ArevaEPRDCPEm Resource

From: Pederson Ronda M (AREVA NP INC) [Ronda.Pederson@areva.com]
Sent: Thursday, September 17, 2009 5:22 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. 227, FSAR Ch 19, Supplement 4
Attachments: RAI 227 Supplement 4 Response US EPR DC.pdf

Getachew,

AREVA NP Inc. provided responses to 12 of the 20 questions of RAI No. 227 on July 6, 2009. AREVA NP submitted Supplement 1 to the response on July 16, 2009 to address one of the remaining 8 questions. AREVA NP submitted Supplement 2 to the response on July 24, 2009 to revise the Supplement 1 response. AREVA NP submitted Supplement 3 to the response on August 27, 2009 to address one of the remaining 8 questions. The attached file, "RAI 227 Supplement 4 Response U.S. EPR DC" provides technically correct and complete responses to three of the remaining 6 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 277 Question 19-293.

The following table indicates the respective pages in the response document, "RAI 227 Supplement 4 Response U.S. EPR DC," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 227 — 19-293	2	3
RAI 227 — 19-294	4	6
RAI 227 — 19-295	7	8

The schedule for the remaining three questions is revised to coordinate the responses with the current work on U.S. EPR instrumentation and controls design. Therefore, the schedule for technically correct and complete responses to the remaining three questions has been changed and is provided below:

Question #	Response Date
RAI 227 — 19-284	December 16, 2009
RAI 227 — 19-287	December 16, 2009
RAI 227 — 19-292	December 16, 2009

Sincerely,

Ronda Pederson
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From: WELLS Russell D (AREVA NP INC)
Sent: Thursday, August 27, 2009 3:24 PM
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. 227, FSAR Ch 19, Supplement 3

Getachew,

AREVA NP Inc. provided responses to 12 of the 20 questions of RAI No. 227 on July 6, 2009. AREVA NP submitted Supplement 1 to the response on July 16, 2009 to address one of the remaining 8 questions. AREVA NP submitted Supplement 2 to the response on July 24, 2009 to revise the Supplement 1 response. The attached file, "RAI 227 Supplement 3 Response U.S. EPR DC" provides a technically correct and complete response to one of the remaining 7 questions.

The following table indicates the respective pages in the response document, "RAI 227 Supplement 3 Response U.S. EPR DC," that contain AREVA NP's response to the subject question.

Question #	Start Page	End Page
RAI 227 — 19-298	2	4

A complete answer is not provided for 6 of the 20 questions. The schedule for a technically correct and complete response to these questions was provided previously and remains as indicated below.

Question #	Response Date
RAI 227 — 19-284	September 18, 2009
RAI 227 — 19-287	September 18, 2009
RAI 227 — 19-292	September 18, 2009
RAI 227 — 19-293	September 18, 2009
RAI 227 — 19-294	September 18, 2009
RAI 227 — 19-295	September 18, 2009

Sincerely,

(Russ Wells on behalf of)
Ronda Pederson

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From: Pederson Ronda M (AREVA NP INC)
Sent: Friday, July 24, 2009 4:54 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. 227, FSAR Ch 19, Supplement 2

Getachew,

AREVA NP Inc. provided responses to 12 of the 20 questions of RAI No. 227 on July 6, 2009. On July 16, 2009, AREVA NP submitted Supplement 1 to the response to address 1of the remaining questions. Several pages were unintentionally omitted in the appended U.S. EPR Final Safety Analysis Report (FSAR) markups provided in Supplement 1.

The attached file, "RAI 227 Supplement 2 Response U.S. EPR DC" provides the affected pages of the U.S. EPR FSAR in redline-strikeout format which support the response to RAI 227 Question 19-285, provided in Supplement 1. These FSAR markups replace, in their entirety, the FSAR markups provided in Supplement 1.

The schedule for a technically correct and complete response to the remaining questions was provided previously and remains as indicated below.

Question #	Response Date
RAI 227 — 19-284	September 18, 2009
RAI 227 — 19-287	September 18, 2009
RAI 227 — 19-292	September 18, 2009
RAI 227 — 19-293	September 18, 2009
RAI 227 — 19-294	September 18, 2009
RAI 227 — 19-295	September 18, 2009
RAI 227 — 19-298	August 28, 2009

Sincerely,

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From: Pederson Ronda M (AREVA NP INC)
Sent: Thursday, July 16, 2009 1:57 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. 227, FSAR Ch 19, Supplement 1

Getachew,

AREVA NP Inc. provided responses to 12 of the 20 questions of RAI No. 227 on July 6, 2009. The attached file, "RAI 227 Supplement 1 Response U.S. EPR DC" provides a technically correct and complete response to one of the remaining 8 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 227 Question 19-285.

The following table indicates the respective pages in the response document, "RAI 227 Supplement 1 Response U.S. EPR DC," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 227 — 19-285	2 A-1 B-1	3 A-90 B-130

A complete answer is not provided for 7 of the 20 questions. The schedule for a technically correct and complete response to these questions was provided previously and remains as indicated below.

Question #	Response Date
RAI 227 — 19-284	September 18, 2009
RAI 227 — 19-287	September 18, 2009
RAI 227 — 19-292	September 18, 2009
RAI 227 — 19-293	September 18, 2009
RAI 227 — 19-294	September 18, 2009
RAI 227 — 19-295	September 18, 2009
RAI 227 — 19-298	August 28, 2009

Sincerely,

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From: WELLS Russell D (AREVA NP INC)
Sent: Monday, July 06, 2009 6:08 PM
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. 227, FSAR Ch 19

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 227 Response US EPR DC.pdf" provides technically correct and complete responses to 12 of the 20 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 227 Questions 19-299 and 19-300.

The following table indicates the respective pages in the response document, "RAI 227 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 227 — 19-284	2	3
RAI 227 — 19-285	4	4
RAI 227 — 19-286	5	5
RAI 227 — 19-287	6	6
RAI 227 — 19-288	7	10
RAI 227 — 19-289	11	11
RAI 227 — 19-290	12	12
RAI 227 — 19-291	13	13
RAI 227 — 19-292	14	14
RAI 227 — 19-293	15	15
RAI 227 — 19-294	16	16
RAI 227 — 19-295	17	17
RAI 227 — 19-296	18	19
RAI 227 — 19-297	20	22
RAI 227 — 19-298	23	23
RAI 227 — 19-299	24	26
RAI 227 — 19-300	27	32
RAI 227 — 19-301	33	33
RAI 227 — 19-302	34	35
RAI 227 — 19-303	36	37

A complete answer is not provided for 8 of the 20 questions. The schedule for a technically correct and complete response to these questions is provided below.

Question #	Response Date
RAI 227 — 19-284	September 18, 2009
RAI 227 — 19-285	July 20, 2009
RAI 227 — 19-287	September 18, 2009
RAI 227 — 19-292	September 18, 2009
RAI 227 — 19-293	September 18, 2009
RAI 227 — 19-294	September 18, 2009
RAI 227 — 19-295	September 18, 2009
RAI 227 — 19-298	August 28, 2009

(Russ Wells on behalf of)
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From: Getachew Tesfaye [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Friday, June 05, 2009 3:29 PM
To: ZZ-DL-A-USEPR-DL
Cc: Theresa Clark; Hanh Phan; Edward Fuller; Lynn Mrowca; Prosanta Chowdhury; Joseph Colaccino; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 227 (2564, 2598),FSAR Ch. 19

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on May 15, 2009, and discussed with your staff on May 29, 2009. Draft RAI Questions 19-296, 19-300, and 19-302 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: 819

Mail Envelope Properties (5CEC4184E98FFE49A383961FAD402D31013C089E)

Subject: Response to U.S. EPR Design Certification Application RAI No. 227, FSAR Ch 19, Supplement 4
Sent Date: 9/17/2009 5:22:18 PM
Received Date: 9/17/2009 5:22:22 PM
From: Pederson Ronda M (AREVA NP INC)

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Files	**Size**	**Date & Time**
MESSAGE	11152	9/17/2009 5:22:22 PM
RAI 227 Supplement 4 Response US EPR DC.pdf	138101	

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

Response to

Request for Additional Information No. 227, Supplement 4

6/05/2009

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

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

Question 19-293:

(Follow-up to Question 19-260) The table of CCF parameters provided in response to Question 19-260 shows separate CCF groups for processors in seven different actuation logic units (ALU) and acquisition and processing units (APU). Even if these processors perform different functions, they could be of the same type with common manufacturing, maintenance, or installation errors. Therefore, justify the use of separate CCF groups. Revise the FSAR to document any important assumptions related to CCF of these processors.

Response to Question 19-293:

TELEPERM XS is AREVA NP's instrumentation and controls (I&C) system platform for safety-related I&C in nuclear power plants. The first TELEPERM XS systems were put into operation more than ten years ago and have been working very reliably. To date TELEPERM XS I&C systems have been installed in 39 units at 24 plant sites located in 11 countries and using 10 different reactor designs. Through 2008, the total cumulative processor module operating experience is 92 million hours. During this time there has never been a processor common cause failure (CCF).

As described in the Reactor Protection System Topical Report EMF-2110(NP)(A) (which is referenced in U.S. EPR FSAR Tier 2, Section 7.1.1.2.1.), the TELEPERM XS platform is carefully designed to preclude processor failures from propagating to other processor modules that perform redundant or diverse functions. Important features that prevent failure propagation between computers include cyclic operating systems that run asynchronously on the independent computers. Communication between processing units inside a TELEPERM XS based system as well as with outside systems is performed in a strictly cyclic manner, using data buffers in statically allocated memory. Data is written and read independently by the sending and receiving units. This results in interference-free communication with minimal coordination. Postulated failures of a sending processor or a communication device cannot influence the cyclic operation of a receiving processor. Communication with minimal coordination is an effective barrier against fault propagation.

TELEPERM XS processing modules in the actuation logic units (ALU) and the acquisition and processing units (APU) are physically identical. However, there is no basis in the operating experience to suggest CCF vulnerability due to manufacturer, installation, or maintenance. Unlike an analog system that sits in standby until demanded, the TELEPERM XS processors with their cyclic operating systems are always active and continuously process the same amount of data whether they are in the midst of a demand challenge (i.e., a postulated accident) or between demands. Hence, postulated failures related to manufacturing, installation, or maintenance are revealed immediately, rather than laying latent until a system challenge.

For conservatism the probabilistic risk assessment (PRA) assigns a CCF potential to the processors. Based on engineering judgment, the CCF grouping was assigned to processors with identical functionality. However, the operating system CCF probability (which is the subject of Question 19-284, Part b) captures the remote possibility of system-wide processor failure.

Modeling logistics is another factor for choosing CCF grouping. The Risk-Spectrum® solution of the Multiple Greek Letter (MGL) CCF methodology becomes unwieldy for very large CCF groups (because of too many cut set combinations). Therefore, the beta-factor methodology was used for processor CCF groups (Total of 20 APU processors and 16 ALU processors in the

various CCF groups) in order to reduce the number of combinations and the computation time. In the beta-factor method, when there are two failures in the group, the entire group is assumed failed – and it was determined that a CCF group consisting of all 36 ALU and APU processors would be an over-simplification. Given the modeling limitations, it was determined that limiting the CCF groups to processors of identical function was a reasonable approach.

A sensitivity case is provided to show the impact of this modeling decision. The sensitivity case places all of the APU and ALU processors in the same CCF group. The combined CCF group was modeled with the same beta-factor (beta= 5E-3) as initially used for the different APU and ALU CCF groups. The results of the sensitivity case are shown in Table 19-293-1.

The following is added to U.S. EPR FSAR Tier 2, Table 19.1-108, Item 6.

> "In addition, the TELEPERM XS platform has features, as described in the Reactor Protection System Topical Report EMF-2110(NP)(A) (Reference 54), that are effective for limiting the propagation of postulated failures if they occur. These features help minimize the potential for common cause failure."

Table 19-293-1—Results of Sensitivity Cases for Digital I&C Common Cause between I&C Processors

Mode	Sensitivity Case Description	CDF (1/year)	Delta CDF
At Power	Base Case	5.26E-07	-
At Power	Combine all processors in APU1 through APU5 (20) and ALU-A and ALU-B (16) into one CCF group (size=36)	5.30E-07	1%
Shutdown	Base Case – Shutdown	5.77E-08	
Shutdown	Combine all processors in APU1 through APU5 (20) and ALU-A and ALU-B (16) into one CCF group (size=36)	5.79E-08	0.3%

Note: The results do not include credit for any diverse automatic or manual actuations that may be required for diversity and defense in depth (D3), other than diverse reactor trip (for the ATWS rule). The diverse actuation system (DAS) will be designed to meet the NUREG-0800, BTP 7-19 diversity requirements as described in U.S. EPR FSAR Tier 2, Chapter 7; however the diverse engineered safety feature actuation system (ESFAS) actuations are not included in the current PRA results. When incorporated, DAS reduces the sensitivity of the PRA with respect to the modeling uncertainty.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 19.1.9 and Table 19.1-108 will be revised as described in the response and indicated on the enclosed markup.

Question 19-294:

(Follow-up to Question 19-260) The table of CCF parameters provided in response to Question 19-260 shows separate CCF groups for many similar sensors (e.g., different groups for each steam generator's level and pressure sensors, different groups for pressurizer and hot leg level sensors). Justify each group of sensors with reference to the function, operating environment, and potential for manufacturing, maintenance, and installation errors. Revise the FSAR to document any important assumptions related to CCF of these sensors.

Response to Question 19-294:

There are some sensors that are similar in function (and operating environment) that were not included in the same common cause failure (CCF) group. However, because details of sensor design will be developed later in the design process and may depend on vendor data, the approach for responding to this question is to perform a sensitivity study examining the impact of using larger CCF groups.

The choice of CCF groups for sensors was optimized based on engineering judgment to get reasonable results and run time. For example, between the four steam generators (SG), there are 32 level sensors. If the Multiple Greek Letter (MGL) method is used for groups of this size, the run time in the Risk Spectrum® computer code becomes unwieldy because there are too many cut set combinations. The alternative (i.e., one CCF group with all of the SG level sensors) would have forced the use of the beta-factor method instead of MGL. The beta-factor method may have been a modeling over-simplification for such a large group because any CCF modeled is automatically mapped to all 32 sensors. In this case it was determined that limiting the CCF group to one SG, and retaining the MGL method is reasonable.

Part of the reasoning for choosing the SG-specific CCF group involves how the sensors are used. For example, SG level sensors are used for functions associated with an "affected SG" and also for functions associated with "any SG." When using the MGL method, small-order cut sets are generated (in addition to "all") that involve CCF of fewer than all of the sensors, such as failure of two or three. Because the coincidence logic for the sensors is two-out-of-four per SG, a three-order cut set is needed to defeat an "affected SG" function, but a 12-order cut set is needed to defeat an "any SG" function. Therefore, for a smaller-order CCF, such as one involving three sensors, the greater risk impact occurs if the failures are concentrated on a single SG; if mapped to multiple SGs, there is no effect. So it is not immediately obvious when using MGL that the larger CCF group is more conservative than the smaller CCF group. The beta-factor method makes this argument moot by assuming that when two sensors are involved, all sensors in the group are affected. However, this is not necessarily realistic if applied to a group with 32 sensors.

Sensors where the PRA might have used a larger CCF group, but did not, include the following:

- SG level: four wide-range and four narrow-range level sensors per SG (group size 32).
- SG pressure: four pressure sensors per SG (group size 16).
- Containment pressure: wide-range and narrow-range pressure sensors (group size 12).

- Reactor coolant system (RCS) temperature: hot leg temperature, and wide-range and narrow-range cold leg temperature sensors (group size 12).

- Residual heat removal (RHR) and in-containment refueling water storage tank (IRWST) alignment: valve position limit switches on inboard and outboard RHR valves and IRWST valves (group size 16).

The pressurizer level sensors (mentioned in the question) are not modeled or credited in the PRA. In addition, they are used for functions (reactor trip on high pressurizer level, CVCS isolation on high pressurizer level) that are applicable to operating modes 1 through 4. Therefore, they have no potential dependency with the hot-leg level functions, which are used for mid-loop operation.

A sensitivity case is provided to show the impact of putting all of the similar sensors in the same CCF group. Hence, the sensitivity case replaces separate CCF groups in the existing model with the corresponding new CCF groups listed above for: SG level, SG pressure, containment pressure, RCS temperature, and RHR/IRWST valve alignment. Due to the modeling limitations, the sensitivity case also replaces the MGL parameters in the original model (as reported in the Response to Question 19-260) with a beta-factor model. The sensitivity case uses the same beta factor (0.0317) as was used in the MGL it replaces. Therefore, the results of this sensitivity case include not only the effect of the CCF grouping, but also additional conservatism associated with changing from the MGL to the beta-factor method. In other words, a CCF involving two components is assumed to fail the whole group. The results of the sensitivity case are shown in Table 19-294-1.

Table 19-294-1—Results of Sensitivity Cases for Digital I&C Common Cause between Like Sensors

Mode	Sensitivity Case Description	CDF (1/year)	Delta CDF	LRF (1/year)	Delta LRF
At Power	Base Case	5.26E-07	-	2.60E-08	-
At Power	Combine like sensors into same CCF group – • SG (1-4) level • SG (1-4) pressure • Containment pressure • RCS temperature • RHR/IRWST valve alignment	5.39E-07	2%	2.89E-08	11%
Shutdown	Base Case – Shutdown	5.77E-08	-	5.70E-09	-
Shutdown	Combine like sensors into same CCF group – • SG (1-4) level • SG (1-4) pressure • Containment pressure • RCS temperature • RHR/IRWST valve alignment	5.78E-08	0.2%	5.72E-09	0.3%

Note: The at-power delta-large release frequency (LRF) in Table 19-294-1 is conservative. As revealed in the Response to Question 19-160, the results of the base at-power LRF model are dominated by the initiator steam line break inside containment (SLBI), because the PRA assumes overly-conservative consequences from SLBI. The LRF results of this sensitivity case are also dominated by SLBI.

FSAR Impact:

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

Question 19-295:

(Follow-up to Question 19-260) The table of CCF parameters provided in response to Question 19-260 does not include CCFs of analog or digital input and output modules, for which failure data was provided in response to Question 19-4. Clarify whether CCFs of these modules were postulated; if not, justify their exclusion.

Response to Question 19-295:

Common cause failure (CCF) groupings were not explicitly generated for input and output (I/O) modules. Because each I/O module is associated with a specific processor, the processor CCFs are representative for the related I/O modules.

Because there are several I/O modules per processor, the modeling limitations related to excessive group size (addressed in the Response to Questions 19-293 and 19-294) become more pronounced if separate CCF groups are created for I/O modules.

In addition, the I/O modules are not software-based and are less complex than processors. Like the other TELEPERM XS components, the I/O modules have an established operating history and there is no basis in this operating history to indicate vulnerability to CCF.

The base modeling of I/O modules in the PRA is inherently conservative. The allocation of signals and functions to specific I/O modules and channels (each I/O module has 16 to 32 separate channels) will be performed later in the design process. Hence, the current PRA conservatively models failure of any I/O module as equivalent to failure of all of the functions on the associated processor. The failure effects in the final design will be less severe than the PRA assumptions because each I/O module assigned to a processor will carry only a subset of that processor's overall functionality. It was decided that compounding this conservatism with a CCF grouping might be unrealistically pessimistic.

Nonetheless, a sensitivity case is provided to show the potential impact of this modeling decision. In the sensitivity study, all of the like I/O modules across the protection system are combined into CCF groups, and modeled with a beta-factor (beta = 5E-3). This yields the following group sizes:

- Digital input modules (group size 48).
- Digital output modules (group size 76).
- Analog input modules (group size 84).
- Analog output modules (group size 32).

The results of the sensitivity case are shown in Table 19-295-1.

Table 19-295-1—Results of Sensitivity Cases for Digital I&C Common Cause between Analog or Digital Input and Output Modules

Mode	Sensitivity Case Description	CDF (1/year)	Delta CDF
At Power	Base Case	5.26E-07	-
At Power	Create 4 CCF groups: • All digital input modules (48) • All digital output modules (76) • All analog input modules (84) • All analog output modules (32)	7.86E-07	49%
Shutdown	Base Case – Shutdown	5.77E-08	-
Shutdown	Create 4 CCF groups: • All digital input modules (48) • All digital output modules (76) • All analog input modules (84) • All analog output modules (32)	6.54E-08	13%

Note: The results do not include credit for any diverse automatic or manual actuations that may be required for diversity and defense in depth (D3), other than diverse reactor trip (for the ATWS rule). The diverse actuation system (DAS) will be designed to meet the NUREG-0800, BTP 7-19 diversity requirements as described in U.S. EPR FSAR Tier 2, Chapter 7; however the diverse engineered safety feature actuation system (ESFAS) actuations are not included in the current PRA results. When incorporated, DAS reduces the sensitivity of the PRA with respect to the modeling uncertainty.

FSAR Impact:

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

U.S. EPR Final Safety Analysis Report Markups

49. D. A. Powers, "Technical Issues Associated with Air Ingression During Core Degredation", SAND2000-1935C, June 2000.

50. T. Kärelä et al. "Experiments on the Behaviour of ruthenium in air ingress Accidents," NKS-151, March 2007.

51. Auvinen et al, "Progress on Ruthenium Release and Transport under Air Ingress Conditions," European Review Meeting on Severe Accident Research (ERMSAR-2007), Karlsruhe, Germany, 12-14 June 2007.

52. M. L. Ang et al., "PWR severe accident behaviour and containment response for some sequences initiated at shutdown," The Nuclear Engineer, volume 38, no. 3, page 79, 1997.

53. ANP-10281P, Revision 0, "U.S. EPR Digital Protection System Topical Report," AREVA NP Inc., March 2007.

19-293

54. EMF-2110(NP)(A), Revision 1, "TELEPERM XS: A Digital Reactor Protection System," Siemens Power Corporation, July 2000.

Table 19.1-108—U.S. EPR PRA Based Insights
Sheet 2 of 5

No	U.S. EPR PRA Based Insight	Disposition
4	**Sensitivity to human reliability** The Level 1 internal events CDF is sensitive to probabilities for human failure events. The U.S. EPR employs active safety systems, and in unlikely sequences of multiple trains failures, operators are credited to initiate recovery actions (e.g., loss of HVAC recovery, feed and bleed, recovery in SBO conditions, or fast cooldown function). The HRA is performed under assumptions that the operating procedures and guidelines will be well written and complete. This applies to operator training as well.	Tier 1, Section 3.04; Tier 2, Section 18.6
5	**EDGs and SBO DGs are assigned to different common-cause groups.** This PRA modeling assumption will be confirmed by assuring diversity between EDGs and SBO DGs (multiple diversities that could be accomplished be selecting different model, control power, heating, ventilation and air conditioning (HVAC), engine cooling, fuel systems, and location.	Tier 2, Section 8.4.1
6	**High I&C system reliability** The fault-tolerant design of the TXS platform contributes to high I&C system reliability. Inherent in the modeling of the fault tolerant design is the "coverage" of the self-monitoring features, which determines for a given module the percentage of failure modes that are assumed to be repaired quickly (24 hours) versus the non-self-monitored failure modes that are detected by periodic surveillance tests. In addition, the TELEPERM XS platform has features, as described in the Reactor Protection System Topical Report (EMF-2110(NP)(A) (Reference 54)), that are effective for limiting the propagation of postulated failures if they occur. These features help minimize the potential for common cause failure	Tier 2, Section 7.1.2.6.26; Tier 2, Section 7.1.2.6.16; Tier 2, Section 7.1.2.6.21; Tier 2, Table 1.8-2, Item 19.1-9; Tier 2, Section 7.1.1.2.1
7	**The AV42 priority module is not susceptible to CCF** Software CCF is not a concern for the AV42 priority module because the safety-related functions contain neither software nor an operating system. The AV42 uses a programmable logic device; the functions on the module are implemented in solid state logic gate arrays and are non-user programmable. The AV42 is 100% testable before installation. The device also undergoes rigorous physical testing and qualification (environmental, electrical, seismic, radiation, electromagnetic interference, and radio frequency interference). The AV42 module is designed with features to ensure independence between the safety-related and non-safety-related circuits.	Tier 2, Section 7.1.1.2.1

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