ArevaEPRDCPEm Resource

From: WILLIFORD Dennis (AREVA) [Dennis.Williford@areva.com]
Sent: Monday, July 16, 2012 5:14 PM
To: Tesfaye, Getachew
Cc: BENNETT Kathy (AREVA); DELANO Karen (AREVA); ROMINE Judy (AREVA); RYAN Tom (AREVA); GUCWA Len (EXTERNAL AREVA)
Subject: Response to U.S. EPR Design Certification Application RAI No. 474 (5550), FSAR Ch. 6, Supplement 5
Attachments: RAI 474 Supplement 5 Response US EPR DC.pdf

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the single question in RAI 474 on April 7, 2011. Supplement 1, Supplement 2, Supplement 3 and Supplement 4 responses to RAI 474 were sent on June 22, 2011, August 31, 2011, November 29, 2011, and February 24, 2012, respectively, to revise the response schedule.

The attached file, "RAI 474 Supplement 5 Response US EPR DC.pdf" provides a technically correct and complete response to the one question in RAI 474.

The following table indicates the respective pages in the response document, "RAI 474 Supplement 5 Response US EPR DC.pdf" that contain AREVA NP's response to the subject question. 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 474 Question 06.02.05-25.

Question #	Start Page	End Page
RAI 474 — 06.02.05-25	2	6

This concludes the formal AREVA NP response to RAI 474, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WILLIFORD Dennis (RS/NB)
Sent: Friday, February 24, 2012 3:05 PM
To: Getachew.Tesfaye@nrc.gov
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB); GUCWA Len (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 474 (5550), FSAR Ch. 6, Supplement 4

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the single question in RAI 474 on April 7, 2011. Supplement 1, Supplement 2 and Supplement 3 responses to RAI 474 were sent on June 22, 2011, August 31, 2011 and November 29, 2011, respectively, to revise the response schedule.

The schedule for a technically correct and complete response to the remaining question has been changed, as provided below. This schedule was transmitted to the NRC in AREVA NP letter NRC:12:008 dated February 21, 2012.

Question #	Response Date
RAI 474 — 06.02.05-25	**July 17, 2012**

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WILLIFORD Dennis (RS/NB)
Sent: Tuesday, November 29, 2011 4:36 PM
To: Getachew.Tesfaye@nrc.gov
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB); GUCWA Len (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 474 (5550), FSAR Ch. 6, Supplement 3

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the single question in RAI 474 on April 7, 2011. Supplement 1 and Supplement 2 responses to RAI 474 were sent on June 22, 2011 and August 31, 2011, respectively, to revise the response schedule.

The schedule has been changed as provided below:

Question #	Response Date
RAI 474 — 06.02.05-25	**March 7, 2012**

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager

AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WILLIFORD Dennis (RS/NB)
Sent: Wednesday, August 31, 2011 4:30 PM
To: Getachew.Tesfaye@nrc.gov
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB); GUCWA Len (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 474 (5550), FSAR Ch. 6, Supplement 2

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the single question in RAI 474 on April 7, 2011. Supplement 1 response to RAI 474 was sent on June 22, 2011 with a revised response schedule

The schedule has been changed as provided below:

Question #	Response Date
RAI 474 — 06.02.05-25	**December 14, 2011**

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WILLIFORD Dennis (RS/NB)
Sent: Wednesday, June 22, 2011 9:42 AM
To: Tesfaye, Getachew
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB); GUCWA Len (External RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 474 (5550), FSAR Ch. 6, Supplement 1

Getachew,

AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the single question in RAI 474 on April 7, 2011.

The schedule has been changed as provided below:

Question #	Response Date

RAI 474 — 06.02.05-25	August 31, 2011

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WELLS Russell (RS/NB)
Sent: Thursday, April 07, 2011 8:12 AM
To: Tesfaye, Getachew
Cc: GUCWA Len (External RS/NB); Miernicki, Michael; BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 474 (5550), FSAR Ch. 6

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 474 Response US EPR DC.pdf" provides a schedule since a technically correct and complete response to the 1 question is not provided.

The following table indicates the respective page in the response document, "RAI 474 Response US EPR DC.pdf," that contains AREVA NP's response to the subject question.

Question #	Start Page	End Page
RAI 474 — 06.02.05-25	2	2

A complete answer is not provided for 1 of the 1 question. The schedule for a technically correct and complete response to this question is provided below.

Question #	Response Date
RAI 474 — 06.02.05-25	June 22, 2011

Sincerely,

Russ Wells
U.S. EPR Design Certification Licensing Manager
AREVA NP, Inc.
3315 Old Forest Road, P.O. Box 10935
Mail Stop OF-57
Lynchburg, VA 24506-0935
Phone: 434-832-3884 (work)

434-942-6375 (cell)
Fax: 434-382-3884
Russell.Wells@Areva.com

From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Tuesday, March 08, 2011 2:35 PM
To: ZZ-DL-A-USEPR-DL
Cc: Grady, Anne-Marie; Jackson, Christopher; McKirgan, John; Carneal, Jason; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 474 (5550), FSAR Ch. 6

Attached please find the subject request for additional information (RAI). A draft of the RAI was provided to you on February 17, 2011, and on March 4, 2011, you informed us that the RAI is clear and no further clarification is needed. As a result, no change is made to the draft RAI. 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: 3967

Mail Envelope Properties (2FBE1051AEB2E748A0F98DF9EEE5A5D4D4190A)

Subject: Response to U.S. EPR Design Certification Application RAI No. 474 (5550), FSAR Ch. 6, Supplement 5
Sent Date: 7/16/2012 5:14:02 PM
Received Date: 7/16/2012 5:14:25 PM
From: WILLIFORD Dennis (AREVA)

Created By: Dennis.Williford@areva.com

Recipients:
"BENNETT Kathy (AREVA)" <Kathy.Bennett@areva.com>
Tracking Status: None
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Tracking Status: None
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Tracking Status: None
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Tracking Status: None
"Tesfaye, Getachew" <Getachew.Tesfaye@nrc.gov>
Tracking Status: None

Post Office: auscharmx02.adom.ad.corp

Files	**Size**	**Date & Time**
MESSAGE	8538	7/16/2012 5:14:25 PM
RAI 474 Supplement 5 Response US EPR DC.pdf		576112

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

Response to

Request for Additional Information No. 474, Supplement 5

3/08/2011

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52 020
SRP Section: 06.02.05 Combustible Gas Control in Containment
Application Section: 6.2.5

QUESTIONS for Containment and Ventilation Branch 1 (AP1000/EPR Projects) (SPCV)

Question 06.02.05-25:

OPEN ITEM

This is related to responses to RAI 410, Questions 06.02.05-16 through 6.2.5-19 and RAI 323.

a. In order for a COL applicant to select a PAR design which achieves the PAR performance in a severe accident environment described in the US EPR FSAR, Tier 2, sections 6.2.5 and 19.2, provide information which will specify the experimental tests or analyses and acceptable results which will verify PAR performance, considering the impact of:
   - severe accident temperatures and pressures in containment,
   - the effect of steam or nitrogen as inert gases,
   - the effects of dome spray and direct spray on PAR start-up and performance,
   - the effects of realistic aerosol exposure generated by a molten core, including poisons such as iodine, tellurium, cesium and antimony. Show how these potential poisons affect PAR performance

b. Coking occurs when elemental carbon in carbon bearing gases is deposited on the surface of a catalyst, blocking the reaction of the recombinants. The sources in a reactor containment severe accident are: (1) molten core/concrete interaction (MCCI) and (2) a fire, in particular the smoke and soot from electrical cable fires. Address the potential of carbon to poison the catalyst in the PARs.

c. The PARs could be subjected to borated water in the IRWST containing trisodium phosphate, HNO3 from the radiolysis of water, and HCl from the radiolysis of the PVC and Hypalon jackets on the electrical cables following a severe accident. Show how these chemicals could affect PAR performance.

d. Discuss the functionality of the PARs after H2 ignition and deflagration.

e. Address the effects of radiation, operational vibrations, welding fumes and solvent fumes.

Response to Question 06.02.05 25:

Response to Question 06.02.05-25a:

The ambient temperatures expected inside the containment during a severe accident ranges from ≈200°F – 410°F; the pressure reaches ≈90 psia. Temperature and pressure are both dependent on the accident progression and containment location, specifically elevation (Refer to U.S. EPR FSAR Tier 2, Figure 19.2-21).

The AREVA Passive Autocatalytic Recombiner (PAR) has been extensively tested to efficiently deplete hydrogen under harsh environmental conditions.

During hydrogen depletion, the temperature on the surface of the PAR catalyst reaches temperatures over 750°F, which exceeds by far the expected ambient temperature in a severe accident. The elevated temperature and pressure during a severe accident are both beneficial for the PAR performance. Tests with ambient temperatures of more than 100°F showed

immediate start-up behavior of the PAR. This result is documented in Sections 2.0, 3.0, and 7.0 of Technical Report “Qualification and Testing of the U.S. EPR Passive Autocatalytic Recombiner,” ANP-10322P.

Elevated pressure is beneficial since the increased gas density provides more hydrogen molecules to the catalyst, which results in higher depletion rates (Refer to ANP-10299P, Revision 2, Supplement 1, Figure 1 and Figure 2). This result is also documented in Section 7.0 of Technical Report “Qualification and Testing of the U.S. EPR Passive Autocatalytic Recombiner,” ANP-10322P.

The second bullet of the RAI requested discussion on the impact of steam and nitrogen on the PAR performance.

The PARs are not adversely affected by high steam concentrations; higher steam contents lead to a higher hydrogen depletion rate. This result is documented as in Section 7.0 of Technical Report “Qualification and Testing of the U.S. EPR Passive Autocatalytic Recombiner,” ANP-10322P.

A high nitrogen concentration, which could affect the PAR efficiency, exists only in inert containments such as BWRs. In general, nitrogen itself has no impact on the PAR performance but a lack of oxygen, typical for an inert containment negatively affects the performance.

The U.S. EPR containment is not nitrogen-inert during power operation and during a severe accident, no high nitrogen concentrations are expected; therefore, this scenario is not applicable for the U.S. EPR design.

The third bullet of the RAI requested discussion on the impact of dome spray and direct spray on the PAR performance.

The discussion on the effect of spray on the PAR performance is discussed in Section 3.0 and Section 4.0 of Technical Report “Qualification and Testing of the U.S. EPR Passive Autocatalytic Recombiner,” ANP-10322P.

The U.S. EPR PAR is protected from direct sprays. Principally, as discussed in Topical Report, ANP-10268P-A, “U.S. EPR Severe Accident Evaluation”, Sections 2.2.4.2 and 5.4.1.2 and U.S. EPR FSAR, Tier 2 Section 19.2.4.4.15, actuation of the U.S. EPR severe accident heat removal system sprays is delayed by 12 hours. This allows the hydrogen recombiners to perform with a high degree of reliability to fulfill its design goal of reducing hydrogen concentration to four percent within that time. As a secondary measure, each PAR is equipped with a housing around the catalyst that protects against direct spraying. With this design configuration, the catalyst may only be impacted if water sprays through the lateral opening on the top of the housing. In addition, mounted PARs are shielded by containment walls and other structures that protect the PARs against direct spraying from the dome spray ring.

The fourth bullet of the RAI requested discussion on the potential effect of realistic aerosol exposure generated by a molten core, including poisons (e.g., iodine, tellurium, cesium, antimony).

Section 2.0 of Technical Report “Qualification and Testing of the U.S. EPR Passive Autocatalytic Recombiner,” ANP-10322P, discusses the conducted “Integrated Core Melt Test.”

This test series addresses the effect on the PAR performance caused by a realistic aerosol exposure of a molten core, including discussion of iodine, tellurium, cesium, and antimony poisons.

ANP-10322P will be incorporated by reference into the U.S. EPR FSAR, Tier 2, Table 1.6-1 and Section 6.2.5. The list of references in U.S. EPR FSAR, Tier 2, Section 6.2.8 will also be updated.

References for 06.02.05-25a:

1. ANP-10268P-A, Revision 0, “U.S. EPR Severe Accident Evaluation Topical Report,” AREVA NP Inc., February, 2008.
2. ANP-10299P, Revision 2, “Applicability of AREVA NP Containment Response Evaluation Methodology to the U.S. EPR for Large Break LOCA Analysis,” including Supplement 1, AREVA NP Inc., August 2011.
3. ANP-10322P, Revision 0, “Qualification and Testing of the U.S. EPR Passive Autocatalytic Recombiner,” AREVA NP Inc., June 2012.

FSAR Impact for 06.02.05-25a:

U.S. EPR FSAR, Tier 2, Table 1.6-1, Section 6.2.5, and Section 6.2.8 will be revised as described in the response and indicated on the enclosed markup.

Response to Question 06.02.05-25b:

The most significant source of carbon that could come in contact with the PARs is CO_2, derived from the burning of CO that autoignites during MCCI. MCCI appears first in the reactor pit following failure of the reactor pressure vessel. Autoignition of combustible gas (primarily from hydrogen) creates a standing flame. Similarly, following failure of the melt plug and gate, MCCI will appear in the spreading room. MCCI ends following complete ablation of the concrete buffering the steel cooling structure. MCCI occurs roughly 4 – 8 hours following reactor pressure vessel failure. The composition of the concrete, components, and equipment in these containment rooms have been selected to effectively eliminate sources of carbon appearing in aerosol form. As such, sources of pure “elemental” carbon are a very conservative assumption. Carbon that reaches the catalytic plates is either an aerosol (soot) or a gas mixture (e.g., CO, CO_2).

Section 5.0 of Technical Report “Qualification and Testing of the U.S. EPR Passive Autocatalytic Recombiner”, ANP-10322P, discusses the effect of combustion products of cable burns on the PAR performance. Section 7.0 of ANP-10322P addresses the effect of carbon monoxide and Section 8.0 addresses how soot, as a result of an oil fire, affects the performance of the PAR.

References for 06.02.05-25b:

1. ANP-10322P, Revision 0, “Qualification and Testing of the U.S. EPR Passive Autocatalytic Recombiner,” AREVA NP Inc., June 2012.

FSAR Impact for 06.02.05-25b:

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

Response to Question 06.02.05-25c:

For water containing boron and sodium hydroxide, the recombiner performance in spray condition tests verified the PAR efficiency under spray conditions with H_3BO_3 and NaOH. The test results are discussed in the response to Question 06.02.05-25a, third bullet.

Regarding the potential effect of trisodium phosphate (TSP) on the PAR performance, a test program, in addition to the H_2 KALI tests, was conducted to investigate the potential effects. The aim of this test program was to study the effect on the PAR performance under containment spray conditions with a TSP, hydrazine, and boric acid solution. The test program identified that the PAR efficiency was not influenced by spraying of TSP, boric acid, and hydrazine.

Section 4.0 of Technical Report "Qualification and Testing of the U.S. EPR Passive Autocatalytic Recombiner", ANP-10322P, discusses the effect of TSP, hydrazine, and boric acid solution spray on the PAR performance.

Nitric acid (HNO_3) formed by radiolysis of water exists in the gaseous and liquid phase. The quantity of nitric acid formed by radiolysis is negligible and is not a concern for systems or components. The effect of HCl from the radiolysis of PVC and Hypalon cable jackets was indirectly tested during the cable burn tests, where the catalyst was exposed to fumes and soot. Burning of PVC forms corrosive, gaseous hydrogen chloride. This is formed as a result of the combination of water or humidity with cable combustion products. The test details are discussed in the response to Question 06.02.05-25b.

References for 06.02.05-25c:

1. ANP-10322P, Revision 0, "Qualification and Testing of the U.S. EPR Passive Autocatalytic Recombiner," AREVA NP Inc., June 2012.

FSAR Impact for 06.02.05-25c:

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

Response to Question 06.02.05-25d:

The housing of the PARs is designed with a lateral opening at the bottom and the top to avoid any differential pressure between the ambient atmosphere and the catalysts. The PAR housing is designed to protect the catalyst against direct spraying impingement and to have sufficient openings to assure a vent that encourages a chimney effect. The catalyst is designed for higher temperatures that occur during deflagrations. Therefore, thermal damage would not occur.

Several hydrogen burn tests were conducted to investigate the potential effect on the PAR performance. Section 6.0 of Technical Report, "Qualification and Testing of the U.S. EPR Passive Autocatalytic Recombiner," ANP-10322P, discusses this topic. The response to Question 06.02.05-25a discusses high temperature effects.

References for 06.02.05-25d:

1. ANP-10322P, Revision 0, “Qualification and Testing of the U.S. EPR Passive Autocatalytic Recombiner,” AREVA NP Inc., June 2012.

FSAR Impact for 06.02.05-25d:

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

Response to Question 06.02.05-25e:

During the developmental tests performed by AREVA laboratories and the German authorized inspection agency (TÜV), various tests and analysis were conducted including irradiation tests of the PAR and the catalyst. Radiation has no influence on the PAR housing since it is made of stainless steel. The catalyst itself consists of stainless steel with a coating of platinum and palladium.

During tests, exposure of the catalyst to welding fumes and solvent fumes was conducted for 22 hours. These results are discussed in the Technical Report, “Qualification and Testing of the U.S. EPR Passive Autocatalytic Recombiner,” ANP-10322P, Section 8.0. The influence of operational and seismic vibrations were examined based on the international codes and standards IEC 68-2-6, 980 and IEEE 344, 382. In addition to the TÜV tests, PAR load calculations and structural stability analysis verified under consideration of acceleration values for loss of coolant accidents, design basis earthquakes and severe accidents, that the allowable stresses were not exceeded for the entire PAR structure. These results are discussed in the Technical Report, “Qualification and Testing of the U.S. EPR Passive Autocatalytic Recombiner,” ANP-10322P, Section 10.0.

References for 06.02.05-25e:

1. ANP-10322P, Revision 0, “Qualification and Testing of the U.S. EPR Passive Autocatalytic Recombiner,” AREVA NP Inc., June 2012.

FSAR Impact for 06.02.05-25e:

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

U.S. EPR Final Safety Analysis Report Markups

Table 1.6-1—Reports Referenced
Sheet 3 of 5

Report No. (See Notes 1, 2, and 3)	Title	Date Submitted to NRC	FSAR Section Number(s)
ANP-10318P	Pipe Rupture External Loading Effects on U.S. EPR Essential Structures, Systems, and Components Technical Report	3/11	3.6.2
ANP-10309P ANP-10309NP Revision ~~3~~<u>4</u>	U.S. EPR Protection System Technical Report	~~06/11~~<u>5/12</u>	4.6, 7.1, 7.2, and 7.3
ANP-10310P Revision 1	Methodology for 100% Combinatorial Testing of the U.S. EPR™ Priority Module Technical Report	~~0~~3/11	7.1
ANP-10315P Revision 1	U.S. EPR Protection System Surveillance Testing and Teleperm XS Self-Monitoring Technical Report	6/11	7.1,7.3
ANP-10317	Design Requirements for the U.S. EPR Aircraft Hazard Protection Structures	5/11	19.2.7.4
ANP-10318P	Pipe Rupture External Loading Effects on U.S. EPR Essential Structures, Systems, and Components Technical Report	3/11	3.6.2
<u>ANP-10322P</u>	<u>Qualification and Testing of the U.S. EPR Passive Autocatalytic Recombiner</u>	<u>6/12</u>	<u>6.2.5</u>
BAW-10132-A	Analytical Methods Description – Reactor Coolant System Hydrodynamic Loadings During a Loss-of-Coolant Accident	7/20/79	App. 3C
BAW-10133P-A BAW-10133-A Revision 1, Addendum 1 and 2	Mark-C Fuel Assembly LOCA-Seismic Analysis	10/30/00	4.2
BAW-10147P-A BAW-10147-A Revision 1	Fuel Rod Bowing in Babcock & Wilcox Fuel Designs	6/28/83	4.2, 4.4
BAW-10156-A Revision 1	LYNXT, Core Transient Thermal-Hydraulic Program	8/18/93	4
BAW-10163P-A BAW-10163-A	Core Operating Limit Methodology for Westinghouse Designed PWRs	6/2/89	4.3 and 16

06.02.05-25

Mixing Dampers

Mixing dampers consist of a spring loaded actuator that is held closed during normal operation by an energized solenoid. The second part of the mixing damper is the flap with a horizontal opening axis, similar to a butterfly valve. This design allows the mixing damper to open against a pressure differential. The flap separates the air space of the IRWST and the lower part of the annular rooms in containment. The mixing dampers open if the differential pressure between operational and equipment rooms exceed 0.5 psi; or if the containment pressure exceeds 17.4 psia. The mixing dampers open fail-safe on a loss of power to the solenoid-operated actuators and can be manually opened by the operator.

The mixing dampers are safety-related items and are included in the equipment qualification program.

Passive Autocatalytic Recombiners

The PARs are part of the combustible gas control system. Unlike the rupture foils, convection foils, and mixing dampers, they are not safety-related components; instead, they are designed for severe accident condition applications.

Large and small PARs are arranged in containment to support global convection, homogenize the containment atmosphere, and reduce local and global peak hydrogen concentrations. The location of the PARs is shown in Figure 6.2.5-1—Arrangement and Location of the Passive Autocatalytic Recombiners.

06.02.05-25

A PAR consists of a metal housing with a gas inlet at the bottom and a lateral gas outlet at the top to promote convection. Numerous parallel plates with a catalytically active coating are arranged vertically in the bottom of the housing. Gas mixtures containing hydrogen are recombined upon contact with the catalyst, with the recombination rate depending primarily on the concentration of hydrogen at the PAR. The PAR recombination efficiencies at different environmental conditions are provided in Supplement 1 to technical report ANP-10299P, Revision 2, "Applicability of AREVA NP Containment Response Evaluation Methodology to the U.S. EPR for Large Break LOCA Analysis," (Reference 15). Technical Report ANP-10322P, Revision 0, “Qualification and Testing of the U.S. EPR Passive Autocatalytic Recombiner” (Reference 28) describes the performed type tests and test results of the AREVA NP PAR. In the presence of oxygen, the PARs will start automatically if the threshold hydrogen concentration is reached at the catalytic surfaces. The heat released from the catalyst helps drive gas flow through the PARs, resulting in high recombination efficiency.

The PARs are arranged inside the equipment rooms to promote convection within the containment, and thereby homogenize the atmosphere and reduce local peak hydrogen concentrations. PARs are also located in the containment dome and in the

28. ANP-10322P, Revision 0, "Qualification and Testing of the U.S. EPR Passive Autocatalytic Recombiner" AREVA NP Inc., June 2012.

06.02.05-25