ArevaEPRDCPEm Resource

From: Pederson Ronda M (AREVA NP INC) [Ronda.Pederson@areva.com]
Sent: Friday, November 13, 2009 5:23 PM
To: Tesfaye, Getachew
Cc: BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC); KOWALSKI David J (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 222, FSAR Ch 3, Supplement 3
Attachments: RAI 222 Supplement 3 Response US EPR DC.pdf

Getachew,

AREVA NP Inc. provided responses to 2 of the 16 questions of RAI No. 222 on July 6, 2009. Supplement 1 response to RAI No. 222 was sent on July 20, 2009 to address 1 of the remaining questions. Supplement 2 response to RAI No. 222 was sent on September 11, 2009 to address 12 of the remaining questions.

The attached file, "RAI 222 Supplement 3 Response US EPR DC.pdf" provides a technically correct and complete response to the one remaining question, as committed.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which supports the response to RAI 222 Question 03.06.02-20.

The following table indicates the respective pages in the response document, "RAI 222 Supplement 3 Response US EPR DC.pdf," that contain AREVA NP's response to the subject question.

Question #	Start Page	End Page
RAI 222 — 03.06.02-20	2	3

This concludes the formal AREVA NP response to RAI 222, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

Ronda Pederson
ronda.pederson@areva.com
Licensing Manager, U.S. EPR Design Certification
AREVA NP Inc.
An AREVA and Siemens company
3315 Old Forest Road
Lynchburg, VA 24506-0935
Phone: 434-832-3694
Cell: 434-841-8788

From: Pederson Ronda M (AREVA NP INC)
Sent: Friday, September 11, 2009 7:44 PM
To: 'Tesfaye, Getachew'
Cc: BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC); WELLS Russell D (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 222, FSAR Ch 3, Supplement 2
Getachew,

AREVA NP Inc. (AREVA NP) provided technically correct and complete response to 2 of the 16 questions of RAI 222 on July 6, 2009 and indicated a response to 03.08.03-18 would be provided by July 24, 2004. The proprietary and non-proprietary versions of the response to RAI No. 222, Supplement 1 were submitted via AREVA NP Inc. letter, "Response to U.S. EPR Design Certification Application RAI No. 222, Supplement 1" NRC 09:076, dated July 20, 2009. The enclosure to that letter provided a technically correct and complete response to 1 of the remaining 14 questions. The attached file, "RAI 222 Supplement 2 Response US EPR DC.pdf" provides technically correct and complete responses to 12 of the remaining 13 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 222 Questions 03.06.02-21, 03.06.02-23, and 03.06.02-31.

The following table indicates the pages in the response document, "RAI 222 Supplement 2 Response US EPR DC.pdf" that contain AREVA NP's response to the subject question.

Question #	Start Page	End Page
RAI 222 — 03.04.02-8	2	2
RAI 222 — 03.04.02-9	3	3
RAI 222 — 03.06.02-21	4	5
RAI 222 — 03.06.02-22	6	8
RAI 222 — 03.06.02-23	9	10
RAI 222 — 03.06.02-24	11	11
RAI 222 — 03.06.02-25	12	15
RAI 222 — 03.06.02-26	16	17
RAI 222 — 03.06.02-27	18	18
RAI 222 — 03.06.02-28	19	19
RAI 222 — 03.06.02-29	20	22
RAI 222 — 03.06.02-31 (items 1 and 2)	23	24

The schedule for a technically correct and complete response to the remaining question has been changed as a result of questions raised during an interdisciplinary review. The revised schedule for the remaining response is provided below:

Question #	Response Date
RAI 222 — 03.06.02-20	November 13, 2009

Sincerely,

Ronda Pederson
ronda.pederson@areva.com
Licensing Manager, U.S. EPR Design Certification
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An AREVA and Siemens company
3315 Old Forest Road
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From: Pederson Ronda M (AREVA NP INC)
Sent: Monday, July 20, 2009 5:58 PM
To: 'Tesfaye, Getachew'
Cc: BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC); WELLS Russell D (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 222, FSAR Ch 3, Supplement 1

Getachew,

AREVA NP Inc. (AREVA NP) provided technically correct and complete response to 2 of the 16 questions of RAI 222 on July 6, 2009 and indicated a response to 03.08.03-18 would be provided by July 24, 2004. The proprietary and non-proprietary versions of the response to RAI No. 222, Supplement 1 are submitted via AREVA NP Inc. letter, "Response to U.S. EPR Design Certification Application RAI No. 222, Supplement 1" NRC 09:076, dated July 20, 2009. The enclosure to that letter provides a technically correct and complete response to the question in RAI No. 222, Supplement 1. An affidavit to support withholding of information from public disclosure, per 10CFR2.390(b), is provided as an enclosure to that letter.

The following table indicates the pages in the response document, "RAI 222 Supplement 1 Response US EPR DC.pdf" that contain AREVA NP's response to the subject question.

Question #	Start Page	End Page
RAI 222 — 03.08.03-18	2	10

The schedule for a technically correct and complete response to the remaining questions of RAI 222 is unchanged and is provided below.

Question #	Response Date
RAI 222 — 03.04.02-8	September 11, 2009
RAI 222 — 03.04.02-9	September 11, 2009
RAI 222 — 03.06.02-20	September 11, 2009
RAI 222 — 03.06.02-21	September 11, 2009
RAI 222 — 03.06.02-22	September 11, 2009
RAI 222 — 03.06.02-23	September 11, 2009
RAI 222 — 03.06.02-24	September 11, 2009
RAI 222 — 03.06.02-25	September 11, 2009
RAI 222 — 03.06.02-26	September 11, 2009
RAI 222 — 03.06.02-27	September 11, 2009
RAI 222 — 03.06.02-28	September 11, 2009
RAI 222 — 03.06.02-29	September 11, 2009
RAI 222 — 03.06.02-31 (items 1 and 2)	September 11, 2009

Sincerely,

Ronda Pederson
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3315 Old Forest Road
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From: WELLS Russell D (AREVA NP INC)
Sent: Monday, July 06, 2009 10:11 AM

To: 'Getachew Tesfaye'
Cc: Pederson Ronda M (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 222, FSAR Ch 3

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 222 Response US EPR DC.pdf" provides a technically correct and complete response to 2 of the 16 questions.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which supports the response to RAI 222 Questions 03.06.02-19 and 03.06.02-31.

The following table indicates the respective pages in the response document, "RAI 222 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 222 — 03.04.02-8	2	2
RAI 222 — 03.04.02-9	3	3
RAI 222 — 03.06.02-19	4	4
RAI 222 — 03.06.02-20	5	5
RAI 222 — 03.06.02-21	6	6
RAI 222 — 03.06.02-22	7	7
RAI 222 — 03.06.02-23	8	8
RAI 222 — 03.06.02-24	9	9
RAI 222 — 03.06.02-25	10	10
RAI 222 — 03.06.02-26	11	11
RAI 222 — 03.06.02-27	12	12
RAI 222 — 03.06.02-28	13	13
RAI 222 — 03.06.02-29	14	14
RAI 222 — 03.06.02-30	15	15
RAI 222 — 03.06.02-31	16	17
RAI 222 —03.08.03-18	18	19

A complete answer is not provided for 14 of the 16. The schedule for a technically correct and complete response to these questions is provided below.

Question #	Response Date
RAI 222 — 03.04.02-8	September 11, 2009
RAI 222 — 03.04.02-9	September 11, 2009
RAI 222 — 03.06.02-20	September 11, 2009
RAI 222 — 03.06.02-21	September 11, 2009
RAI 222 — 03.06.02-22	September 11, 2009
RAI 222 — 03.06.02-23	September 11, 2009
RAI 222 — 03.06.02-24	September 11, 2009
RAI 222 — 03.06.02-25	September 11, 2009
RAI 222 — 03.06.02-26	September 11, 2009
RAI 222 — 03.06.02-27	September 11, 2009
RAI 222 — 03.06.02-28	September 11, 2009
RAI 222 — 03.06.02-29	September 11, 2009
RAI 222 — 03.06.02-31 (items 1 and 2)	September 11, 2009
RAI 222 —03.08.03-18	July 24, 2009

Sincerely,

(Russ Wells on behalf of)
Ronda Pederson
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Licensing Manager, U.S. EPR Design Certification
New Plants Deployment
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From: Getachew Tesfaye [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Friday, June 05, 2009 4:10 PM
To: ZZ-DL-A-USEPR-DL
Cc: Hernando Candra; Samir Chakrabarti; Jim Xu; Ching Ng; Jennifer Dixon-Herrity; Michael Miernicki; Jay Patel; Joseph Colaccino; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 222 (2746, 2699,2720), FSAR Ch. 3

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on May 11, 2009, and discussed with your staff on May 29, 2009. Draft RAI Questions 03.06.02-20 and 03.06.02-31 were 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: 953

Mail Envelope Properties (5CEC4184E98FFE49A383961FAD402D310165DA6A)

Subject: Response to U.S. EPR Design Certification Application RAI No. 222, FSAR Ch 3, Supplement 3
Sent Date: 11/13/2009 5:22:59 PM
Received Date: 11/13/2009 5:23:02 PM
From: Pederson Ronda M (AREVA NP INC)

Created By: Ronda.Pederson@areva.com

Recipients:
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Files	**Size**	**Date & Time**
MESSAGE	10433	11/13/2009 5:23:02 PM
RAI 222 Supplement 3 Response US EPR DC.pdf	148160	

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

Response to

Request for Additional Information No. 222, Supplement 3

6/05/2009

U.S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 03.04.02 - Analysis Procedures
SRP Section: 03.06.02 - Determination of Rupture Locations and Dynamic Effects Associated with the Postulated Rupture of Piping
SRP Section: 03.08.03 - Concrete and Steel Internal Structures of Steel or Concrete Containments
Application Section: FSAR Ch. 3

QUESTIONS for Structural Engineering Branch 2 (ESBWR/ABWR Projects) (SEB2)
QUESTIONS for Engineering Mechanics Branch 2 (ESBWR/ABWR Projects) (EMB2)

Question 03.06.02-20:

This is the supplemental RAI S01 for RAI 107, 03.06.02-2

The response from AREVA concerning RAI #03.06.02-2 is not adequate. Specifically for inside containment, BTP 3-4, Part B, item A(i) states that the effects of postulated piping breaks at any location should be isolated or physically remote from essential systems and components. It does allow an evaluation of each postulated rupture location for its effects on essential systems and components, as identified in the second bullet of the response. However, using the idea of separation and redundancy for the essential systems and components to eliminate the need for detailed evaluation and protection of a ruptured pipe's essential target may not be acceptable. The applicant's effort may include analyses demonstrating that the essential systems and components affected by a rupture in a nearby piping break would be able to perform their intended functions (see BTP 3-3, item B.3 for outside containment) or providing appropriate protection devices. The staff requests the applicant to address the concerns discussed in the original RAI and to clarify the third bullet of the RAI response. The applicant is requested to discuss in detail how its plant design and the separation and redundancy method can be used to mitigate the effect of pipe rupture.

Response to Question 03.06.02-20:

The Response to RAI 107, Question 03.06.02-2, third bullet states:

> "Separation and redundancy for the respective system is used to eliminate the need for detailed evaluation and protection of a rupture's essential targets. For example, if the essential system target is in one train of a four train redundant system, with complete separation of each train; the target can then be considered lost due to the rupture and no further evaluation of the dynamic and environmental effects is required."

The Response to Question 03.06.02-20 provides further information regarding how the U.S. EPR design and the separation and redundancy method are used to mitigate the effects of pipe rupture.

As addressed in U.S. EPR FSAR Tier 2, 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, many 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 accomplished by separate compartments/rooms used for individual trains.

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 pipe break is as follows:

- High-energy pipe breaks are postulated as described in U.S. EPR FSAR Tier 2, Section 3.6.2.1.1.2.

- Essential system targets are identified for each break based on plant layout of these systems relative to the break location.

- 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.

U.S. EPR FSAR Tier 2, Section 3.6.2.1.1.4 and Section 3.6.2.1.2.4 will be revised to include this information and clarify the use of separation and redundancy following high-energy and moderate-energy pipe ruptures. Additionally, the severe accident heat removal system and component cooling water supply train and common header systems will be changed from high-energy systems to moderate-energy systems in U.S. EPR FSAR Tier 2, Table 3.6.1-1—High-Energy and Moderate-Energy Fluid Systems Considered for Protection of Essential Systems, due to limited operations with high-energy conditions in accordance with the criteria in U.S. EPR FSAR Tier 2, Section 3.6.1.1.1 and BTP 3-4. The gaseous fire extinguishing system will be removed from Table 3.6.1-1. The pipe breaks in the Safeguard Buildings that are associated with these systems will be removed from U.S. EPR FSAR Tier 2, Table 3.6.1-2—Building, Room, and Postulated Pipe Ruptures and Table 3.6.1-3—Building, Room, Break, Target, and Protection Required.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 3.6.2.1.1.4, Section 3.6.2.1.2.4, Table 3.6.1-1, Table 3.6.1-2 and Table 3.6.1-3 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

Table 3.6.1-1—High-Energy and Moderate-Energy Fluid Systems Considered for Protection of Essential Systems[1]
Sheet 1 of 2

System	High-Energy	Moderate-Energy
Chemical and Volume Control	•	
Component Cooling Water (Supply Train)[3]	•	•
Component Cooling Water (Common Header)[3]	•	•
Coolant Treatment		•
Decontamination Equipment[3]		•
Demineralized Water		•
Emergency Feedwater[6]	•	
Essential Service Water		•
Extra Borating[3]		•
Feedwater	•	
Fuel Handling		•
Fuel Pool Cooling		•
Fuel Pool Purification[2]		•
~~Gaseous Fire Extinguishing[8]~~	•	
Gaseous Waste Processing	•	
In-Containment Refueling Water Storage Tank		•
Leak-Off 03.06.02-20		•
Low Head Safety Injection[7]	•	
Main Condensate	•	
Medium Head Safety Injection[3]		•
Main Steam[5]	•	
Nuclear Island Drain and Vent[8]	•	
Nuclear Sampling[9]		•
Operational Chilled Water		•
Potable and Sanitary Water		•
RC Pump Seal Injection of CVCS	•	
Reactor Coolant[4,5]	•	
Residual Heat Removal[6]	•	
Safety Chilled Water		•
Sampling for SG Blowdown[9]		•
Seal Water Supply		•

Table 3.6.1-1—High-Energy and Moderate-Energy Fluid Systems Considered for Protection of Essential Systems[1]
Sheet 2 of 2

System	High-Energy	Moderate-Energy
Severe Accident Heat Removal[3]	•	•
Stationary Fire Protection 03.06.02-20		•
Steam Generator Blowdown	•	

Notes:

1. Systems included in this list are high- or moderate-energy fluid systems. Systems that operate at approximately atmospheric pressure, such as vents and drains, have been excluded. Moderate-energy gas systems have also been excluded.

2. This system is considered to be moderate-energy, as it operates above the high-energy limits less than 2% of the system's total operating time.

3. This system is considered to be moderate-energy, as it operates above the high-energy limits less than 1% of the total plant operating time.

4. The reactor coolant loop has been analyzed for LBB criteria.

5. Main steam inside containment and the pressurizer surge line have been analyzed to LBB criteria.

6. This system is only high-energy from its connection to the reactor coolant pressure boundary (RCPB) for the residual heat removal (RHR) system (or SG secondary side for the emergency feedwater (EFW) system) upstream to its isolation valve. The remainder of this system does not operate during normal plant operations, and thus falls under the 1% rule.

7. Portions of this system fall under the 1% or 2% rules.

8. Only a small portion of this system has been identified as high-energy.

9. This system is a sampling system with only high-energy conditions following an accident; thus it falls under the 2% rule.

Table 3.6.1-2—Building, Room, and Postulated Pipe Ruptures[1,2]
Sheet 5 of 6

Compartment		Lines Evaluated to LBB		Lines Not Evaluated to LBB	
Building	**Room No.**	**System**	**Terminal End**	**System**	**Terminal End**
Safeguard Building 1	1UJE26-001	None	None	Feedwater	Piping Anchors
	1UJE29-002	None	None	MS	Decoupled Branch Connections
	~~1UJH01-008~~	~~None~~	~~None~~	~~SAHR~~	~~SAHR Pump Nozzles~~
03.06.02-20	~~1UJH05-012~~	~~None~~	~~None~~	~~SAHR~~	~~SAHR HX Nozzles~~
	1UJK26-030	None	None	Feedwater	Piping Anchors
				MS	Piping Anchors
	2UJE29-002	None	None	MS	Decoupled Branch Connections
	2UJE34-003	None	None	Condensate	Piping Anchors
Safeguard Building 2	~~2UJK26-040~~N/A	None	None	~~Gaseous Fire Ext.~~None	~~SGJ Tanks Nozzles~~None
Safeguard Building 3	N/A	None	None	None	None
Safeguard Building 4	3UJE26-001	None	None	Feedwater	Piping Anchors
	3UJE29-002	None	None	MS	Decoupled Branch Connections
	4UJE29-002	None	None	MS	Decoupled Branch Connections
03.06.02-20	~~4UJH01-007~~	~~None~~	~~None~~	~~CCW~~	~~2" to 10" Branch Connection~~
	~~4UJH01-008~~	~~None~~	~~None~~	~~SAHR~~	~~SAHR Pump Nozzles~~
				~~CCW~~	~~SAHR Pump Nozzles~~
	~~4UJH01-027~~	~~None~~	~~None~~	~~CCW~~	~~CCW Pump Nozzles~~
				~~CCW~~	~~1.5" to 10" Branch Connections~~

Table 3.6.1-2—Building, Room, and Postulated Pipe Ruptures[1,2]
Sheet 6 of 6

Compartment		Lines Evaluated to LBB		Lines Not Evaluated to LBB	
Building	**Room No.**	**System**	**Terminal End**	**System**	**Terminal End**
Safeguard Building 4 (Cont'd.)	~~4UJH05-012~~	~~None~~	~~None~~	~~SAHR~~	~~SAHR HX Nozzles~~
				~~CCW~~	~~SAHR HX Nozzles~~
03.06.02-20	~~4UJH05-026~~	~~None~~	~~None~~	~~CCW~~	~~CCW Pump Nozzles~~
				~~CCW~~	~~CCW Surge Tank Nozzle~~
				~~CCW~~	~~2" to 10" Branch Connection~~
	~~4UJH10-026~~	~~None~~	~~None~~	~~CCW~~	~~CCW HX Nozzles~~
				~~CCW~~	~~2" to 10" Branch Connection~~
	4UJK26-030	None	None	Feedwater	Piping Anchors
				MS	Piping Anchors
Fuel Building	UFA01-035	None	None	CVCS	CVCS Charging Pump Nozzle
	UFA01-085	None	None	CVCS	CVCS Charging Pump Nozzle

Notes:

1. The high-energy breaks listed are terminal end breaks associated with the systems in Table 3.6.1-1 which do not fall under the 1% or 2% rules. The terminal end breaks where the piping has been evaluated to LBB criteria have also been shown as such.
2. The U.S. EPR subscribes to the Kraftwerks Kennzeichen System (KKS) for coding and nomenclature of structures, systems, and components.

Table 3.6.1-3—Building, Room, Break, Target, and Protection Required[1,2]
Sheet 2 of 2

Compartment		Terminal End Break		Essential System Targets	Protection Required
Building	Room No.[2]	System	Terminal End		
Reactor Building	UJA29-004	Feedwater	SG Nozzle	Steam Generator Cubicle Wall	Whip Restraint
	UJA29-007	Feedwater	SG Nozzle	Steam Generator Cubicle Wall	Whip Restraint
	UJA29-008	Feedwater	SG Nozzle	Steam Generator Cubicle Wall	Whip Restraint
Safeguard Building 1	1UJK26-030	Feedwater	Piping Anchor	Concrete Wall Isolating FW and MS Pipes	Whip Restraint
	2UJE34-003	Condensate	Piping Anchors	MS Valve Room Concrete Wall	Whip Restraints
Safeguard Building 2	N/A	None	None	None	None
Safeguard Building 3	N/A	None	None	None	None
Safeguard Building 4	N/A~~4UJH01-027~~	None~~CCW~~	None~~CCW Pump Nozzle~~	None~~Concrete Ceiling With Essential SW Above~~	None~~Whip Restraint~~
	4UJK26-030	Feedwater	Piping Anchor	Concrete Wall Isolating FW and MS Pipes	Whip Restraint
Fuel Building	UFA01-035	CVCS	Charging Pump Nozzle	Electrical Cable Trays Assumed to Contain SR Cables	Jet Shield and/or Whip Restraint
	UFA01-085	CVCS	Charging Pump Nozzle	Electrical Cable Trays Assumed to Contain SR Cables	Jet Shield and/or Whip Restraint

03.06.02-20

Notes:

1. The high-energy breaks listed are terminal end breaks from Table 3.6.1-2, which upon evaluation have been shown to be capable of jeopardizing the operation of essential system components unless protection is provided.

2. The U.S. EPR subscribes to the Kraftwerks Kennzeichen System (KKS) for coding and nomenclature of structures, systems, and components.

Next File

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

03.06.02-20

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, many 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 accomplished by separate compartments/rooms used for individual trains.

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.

03.06.02-20

- Essential system targets are identified for each break based on plant layout of these systems relative to the break location.
- 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:

   A. When the piping is exempted by the criteria in Section 3.6.2.1.2.1 or Section 3.6.2.1.2.3.

   B. Where the ASME Code Class 1 piping stress range is calculated by Equation 10 from Paragraph NB-3653 in Section III of the ASME Code is less than 1.2 S_m.

   C. Where ASME Code Class 2, 3, and non-safety piping stresses are calculated by the sum of Equations 9 and 10 from Paragraph NC/ND-3653 in Section III of

the ASME Code are less than 0.4 times the sum of the stress limits in NC/ND-3653.

2. Leakage cracks, unless exempted by Item 1 above, are postulated at circumferential and axial locations that yield the most severe environmental consequences.

3. Leakage cracks are postulated in piping designed to non-seismic standards at locations where the resultant leakage impacts the functional capability of affected essential equipment.

3.6.2.1.2.3 Moderate-Energy Fluid Systems in Close Proximity to High-Energy Fluid Systems

Leakage cracks are not postulated in moderate-energy lines where the crack is in close proximity to a high-energy line break, as long as the crack does not result in more limiting environmental conditions than the high-energy line break. When a leakage crack in a moderate-energy line causes more limiting environmental conditions than a proximate high-energy line break, the provisions from Section 3.6.2.1.2.2 are used.

3.6.2.1.2.4 Moderate-Energy Fluid Systems Separated from Essential Systems and Components

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The information in Section 3.6.2.1.1.4 also applies to separating moderate-energy piping from essential systems and bringing the unit to a safe shutdown condition following a moderate-energy leakage crack. Separation and redundancy allow safety function survivability for certain effects of moderate-energy leakage cracks (e.g., spray wetting) without the need for specific evaluations or protection considerations.~~For essential system targets identified for a moderate-energy line crack 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 effects of these ruptures (e.g., spray wetting) need not be considered.~~

3.6.2.1.2.5 Fluid Systems that Qualify As Moderate-Energy Systems Based on Short Operational Periods as High-Energy

Leakage cracks, instead of breaks, are postulated in systems that are high-energy for only a short operational period of time and moderate-energy for most of the time. The operational period is defined as "short" if the time that the system operates under high-energy system conditions is two percent or less of the time that the system operates