ArevaEPRDCPEm Resource

From: BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]
Sent: Thursday, July 29, 2010 8:57 PM
To: Tesfaye, Getachew
Cc: DELANO Karen (AREVA); ROMINE Judy (AREVA); BENNETT Kathy (AREVA); NOXON David (AREVA); WILLIFORD Dennis (AREVA)
Subject: Response to U.S. EPR Design Certification Application RAI No.405, FSAR Ch. 11 PHASE 4 RAI, Supplement 1
Attachments: RAI 405 Supplement 1 Response US EPR DC.pdf

Getachew,

AREVA NP Inc. provided a schedule for technically correct and complete response to the one question in RAI No. 405 on June 24, 2010. The attached file, “RAI 405 Supplement 1 Response US EPR DC” provides technically correct and complete responses to 7 of the 8 questions, as committed.

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 405 Questions 11.02-24, 11.03-18, and 11.05-23. Additional U.S. EPR Final Safety Analysis Report markups related to RAI 405 Supplement 1 can be found with the response to RAI 301, Supplement 5.

The following table indicates the respective pages in the response document, “RAI 405 Supplement 1 Response US EPR DC,” that contain AREVA NP’s response to the subject questions.

Question #	Start Page	End Page
RAI 405 — 11.02-22	2	3
RAI 405 — 11.02-23	4	5
RAI 405 — 11.02-24	6	6
RAI 405 — 11.03-18	7	7
RAI 405 — 11.05-22	8	10
RAI 405 — 11.05-23	11	12
RAI 405 — 11.05-25	12	14

The schedule for technically correct and complete response to the one remaining question is unchanged and is provided below:

Question #	Response Date
RAI 405 — 11.05-24	September 16, 2010

Sincerely,

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

From: BRYAN Martin (EXT)
Sent: Thursday, June 24, 2010 2:20 PM
To: 'Tesfaye, Getachew'
Cc: DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); WILLIFORD Dennis C (AREVA NP INC); NOXON David B (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No.405, FSAR Ch. 11 PHASE 4 RAI

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 405 Response US EPR DC.pdf," provides the schedule for technically correct and complete responses to these questions.

The following table indicates the respective pages in the response document, "RAI 405 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 405 — 11.02-22	2	3
RAI 405 — 11.02-23	4	4
RAI 405 — 11.02-24	5	5
RAI 405 — 11.03-18	6	6
RAI 405 — 11.05-22	7	8
RAI 405 — 11.05-23	9	9
RAI 405 — 11.05-24	10	10
RAI 405 — 11.05-25	11	11

The schedule for technically correct and complete responses to these questions is provided below.

Question #	Response Date
RAI 405 — 11.02-22	July 30, 2010
RAI 405 — 11.02-23	July 30, 2010
RAI 405 — 11.02-24	July 30, 2010
RAI 405 — 11.03-18	July 30, 2010
RAI 405 — 11.05-22	July 30, 2010
RAI 405 — 11.05-23	July 30, 2010
RAI 405 — 11.05-24	September 16, 2010
RAI 405 — 11.05-25	July 30, 2010

Sincerely,

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

From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Wednesday, May 26, 2010 12:44 PM
To: ZZ-DL-A-USEPR-DL

Cc: Dehmel, Jean-Claude; Roach, Edward; Jennings, Jason; Patel, Jay; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No.405(4691,4724,4674), FSAR Ch. 11 PHASE 4 RAI

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on May 14, 2010, and discussed with your staff on May 25, 2010. No changes were made to the draft RAI 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: 1758

Mail Envelope Properties (BC417D9255991046A37DD56CF597DB71070A9374)

Subject: Response to U.S. EPR Design Certification Application RAI No.405, FSAR Ch. 11 PHASE 4 RAI, Supplement 1
Sent Date: 7/29/2010 8:56:44 PM
Received Date: 7/29/2010 8:56:47 PM
From: BRYAN Martin (EXTERNAL AREVA)

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

Recipients:
"DELANO Karen (AREVA)" <Karen.Delano@areva.com>
Tracking Status: None
"ROMINE Judy (AREVA)" <Judy.Romine@areva.com>
Tracking Status: None
"BENNETT Kathy (AREVA)" <Kathy.Bennett@areva.com>
Tracking Status: None
"NOXON David (AREVA)" <David.Noxon@areva.com>
Tracking Status: None
"WILLIFORD Dennis (AREVA)" <Dennis.Williford@areva.com>
Tracking Status: None
"Tesfaye, Getachew" <Getachew.Tesfaye@nrc.gov>
Tracking Status: None

Post Office: AUSLYNCMX02.adom.ad.corp

Files	**Size**	**Date & Time**
MESSAGE	4514	7/29/2010 8:56:47 PM
RAI 405 Supplement 1 Response US EPR DC.pdf		204624

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

Response to

Request for Additional Information No. 405(4691, 4724, 4674), Revision 1, Supplement 1

5/26/2010

U.S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 11.02 - Liquid Waste Management System
SRP Section: 11.03 - Gaseous Waste Management System
SRP Section: 11.05 - Process and Effluent Radiological Monitoring Instrumentation and Sampling Systems

Application Section: 11.2

QUESTIONS for Health Physics Branch (CHPB)

Question 11.02-22:

PHASE 4 RAI

Follow-up to Open Item RAI 301, Question 11.02-17(5)

In the response dated March 31, 2010, the applicant provides information addressing staff questions on offsite radiological impacts associated with the postulated failure of a LWMS radwaste tank. A review of the information indicates that the approach and assumptions used are not consistent with SRP 11.2 and BTP 11-6. Specifically, the applicant is requested to address the following issues and revise the response and FSAR accordingly. The issues are:

1. For the tank failure scenario, it is not clear as to why the evaluation assumes the entire inventory of five tanks (two liquid storage and three concentrate tanks) when the guidance of BTP 11-6 states that the malfunction should consider the failure of one tank, with 80% of its inventory available for release to the environment.
2. For the radioactivity inventories presented in Table 11.02-17-6, there is no supporting information on their basis and no details are provided as to where this information can be found in the FSAR.
3. In modeling the movement of radioactivity out of the tank room into the environment, the scenario assumes that spilled liquid wastes would remain static in the room and released over one year via a protracted leak rate (2.71E-04 ft^3 per second). This approach is contrary to the guidance of SRP 11.2 and BTP 11-6 which presumes a sudden failure and prompt release of radioactivity in the environment in characterizing an anticipated operational occurrence. As a consequence to this approach, the listing of radionuclides shown in Table 11.02-17-6 omits important radionuclides since the analysis considers only those with radiological half-lives greater than 30 days.
4. The scenario does not describe the mechanism through which radioactivity is assumed to reach ground water and does not discuss the types, and credits if any, taken for mitigating design features, as discussed in BTP 11-6. The evaluation should describe the postulated failure mechanism, identify the types of mitigating features that are assumed, and describe how such design features are being factored in specific aspects of the evaluation.
5. The response states that the previous results presented in FSAR Table 11.2-8 will be revised to update doses. However, the results presented in FSAR Table 11.2-8 are not expressed in doses, but rather as ratios of radionuclide concentrations in water to their respective effluent concentration limits of 10 CFR Part 20 (Appendix B, Table 2, Column 2). The information presented in the response focuses on doses to an offsite receptor using, in part, information drawn from Regulatory Guide 1.109, but no dose results are included in the response. The exposure scenario assumes fish and invertebrate consumption and shoreline activities. This approach is not consistent with SRP 11.2 and BTP 11-6 acceptance criteria. The BTP 11-6 acceptance criteria rely on compliance with the effluent concentration limits of 10 CFR Part 20 (Appendix B (Table 2, Col. 2)) at the nearest assumed source of potable water located in an unrestricted area. Note that the provisions addressing indirect human consumption (e.g., livestock watering, crop and pasture irrigation, and food processing) are for cases where surface or ground water are not used for direct human consumption under some site-specific conditions.

Also note that the NRC's draft provisions of Interim Staff Guidance (ISG-013, Fed. Reg. Vol. 75, No. 36, p.8411, 2/24/2010) for combined license applications submitted under 10 CFR Part 52 are not in effect at this time.

Response to Question 11.02-22:

The approach taken in analyzing the radiological impacts associated with a liquid tank failure has been revised. See the Response to RAI 301, Question 11.02-17(5).

FSAR Impact:

No additional FSAR impacts are associated with this response. See the response to RAI 301, Question 11.02-17 for related U.S. EPR FSAR changes.

Question 11.02-23:

PHASE 4 RAI

Follow-up to OPEN ITEM RAI 299, Question 11.02-16(j)

In the response dated March 31, 2010, the applicant provides a revision to the noble gas effluent source term and associated offsite doses. The revision reflects a correction in the value applied for the containment low volume exhaust purge rate. The staff confirmed the resulting changes in the noble gas source terms and offsite doses using the PWR-GALE86 and GASPAR II codes. However, it was noted that the proposed markup of FSAR Table 11.3-6 did not include the sum-of-the-ratios in demonstrating compliance with the unity rule under 10 CFR Part 20 (App. B, Table 2, Col. 1) since effluent concentrations at the EAB have also changed. The applicant is requested to include in FSAR Table 11.3-6 the sum-of-the-ratios for normal and max fuel defect releases.

It should be noted that the inclusion of the sum-of-the-ratios in FSAR Table 11.3-6 had been the subject of a prior staff RAI, which is currently being tracked as confirmatory item 11.3-14(a). This is the second instance where the staff observed that a proposed revision to the FSAR does not incorporate all successive updates. This is expected to delay the staff's review and obligate the staff to track all successive changes chronologically to ensure that all prior revisions are included in the version of the FSAR being reviewed.

Response to Question 11.02-23:

Table 11.02-23-1 includes the sum-of-the-ratios in demonstrating compliance with 10 CFR Part 20, Appendix B, Table 2, Column 1 concentrations for both types of gaseous effluent releases: normal and maximum failed fuel. This table supersedes in its entirety Table 11.03-14(a)-1 which was submitted in response to RAI 299, Revision 1, Question 11.03-14(a). Table 11.02-23-1 differs from Table 11.03-14(a)-1 in the entries for Kr-85m, Kr-87, Kr-88, Xe-133m and Xe-135m, and reflects the correction in the containment low volume exhaust purge rate from 2970 cfm to 3210 cfm. Due to the relatively insignificant concentrations of these noble gases, the sum-of-the-ratios for the normal and maximum fuel defect releases remain unchanged from the tabulation in Table 11.03-14(a)-1.

The text in U.S. EPR FSAR Tier 2, Section 11.3.3.5 has already been revised (as a result of the response to RAI 299, Question 11.03-14) to include the results of the sum-of-the-ratios. It is not necessary to include the sum-of-the-ratios by individual radionuclide in U.S. EPR FSAR Tier 2, Table 11.3-6 because this information has minimal significance.

FSAR Impact:

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

Table 11.02-23-1—Comparison of Annual Average Gaseous Release Concentrations with 10 CFR Part 20 Concentration Limits

Nuclide	Release Concentration at Site Boundary (µCi/ml)		10CFR20 App B, Table 2 Effluent Conc. (µCi/ml)	Fraction of Allowable Concentration at Site Boundary	
	Normal Releases	Maximum Fuel Defect		Normal Releases	Maximum Fuel Defect
I-131	1.40E-15	4.99E-14	2.0E-10	6.98E-06	2.49E-04
I-133	5.07E-15	8.33E-14	1.0E-09	5.07E-06	8.33E-05
Kr-85m	2.54E-11	7.15E-11	1.0E-07	2.54E-04	7.15E-04
Kr-85	5.39E-09	4.18E-09	7.0E-07	7.70E-03	5.97E-03
Kr-87	8.88E-12	1.55E-11	2.0E-08	4.44E-04	7.76E-04
Kr-88	3.01E-11	8.53E-11	9.0E-09	3.35E-03	9.48E-03
Xe-131m	5.55E-10	5.00E-10	2.0E-06	2.77E-04	2.50E-04
Xe-133m	3.01E-11	4.50E-10	6.0E-07	5.02E-05	7.50E-04
Xe-133	1.36E-09	3.45E-08	5.0E-07	2.73E-03	6.89E-02
Xe-135m	2.38E-12	2.91E-12	4.0E-08	5.95E-05	7.28E-05
Xe-135	1.90E-10	5.99E-10	7.0E-08	2.72E-03	8.56E-03
Xe-137	0.00E+00	0.00E+00	1.0E-09	0.00E+00	0.00E+00
Xe-138	1.90E-12	2.02E-12	2.0E-08	9.51E-05	1.01E-04
C-14	1.16E-12	1.16E-12	3.0E-09	3.86E-04	3.86E-04
Ar-41	5.39E-12	5.39E-12	1.0E-08	5.39E-04	5.39E-04
H-3	2.85E-11	1.14E-10	1.0E-07	2.85E-04	1.14E-03
Cr-51	1.54E-17	1.54E-17	3.0E-08	5.13E-10	5.13E-10
Mn-54	9.04E-18	9.04E-18	1.0E-09	9.04E-09	9.04E-09
Co-57	1.30E-18	1.30E-18	9.0E-10	1.44E-09	1.44E-09
Co-58	7.61E-17	7.61E-17	1.0E-09	7.61E-08	7.61E-08
Co-60	1.74E-17	1.74E-17	5.0E-11	3.49E-07	3.49E-07
Fe-59	4.44E-18	4.44E-18	5.0E-10	8.88E-09	8.88E-09
Sr-89	2.54E-17	2.54E-14	2.0E-10	1.27E-07	1.27E-04
Sr-90	9.99E-18	9.99E-15	6.0E-12	1.66E-06	1.66E-03
Zr-95	1.59E-18	1.59E-15	4.0E-10	3.96E-09	3.96E-06
Nb-95	6.66E-18	6.66E-15	2.0E-09	3.33E-09	3.33E-06
Ru-103	2.70E-18	2.70E-15	9.0E-10	2.99E-09	2.99E-06
Ru-106	1.24E-19	1.24E-16	2.0E-11	6.18E-09	6.18E-06
Sb-125	9.67E-20	9.67E-17	7.0E-10	1.38E-10	1.38E-07
Cs-134	7.61E-18	7.61E-15	2.0E-10	3.81E-08	3.81E-05
Cs-136	5.23E-18	5.23E-15	9.0E-10	5.81E-09	5.81E-06
Cs-137	1.43E-17	1.43E-14	2.0E-10	7.13E-08	7.13E-05
Ba-140	6.66E-19	6.66E-16	2.0E-09	3.33E-10	3.33E-07
Ce-141	2.06E-18	2.06E-15	8.0E-10	2.58E-09	2.58E-06
			Total	**0.02**	**0.1**

Question 11.02-24:

PHASE 4 RAI

Follow-up to OPEN ITEM RAI 301, Question 11.02-17

In the response dated November 5, 2009 and based on a staff audit of May 6, 2010 of a supporting AREVA dose calculation package for liquid effluent releases and doses, the applicant provides expanded offsite dose results for the maximally exposed individual. The revision includes additional information for the staff to conduct an independent evaluation of the dose results. The staff finds the additional information acceptable and independently confirmed the dose results using the LADTAP II code. Based on a review of the information provided in the response, the applicant is requested to address the following:

1. Confirm that all expanded dose results presented in Table 11.02-17-3 (p.8 and 9 of 28 in the response to Question 11.02-17) will be included in a revision of FSAR Table 11.2-6.
2. Regarding Footnote 1 of FSAR Table 11.2-5, clarify that even though the U.S. EPR is designed to operate for 60 years, the LADTAP II code parameter for the mid-point of reactor operation lifetime was left at the default value of 20 years rather than changing it to 30 years.
3. Regarding the disposition of the balance of the requested information under Question 11.02-17, the applicant is requested to confirm whether additional information will be presented in updating population doses in support of the cost-benefit analysis for the liquid waste management system.

Response to Question 11.02-24(1):

The expanded dose results, shown in the Response to RAI 301, Question 11.02-17(3), Table 11.02-17-3,) have been included in U.S. EPR FSAR Tier 2, Section 11.2 as Table 11.2-13.

Response to Question 11.02-24(2):

A statement will be added to U.S. EPR FSAR Tier 2, Table 11.2-5, Footnote 1 clarifying that even though the U.S. EPR is designed to operate for 60 years, the LADTAP II code parameter for the mid-point of reactor operation lifetime was left at the default value of 20 years.

Response to Question 11.02-24(3):

The cost-benefit analysis has been removed from U.S. EPR FSAR Tier 2, Section 11.2.4 and a COL item has been added requiring a COL applicant to perform a site-specific cost-benefit analysis. See the Response to RAI 301, Question 11.02-17(4).

FSAR Impact:

U.S. EPR FSAR Tier 2, Table 11.2-5 will be revised as described in the response and indicated on the enclosed markup.

Question 11.03-18:

PHASE 4 RAI

Follow-up to OPEN ITEM RAI 301, Question 11.03-15 and RAI 299, Question 11.02-16(j)

In responses dated November 5, 2009 and March 31, 2010, and a staff audit of May 6, 2010 of a supporting AREVA dose calculation package, the applicant provides a revision to the airborne effluent source term and updated offsite dose results for the maximally exposed individual. The revision reflects a correction in the value applied for the containment low volume exhaust purge rate, which resulted in a change in noble gas releases, and inclusion of additional information for the staff to conduct an independent evaluation of the dose results. The staff confirmed the resulting changes in the airborne effluent source term using the PWR-GALE86 code and is in general agreement with the revised offsite doses using the GASPAR II code. Based on a review of the information provided in the responses, the applicant is requested to address the following:

1. Confirm that all expanded dose results presented in Table 11.03-15-2 (p.17 and 18 of 28 in the response to Question 11.03-15) will be included in a revision of FSAR Table 11.3-5.
2. Regarding Footnote 2 of FSAR Table 11.3-4, clarify that even though the U.S. EPR is designed to operate for 60 years, the GASPAR II code parameter for the mid-point of reactor operation lifetime was left at the default value of 20 years rather than changing it to 30 years.
3. Regarding the disposition of the balance of the requested information under Question 11.03-5, the applicant is requested to confirm whether additional information will be presented in updating population doses in support of the cost-benefit analysis for the gaseous waste management system.

Response to Question 11.03-18(1):

The expanded dose results shown in RAI 301, Question 11.03.15(b), Table 11.03-15-2 have been included in U.S. EPR FSAR Tier 2, Table 11.3-11.

Response to Question 11.03-18(2):

A statement will be added to U.S. EPR FSAR Tier 2, Table 11.3-4, Footnote 4 clarifying that even though the U.S. EPR is designed to operate for 60 years, the GASPAR II code parameter for the mid-point of reactor operation lifetime was left at the default value of 20 years.

Response to Question 11.03-18(3):

The cost-benefit analysis has been removed from U.S. EPR FSAR Tier 2, Section 11.3.4 and a COL item has been added requiring a COL applicant to perform a site-specific cost-benefit analysis. See the response to RAI 301 Question 11.03-15(c).

FSAR Impact:

U.S. EPR FSAR Tier 2, Table 11.3-4 will be revised as described in the response and indicated on the enclosed markup.

Question 11.05-22:

PHASE 4 RAI

Follow-up to Open Item 346, Question 11.05-20

In the response dated April 1, 2010, the applicant provides information addressing the staff's questions about the instrumentation performance characteristics in complying with the U.S. EPR Technical Specifications (TS) 16.3.4.12.d and TS B16.3.4.12. The TS specifies a maximum leakage rate of 150 gallons per day (gpd) through any one steam generator (SG) using realistic primary coolant radionuclide concentrations. While the staff confirmed the results of a selected set of conditions, a review of the response and the associated calculation package (U.S. EPR Doc. No. 32-7003827-000, Rev. 14, 4/13/2009) raises additional questions. Specifically, the applicant is requested to address the following issues and revise the response and FSAR accordingly. The issues are:

1. The calculation package assesses the presence of noble gases, in addition to N-16, but the AREVA RAI response to the staff does not present this information and does not describe the associated detector response characteristics, the relationship in detector response and overlap between the two sources of external radiation, and how the derived dynamic response ranges of the instrumentation would be used in demonstrating that the 150 gpd TS criterion would be met. The applicant is requested to provide this information and describe the incremental response of the MSL radiation monitor due to noble gases alone, combined external radiation contributions of noble gases and N-16, and overlap of both sources of external radiation under varying power levels.
2. The response indicates that the external radiation exposure rate at the selected MSL radiation monitor location assumes a MSL pipe thickness of 1.9 inch. A review of FSAR Figure 10.3-1 (notes 1 or 2 depending on fig. sheet) indicates that the MSL pipe external and internal diameters are 30 and 27.5 inches, respectively. A MSL pipe wall thickness of 1.9 inch would result in a different pipe external diameter (31.3 inches) assuming a fixed internal diameter of 27.5 inches for design performance considerations. The applicant is requested to confirm the thickness of the MSL pipe applied in the calculation package in deriving the external radiation exposure rate of 3.6 uR/hr due to N-16 alone.
3. The response and calculation package indicate that a 150 gpd SG tube leak would result in an external radiation exposure rate of 3.6 uR/hr due to N-16 alone. It is not clear if the proposed MSL radiation monitoring system would detect this small incremental exposure rate in actual operation above ambient background due to both naturally occurring radioactivity and plant-induced background in the MSL pipe room. A review of FSAR Table 11.5-1 indicates that the stated dynamic response range of the MSL radiation monitor is from 1.0E-01 to 1.0E+04 cps, based on N-16 alone. The applicant is requested to provide information demonstrating that the MLS radiation monitor is capable of detecting an incremental rise of 3.6 uR/hr at full power above ambient background radiation levels given the locations of radiation detectors, provide in FSAR Table 11.5-1 a meaningful radiological unit in expressing the dynamic response range of the MSL radiation monitors, and revise the response and proposed changes to the FSAR accordingly.
4. The proposed revision to the FSAR should include the expected main steam line radioactivity concentration at the 150 gpd TS limit in addition to the expected range. The applicant is requested to provide this information in the FSAR.

5. While the response acknowledges that some design features and operating characteristics of the MSL radiation monitoring system cannot be defined at this stage of the design certification, there is a need to alert the COL applicant of these important considerations. As a result, AREVA is requested to include a COL information item that places the responsibility on the COL applicant to provide plant-specific information describing how design features, installation, and implementation of operating procedures for this system will address compliance with the SG TS leakage rate of 150 gpd under U.S. EPR TS 16.3.4.12.d. The COL information item should address:
   a. the representativeness of the chosen monitoring location in monitoring N-16 and noble gases in minimizing transient time and radioactive decay and cross-interferences from radiation from other MSL pipes;
   b. type of radiation detection method, detection sensitivity for the expected radionuclide distributions and concentrations or alternate set of surrogate radionuclides, and associated calibration methods; and
   c. placement of radiation monitoring instrumentation in plant areas that minimize interferences from all expected sources of ambient external radiation levels.

Response to Question 11.05-22:

1. AREVA NP concurs that the calculation of record for the main steam line (MSL) radiation monitor sensitivity requirements for steam generator tube leakage detection addressed the presence of noble gases, in addition to N-16, and that the RAI response was limited to the N-16 radiation. The reasons for excluding the noble gases in the RAI response are as follows:
   - For the same concentration at the radiation monitor location, N-16 will yield a radiation field at the detector (in μR/hr) which is about 50 times higher than that generated by the realistic noble-gas mix (based on the ANSI/ANS 18.1-1999 standard). This is due to the predominantly low-energy photon radiation resulting from noble-gas decay in comparison to the high-energy radiation emitted by N-16, and the ensuing significant attenuation of the noble-gas radiation in traversing the 1.9 inch steel wall of the MSLs.
   - When consideration is given to the difference in both the concentrations and photon spectra, the N-16 radiation field at the detector at full power would be about 280 times higher than that generated by the nobles (at all SG tube leakage rates); it drops to a factor about 7.6 at 10 percent power. These ratios would be higher if signal discrimination is employed to reduce the background radiation.

   Based on these considerations, the calculation of record concluded that the noble gas contribution to the monitor signal during normal operation would be minimal in comparison to that from N-16 radiation, at all power levels. The requested information regarding the monitor response to noble-gas activity during normal operation, and noble-gas/N-16 overlap regions is therefore irrelevant.

   Notwithstanding the above, noble-gas radioactivity within the steam lines would still be relied upon for mitigation of a steam generator tube rupture accident (SGTR), after plant cooldown has already been initiated and the N-16 radiation field no longer exists. Based on the reactor coolant system (RCS) noble-gas realistic source term at full power and the maximum expected steam generator (SG) break flow following a double-ended guillotine break, the expected noble gas concentration at the MSL detector would be about 2.8E-3 µCi/cc and the corresponding radiation field at the detector would be 46 µR, about 60 times higher than the recommended alarm setpoint. Therefore, the MSL radiation monitor sensitivity and configuration would be adequate to generate the needed post-accident signal for identification and automatic isolation of the affected SG.

2. U.S. EPR FSAR Tier 2, Figure 10.3-1 states that the "The Main Steam piping header is special wall pipe, nominal 30 inches NPS, with a pipe ID of 27.5 inches. The wall thickness is 1.9 inches, which is the value used in the analysis.

3. U.S. EPR FSAR Tier 2, Table 11.5-1, Radiation Monitor Detector Parameters, lists the range of the main steam system monitors as 1.0E-01 to 1.0E+4 cps (N-16). As a result of the sensitivity requirements for RCS primary-to-secondary leakage detection, this range has been superseded by 1.0E-08 to 1.0E-02 µCi/cc (N-16). This range is consistent with the corresponding ranges of MSL monitors in the design certification of other advanced reactors (see for instance U.S. EPR FSAR Tier 2, Table 11.5-1, Process Gas and Particulate Monitors, which lists the range of the "high sensitivity main steam line (N-16)" monitor range as 1E-8 – 5E-3 µCi/cm^3).

   Additionally, in the U.S. EPR design, all 16 of the MSL high-sensitivity detectors (four per MSL) will be mounted adjacent to the steam lines, within specially designed lead shields that would limit the angle of view to the steam line being monitored. Such an arrangement minimizes the contribution of scatter radiation as well as direct radiation emanating from the adjacent steam lines. It is also anticipated that proper signal discrimination will be employed to reduce the background radiation.

4. U.S. EPR FSAR Tier 2, Section 11.5.4.1, Main Steam Radiation Monitoring System, will be revised to include the expected main steam line N-16 radioactivity concentration at the 150 gpd TS limit.

5. U.S. EPR TS 16.3.4.12.d limits the RCS primary-to-secondary operational leakage to 150 gallons per day through any one steam generator. Surveillance Requirement SR 3.4.12.2 verifies that primary-to-secondary leakage is maintained within the specified limits using continuous process radiation monitors or radiation grab sampling in accordance with EPRI TR-104788, "Pressurized Water Reactor Primary-to-Secondary Leak Guidelines." Thus, the licensee is obligated to demonstrate that the MSL radiation monitors are capable of performing their intended function. Therefore, no COL item is required.

U.S. EPR FSAR Tier 2, Section 11.5.4.1 will be updated to clarify the limitation of noble-gas radioactivity in providing the required MSL radiation monitor signal for identification of primary-to-secondary leakage detection, and to stress that noble-gas radioactivity within the steam lines will still be relied upon for mitigation of an SGTR after plant cooldown has already been initiated and the N-16 radiation field no longer exists. The same section will include the expected N-16 concentration at the MSL radiation monitors at full power, for a primary-to-secondary leakage of 150 gpd.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 11.5.4.1 will be revised as described in the response and indicated on the enclosed markup.

Question 11.05-23:

PHASE 4 RAI

Follow-up to Open Item 273, Supplement 4, Question 11.05-2

In the response dated March 31, 2010, the applicant provides information addressing staff questions on the implementation of the offsite dose calculation manual (ODCM) in assessing offsite from effluent releases. A review of the response and FSAR Sections 1.8.1 and 11.5 indicates that the listing of COL information items is incomplete. Regulatory Guide 1.206 (Section C.III.4) addresses COL information that a COL applicant is required to address because of plant and site-specific conditions that cannot be described at the design certification stage. In this context, the staff has determined that the following COL information items should be added to the FSAR. The COL information items are:

1. The COL applicant is responsible for deriving PERMSS subsystem's lower limits of detection or detection sensitivities, and set-points (alarms and process termination/diversion) for liquid and gaseous process radiation monitoring equipment not covered by the ODCM based on plant and site-specific conditions and operating characteristics of each installed radiation monitoring subsystem.

2. The COL applicant is responsible for the development of a plant-specific process and effluent radiological sampling and analysis plan for systems not covered by the ODCM, including provisions describing sampling and analytical frequencies, and radiological analyses for the expected types of liquid and gaseous samples and waste media generated by the LWMS, GWMS, and SWMS.

3. The COL applicant is responsible for providing plant-specific information describing how design features and implementation of operating procedures for the PERMSS will address the requirements of 10 CFR Part 20.1406(b) and guidance of SRP Section 11.5, Regulatory Guides 4.21 and 1.143, IE Bulletin 80-10, ANSI/HPS-13.1-1999 and ANSI N42.18-2004, and NEI 08-08 for PERMSS subsystems that rely on or augmented with the installation and operation of skid-mounted radiation monitoring and sampling systems connected to permanently installed radioactive process and waste management systems.

Response to Question 11.05-23:

The following COL items will be added to U.S. EPR FSAR Tier 2, Table 1.8-2 and Section 11.5:

- A COL applicant that references the U.S. EPR design certification and that chooses to install and operate skid-mounted radiation monitoring and sampling systems connected to permanently installed radioactive process and waste management systems will include plant-specific information describing how design features and implementation of operating procedures for the PERMSS will address the requirements of 10 CFR Part 20.1406(b) and guidance of SRP Section 11.5, RG 4.21 and 1.143, IE Bulletin 80-10, ANSI/HPS-13.1-1999 and ANSI N42.18-2004, and NEI 08-08.
- A COL applicant that references the U.S. EPR design certification is responsible for deriving PERMSS subsystem's lower limits of detection or detection sensitivities, and set-points (alarms and process termination/diversion) for liquid and gaseous process radiation

monitoring equipment not covered by the ODCM based on plant and site-specific conditions and operating characteristics of each installed radiation monitoring subsystem.

- A COL applicant that references the U.S. EPR design certification is responsible for developing a plant-specific process and effluent radiological sampling and analysis plan for systems not covered by the ODCM, including provisions describing sampling and analytical frequencies, and radiological analyses for the expected types of liquid and gaseous samples and waste media generated by the LWMS, GWMS, and SWMS.

FSAR Impact:

U.S. EPR FSAR Tier 2, Sections 1.8 and 11.5.2 will be revised as described in the response and indicated on the enclosed markup.

Question 11.05-25:

PHASE 4 RAI

Follow-up to OPEN ITEM RAI 273, Question 11.03-13

In the response dated March 31, 2010, the applicant provides new information and proposes the addition of Table 11.3-10 addressing the staff's request in including a failure analysis for the GWMS in FSAR Section 11.3. With respect to the evaluation of offsite radiological impacts associated with an operator error leading to an inadvertent release of radioactivity from the GWMS via a bypass, the staff's evaluation revealed that there is not enough information provided in FSAR Section 11.3.3.6 and RAI response for the staff to conduct an independent confirmation that the postulated event will not result in a dose greater than 100 mrem at the EAB. The applicant is requested to provide information on the origin of the radioactivity within the GWMS, radioactive source term assumed to be released, and the atmospheric dispersion parameter applied at the EAB. The staff needs this information for the purpose of confirming that the consequences of the postulated GWMS failure complies with the acceptance criteria of SRP Section 11.3 and BTP 11-5 of NUREG-0800 and guidance of RG 1.206.

Response to Question 11.05-25:

In the analysis of record, evaluation of the radiological consequences associated with an operator error leading to inadvertent release of radioactivity from the GWMS via a bypass line was based on the following:

- The incident involves the inadvertent bypass of the gaseous waste processing system (KPL) as a result of operator error, whereby valve misalignment leads to direct exhaust of the degasification system (KBG) to the atmosphere via the auxiliary building ventilation system (KLE), until the misalignment is recognized and isolated. This condition is unlikely because of the alarms and mechanical interlocks. The mechanical interlocks prevent the opening of both release pathways (KLE & KPL) at the same time. Also, alarms are provided if the KPL valve to the KBG vacuum pump discharge is open and the KLE release pathway is open. This event alerts the operator that the system is misaligned. Also, there is a radiation monitor in the KLE release pathway that alerts main control room (MCR) operators of the discharge of radioactive gas.
- The RCS noble-gas concentration is at 230 DE Xe-133 μCi/g, about 10 percent higher than the TS limit of 210 DE Xe-133 μCi/g (see U.S. EPR FSAR Tier 2, Table 11.1-2 for the individual radionuclide concentrations). In the computer run for the accident scenario, this concentration was based on the minimum RCS degasification flow rate of 10 kg/sec.
- The RCS degasification flow rate is then increased to 20 kg/sec, at which time the valve-misalignment error is assumed to take place.
- The ensuing release to the atmosphere is assumed to be direct, continuous, and unabated. The release is terminated one hour after the incident as a result of the automatic alarm in the MCR, and operator action.
- The atmospheric dispersion factor at the receptor of interest (at the EAB) is 1.0E-03 (sec/m3).

The computerized analysis yielded a one hour TEDE dose at the EAB of 88 mrem, less than the 100 mrem regulatory limit (NUREG-0800, BTP 11-5). A simplified approach yielding approximately the same result is as follows:

EAB TEDE Dose =

230 (μCi/g, DE Xe-133 RCS concentration)) * 2.0E+04 (g/sec, degas. rate)

* 1.0E-03 (sec/m^3, atmospheric dispersion) * 3600 (sec, exposure interval)

* 5.772E-06 (mrem-m^3/sec-μCi, Xe-133 dose conversion factor)

= 96 mrem.

The listed dose conversion factor corresponds with the air submersion effective DCF of 1.56E-15 (Sv-m^3/sec-Bq) for Xe-133, from Federal Guidance Report No. 12, Table III.1.

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

Table 1.8-2—U.S. EPR Combined License Information Items
Sheet 43 of 54

11.05-23

Item No.	Description	Section	~~Action Required by COL Applicant~~	~~Action Required by COL Holder~~
11.5-2	A COL applicant that references the U.S. EPR design certification and that chooses to install and operate skid-mounted radiation monitoring and sampling systems connected to permanently installed radioactive process and waste management systems will include plant-specific information describing how design features and implementation of operating procedures for the PERMSS will address the requirements of 10 CFR Part 20.1406(b) and guidance of SRP Section 11.5, Regulatory Guides 4.21 and 1.143, IE Bulletin 80-10, ANSI/HPS-13.1-1999 and ANSI N42.18-2004, and NEI 08-08.	11.5.1		
11.5-3	A COL applicant that references the U.S. EPR design certification is responsible for deriving PERMSS subsystem's lower limits of detection or detection sensitivities, and set-points (alarms and process termination/ diversion) for liquid and gaseous process radiation monitoring equipment not covered by the ODCM based on plant and site-specific conditions and operating characteristics of each installed radiation monitoring subsystem.	11.5.2		
11.5-4	A COL applicant that references the U.S. EPR design certification is responsible for developing a plant-specific process and effluent radiological sampling and analysis plan for systems not covered by the ODCM, including provisions describing sampling and analytical frequencies, and radiological analyses for the expected types of liquid and gaseous samples and waste media generated by the LWMS, GWMS, and SWMS.	11.5.2		

Table 11.2-5—Input Parameters for LADTAP II Computer Code

Parameter[1]	Value
Source Term	GALE (Table 11.2-4)
	(Total as Adjusted)
Shore-width factor	1.0
Discharge flow rate	100 cfs
Impoundment reconcentration model	None
Irrigation rate	50 liters/m^2-month
Dilution factor for aquatic food, boating, shoreline, swimming and drinking water	1
Dilution factor for irrigation water usage location	2
Site type	Freshwater
Exposure Pathway:	
• Transit time - aquatic food	24 hrs
• Transit time – boating	0
• Transit time – swimming	0
• Transit time – shoreline	0
• Transit time – drinking water	12 hrs
• Transit time – irrigated crops	0
• Transit time – milk/meat animal water usage	0
Fraction of crops irrigated using non-contaminated water	0
Fraction of milk/meat animal feed irrigated using non-contaminated water	0
Fraction of milk/meat animal drinking water from non-contaminated water	0

Notes:

11.02-24(2)

1. All other values are LADTAP II default values. This includes the LADTAP II code parameter for the mid-point of reactor operation lifetime, which used the default value of 20 years even though the U.S. EPR is designed to operate for 60 years.

Table 11.3-4—Input Parameters for the GASPAR II Computer Code used in Calculating Annual Offsite Doses to the Maximally Exposed Individual from Gaseous Releases

Parameter	Value
Source Term	GALE (Table 11.3-3, Total as Adjusted)
Distance from Reactor Centerline to[1]:	
• Site Boundary	0.5 miles
• Nearest Vegetable Garden	0.5 miles
• Nearest Meat Animal	0.5 miles
• Nearest Milk Animal	0.5 miles
• Nearest Residence	0.5 miles
Milk Animal Considered	Goat[2]
Annual Average Atmospheric Dispersion Factor[3]	5.0E-06 s/m^3
Annual Average Ground Deposition Factor[3]	5.0E-08 m^{-2}

Notes:

1. The most conservative location was assumed for each of the applicable dose pathways.
2. Doses from goat milk consumption are higher than for cow milk consumption.
3. Conservative estimate based on a mixed-mode release.

11.03-18(2)

4. All other values are GASPAR II default values. This includes the GASPAR II code parameter for the mid-point of reactor operation lifetime, which used the default value of 20 years even though the U.S. EPR is designed to operate for 60 years.

11.05-23

A COL applicant that references the U.S. EPR design certification and that chooses to install and operate skid-mounted radiation monitoring and sampling systems connected to permanently installed radioactive process and waste management systems will include plant-specific information describing how design features and implementation of operating procedures for the PERMSS will address the requirements of 10 CFR Part 20.1406(b) and guidance of SRP Section 11.5, Regulatory Guides 4.21 and 1.143, IE Bulletin 80-10, ANSI/HPS-13.1-1999 and ANSI N42.18-2004, and NEI 08-08.

11.5.1.1 Design Objectives

Portions of the process and effluent radiological monitoring and sampling systems perform safety related functions. For those portions of the systems, the safety design bases functions are as follows:

- Initiate main control room air conditioning system supplemental filtration in the event of abnormally high gaseous radioactivity in the main control room supply air.
- Initiate fuel handling area ventilation isolation on high exhaust activity from fuel handling area.
- Provide long-term post-accident monitoring (using both safety-related and non-safety-related monitors) in the event of a postulated accident.

11.5.1.2 Design Criteria

The process and effluent radiological monitoring and sampling systems monitor the containment atmosphere; spaces containing components for recirculation of loss of coolant accident fluids; and effluent discharge paths for radioactivity released from normal operations, AOOs, and postulated accidents. Sampling points are located on both process and effluent radiological monitoring and sampling systems to permit representative sampling for radiochemical analysis. The process and effluent radiological monitoring and sampling systems measure, record and provide a readout in the control room for containment radiation levels, and noble gas effluents at all potential, accident release points. The process and effluent radiological monitoring and sampling systems continuously sample for radioactive iodines and particulates in gaseous effluents from all potential accident release points, and provides for onsite capability to analyze and measure these samples. The monitoring of inplant radiation and airborne radioactivity is provided for a broad range of routine and accident conditions.

This design complies with applicable portions of 10 CFR 50.34(f)(2)(xvii) and 10 CFR 50.34(f)(2)(xxvii), 10 CFR Part 50, Appendix A, GDC 64, and RG 1.97.

The process radiological monitoring and sampling systems indicate the existence and, to the extent possible, the magnitude of reactor coolant and reactor auxiliary system

AREVA NP Inc. has designed safety-related process and effluent radiological monitoring and sampling systems in accordance with the following criteria:

- Radiation detectors and black boxes are powered from the uninterruptible power supply system; sample pumps and heat-tracing systems are powered from Class 1E power.
- Components are environmentally qualified as applicable. Section 3.11 addresses the environmental qualification of instrumentation.
- Components are seismically qualified as applicable. Sections 3.10 and 3.11 address the qualification of instrumentation.
- Systems comply with the fire protection criteria addressed in Section 9.5.
- Multiple (redundant) systems are used and are physically separated in accordance with criteria addressed in Section 8.3.2.

Process and effluent radiological monitoring and sampling systems that sample airborne radioactive materials are designed in accordance with the general principles and guidance contained in ANSI Standard N.13.1-1999 (Reference 1). Use of this ANSI standard is in accordance with RG 1.21.

A COL applicant that references the U.S. EPR will fully describe, at the functional level, elements of the process and effluent monitoring and sampling programs required by 10 CFR Part 50, Appendix I and 10 CFR 52.79(a)(16). This program description, Offsite Dose Calculation Manual (ODCM), will specify how a licensee controls, monitors, and performs radiological evaluations of releases. The program will also document and report radiological effluents discharged to the environment.

11.05-23

A COL applicant that references the U.S. EPR design certification is responsible for deriving PERMSS subsystem's lower limits of detection or detection sensitivities, and set-points (alarms and process termination/diversion) for liquid and gaseous process radiation monitoring equipment not covered by the ODCM based on plant and site-specific conditions and operating characteristics of each installed radiation monitoring subsystem.

A COL applicant that references the U.S. EPR design certification is responsible for developing a plant-specific process and effluent radiological sampling and analysis plan for systems not covered by the ODCM, including provisions describing sampling and analytical frequencies, and radiological analyses for the expected types of liquid and gaseous samples and waste media generated by the LWMS, GWMS, and SWMS.

11.5.3 Effluent Monitoring and Sampling

Sections 12.1 and 12.3 describe how the ALARA provisions of RG 8.8 and RG 8.10 are implemented in system designs and operation to comply with occupational dose limits the ODCM describes how the guidance of NUREG-1301 (Reference 8) and NUREG-0133 (Reference 9) were used in developing the bases of alarm setpoints.

11.5.4 Process Monitoring and Sampling

Process radiation monitoring detects, at an early stage, the escape of radioactive materials from radioactivity-containing systems into systems that are normally free of activity. Process radiation monitors generally operate continuously and provide both local and control room indication and alarm. Certain systems automatically initiate isolation actions along with control room alarm upon the detection of high radiation levels.

11.5.4.1 Main Steam Radiation Monitoring System

11.05-23

Radioactivity releases from the reactor coolant system (RCS) to the main steam system (nitrogen-16, noble gases) can occur because of steam generator tube leakage. Radioactivity in the main steam system is monitored over a wide power range by four redundant measuring arrangements per main steam line, for a total of 16 detectors for the system. The gamma sensitive detectors are mounted adjacent to the main steam lines within the main steam and feedwater valve compartments. ~~At low power levels, radioactivity is detected in the main steam due to the presence of noble gas. At high power levels, radiation is detected from the strong gamma from nitrogen-16. Shielding of detectors helps to prevent false readings from the detectors on the other main steam lines. The redundant measurement signals are processed, and provide alarm in the control room upon detection of radioactivity.~~The detectors are placed within specially designed lead shields that limit the angle of view to the steam line being monitored. Such an arrangement minimizes the contribution of scatter radiation as well as direct radiation emanating from the adjacent steam lines. The redundant measurement signals are processed, and provide alarm in the control room upon detection of radioactivity.

At both low and high power levels, the detected radiation emanating from the main steam lines is primarily due to the presence of N-16 (at a concentration of 4.5E-06 μCi/cc for full-power operation and the Technical Specification leakage rate of 150 gallons per day). The photon radiation from noble-gas decay is predominantly of low energy in comparison to the high-energy radiation emitted by N-16 and, as a result, undergoes significant attenuation in traversing the 1.9 inch steel wall of the main steam lines.

Noble-gas radioactivity within the steam lines is relied upon for mitigation of a steam generator tube rupture accident (SGTR), after plant cooldown has already been initiated and the N-16 radiation field no longer exists. Following such an event, the noble-gas concentration at the MSL detectors of the affected steam generator would be sufficiently high to generate the needed post-accident signal for identification and automatic isolation of the affected SG.