ArevaEPRDCPEm Resource

From: WELLS Russell D (AREVA NP INC) [Russell.Wells@areva.com]
Sent: Tuesday, September 01, 2009 11:28 AM
To: Tesfaye, Getachew
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. 257, FSAR Ch 19, Supplement 1
Attachments: RAI 257 Supplement 1 Response US EPR DC.pdf

Getachew,

AREVA NP Inc. provided responses to 2 of the 3 questions, and a partial response to 1 of the 3 questions of RAI No. 257 on August 17, 2009. The attached file, "RAI 257 Supplement 1 Response U.S. EPR DC" provides a technically correct and complete responses to the remaining part of the remaining 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 257 Questions 19-316.

The following table indicates the respective pages in the response document, "RAI 257 Supplement 1 Response U.S. EPR DC," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 257 — 19-316l	2	6

This concludes the formal AREVA NP response to RAI 257, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

(Russ Wells on behalf of)
Ronda Pederson
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Licensing Manager, U.S. EPR Design Certification
New Plants Deployment
AREVA NP, Inc.
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3315 Old Forest Road
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From: Pederson Ronda M (AREVA NP INC)
Sent: Monday, August 17, 2009 4:50 PM
To: 'Tesfaye, Getachew'
Cc: BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC); NOXON David B (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 257, FSARCh. 19

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 257 Response US EPR DC.pdf" provides technically correct and complete responses to 2 of the 3 questions, and a partial response to 1 of the 3 questions.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the responses to RAI 257 Questions 19-316 and 19-317.

The following table indicates the respective pages in the response document, "RAI 257 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 257 — 19-316	2	12
RAI 257 — 19-317	13	14
RAI 257 — 19-318	15	16

A complete answer is not provided for one part of Question 19-316. The schedule for a technically correct and complete response to this part of the question is provided below.

Question #	Response Date
RAI 257 — 19-316, Part l	September 1, 2009

Sincerely,

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From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Thursday, July 16, 2009 3:16 PM
To: ZZ-DL-A-USEPR-DL
Cc: Clark, Theresa; Phan, Hanh; Fuller, Edward; Mrowca, Lynn; Chowdhury, Prosanta; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 257 (3288), FSARCh. 19

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on July 7, 2009, and on July 15, 2009, 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: 777

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Subject: Response to U.S. EPR Design Certification Application RAI No. 257, FSAR Ch 19, Supplement 1
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From: WELLS Russell D (AREVA NP INC)

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Response to

Request for Additional Information No. 257, Supplement 1

7/16/2009

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 19 - Probabilistic Risk Assessment and Severe Accident Evaluation
Application Section: 19.1

QUESTIONS for PRA Licensing, Operations Support and Maintenance Branch 1
(AP1000/EPR Projects) (SPLA)

Question 19-316:

(Follow-up to Question 19-166) Following the submission of Final Safety Analysis Report (FSAR) Revision 1, the staff has reviewed the various tables of design features, insights, and assumptions in Chapter 19. Specifically, these tables are Table 19.1-2—Features for U.S. EPR that Address Challenges for Current PWRs [pressurized water reactors], Table 19.1-5—Systems Analyzed in U.S. EPR PRA [probabilistic risk assessment], Table 19.1-102—U.S. EPR Design Features Contributing to Low Risk, Table 19.1-108—U.S. EPR PRA-Based Insights, and Table 19.1-109—U.S. EPR PRA General Assumptions. The staff's objective was to confirm that the design details match descriptions elsewhere in the FSAR and that the assumptions are reasonable. The staff found several apparent inconsistencies and areas needing clarification. Please address each of the following and revise the FSAR as appropriate.

a. In Table 19.1-2, the entry on station blackout (SBO) refers to "cross-ties available for selected loads important to the PRA." It is unclear whether this statement refers to the alternate feed connections described in FSAR Section 8.3.1.1.1 or to other electrical cross-ties.

b. In Table 19.1-2, the entry on response to loss-of-coolant accidents (LOCA) refers to the capability to perform fast cooldown (FCD) using the main steam relief trains (MSRT). Although this operation is described in Chapter 19 and the response to Question 19-60, there appears to be no discussion of FCD elsewhere in the FSAR (e.g., in Chapter 10). If FCD is part of the plant design, it should not be described only in Chapter 19.

c. In Table 19.1-2, the entry on potential for reactor coolant pump (RCP) seal failure refers to an automatic trip of the RCPs given total loss of seal cooling. FSAR Section 5.4.1.2.1 also refers to a trip on loss of cooling. The response to Question 19-206 provides the logic for standstill seal system (SSSS) actuation and indicates that the process automation system (PAS) generates a sequence including an RCP trip. However, other FSAR Sections (e.g., Tier 1, Section 2.4.1 and Tier 2, Section 7.3.1.2.15) describe only the protection system (PS) RCP trip on stage two containment isolation or a safety injection (SI) signal combined with a 75-percent pressure difference across two RCPs. If the SSSS sequence including RCP trip is part of the plant design, it should not be described only in Chapter 19 and a single reference in Section 5.4.1.2.1.

d. In Table 19.1-5, the entry on the safety chilled water system (SCWS) states that SCWS provides "direct room cooling to the EFWS [emergency feedwater system] pump rooms." The first bullet on FSAR page 10.4-86 also refers to SCWS room cooling. This function is not included in the Tier 1 or Tier 2 descriptions of SCWS or in the list of major SCWS users provided in response to Question 09.02.02-41. If SCWS provides direct room cooling of the EFWS pump rooms, the function should not be described only in Chapters 10 and 19.

e. The first bullet in item 5 of Table 19.1-102 provides a disposition for full load rejection. This function is also described in Tier 2, Sections 7.7.2.3.4, 10.2.2.7, and 14.2.12.21.4. References to these portions of the FSAR (and others as appropriate) should be added for completeness.

f. Item 8 of Table 19.1-102 provides several references for a medium head safety injection (MHSI) shutoff head lower than the main steam safety valve (MSSV) setpoint. These values are presented in Tier 1, Tables 2.2.3-3 and 2.8.2-3. References to these portions of the FSAR (and others as appropriate) should be added for completeness.

g. The third portion of the question of item 9 in Table 19.1-102 refers only to Tier 2, Section 7.1.1.4.1. The diverse reactor trip devices are described in Tier 2, Section 7.2.1.1. Functional diversity is discussed in Section 10 of topical report ANP-10281P. These references (and others as appropriate) should be added for completeness.

h. Item 10 of Table 19.1-102 refers to Tier 2, Section 9.2.8.2.2. Diversity of the SCWS refrigeration units is stated more clearly in Tier 2, Section 9.2.8.4. This reference (and others as appropriate) should be added for completeness.

i. Item 14 of Table 19.1-102 refers to Tier 2, Section 19.2.3.3.3.1. Passive cooling by the severe accident heat removal system (SAHRS) is described more fully in Tier 2, Section 19.2.3.3.3.2. This reference (and others as appropriate) should be added for completeness.

j. Item 15 of Table 19.1-102 describes the use of SAHRS for backup cooling of the in-containment refueling water storage tank (IRWST) if low head safety injection (LHSI) fails. Although Figure 19.2-2 shows a loop from the IRWST to the SAHRS heat exchanger, this function is not explicitly listed in the Tier 1 or Tier 2 descriptions of SAHRS. Tier 2, Section 6.2.1.1.1 only describes LHSI heat removal from the IRWST, not the SAHRS backup. If the use of SAHRS as a backup source of IRWST cooling is part of the plant design, it should not be discussed only in the description of the Level 1 PRA.

k. Item 20 of Table 19.1-102 refers to Tier 2, Section 5.3.3.1.1. Absence of penetrations in the lower vessel head is stated more clearly in Tier 2, Section 5.3.3.1.3. This reference (and others as appropriate) should be added for completeness.

l. Item 3 in Table 19.1-108 indicates that the current PRA models one component cooling water system (CCWS) header supplying two RCP thermal barriers. The design has been changed to supply all four RCPs from a single header. Until this design change is incorporated in the PRA, the table should acknowledge the difference; once it is incorporated, the table will need further revision.

m. Item 9 in Table 19.1-108 describes automatic isolation of the essential service water system (ESWS) and demineralized water system (DWS) on high sump level. ESWS isolation is described in Sections 3.4.3.4, 9.2.1.3.5, and 9.3.3.3, but appears not to be included in Chapter 7. Fuel building (FB) level measurements and alarms are described in FSAR Sections 3.4.3.6 and 9.2.1.3.5, but automatic isolation of DWS appears not to be included in these sections or in Chapter 7. In addition, the bounding FB flood source identified in Section 3.4.3.5 is the fire water distribution system (FWDS), not DWS. These inconsistencies should be corrected as needed, and the isolation functions should be considered for inclusion in Chapter 7.

n. Item 16 in Table 19.1-108 refers to Tier 2, Section 9.3.4.2.2. Reactor coolant system (RCS) loop level limitation is described more fully in Tier 2, Section 7.7.2.3.13. This reference (and others as appropriate) should be added for completeness.

o. Item 17 in Table 19.1-108 refers to Tier 2, Section 5.4.7.2.1. Reactor coolant system (RCS) loop level control is described more fully in Tier 2, Section 7.7.2.2.3. This reference (and others as appropriate) should be added for completeness.

p. Item 18 in Table 19.1-108 refers to “Insight #3,” but the referenced insight is now the third item in Table 19.1-102.

q. Item 19 in Table 19.1-108 describes residual heat removal (RHR) isolation on high safeguard building (SB) sump level. Although this function appears in the referenced

FSAR section, it appears not to be described in Chapter 7. If this isolation function is part of the plant design, it should not be described only in Chapter 19 and the list of mid-loop design features in Section 5.4.7.2.1.

r. Item 20 in Table 19.1-108 refers to Tier 2, Section 5.4.7.2. These two MHSI actuation signals are also presented in Tier 1, Table 2.4.1-4. This reference (and others as appropriate) should be added for completeness.

s. Item 21 in Table 19.1-108 refers to “Insight #20,” but the referenced insight is now the fourth item in Table 19.1-108.

t. Item 22 in Table 19.1-108 addresses feed and bleed during shutdown, but refers to the FSAR section related to overpressure protection. The pressurizer safety relief valves (PSRV) and severe accident depressurization valves (SADV) are described more fully in Tier 1, Section 2.2.1 and Tier 2, Sections 5.4.13 and 19.2.3.3.4.1. These references (and others as appropriate) should be added for completeness.

u. Item 23 in Table 19.1-108 refers to “Insight #2,” but the referenced insight is now the second item in Table 19.1-102.

v. Item 24 in Table 19.1-108 refers to the thermal barrier cooling design documented in Tier 2, Section 9.2.2.1. This reference (and others as appropriate) should be added for completeness.

w. Item 20 in Table 19.1-109 refers to “EDWS.” This abbreviation is undefined and may be a typographical error meaning DWS, ESWS, or another system.

x. As in part (d) above, item 36 in Table 19.1-109 refers to local room cooling of the EFWS pump rooms. If revisions are made in response to part (d), this assumption may also need clarification.

y. Item 57 in Table 19.1-109 states that the equipment hatch is open in shutdown plant operating states (POS) CA, CB, and E and closed in D. This statement is consistent with Table 19.1-110 and Section 19.1.6.3.1.4, but is not consistent with Table 19.1-89, which states that the hatch is closed in POS CA and CB. The assumed containment status should be verified and made consistent throughout Chapter 19.Response to Question 19-316:

Response to Question 19-316:

Items a through k and m through y were answered in the original RAI 257 response.

Response to Question 19-316l:

Item 3 in U.S. EPR FSAR, Tier 2, Table 19.1-108 will be modified to state: “The design change identified in Bullet 6 of Section 19.1.2.4 will enable cooling to the thermal barriers to be maintained by switching over to the other CCW common header.”

In the process of responding to this question, AREVA NP reviewed the sensitivity calculations presented in the responses to RAI 138, Question 19-247 and RAI 197, Question 19-279. AREVA NP discovered that a power supply to one of the reactor coolant pump (RCP) thermal barriers (TB) crosstie valves was incorrectly identified. This resulted in an overestimate of the core damage frequency (CDF) change reported in these two RAIs.

During the review, AREVA NPs also found that the sensitivity calculations were very sensitive to:

1. Asymmetry in the modeling assumptions, especially which component cooling water (CCW) common header (CH) supplies the RCP TB cooling or HVAC maintenance trains
2. Asymmetry in the initiators, especially loss of component cooling water (CCW) initiators affecting CH1 and fire and flood initiators affecting CH2.

Due to these asymmetries, the assumption that thermal barrier cooling is always provided by CH2 gave some unreasonably conservative results. To avoid this conservatism, the probabilistic risk assessment (PRA) sensitivity model has been modified to model CH1 and CH2 supplying TB cooling 50 percent of the time each.

Correcting the RCP TB crosstie valve power supply, as well as accounting for improvements in model symmetry described above, has changed the sensitivity results reported in RAI 138, Question 19-247 and RAI 197, Question 19-279. These changes are not significant and are summarized below in Tables 19-316l-1 and 19-316l-2.

Table 19-316I-1—Update to Table 19-247-1, Results of a Sensitivity Case with One CCW Common Header Cooling all RCP Thermal Barriers

Event	Base Case CDF (per yr)	Initial Response to Question 19-247		Updated Values	
		Sensitivity Case CDF (per yr)	Relative Change in CDF	Sensitivity Case CDF (per yr)	Relative Change in CDF
Total At-Power CDF	5.3E-07	4.4E-07	-16%	4.6E-07	-12%
Internal Events	2.9E-07	2.8E-07	-3%	2.8E-07	-3%
Internal Fires	1.8E-07	1.2E-07	-31%	1.4E-07	-19%
Internal Floods	6.1E-08	4.3E-08	-29%	4.3E-08	-29%

Table 19-316I-2—Update to Table 19-279-1, Seal LOCA Contribution to CDF

Event	Base Case	Sensitivity case performed for RAI 19-247 (Initial Response)	Updated Values for Sensitivity Case performed for RAI 19-316I
Internal Event CDF	11%	7%	8%
Internal Fire CDF	43%	18%	24%
Internal Flooding CDF	30%	2%	1%
Total At-Power CDF	24%	10%	13%

FSAR Impact:

U.S. EPR FSAR, Tier 2, Table 19.1-108 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

Table 19.1-108—U.S. EPR PRA Based Insights
Sheet 1 of 5

No	U.S. EPR PRA Based Insight	Disposition
1	**Significance of AC power to the core-damage results** Despite the provisions made for the reliable supply of offsite and onsite AC power, the risk results indicate that losses of offsite power are among the dominant contributors to the frequency of core damage. Since the U.S. EPR employs active safety systems that derive their motive power from AC sources, this is to be expected. The CDF remains low because of the level of redundancy and diversity incorporated into the AC systems.	Tier 2, Section 19.1.4.1.2.2
2	**Modest contribution of SLOCA** Small LOCAs are less significant than are losses of offsite power. This is large part due to the four-train redundancy of the safety injection systems. The contribution from SLOCAs is, however, still important on a relative basis, because of the potential for common-cause failures of the systems needed to prevent core damage (e.g., common injection check valves, MHSI and actuation systems).	Tier 2, Section 19.1.4.1.2.2
3	**Potential cross-train impact of loss of HVAC** Because of the normal configuration with two trains of CCW in operation, a loss of HVAC for the building in which one CCW operating train is located can have consequences that affect HVAC for the building in which the standby CCW train is located. For example, as the systems are modeled in the PRA, a failure of HVAC with failure to recover cooling for SB 1 has a potential to result in the following effects: • A complete loss of the AC and DC buses in Division 1. • Loss of operating CCW pump Division 1 and failure of CCW common header switchover. • Loss of CCW flow for thermal-barrier and motor cooling of RCPs 1 and 2. The design change identified in Bullet 6 of Section 19.1.2.4 will enable cooling to the thermal barriers to be maintained by switching over to the other CCW common header. • Loss of charging pump 1. • Loss of cooling to the safety chillers Division 2 and loss of HVAC in SB 2.	Tier 2, Section 9.2.2.2.1; Tier 2, Section 9.4.5; Tier 2, Section 9.4.6; Tier 2, Section 19.1.4.1.1.3

19-316