October 10, 2012

Mr. Pedro Salas, Manager
U.S. EPR New Plants Regulatory Affairs
AREVA NP Inc.
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P.O. Box 10935
Lynchburg, VA 24506-0935

SUBJECT: AUDIT REPORT FOR THE JANUARY 25 AND 26, 2012, AUDIT TO REVIEW U.S. EPR CONFORMANCE TO THE GUIDANCE OF REGULATORY GUIDE 1.97, REVISION 4

Dear Mr. Salas:

In U.S. EPR Final Safety Analyses Report (FSAR) Tier 2, Section 7.5, Revision 3, the applicant discusses the instrumentation and controls (I&C) used to provide information important to safety and to provide an indication means for manual operator actions for accident mitigation. These include the post accident monitoring (PAM) instrumentation, as well as other systems. In U.S. EPR FSAR Tier 2, Revision 3, the applicant described its conformance to Regulatory Guide (RG) 1.97, Revision 4, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants."

The enclosed audit report describes a review of AREVA NP's documentation to address the application's conformance to the guidance of RG 1.97, Revision 4, and a review of the completeness of the post accident monitoring PAM variable list.

The review of the additional technical documents was facilitated by the presence of AREVA NP personnel at the audit. The audit report identifies several clarifying actions on the part of the applicant, as identified in Section V, "Conclusions." If you have any questions regarding this matter, I may be reached at 301-415-3361 or at Getachew.Tesfaye@nrc.gov.

Sincerely,

/RA/

Getachew Tesfaye, Senior Project Manager
LB1 Projects Branch
Division of New Reactor Licensing
Office of New Reactors

Docket No.: 52-020

Enclosure:
Audit Report

cc: See next page

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AREVA NP, Inc.
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Post Accident Monitoring (PAM) Instrumentation Audit Report
U.S. Evolutionary Power Reactor (EPR) Design Certification
Final Safety Analysis Report Chapter 7, Instrumentation and Controls

January 25 - 26, 2012

Date and Location:

January 25-26, 2012, AREVA NP, Inc., 3315 Old Forrest Road, Lynchburg, VA

I. Purpose:

The Office of New Reactors, Division of Engineering, Instrumentation and Controls (I&C) and Electrical Engineering Branch (ICEB) performed a regulatory audit to examine and evaluate non-docketed technical documents with respect to the scope of the audit, as described below in the section titled, "Regulatory Audit Scope." The intent was to gain understanding to support the basis of staff technical decisions, as well as licensing and regulatory decisions.

II. Background and Regulatory Audit Scope:

In U.S. EPR Final Safety Analyses Report (FSAR) Tier 2, Section 7.5, Revision 3, the applicant discussed the instrumentation and controls (I&C) used to provide information important to safety and to provide an indication means for manual operator action for accident mitigation. These include the post accident monitoring (PAM) instrumentation, and other systems. In U.S. EPR FSAR Tier 2, Revision 3, the applicant described its conformance to Regulatory Guide (RG) 1.97, Revision 4, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants."

The scope of the audit includes a review of the documentation to address the applicant's conformance to the guidance of RG 1.97, Revision 4, and a review of the completeness of the PAM variable list.

III. Summary of Audit Results

The scope of the audit was to address the applicant's conformance to the guidance of RG 1.97, Revision 4, and completeness of the post accident monitoring (PAM) variable list. The AREVA NP response to Request for Additional Information (RAI) 505, Question 07.05-10 discussed evaluations, characterizations, and comparisons that were performed as part of a "comprehensive evaluation." The information in the RAI response as well as information in U.S. EPR FSAR Tier 2, Section 7.5, described a process used for identifying the PAM variable list. The NRC staff concluded from this audit that the AREVA NP staff evaluations which resulted in the PAM variable list were adequate.

The details of the audit items and related follow-up actions are described below in Section IV. It is noted that the NRC staff review of the adequacy of AREVA NP RAI responses that address follow-up actions is a separate action and independent of this audit.

ENCLOSURE

IV. Discussion

AREVA NP previously responded to RAI 505, Question 07.05-10, which questioned the applicant's conformance to RG 1.97, Revision 4, and completeness of the PAM variable list. AREVA NP provided a response to the RAI which described their process for conforming to RG 1.97 and compiling the PAM variable list. The AREVA NP response to RAI 505, Question 07.05-10, discussed evaluations, characterizations, and comparisons that were performed as part of a "comprehensive evaluation." The NRC staff identified 11 specific items for audit, based on the information provided in the RAI response.

There were three documents that were provided to the team during the audit that contained the majority of the material that AREVA NP staff referenced as being applicable to addressing the audit items.

- AREVA NP Document Number 74-1152412-10, "AREVA Technical Document, Generic Emergency Operating Procedures Technical Bases Document, Volume 1, Generic Emergency Operation Guidelines," December 31, 2005 (hereinafter, Volume 1 B&W TBD).

- The AREVA NP staff "working document" which was is in the form of an Excel spreadsheet. Throughout this audit report, this document will be referred to as the AREVA NP staff working document or AREVA NP spreadsheet. The spreadsheet was sorted in two different ways; sorted by instrument and sorted by step number. Both formats had the following eight column headings: TBD [Technical Bases Document] Step, Step Type, Action, Required Instrumentation, Instrument Use, PAM Inst Y/N [Instrument Yes/No], PAM Variable Type, and PAM Instrument Determination Basis. For discussion purposes in this audit report, example numbers one through ten, as seen in the "Example" column were added. The AREVA NP staff working document did not include an "Example" column in its Excel spread sheet. The ten examples in the tables provided in this audit report are a small sample from the AREVA NP staff spreadsheet.

- AREVA NP Document Number 51-9044814-001, "U.S. EPR Accident Monitoring Variables," February 3, 2010 (hereinafter, Document 51).

The audit of the 11 items is discussed below.

Audit Item 1 – Evaluation for each step of Volume 1 of the B&W technical bases document to determine whether the action of each step of Volume 1 of the B&W technical bases document was applicable to the U.S. EPR design.

The team interviewed the AREVA NP staff regarding Audit Item 1. The AREVA NP staff indicated that the determination of the applicability of each step of Volume 1 B&W TBD is found in an AREVA NP staff working document. The AREVA NP staff working document is in the form of an Excel spreadsheet. AREVA NP staff provided the team with a copy of the spreadsheet. The spreadsheet indicates whether a step, as found in Volume 1 B&W TBD, is applicable to the U.S. EPR design. For instance, as seen in the "Sort-by-Step-Number" table that is included in this audit report on page 9, example number 5 is one of the steps that AREVA NP staff determined to be applicable to the U.S. EPR design. A sample of the steps that are in the AREVA NP staff working document is provided in the Sort-by-Step-Number Table.

The following discussion pertains to an example in which the AREVA NP staff determined that the step, as found in Volume 1 B&W TBD, is applicable to the U.S. EPR design. The data for example number 5 is provided below, and is from the Sort-by-Step-Number Table.

EXAMPLE #	TBD STEP	STEP TYPE	ACTION	REQUIRED INSTRUMENTATION	INSTRUMENT USE	PAM INST Y/N	PAM VARIABLE TYPE	PAM INSTRUMENT DETERMINATION BASIS
5	III.A.16.0	P	Verify RCS leakage < Normal Makeup Capacity	Pressurizer level	Determine magnitude of RCS pressure boundary leakage relative to makeup capacity.	Y	B	4.2

AREVA NP staff reviewed Step III.A.16.0, as found in Volume 1 B&W TBD. Volume 1 B&W TBD, states the action that corresponds to Step III.A.16.0 is to verify that the reactor coolant system (RCS) leakage is less than the normal makeup capacity; this information appears in the "Action" column. A step is designated as "P" for "primary step" or "C" for "contingency step". AREVA NP stated that the B&W TBD symptom approach builds in contingency responses as part of the guidelines. Those actions were evaluated as part of the selection process. Contingency steps that rely on other than Type A variables would be classified the same as the primary variables. Pressurizer level is the "Required Instrumentation". Determining the magnitude of RCS pressure boundary leakage relative to makeup capacity is the "Instrument Use." The "PAM Instrument Determination Basis" is "4.2." AREVA NP staff reviewed Section 4, "Selection Criteria," of Institute of Electrical and Electronics Engineers (IEEE) Standard (Std) 497-2002. IEEE Std 497-2002, Section 4 has five subsections which describe the selection criteria for accident monitoring variables; Subsection 4.1, Type A variables, Subsection 4.2, Type B variables, Subsection 4.3, Type C variables, Subsection 4.4, Type D variables, and Subsection 4.5, Type E variables. AREVA NP staff reviewed the selection criteria and concluded that the PAM instrument (Inst) associated with Step III.A.16.0 is, indeed, a PAM Inst, and is thus indicated as "Y" for "yes" in the "PAM Inst Y/N" column. The AREVA NP staff reviewed the selection criteria in IEEE Std 497-2002 and determined that the PAM variable associated with Step III.A.16.0 meets the selection criteria of Subsection 4.2 for Type B variables. Therefore, "4.2" is in the ''PAM Instrument Determination Basis" column, and the "B" for Type B variables, is in the "PAM Variable Type" column.

As indicated previously, AREVA NP staff indicated that they evaluated each step as found in Volume 1 B&W TBD to determine applicability to the U.S.EPR design. The above description is one example for which the AREVA NP staff found that the step was applicable to the U.S. EPR design. Conversely, the following description is for example Number 10, for which AREVA NP staff found that the step was not applicable to the U.S. EPR design.

The data for example number 10 is provided below, and is from the Sort-by-Step-Number Table.

EXAMPLE #	TBD STEP	STEP TYPE	ACTION	REQUIRED INSTRUMENTATION	INSTRUMENT USE	PAM INST Y/N	PAM VARIABLE TYPE	PAM INSTRUMENT DETERMINATION BASIS
10	III.D.3.0	P	IF AT ANY TIME BWST LEVEL DECREASES TO [RB sump switchover level], THEN SWITCH ES SUCTION TO THE RB SUMP (Section V.C).	None				[RB sump switchover level] is not applicable to U.S. EPR™.

AREVA NP staff reviewed Step III.D.3.0, as found in Volume 1 B&W TBD. Volume 1 B&W TBD, states the Step III.D.3.0 action indicates that if at any time the borated water storage tank (BWST) level decreases to [reactor building (RB) sump switchover level][1] then switch engineered safeguards (ES) suction to the reactor building (RB) sump[2]. The information associated with this action appears under the "Action" column heading. AREVA NP staff determined that the RB sump is not applicable to the U.S. EPR design; therefore, there is no required instrumentation use or PAM information.[3] Consequently, the AREVA NP staff spreadsheet does not reflect any data under the columns with the headings, "Instrument Use," "PAM Inst Y/N," and "PAM Variable Type."

Based on the information in the AREVA NP spreadsheet and Volume 1 B&W TBD, and interview with the AREVA NP staff, the NRC staff concludes that the AREVA NP evaluation for each step of Volume 1 B&W TBD to determine whether the action of each step of Volume 1 B&W TBD was applicable to the U.S. EPR design was adequate. The NRC staff finds that Audit Item 1 has been adequately addressed.

No follow-up actions are needed in regard to Audit Item 1.

Audit Item 2 – Identify design differences between the U.S. EPR and B&W that were not applicable and therefore eliminated.

AREVA NP staff indicated that Audit Item 2 is described in Document 51, Paragraph 5.2.1. To provide continuity of the information in proper context, the entirety of Paragraph 5.2.1 is

[1] In Volume 1 of the B&W TBD, the brackets are used to identify the insertion of plant specific information.
[2] Section V.C of Volume 1 B&W TBD is titled "Sump Switchover" and indicates the steps for sump switchover.
[3] The U.S. EPR has an in-containment reactor water storage tank (IRWST) that is the source of injection to the RCS and the leak path returns to the IRWST.

provided below. Only the first paragraph relates to the Audit Item 2. The other paragraphs are shaded. (This shading practice is used throughout this audit report).

> Each step of Volume 1 of the B&W Technical Bases Document was first evaluated to determine whether the action was applicable to the EPR design. Some actions in the TBD are not applicable due to differences in the respective designs. For example, actions to mitigate excessive tube to shell differential temperature are not applicable to the EPR design due to differences in the design of the steam generators. If the action was not applicable, it was eliminated from further consideration.

> Each remaining step was then evaluated to determine the minimum set of required instrumentation to support the action. The usage of each identified instrument in the context of the action specified was then characterized. These descriptions of the usage of the instrument were then compared to the definitions of the post accident monitoring variable types as described in IEEE 497-2002, and Regulatory Guide 1.97 Revision 4. If the usage of the instrument did not meet the definition of one of the variable types, it was not assigned a variable type.

> This resulted in a list of Type B and D variables based on their usage in the TBD. This list of instruments was then further evaluated to identify which of these instruments met the definition of Type C variables. Those variables which met these criteria were also classified as Type C variables.

During the interview with the AREVA NP staff, the NRC staff viewed a spreadsheet of variables which detailed a list of the design differences between the U.S. EPR and B&W that were not applicable to a U.S. EPR application. Those variables were, therefore eliminated from consideration. For example, the data regarding Number 9 on the spreadsheet provides information on a B&W action that the AREVA NP staff assessed as NOT applicable to the U.S. EPR design. AREVA NP staff reviewed Step III.D.2.0, as found in Volume 1 B&W TBD. Volume 1 B&W TBD, states the action that corresponds to Step III.D.2.0 is, if at any time the reactor coolant (RC) temperature approaches [core lift limit][4], then reduce to less than four reactor coolant pump (RCP) operation. The information appears under the column heading "Action." AREVA NP staff determined that core lift limit is not applicable to the U.S. EPR design, and this information appears under the column heading "PAM Instrument Determination Basis" as, "[core lift limit] is not applicable to the EPR™." Therefore, there is no required instrumentation use or PAM information. Consequently, the AREVA NP staff spreadsheet does not reflect any data under the columns with the headings, "Instrument Use," "PAM Inst Y/N," and "PAM Variable Type."

[4] In Volume 1 of the B&W TBD, the brackets are used to identify the insertion of plant specific information

The data for example Number 9, from the Sort-by-Step-Number Table, is provided below.

EXAMPLE #	TBD STEP	STEP TYPE	ACTION	REQUIRED INSTRUMENTATION	INSTRUMENT USE	PAM INST Y/N	PAM VARIABLE TYPE	PAM INSTRUMENT DETERMINATION BASIS
9	III.D.2.0	C	IF AT ANY TIME RC TEMPERATURE APPROACHES [core lift limit], THEN REDUCE TO < 4 RCP OPERATION	None				[core lift limit] is not applicable to the U.S. EPR™ .

Based on information in the AREVA NP spreadsheet and Document 51, and interview with the AREVA NP staff, the NRC staff concludes that AREVA NP staff adequately determined the design differences between the U.S. EPR and B&W that were not applicable, and therefore eliminated. The NRC staff finds that Audit Item 2 has been adequately addressed.

No follow-up actions are needed for Audit Item 2.

Audit Item 3 - Evaluation of each remaining step to determine the minimum set of required instrumentation.

AREVA NP staff indicated that the information pertaining to Audit Item 3 is located in Document 51, Paragraph 5.2.1.

> Each step of Volume 1 of the B&W Technical Bases Document was first evaluated to determine whether the action was applicable to the EPR design. Some actions in the TBD are not applicable due to differences in the respective designs. For example, actions to mitigate excessive tube to shell differential temperature are not applicable to the EPR design due to differences in the design of the steam generators. If the action was not applicable, it was eliminated from further consideration.

> Each remaining step was then evaluated to determine the minimum set of required instrumentation to support the action. The usage of each identified instrument in the context of the action specified was then characterized. These descriptions of the usage of the instrument were then compared to the definitions of the post accident monitoring variable types as described in IEEE 497-2002, and Regulatory Guide 1.97 Revision 4. If the usage of the instrument did not meet the definition of one of the variable types, it was not assigned a variable type.

This resulted in a list of Type B and D variables based on their usage in the TBD. This list of instruments was then further evaluated to identify which of these instruments met the definition of Type C variables. Those variables which met these criteria were also classified as Type C variables.

AREVA NP also indicated that “each remaining step” that was evaluated, is described in the AREVA NP Spreadsheet.

The audit team reviewed the information provided in Document 51, Paragraph 5.2.1, and concluded that this information did not clarify what was meant by “each remaining step.” The team interviewed the AREVA NP staff and it was through the interview that clarification was achieved. On the whole, this is what was meant by “each remaining step”: The AREVA NP staff evaluated the steps in Volume 1 B&W TBD and determined if the action was applicable to the U.S. EPR design; they then had a list of the steps applicable to EPR. In addition, AREVA NP staff determined the design differences between the B&W and the U.S. EPR, and in instances where a B&W design characteristic was not applicable to the U.S. EPR, then any action that corresponded to the design difference was also not applicable; thus the step was eliminated. It was at this point that AREVA NP then had a list, and this list consisted of each of the steps that remained and, therefore, AREVA NP called this “each remaining step.”

Based on the information in the Document 51 and interview with the AREVA NP staff, the NRC staff concludes that Audit item 3 was adequately addressed.

No follow-up actions are needed for Audit Item 3.

Audit Item 4 - Characterization of the usage of each identified instrumentation and comparison to the definitions of PAM variables as described in IEEE Std 497-2002 and RG 1.97, Revision 4.

The AREVA NP staff indicated that the characterization of the usage of each identified instrument is described in the AREVA NP Spreadsheet. AREVA NP also indicated the characterization of the usage of the instrument, as seen in the AREVA NP Spreadsheet, was determined based on the instrument usage definition as found in IEEE Std 497-2002 and RG 1.97, Revision 4. AREVA NP staff and the team completed a walk through on selected items from the AREVA NP Spreadsheet that was sorted by instrument, for which an example of some of the items is provided in the table below.

Table 1 - Sort by Instrument

Example #	TBD Step	Step Type	Action	Required Instrumentation	Instrument Use	PAM Inst Y/N	PAM Variable Type	PAM Instrument Determination Basis
1	III.B.4.0	P	If at any time RC pressure < operational pressure and LPI flow exists, then go to section IV.A step 1.0	RCS Hot leg pressure	Evaluate branching logic	N		Usage does not meet any IEEE Std 497-2002 Variable Type definition
2	III.D.1.0	P	CONTROL RCS INVENTORY	Pressurizer level	Monitor pzr level trend as input to efforts to control inventory	N		Usage does not meet any IEEE Std 497-2002 Variable Type definition

In the examples provided in the table above, neither of these instruments is designated a PAM instrument. This is seen by the “N” for “no” in the “PAM Inst Y/N” column. AREVA NP staff indicated that they did not designate the instrument as a PAM Type B variable, because the instrument did not meet the definition of a critical safety function. IEEE Std 497-2002 indicates that a critical safety function pertains to those safety functions that are essential to prevent a direct and immediate threat to the health and safety of the public. AREVA NP staff further stated that the context of the step, meaning what the instrument is used for, is important in determining if a variable is designated as a PAM Type B variable; in one context the instrument may not be a PAM variable and in another context it does rise to the level of being a PAM variable.

AREVA NP staff and the NRC Audit team completed a walk through on selected items from the spreadsheet that was sorted by step number, for which an example of some of the items is provided below

Table 2 - Sort by Step Number

Example #	TBD Step	Step Type	Action	Required Instrumentation	Instrument Use	PAM Inst Y/N	PAM Variable Type	PAM Instrument Determination Basis
3	III.A.16.0	P	Verify RCS leakage < Normal Makeup Capacity	Charging flow	Quantify RCS makeup flow	N		Usage does not meet any IEEE Std 497-2002 Variable Type definition.
4	III.A.16.0	P	Verify RCS leakage < Normal Makeup Capacity	MHSI flow	Quantify RCS makeup flow	N		Usage does not meet any IEEE Std 497-2002 Variable Type definition.
5	III.A.16.0	P	Verify RCS leakage < Normal Makeup Capacity	Pressurizer level	Determine magnitude of RCS pressure boundary leakage relative to makeup capacity.	Y	B	4.2
6	III.B.16.0	C	If required HPI flow > normal makeup capacity exists then go to section IV.a step 1.0	MHSI flow	Determine if RC leakage > MU capacity	N		Usage does not meet any IEEE Std 497-2002 Variable Type definition.
7	III.B.16.0	C	If required HPI flow > normal makeup capacity exists then go to section IV.a. step 1.0	Pressurizer level	Determine magnitude of RCS pressure boundary leakage relative to makeup capacity.	Y	B	4.2

Table 2 - Sort by Step Number

Example #	TBD Step	Step Type	Action	Required Instrumentation	Instrument Use	PAM Inst Y/N	PAM Variable Type	PAM Instrument Determination Basis
8	III.C.4.0	P	Reduce RCP operation to a 1/1 configuration and run as long as SCM exists and SG TSDT limits are not exceeded.	Subcooling margin	Determine need to trip RCPs.	N		Usage does not meet any IEEE Std 497-2002 Variable Type definition.
9	III.D.2.0	C	IF AT ANY TIME RC TEMPERATURE APPROACHES [core lift limit], THEN REDUCE TO < 4 RCP OPERATION	None				[core lift limit] is not applicable to the U.S. EPR™ .
10	III.D.3.0	P	IF AT ANY TIME BWST LEVEL DECREASES TO [RB sump switchover level], THEN SWITCHES SUCTION TO THE RB SUMP (Section V.C).	None				[RB sump switchover level] is not applicable to U.S. EPR™.

Also, AREVA NP staff indentified the following information, which was obtained from Document 51, Paragraph 6.2.20, “Pressurizer Level.”

> Pressurizer level indication is used to support credited operator manual actions to manage MHSI during a SGTR, and to detect an RCS inventory control upset during the EBS [extra borating system] malfunction event. These usages of the instrument results in it being classified as a Type A variable, since it meets the definition of IEEE 497-2002, paragraph 4.1.a).
>
> Pressurizer level indication is also used to provide information to the operator on the magnitude an RCS pressure boundary breach to support SIS management actions. This usage of the instrument results in it being classified as a Type B variable, since it meets the definition of IEEE 497-2002, paragraph 4.2

Four channels of pressurizer level (1 per division) are available and have a range of 0 to 100%.

The data for Example 7 is provided below.

Example #	TBD Step	Step Type	Action	Required Instrumentation	Instrument Use	PAM Inst Y/N	PAM Variable Type	PAM Instrument Determination Basis
7	III.B.16.0	C	If required HPI flow > normal makeup capacity exists then go to section IV.a. step 1.0	Pressurizer level	Determine magnitude of RCS pressure boundary leakage relative to makeup capacity.	Y	B	4.2

AREVA NP staff reviewed Step III.B.16.0, as found in Volume 1 B&W TBD. Volume 1 B&W TBD states that the action that corresponds to Step III.B.16.0 is, if the required high pressure injection (HPI) flow is greater than the normal makeup capacity that exits, then go to Section IV.A Step 1.0. The information associated with this action appears in the column designated as "Action." As seen under the column, "Required Instrumentation," AREVA NP staff indicated that pressurizer level was the instrumentation required for the action associated with Step III.B.16.0. As seen in the column, "Instrument Use," the instrument is used to determine the magnitude of the reactor coolant system (RCS) pressure boundary leakage relative to makeup capacity. The column designated as "PAM Instrument Determination Basis" has "4.2." AREVA NP staff reviewed IEEE Std 497-2002 in which Section 4 is titled "Selection Criteria." As stated previously in the discussion for Audit Item 1, Section 4 of IEEE Std 497-2002 has five subsections which describe the selection criteria for accident monitoring variables; Subsection 4.1, Type A variables, Subsection 4.2, Type B variables, Subsection 4.3, Type C variables, Subsection 4.4, Type D variables, and Subsection 4.5, Type E variables. The AREVA NP staff reviewed the information found in IEEE Std 497-2002 and concluded that the PAM instrument (Inst) associated with Step III.B.16.0 is indeed a PAM Inst and is, thus, indicated as "Y" for "yes" in the column indicated as "PAM Inst Y/N." The AREVA NP staff reviewed the selection criteria in IEEE Std 497-2002 and determined that the PAM variable associated with Step III.B.16.0 meets the selection criteria of IEEE Std 497-2002 Subsection 4.2 for Type B variables; therefore, the "4.2" in the ''PAM Instrument Determination Basis" column, and the "B" for Type B variables in the "PAM Variable Type" column. IEEE Std 497-2002 Subsection 4.2, Type B variables, states that Type B variables are those variables that provide primary information to the control room operators to assess the plant critical safety functions.

Based on the information in the AREVA NP Spreadsheet and Document 51, and interview with the AREVA NP staff, the NRC staff concludes that AREVA NP staff adequately characterized the usage of each identified instrumentation and compared to the definitions of PAM variables as described in IEEE Std 497-2002 and RG 1.97, Revision 4. The NRC staff finds that Audit Item 4 has been adequately addressed.

No follow up actions are needed in regard to Audit Item 4**.**

Audit Item 5 – Assessment of the evaluation which identified the Type C variables.

During the discussion, the AREVA NP staff indicated that the evaluation identifying Type C variables is located in Document 51 Paragraph 5.2 1, and Paragraph 5.2.3. From Paragraph 5.2.1:

> Each step of Volume 1 of the B&W Technical Bases Document was first evaluated to determine whether the action was applicable to the EPR design. Some actions in the TBD are not applicable due to differences in the respective designs. For example, actions to mitigate excessive tube to shell differential temperature are not applicable to the EPR design due to differences in the design of the steam generators. If the action was not applicable, it was eliminated from further consideration.

> Each remaining step was then evaluated to determine the minimum set of required instrumentation to support the action. The usage of each identified instrument in the context of the action specified was then characterized. These descriptions of the usage of the instrument were then compared to the definitions of the post accident monitoring variable types as described in IEEE 497-2002, and Regulatory Guide 1.97 Revision 4. If the usage of the instrument did not meet the definition of one of the variable types, it was not assigned a variable type.

> This resulted in a list of Type B and D variables based on their usage in the TBD. This list of instruments was then further evaluated to identify which of these instruments met the definition of Type C variables. Those variables which met these criteria were also classified as Type C variables.

The portion of Paragraph 5.2.1 that specifically addresses Audit Item 5, the evaluation which identified the Type C variables, is discussed in the statements which indicated that, after having obtained a list of Type B and D variables, based on their usage in the B&W TBD, the Type B and D variable list was further evaluated to identify which Type B and D variables met the definition of Type C variables. Those Type B and D variables which met the criteria for Type C variables, were subsequently also classified as Type C variables.

Document 51, Paragraph 5.2.3, “Radiation Monitoring System Description Document,” states:

> The radiation monitoring instruments described in the Radiation Monitoring System Description Document were reviewed to determine which of the instruments met the definitions in IEEE 497-2002 and Regulatory Guide 1.97 Revision 4 of Type C and Type E variables. Those instruments meeting the variable type definitions were assigned the appropriate variable types.

The NRC staff notes that the process by which the AREVA NP staff determined which of the radiation monitoring instruments met the definition Type C and Type E variables, is similar to that which was discussed previously in Example 5, under Audit Item 1, for which the PAM variable was determined to be a Type B variable. In the case of making the determination between Type C and Type E variables, the AREVA NP staff referred to the definitions for Type C and Type E variables as found in IEEE Std. 497-2002.

Based on the information in Document 51, Paragraphs 5.2 1 and 5.2.3, and interview with the AREVA NP staff, the NRC staff concludes that the evaluation which identified Type C variables is adequate. The NRC staff finds that Audit Item 5 has been adequately addressed.

No follow up actions are need for Audit Item 5.

Audit Item 6 – Assessment of the evaluation of the credited operator manual action to determine the required instrumentation, and the evaluation to determine if the instrumentation was a Type A variable.

The AREVA NP staff indicated that the description of the evaluation is located in Document 51, Paragraph 5.2.2, "FSAR Chapter 15," which indicates the following:

> FSAR Chapter 15 Section 15.0.0.3.7, 'Operator Actions,' contains a list of credited operator manual actions for which no automatic control is provided. Each of these actions was evaluated to determine instrumentation required to support performance of the actions.
>
> The instrumentation required to support each action was then evaluated to determine whether that instrument was uniquely required for the performance of the action. If a multitude of indications existed to provide the required information to the operator, such that no one indication was a required key instrument, then no post accident monitoring variable type was assigned. If the instrument constituted a key instrument to support performance of the manual action, then the instrument was designated as a Type A variable.
>
> Appendix A provides a discussion of the specific instrumentation supporting each FSAR Chapter 15 manual operator action.

AREVA NP staff and the NRC Audit team completed a walkthrough of some examples which traced the process of how AREVA NP staff used the information in Appendix A, to produce the data that is in the AREVA NP spreadsheet.

During discussion, AREVA NP staff provided clarification on information that was provided in Paragraph 5.2.2. In the second paragraph, the first and the third statement appear to be equivalent, such that, "The instrumentation required to support each action was then evaluated to determine whether that instrument was uniquely required for the performance of the action," had the same meaning and intent as, "… the instrument constituted a key instrument to support performance of the manual action, then the instrument was designated as a Type A variable." The second statement indicates, "If a multitude of indications existed to provide the required information to the operator, such that no one indication was a required key instrument, then no post accident monitoring variable type was assigned." AREVA NP staff provided clarification on how are the following were related; "instrumentation … a key instrument," and, "indication … a … key instrument;" in which AREVA NP staff indicated that the terms indications and instrumentation were used interchangeably.

Through additional interview, AREVA NP staff indicated that U.S. EPR FSAR Tier 2, Section 15.0.0.3.7 lists credited operator actions for which all variables needed to accomplish those actions are addressed. AREVA NP staff indicated that if there were multiple diverse methods to determine requirements to perform an action and no instrument could be considered a key variable, then there is no variable selected as Type A. For example, pressurizer level

rising would provide indication of either an inventory addition or an upset in heat removal from the RCS. Other indication is required to determine the source. Manual action to terminate EBS flow would be cued by increasing pressurizer level, but multiple other indications must be used to determine that the EBS pumps are the source. None of them alone indicates that the EBS needs to be terminated.

Based on the information in Document 51 and interview with AREVA NP staff, the NRC staff concludes that the evaluation of the credited operator manual action to determine the required instrumentation, and the evaluation to determine if the instrumentation was a Type A variable, are adequate. The NRC staff finds that Audit Item 6 has been adequately addressed.

No follow-up actions are needed in regard to Audit Item 6.

Audit Item 7 – Assessment of the review to determine which of the instruments were Type C and Type E variables.

The AREVA NP staff indicated that information pertaining to the review to determine which of the instruments were Type C and Type E, is located in Document 51 Paragraph 5.2.3, "Radiation Monitoring System Description Document," which states:

> The radiation monitoring instruments described in the Radiation Monitoring System Description Document were reviewed to determine which of the instruments met the definitions in IEEE 497-2002 and Regulatory Guide 1.97 Revision 4 of Type C and Type E variables. Those instruments meeting the variable type definitions were assigned the appropriate variable types.

AREVA NP staff and the NRC Audit team completed a walkthrough of the process that AREVA NP used. The following information was indentified during the walkthrough: the name of the radiation monitoring instrument selected, the indication that it meets or does not meet the definition for Type C and Type E variables, and indication that assigns the appropriate variable type.

Based on the information in Document 51 and discussion with AREVA NP staff, the NRC staff concludes that the AREVA NP staff review used to determine which of the instruments were Type C and Type E variables was adequate. The NRC staff finds that Audit Item 7 has been adequately addressed.

No follow-up actions are needed for Audit Item 7.

Audit Item 8 - The evaluation which resulted from interviews with the "team of personnel" that performed the review of the list of instruments generated by the previous steps.

The AREVA NP staff indicated that information pertaining to the evaluation which resulted from the "team of personnel," is located in Document 51, Paragraph 5.2.4, "Engineering Judgment," which indicates the following:

> The TBD is written to provide high level guidance on the implementation of transient mitigation strategies. The EOPs [emergency operating procedures] that will be written based on this guidance will contain a greater level of detail, and therefore more actions. Although it is not possible to predict what all of these actions will be, it is possible to identify certain actions that would need to be

> included in the EOPS and identify instruments required to support these actions. A team [AREVA NP staff] of personnel familiar with the EPR design and with experience that included plant operations, EOP generation and auditing EOPs for conformance to the TBD reviewed the list of instruments generated by the previous steps. Additional instrumentation was identified that would be required to perform actions that were required, but were either below the level of detail of the TBD, or driven by design features unique to the EPR design. As a result of this evaluation, Hot Leg Injection Flow and EFW [emergency feedwater] Pool Level WR [wide range] were added to the list of Post Accident Monitoring Instruments.

Based on the information in Document 51 and interview with the AREVA NP staff, the NRC staff concludes that the AREVA NP staff evaluation which resulted from the "team of personnel" which reviewed the list of instruments generated by the previous steps was adequate. The NRC staff finds that Audit Item 8 has been adequately addressed.

No follow-up actions are needed for Audit Item 8.

Audit Item 9 – Assessment of the selection and classification of the variables, to verify the list of Type B and Type C variables.

The AREVA NP staff indicated that information pertaining to the evaluation that was performed following selection and classification of the variables, to verify the list of Type B and Type C variables, is located in Document 51, Paragraph 5.2.5, "Gap Evaluation," which indicates the following:

> Following selection and classification of the variables, further evaluation was performed to ensure that the list of Type B and Type C variables provided complete monitoring coverage of critical safety functions and fission product barriers described in IEEE 497-2002 and Regulatory Guide 1.97 Revision 4.

AREVA NP staff provided clarification on what was meant by "gap analyses," which focused on Type B and C variables. AREVA NP indicated that the critical safety function was identified and fission product barriers and then determined what variables were needed for the fission product variable. In this way, AREVA NP staff was able to determine if a variable (from their earlier identification of variables) had been overlooked. AREVA NP staff discussed the example of looking at "fission product barrier" and it was through this analysis process that AREVA NP staff determined that it was appropriate to remove "annulus ventilation" from the list. The AREVA NP staff indicated that the U.S. EPR has two containment barriers; the first containment barrier is the primary barrier, and the second containment barrier is provided to address air impact concerns.

AREVA NP staff indicated that instruments were selected based on the credited manual operator actions as stated in U.S. EPR FSAR Tier 2, Section 15.0.0.3.7, as well as the review of the mitigation strategies in the B&W TBD. (The transient mitigation sections provide guidance to bring the plant to a safe and stable condition.). These instruments were then categorized using the criteria in IEEE Std 497-2002, which are the criteria for identifying the variables for accident monitoring. Once this was completed, the criteria were sorted by type and function/barrier. Then a review of the critical safety function (CSF) and fission product barrier (FPB) was performed and compared to the list to determine if there was a "gap" in the

monitoring of the CSFs or FPBs. The identified gaps were then reviewed to determine if additional instruments were needed to ensure they were adequately covered.

During the audit, AREVA NP staff stated that clarification would be provided regarding the meaning of "gap analysis" as well as a revision to U.S. EPR FSAR Tier 2, Section 7.5 as part of their response to RAI 505, Question 07.05-10. The NRC staff review of the RAI response is a separate action and is independent of this audit.

Based on the information in Document 51 and discussion with AREVA NP staff, the NRC staff concludes that evaluation performed following selection and classification of the variables, to verify the list of Type B and Type C variables, was adequate.

Other than the above action to clarify "gap analysis" in the response to RAI 505, Question 07.05-10, the NRC staff finds that no follow-up actions on the part of AREVA NP staff are needed in regard to Audit Item 9.

Audit Item 10 - Evaluation of the list of Type B variables to verify that all of the critical safety functions would be adequately monitored.

The AREVA NP staff indicated that information pertaining to the evaluation of the list of Type B variables to verify that all of the critical safety functions would be adequately monitored is located in Document 51, Paragraph 5.2.1. As stated previously, Paragraph 5.2.1 indicates:

> Each step of Volume 1 of the B&W Technical Bases Document was first evaluated to determine whether the action was applicable to the EPR design. Some actions in the TBD are not applicable due to differences in the respective designs. For example, actions to mitigate excessive tube to shell differential temperature are not applicable to the EPR design due to differences in the design of the steam generators. If the action was not applicable, it was eliminated from further consideration.

> Each remaining step was then evaluated to determine the minimum set of required instrumentation to support the action. The usage of each identified instrument in the context of the action specified was then characterized. These descriptions of the usage of the instrument were then compared to the definitions of the post accident monitoring variable types as described in IEEE 497-2002, and Regulatory Guide 1.97 Revision 4. If the usage of the instrument did not meet the definition of one of the variable types, it was not assigned a variable type.
>
> This resulted in a list of Type B and D variables based on their usage in the TBD. This list of instruments was then further evaluated to identify which of these instruments met the definition of Type C variables. Those variables which met these criteria were also classified as Type C variables.

The NRC staff finds the information obtained during discussion with AREVA NP staff regarding Audit Item 9 applicable to Audit Item 10, in that the AREVA NP staff indicated that they performed a review of the CSFs to determine if there was a "gap." The AREVA NP staff identified gaps were that were then reviewed to determine if additional instruments were needed to ensure they were adequately covered.

Based on discussion with AREVA NP staff, the NRC staff concludes that the evaluation of the list of Type B variables to verify that all of the critical safety functions would be adequately monitored, is adequate. The NRC staff finds that Audit Item 10 has been adequately addressed.

No follow-up actions are needed in regard to Audit Item 10.

Audit Item 11 - Evaluation of the list of Type C variables to ensure that all of the fission product barriers would be adequately monitored.

AREVA NP staff indicated that information pertaining to the evaluation of the list of Type C variables to ensure that all of the fission product barriers would be adequately monitored is located in Document 51, Paragraph 5.2.5.2, "Type C Variables." Paragraph 5.2.5.2 states:

> IEEE 497-2002 paragraph 4.3 describes Type C variables as those that provide primary information to the control room operators to indicate the potential for breach or the actual breach of the three fission product barriers: the fuel cladding, the reactor coolant system pressure boundary, and the containment pressure boundary. Each Type C variable was listed along with the fission product barrier that it monitored. This list was then evaluated in the aggregate to ensure that all of the fission product barriers would be adequately monitored by the list of Type C variables.
>
> Appendix B [Type B and Type C Variables Gap Evaluation Results] provides a discussion of the instrumentation supporting each fission product barrier.

Based on the information in Document 51 and discussion with AREVA NP staff, the NRC staff concludes that the evaluation of the list of Type C variables to ensure that all of the fission product barriers would be adequately monitored is adequate. Audit Item 11 has been adequately addressed.

No follow-up actions on the part of AREVA NP staff are needed in regard to Audit 11.

Additional Discussion

In addition to the above 11 Audit Items, the NRC Audit team and AREVA NP staff discussed the following:

- The U.S. EPR Technical Basis Document that is mentioned in the AREVA NP draft response to RAI 505 does not currently exist, and will not be created during the U.S. EPR licensing application process.

- The PAM function titles as seen in U.S.EPR Technical Specification (TS), Table 3.3.2-1, were different from the titles seen in Document 51. AREVA NP staff provided a comparison and reviewed with the NRC Audit team. AREVA NP staff also indicated they are planning on adding a placeholder for any site-specific PAM variables that may be created by the RCOL or SCOL applicant. AREVA NP agreed to update the differences identified with the Document 51 titles in the updated response to RAI 505, Questions 7.5-10 and 7.5-11. The NRC Audit team finds that no further action on this matter was needed during the audit. The NRC staff review of the RAI response is a separate action and is independent of this audit.

- The NRC Audit team requested an analysis comparing PAM variable lists for RG 1.97 Revision 3 for Pressurized Water Reactors (PWRs) and U.S. EPR FSAR Tier 2, Revision 3 Section 7.5, and Section 16.3.3. (This request is related to RAI 505, Question 07.05-10). AREVA NP staff provided an informal comparison of the tables, and reviewed with the team. The comparison did not result in identifying any additional PAM variables. The NRC Audit team finds that the AREVA NP staff adequately addressed this matter during the audit. The team concluded that no further action on this matter was needed during the audit.

- The reference combined license (RCOL) and subsequent combined operating license (SCOL) holder will review its plant-specific PAM list against the U.S. EPR FSAR PAM variable list, since it is only after the license is issued, that the RCOL or SCOL holder can write the emergency operating procedures (EOPs) and abnormal operating procedures (AOPs), in which the EOPs derive from the emergency procedure guidelines (EPGs). The U.S. EPR FSAR Tier 2, Section 7.5 description of conformance to RG 1.97, Revision 4 is not actually being followed in that the EOPs and AOPs have not been completed. (RG 1.97, Revision 4 endorses IEEE Std 497-2002 which indicates that PAM variables are determined after the completion of EOPs and AOPS). U.S. EPR FSAR Tier 2, Section 7.5 describes a process which is actually an alternative process for PAM variable determination, which includes a step-by-step evaluation of Volume 1 B&W TBD to identify required instrumentation, and the evaluation considered the differences in the U.S. EPR and the B&W plant designs. AREVA NP staff stated that they will provide a markup of U.S. EPR FSAR Tier 2, Section 7.5 as part of the response to RAI 505, Questions 07.05-10 and 07.05-11. The NRC Audit team finds that no further action on this matter was needed during the audit. The NRC staff review of the RAI response is a separate action and is independent of this audit.

V. Conclusion

The NRC Audit team concluded that the AREVA NP staff evaluations, as delineated in the discussion of the 11 audit items, which resulted in identification of the PAM variable list were adequate. AREVA NP agreed to include the following information as part of their response to RAI 505, Questions 07.05-10 and 07.05-11.

- Clarification on the meaning of “gap analysis” and a revision to U.S. EPR FSAR Tier 2, Section 7.5.

- Clarify the identified differences in U.S.EPR TS, Table 3.3.2-1 and the titles in Document 51.

- Clarify the alternative process for PAM variable determination in U.S. EPR FSAR Tier 2, Section 7.5.

The NRC staff evaluation of the RAI response is a separate staff action.

List of Documents Reviewed

Document Description
AREVA NP Document, 51-9044814-001, U.S. EPR Accident Monitoring Variables
AREVA NP Document, 74-1152414-10, Emergency Operating Procedures Technical Bases Document, Volume 1
U. S. EPR System Description Document: Radiation Monitoring System (RMS), 15-9037345-001
AREVA NP Staff Working Document Spreadsheet sorted by step number and by instrument

Appendix A

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