January 28, 2010

Mrs. Sandra Sloan
AREVA NP, Inc.
3315 Old Forest Road
P.O. Box 10935
Lynchburg, VA 24506-0935

SUBJECT: SUMMARY OF AUDIT TO REVIEW AREVA NP, INC., CHEMICAL EFFECTS TESTING RELATING TO SUMP PERFORMANCE, AUGUST 18, 2009

Dear Mrs. Sloan:

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 staff initiated the design certification review on March 19, 2008. On February 11, 2008, AREVA submitted ANP-10293, "U.S. EPR Design Features to Address GSI-191 Technical Report" (ADAMS ML080420149). Several requests for additional information (RAIs) have been submitted by NRC staff in Chapter 6 concerning ANP-10293. A public meeting was held to address these issues in detail on July 8, 2009, and is summarized in ML092100287. As a result of the public meeting, frequent interactions were identified as necessary to support the review of these topics.

In order to cover important review areas handled by the NRO Component Integrity, Performance, and Testing Branch (CIB1) and Containment and Ventilation Branch (SPCV), the staff held an additional audit at AREVA facilities in Lynchburg, VA. 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. If you have any questions regarding this matter, I may be reached at 301-415-3361 or by email at Getachew.Tesfaye@nrc.gov

Sincerely,

/RA/

Getachew Tesfaye
Senior 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: ML092960188 **NRO-002**

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DATE	10/23/09	1/22/10	1/22/10	1/27/10	1/28/10

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APPLICANT: AREVA NP, INC.

PROJECT: EPR DESIGN CERTIFICATION

SUBJECT: SUMMARY OF AUDIT TO REVIEW AREVA NP, INC., CHEMICAL EFFECTS TESTING RELATING TO SUMP PERFORMANCE, AUGUST 18, 2009

On August 18, 2009, an audit was carried out at the AREVA NP, Inc., (AREVA) Mount Athos Chemical Laboratory in Lynchburg, VA. The purpose of the audit was to review several issues identified by the staff regarding chemical effects testing and sump strainer performance. The topics covered in the audit included chemical effects test protocols, calculations, and test facilities. The audit was extended to facilitate the evaluation of further documents by the U.S. Nuclear Regulatory Commission (NRC) staff. An audit extension took place on August 21, 2009, at the AREVA Twinbrook Office in Rockville, MD.

To achieve the review goals in an efficient manner, the staff assembled an interdisciplinary audit team with experts from the NRC. To facilitate and expedite the work, the audit was attended by representatives from AREVA who introduced the audit topics and provided supporting documents and technical evidence to the reviewers. The audit lead was Jeffrey Poehler of the Office of New Reactors (NRO). The meeting agenda is provided as Attachment A and attendees are identified in Attachment B.

This meeting summary is available through the Agencywide Documents Access and Management System (ADAMS) as a document with Accession No. ML092960188. Documents in ADAMS are available electronically at the NRC's Electronic Reading Room at http://www.nrc.gov/reading-rm/adams.html. If you do not have access to ADAMS or have problems accessing the documents located in ADAMS, contact the NRC Public Document Room (PDR) staff at 1-800-397-4209, 301-415-4737, or pdr@nrc.gov.

A summary of the subjects covered and respective findings is provided in the following sections.

BACKGROUND

AREVA has submitted to the NRC a Final Safety Analysis Report (FSAR) for its application of the U.S. EPR in December 2007. NRC staff has initiated the design certification review on March 19, 2008. In order to address Generic Safety Issue (GSI)-191, AREVA submitted ANP-10293, "U.S. EPR Design Features to Address GSI-191 Technical Report" (ML080420149), on February 11, 2008. Several requests for additional information (RAIs) have been submitted by NRC staff in Chapter 6 concerning sump strainer performance and chemical effects. A public meeting was held to address these issues in detail on July 8, 2009. As a result of the public meeting, frequent interactions were identified as necessary to support the review of these topics. To support this strategy, NRO staff performed a GSI-191 Chemical Effects audit at the AREVA Lynchburg, VA facility on August 18, 2009.

AUDIT APPROACH

During this audit, the staff reviewed additional documents and calculations provided by AREVA that pertain to the planned chemical effects tests.

ENCLOSURE

To achieve the review goals in an efficient manner, the staff assembled an audit team comprised of experts from NRC. Representatives from AREVA NP introduced the audit topics and provided supporting documents and technical evidence to the reviewers on each topic during the audit.

AUDIT SUMMARY

AREVA presented the proposed methodology for the chemical effects tests to NRC staff. The approach will rely on a combination of testing and modeling to determine the type and amount of precipitates expected to form after a loss of coolant accident (LOCA), or chemical source term. AREVA explained that their methodology is an alternate to the methodology of WCAP-16530-NP, "Evaluation of Post-Accident Chemical Effects in Containment Sump Fluids to Support GSI-191" (ML060890509), which has been used by many operating plants to determine the chemical source term. A commercial software package will be used to determine the type and amount of chemical precipitates. The inputs to the software are the concentrations of chemical species in solution in the post-LOCA sump water as a function of time. These concentrations are determined from leaching/corrosion rates of materials reported in the literature supplemented by bench-top leaching/corrosion rate tests if necessary. AREVA will also perform a validation test in which all the different types of sump debris will be included, which will also simulate the pressure and temperature transient following a LOCA. The validation test results will be compared to the model results and should match closely, with respect to elemental concentrations and type and amount of precipitates. The chemical source term will be represented in the integrated head loss testing by a surrogate precipitate.

More detail on the debris source term, bench testing, modeling, and validation testing are provided below.

Debris Source Term and Debris Generation

The debris source term for the chemical effects tests is based on a debris generation analysis calculation. In this analysis, AREVA used the largest amount of debris from any of the postulated break locations for each debris type. A table with material type and amounts was included in the presentation. AREVA further committed to provide the full documentation for NRC staff review as part of an audit extension. This audit extension was carried out on August 21, 2009.

Debris Generation Calculation Audit Extension, August 21, 2009

During the extension, the full debris generation analysis was made available for NRC staff review. NRC staff reviewed AREVA internal Document No. 32-9114102-000, "Debris Generation Evaluation for the U.S. EPR." AREVA performed a debris generation evaluation using a U.S. EPR piping and equipment computer model. Based on modeling information, AREVA developed a debris source inventory database for use as input to debris generation calculations. AREVA then used analytical methods to perform debris generation calculations to determine the maximum anticipated debris load for selected LOCA break locations.

Several areas were audited in the debris generation analysis, including break location, zone of influence (ZOI), latent debris, and coatings. Each of these areas was reviewed in detail for consistency with applicable guidance. The staff has issued follow-up RAIs regarding the debris generations analysis as a result of the extended audit.

Bench Testing

The bench tests, if required, will be separate chemical effects tests, where one chemical at a time will be exposed to simulated post-LOCA sump water. The bench tests for material release rate/corrosion/leaching will be conducted at different temperatures and different pH levels for each material. Chemical analysis will be performed using the inductively coupled plasma (ICP) method for elemental and ionic species in solution and repeated until completion of the test. The time frame is different than that used by other standard design applicants; however, AREVA explained that material release rates are expected to decrease or plateau with time. In addition, they will use a higher initial rate to ensure conservatism of the approach.

Modeling

AREVA will use a commercially available software package for prediction of electrolyte equilibrium and to predict which chemical species are present in solution, pH, and precipitate formation versus time. The software has been used previously and evaluated in NUREG/CR-6873. AREVA presented several graphs of various chemical showing values predicted versus actual experimental data, which exhibited good agreement between the prediction and experimental results.

Validation Testing

AREVA will perform a validation test to validate the model predictions. The test will expose a representative post-LOCA debris mixture to a simulated post-LOCA environment, including chemistry, temperature, and pressure. The test will be conducted in an autoclave and all solids will be drained and collected to identify the precipitate types formed and the mass of each precipitate.

Surrogate Precipitate Development

During the integrated head loss testing to be performed, AREVA will use a surrogate to represent the expected precipitate that is expected based on the model prediction. The final formulation of the surrogate precipitate will be tested in the laboratory to verify that the type and quantity is representative of the properties of the precipitate predicted by the model and bench tests. Use of a surrogate precipitate is consistent with the NRC staff's review guidance on plant-specific chemical effects evaluations. The NRC staff asked AREVA where the surrogate precipitates would be injected in the test loop, since the amount of head loss caused by the precipitates could depend on whether the precipitates are filtered out by the retaining basket or actually reach the sump strainer screen. AREVA indicated that the injection location had not been determined yet, but may not matter since the precipitate particle size may be fine enough that it passes through the screen.

Laboratory Tour

During the audit, the NRO personnel also toured AREVA's new chemistry and materials lab facility where the chemical effects testing will be performed. NRC staff viewed the equipment that will be used for the chemical effects testing, such as autoclaves and chemical analysis equipment. The lab appeared to contain all the necessary equipment to perform the chemical effects testing as described by AREVA.

AUDIT FINDINGS

The August 18, 2009, audit on chemical testing was performed successfully at AREVA Mount Athos Chemical Laboratory in Lynchburg, VA. The information presented by the applicant provided the staff with a better understanding of several issues that were raised in previous RAIs.

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

- Head Loss Testing has moved to November 30, 2009, from September 2009, as was reported by AREVA in the public meeting on July 8, 2009. This delay may impact the schedule for staff's review of Chapter 6 if the December 18, 2009, submittal is affected.
- Head Loss Testing will occur at Alden Labs in Massachusetts.
- Submission of the final report, presumably a revision to ANP-10293, is still planned for December 18, 2009.
- The documentation that was reviewed in the scope of the audit extension generated additional questions pertaining to potential types and quantities used in the debris generation calculation. These issues will be documented in the issuance of RAIs.

One follow up action related to the chemical effects evaluation portion of the audit was identified:

- NRC staff will review the test specification for the chemical effects test program, which will be ready in mid-September 2009, during a follow-up audit at AREVA's Rockville offices.

NRC and AREVA agreed to discuss head loss test protocols in September and October 2009. AREVA also committed to use the head loss testing guidance found in Nuclear Energy Institute (NEI) 04-07 and RG 1.82 for the planned head loss testing.

Many of the current RAI responses in relation to sump performance and downstream effects for the U.S. EPR design certification are not valid due to the planned design changes. These RAIs need to be revised or supplemented to reflect the actual U.S. EPR plant design. This issue was raised at the public meeting on July 8, 2009. AREVA agreed to look into RAI responses and provide more information at a later date.

AGENDA
AUDIT TO REVIEW AREVA NP, INC., CHEMICAL EFFECTS TESTING PROTOCOLS, CHEMICAL EFFECTS TESTING FACILITIES, AND OTHER ISSUES RELATING TO SUMP PERFORMANCE
August 18, 2009
AREVA NP, Inc., Lynchburg, VA

Tuesday, August 18, 2009, MORNING SESSION: AUDIT - proprietary

9:00-9:15 A.M.	Entrance / Introduction	[NRC/AREVA NP]
9:15-9:30 A.M.	Overview: Chemical Effects Test Plan and Methodology	[AREVA NP]
9:30-10:00 A.M.	Containment Materials and Quantities	[AREVA NP]
10:00-10:30 A.M.	Elevated Temperature Leach Testing	[AREVA NP]
10:30-11:00 A.M.	IRWST Precipitates	[AREVA NP]
11:00-11:30 A.M.	Integrated Testing	[AREVA NP]
11:30 A.M.-12:00 P.M.	Formulation and Testing of Surrogate Materials	[AREVA NP]
12:00-12:30 P.M.	Chemical Effects Testing Schedule / Summary	[AREVA NP]
12:30 P.M.	Lunch	

Tuesday, August 18, 2009, AFTERNOON SESSION: AUDIT - proprietary

1:30 – 2:30 P.M.	Tour of Chemistry and Materials Center	[AREVA NP]
2:30 – 3:30 P.M.	Debris Generation Analysis	[AREVA NP]
3:30-4:15 P.M.	Overall Progress and Schedule Update	[AREVA NP]
4:15-4:30 P.M.	Break / Caucus	[AREVA NP]
4:30-5:00 P.M.	Audit Summary and Next Steps	[NRC/AREVA]
5:00 P.M.	Adjourn / Exit	

ATTACHMENT A

Attendee List
AUDIT TO REVIEW AREVA NP, INC., CHEMICAL EFFECTS TESTING PROTOCOLS, CHEMICAL EFFECTS TESTING FACILITIES, AND OTHER ISSUES RELATING TO SUMP PERFORMANCE
August 18, 2009
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Florian Jansen	NRC
Jeffrey Poehler	NRC
Clinton Ashley	NRC
Len Gucwa	AREVA
Gordon Wissinger	AREVA
Ronda Pederson	AREVA
Fariba Gartland	AREVA

August 21, 2009
AREVA NP, Inc., Rockville, MD

Name	Affiliation
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