007, as supplemented by letters dated February 7, 2008, and February 20, 2008, AREVA Inc. (AREVA) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for a standard design certification (DC) of the U.S. EPR, pursuant to title 10 of the *Code of Federal Regulation* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." On December 21, 2010, the NRC staff issued to AREVA a request for additional information (RAI) No. 455 related to Probabilistic Risk Assessment-Based Seismic Margin Assessment (SMA). By letter dated June 24, 2011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML11175A362), AREVA submitted a response to this RAI.

To assist in their review, the NRC staff reviewed documents at the AREVA Inc. facilities in Marlborough, Massachusetts, on July 8 - 10, 2013. The NRC staff discussed systems and accident sequence analysis and seismic fragilities along with reviewing AREVA's seismic margin analysis calculations and supporting documentation. Enclosed is a summary report of the audit along with the audit plan.

CONTACT: Michael Eudy, NRO/DNRL/LB1
301-415-3104

Docket No.: 52-020

Enclosures:
1. Audit Report – SMA
2. Audit Plan
3. Audit Agenda (Attachment A)
4. SMA Audit List of Attendees

cc: See next page

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ADAMS Accession No. ML14141A036 *via email NRO-002

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DATE	05/23/2014	05/22/2014	06/03/2014	06/03/2014

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AUDIT REPORT
SEISMIC MARGINS ASSESSMENT
CHAPTER 19, SECTION 19.1.5.1
AREVA, INC
U.S. EPR FINAL SAFETY ANALYSIS REPORT

Dates of Audit: July 8-10, 2013

Audit Location: AREVA Inc., 400 Donald Lynch Boulevard, Marlborough, MA 01752

NRC Review Team: Jim Xu (NRC Branch Chief and Audit Lead Reviewer)
George Thomas (NRC Technical Reviewer)
Robert J. Budnitz (NRC Contractor, at Lawrence Berkeley National Laboratory (LBNL))
Robert D. Campbell (NRC, Contractor to Lawrence Berkeley National Laboratory)
Tanya Ford (NRC Project Manager)

Audit Scope

To facilitate the NRC staff's evaluation of the PRA-based Seismic Margins Assessment (SMA) and to complete its safety review of U.S. EPR FSAR Chapter 19, "Probabilistic Risk Assessment and Severe Accident," Section 19.1.5.1 "Seismic Risk Evaluation," the focus of the audit was to gain understanding of AREVA's SMA analyses in two technical areas: 1) systems and accident sequence analysis and 2) seismic fragilities. The overall scope of the audit consisted of reviewing AREVA's seismic margin analysis calculations (systems analyses, and seismic fragility analyses of structures), and supporting documents for the US EPR design to verify conformance to the guidance in Interim Staff Guidance (ISG-20) and identifying the need for additional information, if any. The objective of the review was to confirm that adequate seismic margin has been demonstrated or will be established for the U.S. EPR design.

Audit Summary

The Audit Plan (Enclosure 2) with agenda (Enclosure 3) for the audit was prepared in advance by the U.S. Nuclear Regulatory Commission (NRC) staff and agreed upon with AREVA. Representatives from NRC, Lawrence Berkeley National Laboratory (LBNL), and AREVA, including all key technical personnel, were present during the audit. A list of attendees is provided in Enclosure 4.

The Audit Entrance Meeting commenced at 1:30 p.m. on July 8, 2013. After introductions and a review of the agenda, NRC staff made some introductory remarks regarding the audit background and objectives. Following these remarks, the Audit proceeded in two parallel review tracks: (i) Seismic Fragility Calculations (R. Campbell and G. Thomas - NRC reviewers) and (ii) Systems /Accident Sequence analysis documents (R. Budnitz and J. Xu – NRC reviewers). In each of these tracks, AREVA presented a brief overview of the calculations and/or documents prepared in support of the SMA.

Following AREVA's presentation and during the subsequent two days, the NRC staff and the Lawrence Berkeley National Laboratory (LBNL) consultants conducted a detailed review of AREVA's systems analyses for developing seismic induced accident sequences and structural fragility analyses calculations and supporting documents that were made available for audit. Also, there was further discussion/feedback on the draft response to RAI 455, Question 19-341, that was the subject of a public meeting held earlier between 8:30 a.m. - 12 p.m. on July 8, 2013. The structural fragility analyses calculations for the following structures on the Seismic Equipment List (SEL) were made available and reviewed: Emergency Power Generating Buildings (EPGB), Essential Service Water Buildings (ESWB), Safeguard's Buildings (SB) 1, 2, 3, & 4, Reactor Containment Building (RCB), Reactor Shield Building (RSB), Reactor Building Internal Structures (RBIS), and the Vent Stack. The NRC staff noted that the fragility analysis calculations for the Fuel Building (FB), which houses the spent fuel pool (SFP) were not completed nor made available for audit as previously committed by AREVA, and AREVA was not able to provide an explanation of the reason for this. Details of the audit discussions are given in the following section.

The audit concluded with an exit meeting, between 9 a.m. – 10 a.m. on July 10, 2013, that summarized the discussions and the disposition of the issues raised during the audit and outstanding open issues. A summary of the SMA Audit results highlighted in the exit meeting is described below.

Systems analysis for developing seismic induced accident sequences and structural fragility analyses were reviewed during the audit. Systems review confirmed that AREVA has addressed issues raised during the last audit two years ago and incorporated related changes. The NRC Audit Team concluded that the systems analysis is conservative and, subject to Final Safety Analysis Report (FSAR) changes being incorporated as agreed upon, no additional issues were identified except the following **open issue**. Since the fuel assembly design is completed within the scope of the US EPR standard design certification (DC) and therefore not considered as procured items, AREVA should demonstrate through fragility analyses, within the DC FSAR, that the Reactor Internal components (fuel assembly spacer grids, guide tubes) and the core fuel assemblies have seismic high confidence low probability of failure (HCLPF) capacities of at least 1.67 times the certified seismic design response spectrum (CSDRS) (i.e. 0.5g) to ensure that control rod insertion is not prevented by a seismic initiating event. Currently, these components are included in US EPR Tier 2 FSAR, Table 19.1-106 with an assigned HCLPF value of 0.5g considering them as procured components to be confirmed by the combined license (COL) applicant. This was discussed during the public meeting, the audit, and agreeable to AREVA, but remains an open issue.

With regard to the fragility analyses of credited Seismic Category 1 structures, although there were some inconsistencies and other minor issues noted, the structural fragility calculations were generally of good quality. However, the review of structural fragility analyses calculations identified **two open issues**, which are as follows.

1. The first issue is that AREVA did not provide the fragility analysis for the fuel building as committed. The NRC Staff was not informed of this prior to the audit and AREVA team was unable to provide an explanation for this. The issue remained open and AREVA was requested that this issue should be discussed in the next NRC-AREVA management conference call.

2. The second issue is associated with the use of the modified Barda equation in EPRI Report TR-103959 "Methodology for Developing Seismic Fragilities" for calculations of shear capacity for piers which are shear walls near openings. These shear walls do not

have boundary stiffening elements and the use of the stated equation has been found to overestimate shear capacities, and therefore, could potentially lead to un-conservative fragility estimate. Since the HCLPF capacities for these structures (safeguard buildings and ESWB) were calculated with very slim margins, if corrections were made to the shear capacity calculations, the respective HCLPF capacities could be estimated below the 0.5g expectation. This issue remained open and AREVA was advised that the NRC will issue a new RAI to address this potential issue.

As mentioned previously, a public meeting between AREVA and NRC was conducted on July 8 (8:30 a.m. – 12 p.m.) in AREVA's office in Marlborough, MA to discuss AREVA's advanced response to RAI 455 Question 19-341, concerning SMA assessment on EPR DC. Briefly, the discussion covered all topics related to SMA, including systems and seismic accident sequence analysis, seismic fragility analyses of structures and procured components, and related COL Information Items in the FSAR. The NRC staff provided feedback to AREVA and successfully reached resolutions on all important issues concerning AREVA proposed SMA process. AREVA has agreed to incorporate additional changes in FSAR markup to ensure an adequate process for SMA implementation. It was concluded that this process together with an added COL information item should provide an adequate assurance that EPR DC will have a seismic margin at least 1.67 time CSDRS.

<u>Discussions of Audit Observations/Findings</u>

A. <u>Systems Analyses</u>

The NRC Audit Team's observations and conclusions concerning the various "systems analysis" issues that were covered during the audit are as indicated below.

Issue #1 – Very small loss-of-coolant accident (LOCA)

<u>Issue</u>: The SMA and seismic probabilistic risk assessment (SPRA) guidance requires that every accident sequence must also have the capability to mitigate a so-called "very small LOCA" that might result from the seismic-caused failure of a tiny impulse line or instrument line in the primary system. In practice, this comes down to including the ability to inject "make-up" water into the primary system, or better-still even more water.

AREVA's loss of offsite power (LOOP) event tree does not have a branch that requires this capability. However, AREVA told us that this capability is on the seismic equipment list (SEL) equipment list because it arises on one of the other event trees.

<u>Resolution</u>: AREVA has agreed to modify their FSAR to explain this fact. The draft of the newly revised text that AREVA has developed was reviewed, and found to be satisfactory.

Issue #2 – Table 19.1-106 is not explicit enough

Issue: Several entries in FSAR Table 19.1-106 are not explicit enough about exactly which structure, system, or component (SSC) items are to be included on the SEL. Examples are entries such as "piping, safety, manual, check valves, and motor-operated check valves." Another example is "fuel oil day tanks." During the audit, we observed, and AREVA agreed, that these entries are too general to provide an unambiguous description of the SSCs to be included.

AREVA agreed to amend this table by adding a footnote, that provides a more inclusive description of which types of SSC items are intended to be included. It is not necessary to list each individual item – indeed, at this stage that sort of listing would not be possible – but something more than what is currently in the table is needed.

Resolution: The draft of the newly revised text that AREVA has developed was reviewed, and found to be satisfactory.

Issue #3 – Human actions and recoveries in the seismic systems model

Issue: In compiling a seismic-PRA-type systems model, there is a general concern about how human actions (and human failures) are modeled after a large earthquake.

AREVA noted that in the systems analysis that is part of the SMA assessment, there is no credit taken anywhere for any human actions. Every human action in either the event tree(s) or the fault tree(s) is assumed to fail every time. Hence no credit is taken for any human actions.

This is also true of any "recoveries" that might involve a human action, including such complex recoveries as "feed and bleed" cooling.

Resolution: This approach obviates any concern about this issue.

Issue #4: The basis for part of the analysis for "transient initiators and loss of offsite power."

Issue: The AREVA FSAR text states in part that for "transient initiators and loss of offsite power", "*However, it is noted that in some cases the availability of offsite power will make certain scenarios worse. For example, a loss of condenser vacuum ATWS is more limiting than a loss of offsite power ATWS. Where this situation was noted (e.g. on the ATWS scenarios), the importance of the reactor trip function (and maintaining core geometry so that rod drop is ensured) was qualitatively evaluated ...."* The issue is with understanding how this evaluation is accomplished.

AREVA explained how this evaluation is done. Wherever this type of scenario arises in an event tree, the analysis includes the entire reactor trip function (including maintaining core geometry so that rod insertion is assured) within the analysis, and hence each relevant SSC is on the SEL.

Resolution: This explanation and approach obviate any concern about this issue.

Issue #5: Seismic caused dependencies

Issue: In compiling a seismic-PRA-type systems model, there is a general concern about how correlations and dependencies among failures of co-located similar SSCs are modeled after a large earthquake.

AREVA noted that in the systems analysis that is part of the SMA assessment, every situation in which co-located similar SSCs are in the model includes the assumption that there is full correlation of the failures.

Resolution: This approach by AREVA obviates any concern about this issue.

Issue #6: The basis for the seismic fragilities for the major primary-system items (steam generators, pressurizer, primary coolant pumps, etc.)

Issue: For each of the major primary-system items mentioned (steam generators, pressurizer, primary coolant pumps including their supports), a question arose as to how the seismic capacity (or fragility) is determined.

AREVA noted that each of these major items is being treated as an item of equipment to be procured at the COL stage, rather than as a structure to be analyzed and its seismic-capacity to be included in technical detail in the DC FSAR.

Resolution: This approach described by AREVA obviates any concern about this issue for primary system components that are procured items. However, since the fuel assembly design is completed within the scope of the US EPR standard design certification (DC) and therefore not considered as procured items, AREVA should demonstrate through fragility analyses, within the DC FSAR, that the Reactor Internal components (fuel assembly spacer grids, guide tubes) and the core fuel assemblies have seismic HCLPF capacities of at least 1.67 times the CSDRS (i.e. 0.5g) to ensure that control rod insertion is not prevented by a seismic initiating event. These components are currently included in US EPR Tier 2 FSAR, Table 19.1-106 with an assigned HCLPF value of 0.5g considering them as procured components to be confirmed by the COL applicant. This was discussed during the public meeting and the audit and agreeable to AREVA. This remains an **OPEN** issue.

Issue #7: Review of selected event trees in the systems model

Issue: Part of the audit involved the review of certain event trees.

As requested by the NRC review team, AREVA discussed certain selected event trees. AREVA explained that the event trees used in the SMA systems analysis are identical to those used in the internal-events-PRA model, with the appropriate changes to the numerical assignments on the trees (such as taking zero credit for human actions.) The review concentrated on the LOOP event tree because it usually contains most of the important seismic accident sequences. Other event trees were also reviewed, including some of the shutdown event trees.

Resolution: Nothing unusual was noted. The concern about this issue was resolved by this review.

Issue #8: Methodology for assuring that the seismic capacities of equipment that are not included in the DC FSAR (and hence are deferred to the COL stage) are adequate

Issue: The question was raised about how AREVA will assure that the seismic capacities of individual SSC equipment items will be adequate, if their specification is deferred to the COL stage.

AREVA explained their methodology, which is documented in the FSAR, and the staff review found it adequate to provide reasonable assurance.

Resolution: The approach described by AREVA obviates any concern about this issue.

Issue #9: Methodology for assuring that the plant-level HCLPF capacity is adequate if one or more individual SSCs do not have high enough HCLPF capacities

Issue: AREVA has committed, as shown in Table 19.1-106, that each SSC on the SEL will possess a seismic HCLPF capacity that will meet or exceed 1.67 times the CSDRS. However, it is possible that, at the COL stage, one or more SSCs (as procured and installed) will not possess enough seismic capacity to meet this benchmark criterion. Because the NRC's criterion is that the plant-level HCLPF capacity must meet or exceed 1.67 times the CSDRS, it is not necessary that each individual SSC do so. AREVA has therefore added text to the FSAR that states that, if any individual SSC does not meet the criterion, an analysis will be performed that demonstrates that the plant-level HCLPF capacity will do so. Because this latter criterion is an NRC requirement, this is a COL commitment.

Resolution: This approach obviates any concern about this issue.

B. Structural Fragility Analyses

Seismic fragility calculations of the Nuclear Island structures and other safety related structures were reviewed. The calculations were performed by Simpson, Gumpertz and Heger (SG&H), a Contractor to AREVA. The objective of the audit of these calculations was to confirm that the methodology and procedures complied with the guidance in ISG-20 for performing a PRA-based SMA. ISG-20 endorses EPRI Report TR-103959, Methodology for Developing Seismic Fragilities. It was concluded that the methodology in EPRI TR-103959 was followed and that overall the fragility calculations were well done.

The development of seismic loads for use in the fragility calculations was a two-step process. Initially a SASSI soil-structure interaction analysis was conducted that resulted in response spectra and nodal accelerations. The response spectra are used to evaluate components within the structures and, in the case of the stack that is mounted on top of the fuel building, the response spectra were used to develop the stresses and fragility of the stack. The nodal accelerations from SASSI were then applied to a static model to develop story shears for use in the evaluation of the capacity of the structures. The static analysis is considered to be conservative since the maximum calculated acceleration at the nodes was used. These maximum accelerations do not necessarily occur at the same time so the resulting response from the static model is conservatively calculated. This conservatism was not quantified in the fragility calculation.

There were minor inconsistencies in some of the uncertainties assigned to variables in the fragility calculations. The assignment of uncertainty to the variables in the fragility analysis is subjective and the assumed uncertainties were generally within the boundaries suggested in EPRI TR-103959. If these uncertainties were made completely consistent there would be very little effect on the calculated HCLPF values. Thus, there are no outstanding issues with the uncertainties assigned. There were only three potential issues raised that require further resolution.

Issue #1: Fragility Analysis of the Fuel Building not made available for audit.

Issue: Structural Fragility Analysis for the Fuel Building was not made available for audit as committed by AREVA. The NRC staff was not informed of this prior to the audit. AREVA did not have an explanation of the reason for this at the audit.

Resolution: AREVA needs to complete and make the calculation available for NRC review. This issue was unresolved and remains **OPEN**. Issue to be discussed at the next NRC-AREVA management call following the audit.

Issue #2: Potential Unconservatism in Evaluating Pier Walls Without Boundary Elements

Issue: Diagonal shear failure mode in reinforced concrete piers governed the seismic capacity of some US EPR structures such as EPGB, ESWB, and the Safeguards Buildings 1-4. AREVA used the EPRI Technical Report TR-103959 “Methodology for Development of Seismic Fragilities” Equation 3-11 (modified Barda equation), applicable to low-rise shear walls with boundary elements, for computing the median shear strength of the pier walls. Analysis of shear wall tests documented in Multidisciplinary Center for Earthquake Engineering Research (MCEER) Technical Report MCEER-09-0010 “Performance-Based Assessment and Design of Squat Reinforced Concrete Shear Walls,” September 15, 2009, shows that rectangular walls without barbells or flanges or suitable boundary elements have a shear capacity less than predicted by the TR-103959 equation. It is noted that the modified Barda equation in TR-103959 is also adopted in American Society of Civil Engineers (ASCE) Standard 43-05 “Seismic Design Criteria for Structures, Systems and Components in Nuclear Facilities” with a Φ factor applied for design. The equation without the Φ facor is evaluated in the MCEER report as ASCE 43-05 equations (Equation Set IV). ACI 349 (the design code for the above structures), paragraph 21.7.6, states that boundary elements for piers are not required for h_w/l_w of 2 or less, and consequently it is assumed that the detailing of the reinforcement bar will not result in boundary elements for these structures. Drawings were checked on one structure and it was determined that the rebar detail at the end of a pier would not provide a boundary element. If boundary elements are not present in the piers, the fragility calculation may be un-conservative and the HCLPF capacity could be lower than 0.5g for Safeguards Buildings 1-4 and the ESWB, for which HCLPF capacities were higher than 0.5g by a small margin. This also applies to the EPGB but the HCLPF capacity for that structure has a higher margin and a reduction in capacity of piers would be less of a concern. Table 4-2 in the MCEER report shows that the shear wall capacity equation used for fragility analysis of US EPR structures over-predicts the shear capacity of shear walls without boundary elements by a median factor of 1.41 with a coefficient of variation (COV) of 0.31. For shear walls with barbells, flanges or suitable boundary elements the EPRI TR-103959 capacity equation appears to be slightly conservative although the uncertainty is higher than assumed in the fragility calculations. Thus, there is not an issue for shear walls with boundary elements.

Resolution: This issue was unresolved and AREVA will address the potential impact of this concern on the fragility analyses of structures that use pier walls without boundary elements. On August 1, 2013, NRC issued RAI 596, Question 19-371, to address this issue. The applicant's response is pending. This issue remains **OPEN.**

Issue #3: Simplified Calculation of Inelastic Energy Absorption Factor (Fμ)

Issue: The inelastic energy absorption factor (Fμ) was calculated in a simplified manner for shear walls. The guidance in EPRI TR-103959 for calculation of Fμ for shear walls is to use the modified Riddell/Newmark method and the effective frequency/effective damping method and to average the two values. This requires the deflections and effective mass at each story to develop a systems ductility based on recommended story drift limits. For shear wall structures the median story drift limit in EPRI TR-103959 is 0.005. The approach taken by AREVA was a more simplified approach based on generic Fμ factors in ASCE 43-05. ASCE has story drift and Fμ factors for limits states A through D. Limit state D is essentially elastic response and limit state A is at or near collapse. The 0.005 story drift limit in EPRI TR-103959 corresponds to ASCE 43-05 story drift between limit states B and C. The corresponding Fμ factor was interpolated to correspond to a story drift of 0.005 and the calculated value was 2.26 with a composite Beta U of 0.2. The methodology used appears to be a reasonable approximation of Fμ but is not in strict compliance with EPRI TR-103959 methodology which is endorsed in ISG-20. It is also noted that the uncertainty in the 0.005 story drift limit is higher in EPRI TR-103959 than the uncertainty used in the fragility calculations. As an example, the Safeguards Building 1 has the lowest calculated HCLPF capacity of 0.54g, thus any reduction in the inelastic energy absorption factor coupled with an increase in uncertainty could result in a HCLPF of less than 0.5g.

Resolution: AREVA has committed to performing a more rigorous calculation of the inelastic energy absorption factor for the Safeguards Building 1 to verify the simplified approach used in the fragility calculations. The proposed resolution is reasonable and acceptable to the Audit team, and the issue is considered **resolved.**

Acronyms and Initialisms:

ASCE	American Society of Civil Engineers
ATWS sequence	anticipated transient without scram sequence
COL	combined license
COV	coefficient of variation
CSDRS	certified seismic design response spectrum
DC	design certification
EPGB	Emergency Power Generating Buildings
EPRI	Electric Power Research Institute
ESWB	Essential Service Water Building
FB	Fuel Building
FSAR	final safety analysis report
HCLPF capacity	high confidence low probability of failure capacity

ISG	Interim Staff Guidance
LBNL	Lawrence Berkely National Laboratory
LOCA	loss-of-coolant accident
LOOP	loss of offsite power
MCEER	Multidisciplinary Center for Earthquake Engineering Research
NRC	Nuclear Regulatory Commission
PRA	probabilistic risk assessment
RBIS	Reactor Building Internal Structures
RCB	Reactor Containment Building
RSB	Reactor Shield Building
SB	Safeguard's Buildings
SEL	seismic equipment list
SFP	spent fuel pool
SG&H	Simpson, Gumpertz and Heger
SMA	seismic margin assessment
SPRA	seismic probabilistic risk assessment
SSC	structure, system, or component

U.S. NUCLEAR REGULATORY COMMISSION
REGULATORY AUDIT OF SEISMIC FRAGILITY AND SEISMIC SYSTEMS ANALYSIS
TO SUPPORT THE
AREVA SEISMIC MARGIN ASSESSMENT

U.S. EPR DESIGN CERTIFICATION
Docket No. 52-020

AUDIT PLAN

APPLICANT:	AREVA, Inc.
APPLICANT CONTACTS:	Len Gucwa David Noxon
DURATION:	July 8-10, 2013
LOCATION:	AREVA, Inc. Solomon Pond Park 400 Donald Lynch Boulevard Marlborough, MA 01752
NRC REVIEWERS:	Jim Xu (NRC, Audit Lead Reviewer) George Thomas (NRC, Technical Review) Robert Budnitz (LBNL, NRC Contractor) Robert Campbell (LBNL, NRC Contractor) Tanya Ford (NRC, Project Manager)

BACKGROUND

AREVA NP, Inc. (AREVA) submitted by a letter dated December 11, 2007, to the U.S. Nuclear Regulatory Commission (NRC) a Final Safety Analysis Report (FSAR) for its Design Certification (DC) application of the U.S. EPR design, accessible by Agencywide Documents Access and Management System (ADAMS) Accession No. ML073520305. The NRC staff initiated this design certification review on March 19, 2008. To address the seismic risk for the U.S. EPR design, the NRC staff proposed a position in SECY-93-087, which the Commission approved, as modified, in an NRC Staff Requirements Memorandum (SRM) dated July 21, 1995, the use of a PRA-based seismic margins analysis for assessing the seismic risk for the design. As stated in the SRM, the seismic margins analysis should use a plant-level seismic margin of 1.67 times the design-basis safe shut earthquakes (SSE). To provide detailed guidance on this analysis, the NRC staff developed Interim Staff Guidance (ISG-20), "Implementation of a Probabilistic Risk Assessment-Based Seismic Margin Analysis (SMA) for New Reactors." ISG-20 provides an implementation process acceptable to the NRC staff for performing the PRA-based SMA and identifies the information to be included in an application needed to support the NRC staff's review and safety findings.

PURPOSE

The purpose of this audit is for the NRC staff to gain an understanding of AREVA's seismic fragilities calculations and systems analysis for the U.S. EPR design. The audit will consist of reviewing seismic margin calculations and supporting documents.

REGULATORY AUDIT BASIS

An audit is needed to evaluate and identify detailed information related to the applicant's submittals in direct support of the safety conclusions that need to be made regarding U.S. EPR FSAR Chapter 19, with respect to SMA.

Title 10 of the *Code of Federal Regulations* (CFR) 10 CFR 52.47, "Contents of applications; technical information," states there is a requirement that each application for design certification (DC) must include a "description of the design-specific probabilistic risk assessment (PRA) and its results" (§ 52.47(a)(27)).

The NRC staff must have sufficient information to ensure that acceptable risk and adequate assurance of safety can be documented in the NRC staff's safety evaluation report (SER).

REGULATORY AUDIT SCOPE

To facilitate the NRC staff's evaluation of PRA-based SMA to complete its safety review of U.S. EPR FSAR Chapter 19, "Probabilistic Risk Assessment and Severe Accident," the NRC staff is planning an audit which will focus on two technical areas: 1) seismic fragilities and 2) systems analysis. The NRC staff needs to review this information to confirm that adequate seismic margin has been demonstrated or will be established for the U.S. EPR design. The audit will consist of reviewing seismic margin calculations and supporting documents.

AUDIT ACTIVITIES AND DELIVERABLES

The NRC audit team is expected to consist of five individuals covering the technical areas of seismic fragilities and systems analysis.

The NRC staff acknowledges the proprietary nature of the information requested. It will be handled appropriately throughout the audit. NRC staff will not remove hard copy or electronic files from the audit site(s).

An audit report will be generated after completion of the audit. The audit outcome will be used to identify additional information needed for making regulatory decisions. The audit will assist the NRC staff in the issuance of further requests for additional information (if necessary) for the licensing review of FSAR Chapter 19 of the U.S. EPR design certification application and in preparation of the NRC staff's final SER.

The 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 Michael Eudy (NRC) at 301-415-3104 or Michael.Eudy@nrc.gov.

ATTACHMENT A

U.S. EPR FSAR Chapter 19 PRA Regulatory Audit – Part 1
July 8 – 10, 2013
AREVA NP, Inc., Marlborough, MA

AUDIT AGENDA

Monday, July 8, 2013:

1:30 P.M. – 2:00 P.M. Entrance Meeting... [NRC/AREVA NP]
- Introductions
- Audit Purpose and Objectives
- Review of Audit Plan and Schedule

2:00 P.M. – 4:30 P.M. Parallel Review Tracks……………………………......... [NRC/AREVA NP]

Track 1
2:00 – 2:30: Overview of EPGB Seismic Fragility Calculations [AREVA]
2:30 – 3:00: Overview of ESWB Seismic Fragility Calculations [AREVA]
3:00 – 4:30: Review of Fragility Calculations for EPGB and ESWB [NRC]

Track 2
2:00 – 2:30: Overview of approach to tying together fragility and [AREVA]
Systems analyses to provide complete SMA and
Identify supporting documents for review of
Systems analysis
2:30 – 4:30: Review of supporting documents [NRC]

4:30 P.M. – 5:00 P.M. NRC Staff Caucus...…........ [NRC]

5:00 P.M. – 5:30 P.M. Summary of the Day and Action Items........................ [NRC/AREVA NP]

5:30 P.M. Adjourn

Tuesday, July 9, 2013:

8:00 A.M. – 8:30 A.M. Follow up on Previous Day's Action Items and…...... [NRC/AREVA NP]
Plan of the Day

8:30 A.M. – 12:00 P.M. Parallel Review Tracks……………………………......... [NRC/AREVA NP]

Track 1
8:30 – 9:30: Overview of RCB and RSB Seismic Fragility Calculations [AREVA]
9:30 – 10:00: Overview of RBIS Seismic Fragility Calculations [AREVA]
10:00 – 12:00: Review of Fragility Calculations for RCB, RSB, and RBIS [NRC]

Track 2
8:30 – 12:00: Continue review of supporting documents for system [NRC] analysis
12:00 P.M. – 1:00 P.M. Lunch

1:00 P.M. – 4:30 P.M. Parallel Review Tracks……………………………......... [NRC/AREVA NP]

Track 1
1:00 – 1:30: Overview of SB Seismic Fragility Calculations [AREVA]
1:30 – 2:00: Overview of Vent Stack Seismic Fragility Calculations [AREVA]
2:00 – 4:00: Review of supporting Fragility Calculations [NRC]

Track 2
1:00 – 4:30: Continue review of supporting documents for system [NRC] analysis

4:30 P.M. – 5:00 P.M. NRC Staff Caucus.. [NRC]

5:00 P.M. – 5:30 P.M. Summary of the Day and Action Items........................ [NRC/AREVA NP]

5:30 P.M. Adjourn

Wednesday, July 10, 2013:

8:00 A.M. – 8:30 A.M. Follow up on Previous Day's Action Items and Plan of the Day……... [NRC/AREVA NP]

8:30 A.M. – 12:00 P.M. Parallel Review Tracks……………………………………………..… [NRC]

Track 1
8:30 – 12:00: Continue Review of Fragility Calculations [NRC]

Track 2
8:30 – 12:00: Continue review of supporting documents for system [NRC] analysis

12:00 P.M. – 1:00 P.M. Lunch

1:00 P.M. – 2:00 P.M. NRC Staff Caucus.. [NRC]

2:00 P.M. – 2:30 P.M. Exit Meeting*…………………………........................ [NRC/AREVA NP]

2:30 P.M. Adjourn

** Audit Plan may be updated on a daily basis and if more review time is required, the time for exit meeting will be adjusted*

[Note: The Audit ended at around 10:00am on July 10, 2013]

SMA Audit List of Attendees

Name	Organization
Len Gucwa	AREVA
David Noxon	AREVA
Ogden Sawyer	AREVA
Todd Oswald	AREVA (By Phone)
Brian Loseke	AREVA (By Phone)
Garry Pod	SCIENTECH (AREVA Contractor)
Wen Tong	SG&H (AREVA Contractor)
Kevin Hwang	SG&H (AREVA Contractor)
Tanya Ford	NRC
Jim Xu	NRC
George Thomas	NRC
Robert Budnitz	NRC Contractor, at Lawrence Berkeley National Laboratory (LBNL)
Robert Campbell	NRC, Contractor to LBNL
Hanh Phan	NRC (By phone)
Amy Snyder	NRC (By phone)

Enclosure 4

U.S. NRC REGUALTORY AUDIT OF THE U.S. EPR DESIGN CERTIFICATION SEISMIC MARGIN ASSESSMENT

Attendance Sheet

July 8 - 10, 2013

	First Name	Last Name	Organization	Phone #	Email Address
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13	Brian	Loseke (phone)	AREVA		
14	Amy	Snyder (phone)	NRC		
15	Todd	Oswald (phone)	AREVA		
16					
17					
18					
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20					

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