AREVA

June 16, 2010
NRC:10:030

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Response to U.S. EPR Design Certification Application RAI No. 339, Supplement 3

Ref. 1: E-mail, Getachew Tesfaye (NRC) to Ronda Pederson, et al (AREVA NP Inc.), "U.S. EPR Design Certification Application RAI No. 339 (4063, 4056), FSAR Ch .4 OPEN ITEM," January 8, 2010.

Ref. 2: E-mail, Leslie Duncan (AREVA NP Inc.) to Getachew Tesfaye (NRC) "Response to U.S. EPR Design Certification Application RAI No. 339, FSAR Ch .4 OPEN ITEM," February 19, 2010.

Ref. 3: E-mail, Martin Bryan (AREVA NP Inc.) to Getachew Tesfaye (NRC) "Response to U.S. EPR Design Certification Application RAI No. 339, FSAR Ch .4 OPEN ITEM, Supplement 1," March 22, 2010.

Ref. 4: E-mail, Martin Bryan (AREVA NP Inc.) to Getachew Tesfaye (NRC) "Response to U.S. EPR Design Certification Application RAI No. 339, FSAR Ch .4 OPEN ITEM, Supplement 2," April 30, 2010.

Ref. 5: E-mail, Martin Bryan (AREVA NP Inc.) to Getachew Tesfaye (NRC) " PROPRIETARY Draft Response to RAI 339 Supplement 2," May 18, 2010.

In Reference 1, the NRC provided a request for additional information (RAI) regarding the U.S. EPR design certification application (i.e., RAI No. 339). A schedule for responding to this RAI was provided in Reference 2. A revised schedule for responding to this RAI was provided in Reference 3. A second revised schedule was provided in Reference 4. A draft response to this RAI was provided in Reference 5, and discussed at the May 27, 2010 public meeting on Chapter 4 open item RAIs. Technically correct and complete responses to all questions in RAI No. 339 are enclosed with this letter.

The enclosed response consists of the following:

Question #	Start Page	End Page
RAI 339 — 04.02-17	2	2
RAI 339 — 04.05.02-09	3	3
RAI 339 — 04.05.02-10	4	4
RAI 339 — 04.05.02-11	5	5

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AREVA NP considers some of the material contained in the enclosure to be proprietary. As required by 10 CFR 2.390(b), an affidavit is enclosed to support the withholding of the information from public disclosure. Proprietary and non-proprietary versions of the enclosure to this letter are provided.

If you have any questions related to this submittal, please contact me by telephone at 434-832-2369 or by e-mail at sandra.sloan@areva.com.

Sincerely,

Darrell Gardner
for

Sandra M. Sloan, Manager
New Plants Regulatory Affairs
AREVA NP Inc.

Enclosures

cc: G. Tesfaye
Docket No. 52-020

AFFIDAVIT

COMMONWEALTH OF VIRGINIA)
) ss.
CITY OF LYNCHBURG)

1. My name is George L. Pannell. I am Manager, Product Licensing for AREVA NP Inc. and as such I am authorized to execute this Affidavit.

2. I am familiar with the criteria applied by AREVA NP to determine whether certain AREVA NP information is proprietary. I am familiar with the policies established by AREVA NP to ensure the proper application of these criteria.

3. I am familiar with the AREVA NP information contained in letter NRC:10:030, the enclosed "Response to U.S. EPR Design Certification Application RAI No. 339, Supplement 3" and referred to herein as "Document." Information contained in this Document has been classified by AREVA NP as proprietary in accordance with the policies established by AREVA NP for the control and protection of proprietary and confidential information.

4. This Document contains information of a proprietary and confidential nature and is of the type customarily held in confidence by AREVA NP and not made available to the public. Based on my experience, I am aware that other companies regard information of the kind contained in this Document as proprietary and confidential.

5. This Document has been made available to the U.S. Nuclear Regulatory Commission in confidence with the request that the information contained in this Document be withheld from public disclosure. The request for withholding of proprietary information is made in accordance with 10 CFR 2.390. The information for which withholding from disclosure is

requested qualifies under 10 CFR 2.390(a)(4) "Trade secrets and commercial or financial information".

6. The following criteria are customarily applied by AREVA NP to determine whether information should be classified as proprietary:

(a) The information reveals details of AREVA NP's research and development plans and programs or their results.

(b) Use of the information by a competitor would permit the competitor to significantly reduce its expenditures, in time or resources, to design, produce, or market a similar product or service.

(c) The information includes test data or analytical techniques concerning a process, methodology, or component, the application of which results in a competitive advantage for AREVA NP.

(d) The information reveals certain distinguishing aspects of a process, methodology, or component, the exclusive use of which provides a competitive advantage for AREVA NP in product optimization or marketability.

(e) The information is vital to a competitive advantage held by AREVA NP, would be helpful to competitors to AREVA NP, and would likely cause substantial harm to the competitive position of AREVA NP.

The information in the Document is considered proprietary for the reasons set forth in paragraph 6(d) above.

7. In accordance with AREVA NP's policies governing the protection and control of information, proprietary information contained in this Document has been made available, on a limited basis, to others outside AREVA NP only as required and under suitable agreement providing for nondisclosure and limited use of the information.

8. AREVA NP policy requires that proprietary information be kept in a secured file or area and distributed on a need-to-know basis.

9. The foregoing statements are true and correct to the best of my knowledge, information, and belief.

SUBSCRIBED before me on this 14th

day of June, 2010.

Sherry L. McFaden
NOTARY PUBLIC, COMMONWEALTH OF VIRGINIA
MY COMMISSION EXPIRES: 10/31/10
Reg. # 7079129

SHERRY L. MCFADEN
Notary Public
Commonwealth of Virginia
7079129
My Commission Expires Oct 31, 2010

Response to

Request for Additional Information No. 339, Supplement 3

01/08/2010

U.S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 04.02 - Fuel System Design
SRP Section: 04.05.02 - Reactor Internal and Core Support Structure Materials

Application Section: FSAR Chapter 4

QUESTIONS for Reactor System, Nuclear Performance and Code Review (SRSB)
QUESTIONS for Component Integrity, Performance, and Testing Branch 1 (AP1000/EPR Projects) (CIB1)

Question 04.02-17:

OPEN ITEM

Throughout the U.S. EPR Final Safety Analysis Report (FSAR) Tier 2, Section 4.2, AREVA NP refers to licensing topical report ANP-10285P, "U.S. EPR Fuel Assembly Mechanical Design Topical Report." This document is currently under review by the NRC staff. This RAI is created to track an open item associated with this review. It will be closed upon completion of the review by the NRC staff. AREVA is requested to acknowledge receipt of this open item.

Response to Question 04.02-17:

AREVA NP acknowledges receipt of this open item.

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

Question 04.05.02-9:

OPEN ITEM:

AREVA's response to RAI No. 50, Question 04.05.02-1 stated that Stellite 6 is used for hardfacing the Radial Key Inserts, Upper Core Plate Guide Pins and Inserts. Your response also lists the applicable ASME specifications for the Stellite 6 (ASME SFA5.21 Classification ERCCoCr-A, ASME SFA 5.21 Classification ERCoCr-A and ASME SFA5.13 Classification ECoCr-A) that could be used for weld deposition of the Stellite 6 onto the applicable components base material. The staff requests that the applicable ASME code specifications for the hardfacing material, Stellite 6, be included in the U.S. EPR FSAR, Tier 2, Table 4.5.2.

Response to Question 04.05.02-9:

U.S. EPR FSAR Tier 2, Table 4.5-2 will be revised to include the welding filler material specifications ASME SFA-5.21 ERCCoCr-A or ERCoCr-A and ASME SFA-5.13 ECoCr-A for Stellite 6 hardfacing materials.

FSAR Impact:

U.S. EPR FSAR Tier 2, Table 4.5-2 will be revised as described in the response and indicated on the enclosed markup.

Question 04.05.02-10:

OPEN ITEM:

In response to RAI No. 50, Question 04.05.02-4, your response stated that the reentrant corners of the heavy reflector are estimated to experience a peak 60-EFPY neutron fluence of 8.56×10^{22} n/cm^2 (E>1.0 MeV) which exceeds the threshold for IASCC and void swelling. Therefore, AREVA plans on participating in the industry EPRI/MRP programs to manage IASCC and void swelling to screen the heavy reflector for IASCC and void swelling. To verify that IASCC and void swelling does not impact the safety function of the heavy reflector or create loose parts, an augmented ASME Code, Section XI inspection program will be developed. Therefore, the staff requests that AREVA include in the U.S. EPR DCD, a license condition or a COL Action Item to address this issue.

Response to Question 04.05.02-10:

U.S. EPR FSAR Tier 2, Section 4.5.2.1 will be modified to include consideration of neutron fluence in design of the reactor internals and evaluation of the materials relative to susceptibility to known aging degradation mechanisms such as irradiation-assisted stress corrosion cracking and void swelling.

U.S. EPR FSAR Tier 2, Table 1.8-2 and Section 3.9.3 will be modified to also require the COL applicant to address reactor internals materials with regard to known aging degradation mechanisms such as irradiation assisted stress corrosion cracking and void swelling.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 3.9.3, Section 4.5.2-1, and Table 1.8-2 will be revised as described in the response and indicated on the enclosed markup.

Question 04.05.02-11:

OPEN ITEM:

AREVA's response to RAI No. 50, Question 04.05.02-2b did not address the staff's request for a discussion on the prevention of notches on the vertical keys and keyways that can act as stress concentrations and crack initiation sites, which could lead to the loss of function of the heavy reflector. Therefore, the staff requests a discussion on this topic.

Response to Question 04.05.02-11:

Under normal and upset conditions, the heavy reflector slabs are not subject to significant primary loads. Loading during these conditions is mainly attributable to the loading induced by the preload of [ ] tie rods which hold the heavy reflector assembly together and attach it to the lower support plate of the core barrel assembly and thermal loading (from both gamma heating and surrounding fluid temperature). The vertical keys within the heavy reflector assembly mainly provide lateral restraint between the heavy reflector slabs during faulted conditions; however, they may also be credited for vertical restraint during faulted conditions in conjunction with the tie rods. Specific configurations are evaluated with consideration of any notch affects (and associated stress concentration factors) to confirm that the structural and fatigue requirements of ASME Section III, Subsection NG are met as specified in U.S. EPR FSAR Tier 2, Section 3.9.5.2

The width of the vertical key is controlled for a distance [ ] above and below each of the heavy reflector slab interfaces to provide a clearance fit [ ]. The lateral restraint function of the vertical keys is provided only within these portions of the vertical keys. For the remainder of the vertical key length, greater clearances [ ] between the vertical keys and the heavy reflector slabs are provided. For the keyway within the heavy reflector slabs, the reentrant corners are provided with a small radius for the full length of the keyway to preclude sharp notches.

Each end of the vertical keys is configured with a 'T' connection where the width is increased to engage with the upper and lower heavy reflector slabs for the vertical restraint function. During assembly, a gap is provided between the vertical keys and the lower slab so that vertical keys / heavy reflector slabs are not subjected to tensile loading in the vertical direction during normal operation. Within the keyway opening in the upper and lower slabs, a small radius is provided for all reentrant corners to preclude sharp notches.

FSAR Impact:

U.S. EPR FSAR, Tier 2, Section 3.9.5.1.2.7 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

Table 1.8-2—U.S. EPR Combined License Information Items
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Item No.	Description	Section	~~Action Required by COL Applicant~~	~~Action Required by COL Holder~~
3.8-12	A COL applicant that references the U.S. EPR design certification will describe the program to examine inaccessible portions of below-grade concrete structures for degradation and monitoring of groundwater chemistry.	3.8.5.7	~~Y~~	
3.8-13	A COL applicant that references the U.S. EPR design certification will identify if any site-specific settlement monitoring requirements are required for Seismic Category I foundations based on site-specific soil conditions.	3.8.5.7	~~Y~~	
3.8-14	A COL applicant that references the U.S. EPR design certification will describe the design and analysis procedures used for buried conduit and duct banks, and buried pipe and pipe ducts.	3.8.4.4.5	~~Y~~	
3.8-15	A COL applicant that references the U.S. EPR design certification will use results from site-specific investigations to determine the routing of buried pipe and pipe ducts.	3.8.4.4.5	~~Y~~	
3.8-16	A COL applicant that references the U.S. EPR design certification will perform geotechnical engineering analyses to determine if the surface load will cause lateral and/or vertical displacement of bearing soil for the buried pipe and pipe ducts and consider the effect of wide or extra heavy loads.	3.8.4.4.5	~~Y~~	
3.9-1	A COL applicant that references the U.S. EPR design certification will submit the results from the vibration assessment program for the U.S. EPR RPV internals, in accordance with RG 1.20.	3.9.2.4		~~Y~~
3.9-2	A COL applicant that references the U.S. EPR design certification will prepare the design specifications and design reports for ASME Class 1, 2, and 3 components, piping, supports and core support structures that comply with and are certified to the requirements of Section III of the ASME Code.	3.9.3		~~Y~~

Table 1.8-2—U.S. EPR Combined License Information Items
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04.05.02-10

Item No.	Description	Section	~~Action Required by COL Applicant~~	~~Action Required by COL Holder~~
	The COL applicant will address the results and conclusions from the reactor internals material reliability programs applicable to the U.S. EPR reactor internals with regard to known aging degradation mechanisms such as irradiation-assisted stress corrosion cracking and void swelling.			
3.9-3	A COL applicant that references the U.S. EPR design certification will examine the feedwater line welds after hot functional testing prior to fuel loading and at the first refueling outage, in accordance with NRC Bulletin 79-13. A COL applicant that references the U.S. EPR design certification will report the results of inspections to the NRC, in accordance with NRC Bulletin 79-13.	3.9.3.1.1		~~Y~~
3.9-4	As noted in ANP-10264NP-A, a COL applicant that references the U.S. EPR design certification will confirm that thermal deflections do not create adverse conditions during hot functional testing.	3.9.3.1.1		~~Y~~
3.9-5	As noted in ANP-10264NP-A, should a COL applicant that references the U.S. EPR design certification find it necessary to route Class 1, 2, and 3 piping not included in the U.S. EPR design certification so that it is exposed to wind and tornadoes, the design must withstand the plant design-basis loads for this event.	3.9.3.1.1	~~Y~~	
3.9-6	A COL applicant that references the US EPR design certification will identify any additional site-specific valves in Table 3.9.6-2 to be included within the scope of the IST program.	3.9.6.3	~~Y~~	
3.9-7	A COL applicant that references the U.S. EPR design certification will submit the preservice testing (PST) program and IST program for pumps, valves, and snubbers as required by 10 CFR 50.55a.	3.9.6		~~Y~~

This section refers to U.S. EPR Piping Analysis and Pipe Support Design Topical Report (~~Reference 2~~References 2 and 7) for information related to the design and analysis of safety-related piping. This topical report presents the U.S. EPR code requirements, acceptance criteria, analysis methods, and modeling techniques for ASME Class 1, 2, and 3 piping and pipe supports. Applicable COL action items in the topical report are identified in the applicable portions of this section. The U.S. EPR design is based on the 2004 ASME Code, Section III, Division 1, with no addenda subject to the limitations and modification identified in 10 CFR 50.55a(b)(1) and the piping analysis criteria and methods, modeling techniques, and pipe support criteria described in ~~Reference 2~~References 2 and 7.

04.05.02-10

A design specification is required by Section III of the ASME Code for Class 1, 2, and 3 components, piping, supports, and core support structures. In addition, the ASME Code requires design reports for all Class 1, 2, and 3 components, piping, supports and core support structures documenting that the as-designed and as-built configurations adhere to the requirements of the design specification. A COL applicant that references the U.S. EPR design certification will prepare the design specifications and design reports for ASME Class 1, 2, and 3 components, piping, supports and core support structures that comply with and are certified to the requirements of Section III of the ASME Code. The COL applicant will address the results and conclusions from the reactor internals material reliability programs applicable to the U.S. EPR reactor internals with regard to known aging degradation mechanisms such as irradiation-assisted stress corrosion cracking and void swelling addressed in Section 4.5.2.1.

Other sections that relate to this section are described below:

- Section 3.9.6 describes the snubber inspection and test program.
- Section 3.10 describes the methods and criteria for seismic qualification testing of Seismic Category I mechanical equipment and a description of their seismic operability criteria.
- Section 3.12 describes the design of systems and components that interface with the RCS with regard to intersystem LOCAs.
- Section 3.13 describes bolting and threaded fastener adequacy and integrity.
- Section 5.2.2 describes the pressure-relieving capacity of the valves specified for RCPB.
- Section 10.3 describes the pressure-relieving capacity of the valves specified for the steam and feedwater systems.

3.9.3.1 Loading Combinations, System Operating Transients, and Stress Limits

Section 3.9.3.1.1 describes the design and service level loadings used for the design of ASME Class 1, 2, and 3 components, piping, supports, and core support structures,

3.9.5.1.2.6 Flow Distribution Device

The flow distribution device is located below, and attached to, the LSP. The flow distribution device is composed of a distribution plate and support columns. The flow distribution device provides a homogeneous flow distribution between the LSP holes.

3.9.5.1.2.7 Heavy Reflector

04.05.02-11

The heavy reflector is located inside the core barrel between the core and core barrel shells. The heavy reflector increases neutron efficiency due to its neutron reflective properties, protects the RPV from radiation-induced embrittlement, improves the long-term mechanical behavior of the lower internals, and provides lateral support to maintain the geometry of the core. To avoid any welded or bolted connections close to the core, the heavy reflector consists of stacked slabs positioned one above the other (see Figure 3.9.5-3—Reactor Pressure Vessel Heavy Reflector). The heavy reflector rests on the LSP, but does not contact the UCP. The internal contour of the slabs conforms to the core, while the external contour is cylindrical. The top slab is fitted with alignment pins that extend through the UCP to provide proper alignment. Vertical keys are installed into keyways machined into the external contour of the slabs to provide additional lateral and vertical restraint. The reentrant corners of the keyways within the slabs are provided with a small radius.

Since the heavy reflector is located between the core and the core barrel, it limits the core bypass flow at the core periphery. It also provides lateral support to the core and contributes to the decrease of neutron fluence on the RPV inner wall.

Additional information on the heavy reflector is provided in 4.3Nuclear Design.

3.9.5.1.3 Upper Internals

The upper internals are shown in Figure 3.9.5-4—Reactor Pressure Vessel Upper Internals, and are described in further detail below. The primary functions of the upper internals are:

- Support, locate, restrain, protect, and guide the core components.
- Direct the coolant flow from the core outlet to the RPV outlet nozzles.
- Permit core loading, unloading, and reloading.
- Support, align, and protect the rod cluster control assemblies (RCCAs).
- Guide, support, and protect the incore instrumentation.

The upper internals consist of the:

- Upper support assembly (including the flange, shell, and USP).

4.5.2.1 Materials Specifications

The major components for the reactor internals are fabricated from austenitic stainless steel except for the hold-down spring, which is made from martensitic stainless steel and pins and inserts which are coated with Stellite 6 or equivalent which is a cobalt alloy. The materials specifications for the reactor internals and core support materials including weld filler materials are listed in Table 4.5-2—Reactor Vessel Internal Materials, which includes the use of ASME Code Case N-60-5 which is listed as an acceptable code case under RG 1.84. There are no other materials used in the reactor internals or core support structures that are not otherwise allowed under ASME Code, Section III, Subsection NG-2120 (Reference 4). Reactor internals and core support structure weld filler materials are specified in ASME BPV Code, Section II (Reference 2) which is in accordance with GDC 1 and 10 CFR 50.55(a).

04.05.02-10

Design of the reactor internals considers the estimated peak neutron fluence to which the materials may be subjected. The reactor internals materials are evaluated for susceptibility to known aging degradation mechanisms such as irradiation-assisted stress corrosion cracking and void swelling that have been identified in current operating pressurized water reactors and are being addressed in the reactor internals material reliability programs.

4.5.2.2 Controls on Welding

The controls on welding of austenitic stainless steel pressure boundary components provided in Section 5.2.3 apply to the welding of reactor internals and core support components. When Section 5.2.3 is applied to the reactor internals and core support materials, ASME BPV Code, Section III (Reference 4) applies as in accordance with GDC 1 and 10 CFR 50.55(a).

4.5.2.3 Nondestructive Examination

Nondestructive examination (NDE) of base materials is in accordance with ASME Code Section III, Division I, NG-2500 (Reference 4). The NDE methods and acceptance criteria for welds are in accordance with the requirements of the ASME Code Section III, Division 1, NG-5000 (Reference 4) and GDC 1 and 10 CFR 50.55(a).

4.5.2.4 Fabrication and Processing of Austenitic Stainless Steel Components

The details provided in Section 5.2.3 concerning the processing, inspections, and tests on unstabilized austenitic stainless steel components to minimize susceptibility to intergranular corrosion caused by sensitization are applicable to the austenitic stainless steel materials used in the reactor internals and core support structures. Section 5.2.3 verifies compliance of reactor internals and core support structures with RG 1.44. The reactor internals and core support structures are fabricated from low carbon austenitic stainless steels which are heat treated in accordance with RG 1.44 to minimize their

Table 4.5-2—Reactor Vessel Internal Materials

Component	Material Specifications
Lower Internals Assembly	ASME SA-182 Grade F304~~LN~~ (see Notes 1&2) ASME SA-336 Grade F304~~LN~~ (see Notes 1&2) ASME SA-240 Type 304~~LN~~ (see Notes 1&2) ASME SA-479 Type 304~~LN~~ (see Notes 1&2) ASME SA-479 Type 316 Strain Hardened Level 1 (Code Case N-60-5) Carbon content shall be 0.03 wt% or less ASME SB-168 UNS-N06690 ASME SB-637 UNS-N07750, Type 2 Stellite 6 (see Note 3) or equivalent (hard facing)
Upper Internals Assembly	ASME SA-182 Grade F304~~LN~~ (see Notes 1&2) ASME SA-376 Grade TP304~~LN~~ (see Notes 1&2) ASME SA-240 Type 304~~LN~~ (see Notes 1&2) ASME SA-479 Type 304~~LN~~ (see Notes 1&2) ASME SA-479 Type 316 Strain Hardened Level 1 (Code Case N-60-5) Carbon content shall be 0.03 wt% or less Stellite 6 (see Note 3) or equivalent (hard facing)
Heavy Reflector	ASME SA-336 Grade F304~~N~~ (see Notes 1&2) ASME SA-240 Type 304~~LN~~ (see Notes 1&2) ASME SA-336 Grade F304~~LN~~ (see Notes 1&2) ASME SA-479 Type 304~~LN~~ (see Notes 1&2) ASME SA-479 Type 316 Strain Hardened Level 1 (Code Case N-60-5) Carbon content shall be 0.03 wt% or less Stellite 6 (see Note 3) or equivalent (hard facing)
Control Rod Guide Assembly	ASME SA-182 Grade F304~~LN~~ (see Notes 1&2) ASME SA-240 Type 304~~LN~~ (see Notes 1&2) ASME SA-479 Type 304~~LN~~ (see Notes 1&2) ASME SA-376 Grade TP304~~LN~~ (see Notes 1&2)
Hold Down Spring	ASME SA-182 Grade F6NM
Reactor Vessel Internals Welds	Type 308L/309L/316L austenitic stainless steel per SFA 5.4, 5.9, or 5.22

04.05.02-9

Notes:

1. Solution annealed and rapidly cooled.
2. Carbon content not exceeding 0.03 wt%.
3. ASME SFA-5.21 ERCCoCr-A or ERCoCr-A, ASME SFA-5.13 ECoCr-A.

04.05.02-10

Next File