ArevaEPRDCPEm Resource

From:	BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]
Sent:	Thursday, July 29, 2010 7:40 PM
To:	Tesfaye, Getachew
Cc:	DELANO Karen (AREVA); BENNETT Kathy (AREVA); ROMINE Judy (AREVA); CORNELL Veronica (EXTERNAL AREVA)
Subject:	Response to U.S. EPR Design Certification Application RAI No. 354, FSAR Ch. 3, Supplement 4
Attachments:	RAI 354 Supplement 4 Response US EPR DC - Public.pdf

Getachew,

AREVA NP Inc. (AREVA NP) provided a response to 1 of the 22 questions of RAI No. 354 on April 15, 2010, and a schedule for the remaining 21 questions. AREVA NP submitted Supplement 1 on June 3, 2010, to provide a schedule for the remaining 21 questions. Supplement 2 was submitted on June 24, 2010, and included a revised schedule for Questions 03.08.02-11, 12, 13, 14, 15, 16; 03.08.05-22 and 03.08.05-23. AREVA NP submitted Supplement 3 on July 7, 2010, responding to 1 of the remaining 21 questions.

The attached file, "RAI 354 Supplement 4 Response U.S. EPR DC.pdf" provides technically correct and complete responses to Questions 03.06.02-32, 03.06.02-41, and 03.08.02-16. Because the response file contains security-related sensitive information that should be withheld from public disclosure in accordance with 10 CFR 2.390, a public version is provided with the security-related sensitive information redacted. This email and attached file do not contain any security-related information. An unredacted security-related version is provided under separate email.

The schedules for Questions 03.06.02-33 through 03.06.02-40 are being revised to allow additional time for AREVA NP to address NRC comments. The schedule for the remaining 9 questions is unchanged.

The following table indicates the respective pages in the response document, "RAI 354 Supplement 4 Response U.S. EPR DC," that contain the AREVA NP response to the subject questions.

Question #	Start Page	End Page
RAI 354 - 03.06.02-32	2	3
RAI 354 - 03.06.02-41	4	6
RAI 354 – 03.08.02-16	7	7

The revised schedule for the technically correct and complete responses to the remaining questions is provided below.

Question #	Response Date
RAI 354 - 03.08.02-11	August 31, 2010
RAI 354 - 03.08.02-12	August 31, 2010
RAI 354 - 03.08.02-13	August 31, 2010
RAI 354 - 03.08.02-14	August 31, 2010
RAI 354 - 03.08.02-15	August 31, 2010
RAI 354 - 03.08.05-21	September 8, 2010
RAI 354 - 03.08.05-22	January 13, 2011
RAI 354 - 03.08.05-23	August 10, 2010
RAI 354 - 03.06.02-33	November 18, 2010
RAI 354 - 03.06.02-34	November 18, 2010
RAI 354 - 03.06.02-35	November 18, 2010

Question #	Response Date
RAI 354 - 03.06.02-36	November 18, 2010
RAI 354 - 03.06.02-37	November 18, 2010
RAI 354 - 03.06.02-38	November 18, 2010
RAI 354 - 03.06.02-39	November 18, 2010
RAI 354 - 03.06.02-40	November 18, 2010
RAI 354 - 03.06.02-42	August 5, 2010

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
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Martin.Bryan.ext@areva.com

From: BRYAN Martin (EXT)
Sent: Wednesday, July 07, 2010 5:27 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); CORNELL Veronica (EXT); VAN NOY Mark (EXT)
Subject: Response to U.S. EPR Design Certification Application RAI No. 354, FSAR Ch. 3, Supplement 3

Getachew,

AREVA NP Inc. (AREVA NP) provided a response to 1 of the 22 questions of RAI No. 354 on April 15, 2010, and a schedule for the remaining 21 questions. AREVA NP submitted Supplement 1 on June 3, 2010, to provide a schedule for the remaining 21 questions.

On June 9, 2010, AREVA NP submitted draft Supplement 2 responses to questions 03.08.05-20, 03.08.05-21, 03.06.02-32, 03.06.02-41 and 03.06.02-42. Supplement 2 was submitted on June 24, 2010, and included a revised schedule to reflect the civil/structural re-planning activities and time allowance to interact with the NRC on the responses for 03.08.02-11, 12, 13, 14, 15, 16; 03.08.05-22 and 03.08.05-23.

The attached file, "RAI 354 Response U.S. EPR DC.pdf" provides a technically correct and complete response to Question 03.08.05-20.

The schedule for Question 03.08.05-21 is being revised to accommodate development of a revised response and to allow time to interact with the NRC on the response. The schedule for Questions 03.06.02-32, 03.06.02-41 and 03.06.02-42 is also being revised to provide additional time to interact with the NRC on the responses. The schedule for the remaining 16 questions is unchanged.

The following table indicates the respective pages in the response document, "RAI 354 Response U.S. EPR DC," that contain the AREVA NP response to the subject questions.

Question #	Start Page	End Page
RAI 354 — 03.08.05-20	2	3

The revised schedule for the technically correct and complete responses to the remaining questions is provided below.

Question #	Response Date
RAI 354 - 03.08.02-11	August 31, 2010
RAI 354 - 03.08.02-12	August 31, 2010
RAI 354 - 03.08.02-13	August 31, 2010
RAI 354 - 03.08.02-14	August 31, 2010
RAI 354 - 03.08.02-15	August 31, 2010
RAI 354 - 03.08.02-16	August 10, 2010
RAI 354 - 03.08.05-21	September 8, 2010
RAI 354 - 03.08.05-22	January 13, 2011
RAI 354 - 03.08.05-23	August 10, 2010
RAI 354 - 03.06.02-32	August 5, 2010
RAI 354 - 03.06.02-33	July 30, 2010
RAI 354 - 03.06.02-34	July 30, 2010
RAI 354 - 03.06.02-35	July 30, 2010
RAI 354 - 03.06.02-36	July 30, 2010
RAI 354 - 03.06.02-37	July 30, 2010
RAI 354 - 03.06.02-38	July 30, 2010
RAI 354 - 03.06.02-39	July 30, 2010
RAI 354 - 03.06.02-40	July 30, 2010
RAI 354 - 03.06.02-41	August 5, 2010
RAI 354 - 03.06.02-42	August 5, 2010

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
Tel: (434) 832-3016
702 561-3528 cell
Martin.Bryan.ext@areva.com

From: BRYAN Martin (EXT)
Sent: Thursday, June 24, 2010 12:29 PM
To: 'Tesfaye, Getachew'
Cc: ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); CORNELL Veronica (EXT); VAN NOY Mark (EXT); RYAN Tom (AREVA NP INC); GARDNER George Darrell (AREVA NP INC); DELANO Karen V (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 354, FSAR Ch. 3, Supplement 2

Getachew,

AREVA NP Inc. (AREVA NP) provided a response to 1 of the 22 questions of RAI No. 354 on April 15, 2010, and a schedule for the remaining 21 questions. AREVA NP submitted Supplement 1 to the response on June 3, 2010, to provide a schedule for the remaining 21 questions, one of which was affected by the work underway to address NRC comments from the April 26, 2010, audit.

Based upon the civil/structural re-planning activities and revised RAI response schedule presented to the NRC during the June 9, 2010, Public Meeting, and to allow time to interact with the NRC on the responses, the schedule for questions 03.08.02-11, 12, 13, 14, 15, 16, 03.08.05-22 and 03.08.05-23 has been changed. The schedule for the remaining 13 questions remains unchanged.

The revised schedule for the technically correct and complete response to these questions is provided below.

Question #	Response Date
RAI 354 - 03.08.02-11	August 31
RAI 354 - 03.08.02-12	August 31
RAI 354 - 03.08.02-13	August 31
RAI 354 - 03.08.02-14	August 31
RAI 354 - 03.08.02-15	August 31
RAI 354 - 03.08.02-16	August 10, 2010
RAI 354 - 03.08.05-20	July 7, 2010
RAI 354 - 03.08.05-21	July 7, 2010
RAI 354 - 03.08.05-22	January 13, 2011
RAI 354 - 03.08.05-23	August 10, 2010
RAI 354 - 03.06.02-32	July 7, 2010
RAI 354 - 03.06.02-33	July 30, 2010
RAI 354 - 03.06.02-34	July 30, 2010
RAI 354 - 03.06.02-35	July 30, 2010
RAI 354 - 03.06.02-36	July 30, 2010
RAI 354 - 03.06.02-37	July 30, 2010
RAI 354 - 03.06.02-38	July 30, 2010
RAI 354 - 03.06.02-39	July 30, 2010
RAI 354 - 03.06.02-40	July 30, 2010
RAI 354 - 03.06.02-41	July 7, 2010
RAI 354 - 03.06.02-42	July 7, 2010

Sincerely,

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Martin.Bryan.ext@areva.com

From: BRYAN Martin (EXT)
Sent: Thursday, June 03, 2010 6:39 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); VAN NOY Mark (EXT); CORNELL Veronica (EXT)
Subject: Response to U.S. EPR Design Certification Application RAI No. 354, FSAR Ch. 3, Supplement 1

Getachew,

AREVA NP Inc. (AREVA NP) provided a response to 1 of the 22 questions of RAI No. 354 on April 15, 2010, and a schedule for the remaining 21 questions. The schedule for questions 03.08.02-11 through 15 is not being changed by this supplement. To allow time to interact with the NRC, the schedule for 16 questions is being changed. The date provided below for question 03.08.05-22 will be revised based on the information that will be presented at the June 9, 2010 public meeting and subsequent NRC feedback.

Question #	Response Date
RAI 354 - 03.08.02-11	July 30, 2010
RAI 354 - 03.08.02-12	July 30, 2010
RAI 354 - 03.08.02-13	July 30, 2010
RAI 354 - 03.08.02-14	July 30, 2010
RAI 354 - 03.08.02-15	July 30, 2010
RAI 354 - 03.08.02-16	July 30, 2010
RAI 354 - 03.08.05-20	July 7, 2010
RAI 354 - 03.08.05-21	July 7, 2010
RAI 354 - 03.08.05-22	July 30, 2010
RAI 354 - 03.08.05-23	July 30, 2010
RAI 354 - 03.06.02-32	July 7, 2010
RAI 354 - 03.06.02-33	July 30, 2010
RAI 354 - 03.06.02-34	July 30, 2010
RAI 354 - 03.06.02-35	July 30, 2010
RAI 354 - 03.06.02-36	July 30, 2010
RAI 354 - 03.06.02-37	July 30, 2010
RAI 354 - 03.06.02-38	July 30, 2010
RAI 354 - 03.06.02-39	July 30, 2010
RAI 354 - 03.06.02-40	July 30, 2010
RAI 354 - 03.06.02-41	July 7, 2010
RAI 354 - 03.06.02-42	July 7, 2010

Sincerely,

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From: BRYAN Martin (EXT)
Sent: Thursday, April 15, 2010 5:46 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); VAN NOY Mark (EXT)
Subject: Response to U.S. EPR Design Certification Application RAI No. 354, FSAR Ch. 3

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 354 Response US EPR DC.pdf" provides technically correct and complete responses to 1 of the 22 questions.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 354 Question 03.08.05-19.

The following table indicates the respective pages in the response document, “RAI 354 Response US EPR DC.pdf,” that contain AREVA NP’s response to the subject questions.

Question #	Start Page	End Page
RAI 354 - 03.08.02-11	2	2
RAI 354 - 03.08.02-12	3	3
RAI 354 - 03.08.02-13	4	4
RAI 354 - 03.08.02-14	5	5
RAI 354 - 03.08.02-15	6	6
RAI 354 - 03.08.02-16	7	7
RAI 354 - 03.08.05-19	8	8
RAI 354 - 03.08.05-20	9	9
RAI 354 - 03.08.05-21	10	10
RAI 354 - 03.08.05-22	11	11
RAI 354 - 03.08.05-23	12	12
RAI 354 - 03.06.02-32	13	13
RAI 354 - 03.06.02-33	14	14
RAI 354 - 03.06.02-34	15	15
RAI 354 - 03.06.02-35	16	16
RAI 354 - 03.06.02-36	17	17
RAI 354 - 03.06.02-37	18	18
RAI 354 - 03.06.02-38	19	19
RAI 354 - 03.06.02-39	20	20
RAI 354 - 03.06.02-40	21	21
RAI 354 - 03.06.02-41	22	22
RAI 354 - 03.06.02-42	23	24

A complete answer is not provided for 21 of the 22 questions. The schedule for a technically correct and complete response to these questions is provided below.

Question #	Response Date
RAI 354 - 03.08.02-11	July 30, 2010
RAI 354 - 03.08.02-12	July 30, 2010
RAI 354 - 03.08.02-13	July 30, 2010
RAI 354 - 03.08.02-14	July 30, 2010
RAI 354 - 03.08.02-15	July 30, 2010
RAI 354 - 03.08.02-16	June 3, 2010
RAI 354 - 03.08.05-20	June 3, 2010
RAI 354 - 03.08.05-21	June 3, 2010
RAI 354 - 03.08.05-22	June 3, 2010
RAI 354 - 03.08.05-23	June 3, 2010
RAI 354 - 03.06.02-32	June 3, 2010
RAI 354 - 03.06.02-33	June 3, 2010
RAI 354 - 03.06.02-34	June 3, 2010
RAI 354 - 03.06.02-35	June 3, 2010
RAI 354 - 03.06.02-36	June 3, 2010
RAI 354 - 03.06.02-37	June 3, 2010
RAI 354 - 03.06.02-38	June 3, 2010
RAI 354 - 03.06.02-39	June 3, 2010
RAI 354 - 03.06.02-40	June 3, 2010

RAI 354 - 03.06.02-41	June 3, 2010
RAI 354 - 03.06.02-42	June 3, 2010

Sincerely,

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Licensing Advisory Engineer
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Martin.Bryan.ext@areva.com

From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Tuesday, March 16, 2010 12:29 PM
To: ZZ-DL-A-USEPR-DL
Cc: Xu, Jim; Hawkins, Kimberly; Ng, Ching; Dixon-Herrity, Jennifer; Miernicki, Michael; Patel, Jay; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 354 (4106,4107,4220), FSAR Ch. 3

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on January 8, 2010, and discussed with your staff on February 25, 2010. Drat RAI Questions 03.08.05-23 was modified as a result of that discussion. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,
Getachew Tesfaye
Sr. Project Manager
NRO/DNRL/NARP
(301) 415-3361

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 1755

Mail Envelope Properties (BC417D9255991046A37DD56CF597DB71070A9333)

Subject: Response to U.S. EPR Design Certification Application RAI No. 354, FSAR Ch. 3, Supplement 4
Sent Date: 7/29/2010 7:39:51 PM
Received Date: 7/29/2010 7:39:55 PM
From: BRYAN Martin (EXTERNAL AREVA)

Created By: Martin.Bryan.ext@areva.com

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"DELANO Karen (AREVA)" <Karen.Delano@areva.com>
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Tracking Status: None
"CORNELL Veronica (EXTERNAL AREVA)" <Veronica.Cornell.ext@areva.com>
Tracking Status: None
"Tesfaye, Getachew" <Getachew.Tesfaye@nrc.gov>
Tracking Status: None

Post Office: AUSLYNCMX02.adom.ad.corp

Files	Size	Date & Time
MESSAGE	14676	7/29/2010 7:39:55 PM
RAI 354 Supplement 4 Response US EPR DC - Public.pdf	84788	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

Response to

Request for Additional Information No. 354, Supplement 4

3/16/2010

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 03.08.02 - Steel Containment
SRP Section: 03.08.05 - Foundations
SRP Section: 03.06.02 - Determination of Rupture Locations and Dynamic Effects Associated with the Postulated Rupture of Piping

Application Section: FSAR Ch 3

QUESTIONS for Structural Engineering Branch 2 (ESBWR/ABWR Projects) (SEB2)

Question 03.08.02-16

Follow-up to RAI 155, Question No. 03.08.02-10

For the staff to complete its assessment of the containment structure, the design details and methods of qualification for the seals on the equipment hatch and the air locks need to be reviewed. The staff requests that the applicant submit the following information for the seals of the equipment hatch and the airlocks:

(1) the material(s) of construction and detailed geometry;

(2) a description of the vendor qualification tests that will be conducted; and

(3) a description of the in-situ tests that will be conducted prior to operation.

This information should also be included in FSAR Section 3.8.2.

Response to Question 03.08.02-16

The seals for the airlocks and for the equipment hatch have a similar design concept. Both use an elastomeric material, which is compressed by the action of the mechanical closure devices associated with each of the components. This material is selected based on its ability to maintain elasticity at elevated temperatures for extended durations, and because it conforms to the NUREG/CR-5096 guidance for the materials tested for severe accident conditions.

This material (double seals) will be recessed into two concentric grooves around the perimeter of the airlock doors, around the equipment hatch flange, and around the equipment hatch penetration mating flange. The material is attached to the grooves of the airlocks using a silicone adhesive sealant. Seal clamps in the seal housing maintain the equipment hatch in position in the grooves of the penetration flange.

Testing is conducted to verify the seal performance in normal operation conditions, and for temperature and pressure conditions associated with a loss of coolant accident.

The vendor qualification tests will be performed by pressurizing the space within the two seals and then measuring the pressure losses in this volume over a testing time period. Data from this test is evaluated to determine if the leak rate observed meets the acceptance criteria for the leakage rate or if remedial actions are required.

In-situ testing of the equipment hatch and airlocks will be performed in a manner similar to the factory tests. Once the equipment is installed in containment, the air space between the two seals will be continuously under a negative pressure provided by connection to the leak-off system. This system will also be used to pressurize the air space between the seals for future testing operations.

U.S. EPR FSAR Tier 2, Sections 3.8.2.1.1, 3.8.2.4.1, 3.8.2.6, 3.8.2.7, and 3.8.6 will be updated to include this information.

FSAR Impact:

U.S. EPR FSAR Tier 2, Sections 3.8.2.1.1, 3.8.2.4.1, 3.8.2.6, 3.8.2.7, and 3.8.6 will be revised to include additional information as described in the above response and indicated on the enclosed markup.

Question 03.06.02-32:

Follow-up to RAI 222, Question No. 03.06.02-20 and RAI 107, Question No. 03.06.02-2

The response from AREVA concerning RAI 222, 03.06.02-20 is not adequate. In the response, AREVA revised the EPR FSAR Tier 2 Section 3.6.2.1.1.4 to discuss how the US EPR design and the separation and redundancy method are used to mitigate the effects of pipe rupture of high energy lines.

i) It is not clear to the staff how AREVA is intended to apply the method of separation and redundancy. The applicant is requested to clarify whether the separation and redundancy method is used

   a) when the source of the postulated pipe failure is one of the essential systems that is separated and redundant.

   b) when the target of the postulated pipe failure is one of the essential systems that is separated and redundant

ii) In particular, the revised FSAR indicated that "For outside containment, each redundant train is located in one of four separate Safeguard Buildings. For inside containment, this separation is often accomplished by separate compartments/rooms." It is not clear if there are cases where they are not separated by compartments inside the containment. AREVA should clarify what it meant by “often” or remove the word "often". AREVA should also clarify if these compartments and rooms are capable of resisting the effect of pipe whip and mitigating the extreme environmental effects resulting from a pipe break in the U.S. EPR. The applicant is requested to revise FSAR 3.6.2.1.1.4 to clarify aforementioned issues.

iii) AREVA stated in its response that the system train redundancy and separation of trains of essential systems are key to mitigating the effects of pipe breaks. It also stated that many essential systems are designed with 4 redundant trains, with each train capable of performing the system’s safety function. It is not clear to the staff whether each train is capable of performing 100 percent of the system's function when the separation and redundancy method is used. It is also not clear if there are still other essential systems, in addition to the "many essential systems", which may not have this separation/redundancy characteristic. The applicant is requested to address the above staff concerns.

Response to Question 03.06.02-32:

Subpart (i) to this question asks for clarification as to when the method of separation and redundancy is used, and specifically asks if the method will be used when the source is a separated and redundant essential system, or when the target is in a separated and redundant essential system.

A key point about the use of four train separation and redundancy is that it is used as a tool for evaluating the effects of breaks on essential structures, systems and components (SSC) targets. It is not used to preclude the need for break postulation and subsequent evaluation. Therefore, it doesn’t matter if the break is in essential system piping or in non-essential system piping, as long as all essential system elements impacted by the break are evaluated. The effects of either type of break are evaluated on a case-by-case basis to evaluate the capability for safe shutdown of the plant following the break. This was discussed in the third bullet of the Response to RAI 222, Supplement 3, Question 03.06.02-20, which stated:

> "If the targets are within the same train of four train redundant systems (including the broken pipe, if it is also within an essential system), then the survivability of the systems' safety functions is confirmed without the need for further target analysis or protection considerations."

To provide further clarification to U.S. EPR FSAR Tier 2, Section 3.6.2.1.1.4, the following sentence will be added to the end of the first paragraph, as shown on the attached markup:

> "Since not all essential systems have four completely separated and redundant trains capable of performing the system's safety function, all ruptures must be evaluated with the four train separation and redundancy concept providing a useful evaluation tool, where it is available."

Note that this also provides clarification for question subparts (ii) and (iii)

Subpart (ii) to this question asked for clarification of the sentence "Inside containment, this separation is often accomplished by separate compartments/rooms used for individual trains." The use of the word "often" required clarification. Also, it was asked if compartments and rooms were capable of resisting the effects of the break in order to maintain separation.

The use of the word "often" in the subject sentence was by design since inside containment, even for four train redundant systems, it is not always possible to show complete separation of the trains. There are a number of areas, however, where the trains are completely separated by the use of four separate compartments or rooms. Thus, for clarification, the sentence will be modified to state "often, but not always" as shown on the attached markup.

For all postulated breaks, the targets to be evaluated fall into the categories of SSC. Thus, each break is evaluated for nearby essential system distribution targets, such as piping, conduits, cable trays, and heating, ventilation, air conditioning (HVAC), as well as protective structures for other essential system targets beyond, and nearby essential system components (equipment). In response to the second part of the question, surrounding compartment and room structural elements are designed for all effects of the break where such structural elements are credited for separation.

To provide further clarification to U.S. EPR Tier 2, Section 3.6.2.1.1.4, the following information will be added after the word targets in the second bullet: "(equipment, piping, HVAC, electrical distribution elements and structures)".

Subpart (iii) to this question asked for clarification of the phrase "many of the U.S. EPR essential systems are designed with four redundant trains". In particular, the use of the word "many" requires clarification. Also, it was asked whether each train is capable of performing 100 percent of the system's function.

The use of the word "many" in the subject phrase was by design since not all essential systems have four trains, and not all four train essential systems have 100 percent capability of performing the safety function in each of the four trains. Thus, for clarification, the sentence will be modified to state "most, but not all."

In response to the question about the 100 percent capability of each train, this was specified in the subject sentence when it states “with each train capable of performing the system’s safety function of bringing the unit to a safe shutdown condition”.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 3.6.2.1.1.4 will be revised as described in the response and indicated on the attached markup.

Question 03.06.02-41:

Follow-up to RAI 222, Question No. 03.06.02-30 and RAI 107, Question No. 03.06.02-15

In its response to Question 03.06.02-30, AREVA stated that the seismic loadings on the whip restraint structure from the piping are excluded because there are sufficient gaps between the pipe and the structure to preclude contact during a safe shutdown earthquake, and AREVA will include self-weight seismic excitation in the appropriate load combinations. The staff finds that AREVA did not define the appropriate load combinations. The staff also notes that the loads and load combinations appropriate for the design and analysis of these restraints should be similar to those applicable to Seismic Category I structures (i.e., SRP Section 3.8.4 for miscellaneous steel structures), since the whip restraint must survive all other loads and the environment to perform its one-time restraint action to the whipping pipe anything during its design life. The applicant is requested to provide the design and analysis of whip restraint, loads and load combinations, and the Codes and Standards to be used for maintaining its structural integrity prior to a pipe break event.

Response to Question 03.06.02-41:

A paragraph will be added to U.S. EPR FSAR Tier 2 Section 3.6.2.5.1.2 to identify the applicable loads, load combinations, Codes and Standards, and acceptance criteria for whip restraints. This paragraph will identify loads for these restraints as deadweight, self-weight seismic excitation, and the one-time pipe whip force. These restraints are designed as Seismic Category I miscellaneous structures, in accordance with U.S. EPR Tier 2 Section 3.8.4, which identifies the appropriate load combinations, Codes and Standards, and acceptance criteria.

FSAR Impact:

U.S. EPR FSAR Tier 2 Section 3.6.2.5.1.2 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

2. ASME Code, III, Division 1 – Class 2, 3, and non-ASME Code Class Piping in Areas other than Containment Penetration Areas.

   With the exception of the portions of piping identified in Item 2 in Section 3.6.2.1.1.1 above, leakage cracks in ASME Code Class 2, 3, and non-ASME Code piping are postulated at axial locations where the stress calculated by the sum of Equations 9 and 10 from Paragraph NC/ND-3653 in Section III of the ASME Code, exceeds 0.4 times the sum of the stress limits given in NC/ND-3653.

3. Unanalyzed Non-Safety Class Piping.

   Non-safety-class piping that does not have detailed stress information has a through-wall crack postulated at axial locations that yield the most severe environmental consequences.

3.6.2.1.1.4 High-Energy Fluid Systems Separated From Essential Systems and Components

As addressed in Section 3.6.1, separation of high-energy piping from essential systems and components is an important consideration to prevent pipe ruptures from having direct effects on essential systems and components, and challenging the ability to safely shut down the unit following a pipe rupture. The U.S. EPR has extended this safety concept to include additional system train redundancy, along with separation of trains of essential systems. Specifically, most, but not all of the U.S. EPR essential systems are designed with four redundant trains, with each train capable of performing the system's safety function of bringing the unit to a safe shutdown condition. Outside of containment, each of these trains is contained in a separate Safeguard Building to complete separation. Inside containment, this separation is often, but not always accomplished by separate compartments/rooms used for individual trains. Since not all essential systems have four completely separated and redundant trains capable of performing the system's safety function, all ruptures must be evaluated with the four train separation and redundancy concept providing a useful tool, where it is available.

03.06.02-32

03.06.02-32

03.06.02-32

This four train separation and redundancy inherently provides design basis safety function survivability for certain rupture effects with the fourth train, while postulating the required effects of concurrent pipe rupture, single failure, and one train potentially out of service for maintenance. Separation and redundancy allow safety function survivability for the dynamic effects of high-energy line breaks. Since these are direct loading effects from the broken pipe, such as jet impingement and pipe whip, the separation of trains by structures or spatial location can be shown. This methodology by itself, however, cannot always be used for environmental effects of high-energy line breaks because fluid flow between compartments is still possible within the Reactor Building.

The applied methodology for using four train separation and redundancy to demonstrate essential system function survivability for dynamic effects of a break is as follows:

- High-energy pipe breaks are postulated as described in Section 3.6.2.1.1.2.
- Essential system targets (equipment, piping, HVAC, electrical distribution elements, and structures) are identified for each break based on plant layout of these systems relative to the break location. 03.06.02-32
- If the targets are within the same train of four train redundant systems (including the broken pipe, if it is also within an essential system), then the survivability of the systems' safety functions is confirmed without the need for further target analysis or protection considerations.

~~For essential system targets identified for a high-energy line rupture that are part of a system with complete separation and redundancy, the evaluation of such targets need only identify this separation and redundancy, as the target may be considered lost due to the rupture without having an adverse impact on essential equipment. The U.S. EPR design has many essential systems with redundant safety trains located in each of four separate Safeguard Buildings. This four train separation and redundancy allows for one train to be lost due to the rupture, while a second train is lost due to single active failure and a third is down due to normal maintenance. With the fourth train still capable of operating the system, protection for the dynamic and environmental effects of these ruptures need not be considered.~~

3.6.2.1.2 Locations of Leakage Cracks in Moderate Energy Lines

3.6.2.1.2.1 Leakage Crack Locations in Fluid Systems in Containment Penetration Areas

Leakage cracks are not postulated in those portions of moderate-energy lines that extend from the containment wall up to and including the inboard and outboard containment isolation valves where they meet the requirements of Subarticle NE-1120 in Section III of the ASME Code, and where the Level A or Level B stress calculated by the sum of Equations 9 and 10 from Paragraph NC-3653 does not exceed 0.4 times the sum of the stress limits given in NC-3653.

3.6.2.1.2.2 Leakage Crack Locations in Fluid Systems in Areas other than Containment Penetration Areas

With the exception of the portions of piping identified in Section 3.6.2.1.2.1, leakage cracks are postulated at the following locations:

1. Through-wall cracks are postulated in piping located adjacent to safety-related SSC except:

With the pipe break jets and whips characterized per the sections above, there is still a need to design pipe whip restraints which have been assumed in the rupture analysis, or to design structural barriers between the break and potential essential system targets. Both of these types of structural designs are for essential system protection purposes.

3.6.2.5.1.2 Pipe Whip Support Design

Pipe whip supports are typically only designed for the restraint of a whipping pipe following a postulated high-energy line break, and are typically separate from the other system pipe supports which are designed for other design basis loadings. Whip restraints are typically designed for a one-time accident event; so they are designed to undergo deformation as long as the whipping pipe is fully restrained for the entire time of the blowdown event. Similarly, the whip restraint has gaps to allow for the free thermal and seismic movements of the pipe at that location, so that the restraint does not affect the parameters of the design basis piping analysis. If a support is designed as both a standard pipe support and a pipe whip restraint, the design of the support meets the design criteria of a standard pipe support for loadings using the appropriate loading combinations.

03.06.02-41

Whip restraints which are not also standard pipe supports are designed as Seismic Category I miscellaneous structures in accordance with Section 3.8.4. The loadings to be applied to these restraints are self-weight, seismic self-weight excitation, and the one-time whipping load from the broken pipe. The load combinations, Codes and Standards, and acceptance criteria are defined in Section 3.8.4, as supplemented by the guidance and requirements in this section.

The calculation of design loads to be utilized in the design of pipe whip supports is described in Section 3.6.2.4.3. For a whip restraint near the first elbow upstream of a circumferential break, or near a longitudinal break, a static analysis calculation can be performed using the maximum jet discharge force multiplied by a factor of 1.1 for rebound effects, and a factor of 2.0 for a dynamic load factor. With this design load, a typical whip restraint usually consists of crushable, energy-absorbing material. The allowable capacity of such a crushable material is limited to 80 percent of its rated energy dissipating capacity, as determined by dynamic testing, at loading rates within plus or minus 50 percent of the specified design loading rate. The rated energy dissipating capacity is not greater than the area under the load-deflection curve from Figure 3.6.2-1 of SRP 3.6.2.

3.6.2.5.2 Structural Barrier Design

Structural barriers are used for high-energy line break protection purposes in order to provide separation between safety trains of essential systems, and to provide shields between rupture effects and an essential system component. The dynamic effects of a

Section 6.2.6 contains a description of the associated leak-rate test procedure, Containment Integrated Leakage Rate Test (CILRT). Containment pressure testing will occur in conjunction with the CILRT.

Sufficient physical access is provided in the annulus between the RCB and the RSB to perform inservice inspections on the outside of the containment. Space is available inside of the RCB to perform inservice inspections of the liner plate. Gaps are provided between the liner and RB internal structures concrete structural elements, which provide space necessary to inspect the liner at wall and floor locations inside containment. Inservice inspection of the embedded portion of the containment liner and the surface of the concrete containment structure covered by the liner are exempted in accordance with Section III of the ASME BPV Code for Class CC components.

3.8.2 Steel Containment

The steel containment section describes major RCB penetrations and portions of penetrations not backed by structural concrete that are intended to resist pressure. Section 3.8.1 describes the concrete RCB.

3.8.2.1 Description of the Containment

Steel items that are part of the RCB pressure boundary and are not backed by concrete include the equipment hatch, airlocks, construction opening, piping penetration sleeves, electrical penetration sleeves, and fuel transfer tube penetration sleeve. Section 3.8.1.1 describes RCB steel items that are backed by concrete, such as the liner plate.

3.8.2.1.1 Equipment Hatch, Airlocks, and Construction Opening

03.08.02-16

The equipment hatch, illustrated in Figure 3.8-25 is a welded steel assembly with a double-~~gasketed~~sealed, flanged, and bolted cover. ~~Provision is made for leak testing of the flange gaskets by pressurizing the annular space between the gaskets.~~ The cover for the equipment hatch attaches to the hatch ~~barrel~~sleeve from inside of the RCB. The cover seats against the sealing surface of the ~~barrel~~ penetration sleeve mating flange when subjected to internal pressure inside the RCB. The equipment hatch opens into the Seismic Category I FB, which provides protection of the hatch from external environmental hazards (e.g., high wind, tornado wind and missiles, and other site proximity hazards, including aircraft hazards and blasts). The equipment hatch ~~barrel~~sleeve has an inside diameter of approximately 27 feet, 3 inches.

One personnel airlock and one emergency airlock are provided for personnel to access the RCB. Figure 3.8-26—Personnel Airlock, Emergency Airlock General Overview illustrates a typical arrangement for the airlocks. Each airlock is a welded steel assembly that has two doors, each with double ~~gaskets~~seals. The airlocks open into

03.08.02-16

containment so that internal pressure inside the RCB seats the doors against their sealing surfaces. ~~Provision is made to pressurize the annular space between the gaskets during leak testing.~~

The doors mechanically interlock so that one door can not be opened unless the second door is sealed during plant operation. Provisions are made for deliberately overriding the interlocks by the use of special tools and procedures for ease of access during plant maintenance. Each door is equipped with valves for equalizing the pressure across the doors. The doors are not operable unless the pressure is equalized. Pressure equalization is possible from the locations at which the associated door can be operated. The valves for the two doors interlock so that only one valve can open at a time and only when the opposite door is closed and sealed. Each door is designed to withstand and seal against design and testing pressures of the containment vessel when the other door is open. A visual indication outside each door shows whether the opposite door is open or closed. In the event that one door is accidentally left open, provisions outside each door allow remote closing and latching of the opposite door.

The personnel airlock at [ ] opens into a [ ] which is a Seismic Category I structure. The emergency airlock opens into the [ ], which is a Seismic Category I structure. Therefore, both airlocks are protected from external environmental hazards (e.g., high wind, tornado wind and missiles, and other site proximity hazards, including aircraft hazards and blasts). The personnel airlock and the emergency airlock have inside diameters of approximately 10 feet, 2 inches.

The construction opening is located at [ ] and opens to the heavy load operating floor level from [ ] This passage serves as personnel and material access into the RB during construction. The construction opening has an outside diameter of approximately 9 feet, 6 inches. Upon completion of construction work, the cavity in the RCB is permanently sealed with a metal closure cap welded ~~in place metal closure cap~~to an embedded sleeve.

The equipment hatch, two airlocks, and construction opening closure cap and sleeve are designated as Class MC components in compliance with Article NE-3000 of the ASME BPV Code, Section III, Division I, and are stamped pressure vessels designed and tested in accordance with this code (GDC 1 and GDC 16).

3.8.2.1.2 Piping Penetration Sleeves

Piping penetrations through the RCB pressure boundary are divided into the following three general groups:

3.8.2.4 Design and Analysis Procedures

The steel items described in Section 3.8.2.1 will be designed and analyzed in accordance with Article NE-3000 of Subsection NE of the ASME BPV Code, Section III, Division 1, and as augmented by the applicable provisions of RG 1.57 (GDC 1 and GDC 16).

Containment penetrations, or portions thereof, within the jurisdictional boundaries defined by ASME BPV Code, Section III, Division 1, Subsection NE do not exceed the stress intensity limits defined by Articles NE-3221.1, NE-3221.2, NE-3221.3, and NE-3221.4 of the ASME BPV Code. Code class shell components are evaluated for buckling under earthquake, thermal, and pressure loads. Buckling of shells with more complex geometries and loading conditions than those covered by Article NE-3133 of the Code is considered in accordance with ASME BPV Code Case N-284-1 and additional guidance in RG 1.193. An acceptable approach to evaluating buckling of shells is to perform a non-linear analysis. Code class MC components are screened for cyclic service analysis according to the criteria given in Article NE-3221.5 of the ASME BPV Code.

Refer to Section 3.5.3 for a description of requirements for missile barrier design and ductility requirements applicable to the design of steel portions of the RCB.

The following sections provide individual descriptions of the design and analysis procedures performed to verify the structural integrity of the steel items. Section 3.8.1 addresses the design and analysis procedures used to qualify the RCB concrete structure for openings provided through the containment pressure boundary for these items. Containment ultimate capacity analysis results are described in Section 3.8.1.4.11, which includes evaluation of major containment steel penetrations.

3.8.2.4.1 Equipment Hatch, Airlocks, and Construction Opening

03.08.02-16

The equipment hatch described in Section 3.8.2.1.1 is supported entirely by the concrete shell of the RCB. The ~~barrel~~sleeve of the equipment hatch is embedded in the concrete containment shell and welded at the periphery to the liner plate. The liner plate is thickened in the vicinity of the equipment hatch penetration. The equipment hatch cover is dished and stiffened by a reinforcing ring where it interfaces with the ~~barrel~~sleeve of the equipment hatch.

The two airlocks described in Section 3.8.2.1.1 are supported by attachment to sleeves embedded in the concrete shell of the RCB and by supports attached to the RSB wall. These supports provide for differential movements of the containment and shield walls. The doors for both ends of the airlocks are flat, and the bulkhead ends of the components are dished.

The design and analysis methods, as well as the type of construction materials, are chosen to allow assessment of the capability of steel items to function properly throughout the plant life.

A SIT is performed as described in Section 3.8.2.7. Surveillance testing provides assurance of the continuing ability of each item to meet its design functions. Surveillance requirements are addressed in Section 3.8.2.7.

Items that form part of the containment pressure boundary are stamped in accordance with the applicable section of the ASME BPV Code used for their design or fabrication.

3.8.2.6 Materials, Quality Control, and Special Construction Techniques

Steel items that are not backed by concrete that are part of the containment pressure boundary are fabricated from materials that meet the requirements specified in Article NE-2000 of Section III, Division 1 of the ASME BPV Code, except as modified by applicable and acceptable ASME BPV Code cases (GDC 1).

Quality control for containment steel items conforms to Articles NE-2000, NE-4000, and NE-5000 of Section III, Division 1 of the ASME BPV Code (GDC 1).

Section 3.8.1.6 provides a description of welding requirements for steel items for the RCB, quality control for steel items for the RCB, and materials used for penetration sleeves, steel embedments, and corrosion retarding compounds.

03.08.02-16

Use of neoprene-based ~~gaskets and~~ seals are kept to a minimum because of the presence of fluoride or chloride ions and the increased potential for stress corrosion cracking.

The seals for the airlocks and the equipment hatch make use of elastomer seal material (Dupont Viton®, or equal) which is compressed by the action of the mechanical closure devices associated with each of the components. This material is recessed into two concentric grooves (double seals) around the perimeter of the airlock doors and around the equipment hatch flange penetration mating flange. This material is selected based on its ability to maintain elasticity at elevated temperatures for extended durations and to be in compliance with the materials tested for severe accident conditions as specified in NUREG/CR-5096.

Steel items such as the equipment hatch, airlocks, fuel transfer tube, and penetrations are prefabricated and installed as subassemblies during construction. No special techniques are used for construction of containment steel items not backed by concrete. Section 3.8.1.6 provides additional information of modular construction techniques used for the RCB.

3.8.2.7 Testing and Inservice Inspection Requirements

A SIT is performed for steel containment components not backed by concrete in accordance with Article NE-6000 of Subsection NE of the ASME BPV Code, Section III, Division 1 (GDC 1).

Testing and iInservice surveillanceinspections for the steel items consists of leakage testing of the containment and pressure retaining subassemblies follow the requirements of the ASME BPV Code, Section XI, Subsection IWE with the additional requirements of 10 CFR 50.55a (GDC 1 and GDC 16). Section 6.2.6 describes the leakage tests and associated acceptance criteria.

03.08.02-16

Vendor testing and in-situ testing of the seals is conducted to provide assurance of the seal performance for normal operating conditions and for temperature and pressure conditions associated with a loss of coolant accident. Once this equipment is installed in containment, the air space between the two seals will be continuously maintained under a negative pressure by connection to the Leak-Off system. This system is also used to pressurize the air space between the seals for in-situ testing operations.

3.8.3 Concrete and Steel Internal Structures of Concrete Containment

3.8.3.1 Description of the Internal Structures

RB internal structures consist of reinforced concrete walls and floors, steel framing members, and other concrete and steel structural elements that are located inside of the RCB. The RB internal structures provide support for components and radiation shielding for the RCS and refueling operations. The foundation basemat inside of the RCB supports the RB internal structures at the bottom interface. To prevent an interaction between the structures for design basis loading conditions, clearance is maintained between the containment wall and internal structures. RB internal structures important to safety are not shared with another unit (GDC 5).

The RB internal structures are Seismic Category I, except for miscellaneous structures such as platforms, stairs, guard rails, and other ancillary items. These miscellaneous structures are designed as Seismic Category II to prevent adverse impactimpairment of the design basis safety function onof the Seismic Category I structuressafety-related SSC in the event of a SSE. Seismic classification of structures, systems and components (SSC) is addressed in Section 3.2.

The following figures show the main levels of the RB internal structures and sectional views of the building:

- Figure 3.8-2—Reactor Building Plan at Elevation -20 Feet (top of the foundation basemat inside containment).

58. ACI 350-06, "Code Requirements for Environmental Engineering Concrete Structure," American Concrete Institute, 2006.

59. ACI 350.3-06, "Seismic Design of Liquid-Containing Concrete Structures," American Concrete Institute, 2006.

60. ASME B31.3, "Process Piping, American Society of Mechanical Engineers," American Society of Mechanical Engineers, 1996.

61. ASME B31.4, "Liquid Transportation System for Hydrocarbon, Liquid Petroleum Gas, Anhydrous Ammonia, and Alcohols," American Society of Mechanical Engineers, 1992.

62. ASME B31.8, "Gas Transportation and Distribution Piping Systems," American Society of Mechanical Engineers, 1995.

63. ACI 349-06/349R-06, "Code Requirements for Nuclear Safety-Related Concrete Structures" and Commentary, American Concrete Institute, 2006.

64. NUREG/CR-5096 - "Evaluation of Seals for Mechanical Penetrations of Containment Buildings," August 1998.

03.08.02-16