ArevaEPRDCPEm Resource

From: Pederson Ronda M (AREVA NP INC) [Ronda.Pederson@areva.com]
Sent: Thursday, November 05, 2009 8:01 PM
To: Tesfaye, Getachew
Cc: BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC); SLIVA Dana (AREVA NP INC); WILLIFORD Dennis C (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 299, FSAR Ch. 11
Attachments: RAI 299 Response US EPR DC.pdf

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 299 Response US EPR DC.pdf" provides technically correct and complete responses to 2 of the 2 questions.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report (FSAR) in redline-strikeout format which support the response to RAI 299 Questions11.02-16 and 11.03-14.

A complete FSAR markup is not provided for Question 11.02-16(j). As agreed by NRC staff during an FSAR Chapter 11 audit on October 7, 2009, FSAR markups may be submitted after Phase 2 completion to support Staff review to close confirmatory items. Therefore, a complete FSAR markup for this portion of the question will be provided as indicated in the following table:

Question #	Supplement Date (providing FSAR Markup)
RAI 299 — 11.02-16 (j)	March 31, 2010

The following table indicates the respective pages in the response document, "RAI 299 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 299 — 11.02-16	2	6
RAI 299 — 11.03-14	7	10

This concludes the formal AREVA NP response to RAI 299, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

Ronda Pederson
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AREVA NP Inc.
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From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Tuesday, October 06, 2009 6:03 PM
To: ZZ-DL-A-USEPR-DL
Cc: Dehmel, Jean-Claude; Frye, Timothy; Jennings, Jason; Colaccino, Joseph; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 299 (3783,3784),FSAR Ch. 11

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on September 23, 2009, and discussed with your staff on October 6, 2009. No changes were made to the draft RAI as a result of that discussion except for minor typographical error corrections. 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: 944

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Response to

Request for Additional Information No. 299 (3783, 3784), Revision 1

10/06/2009

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

Application Sections: 11.2 and 11.3

QUESTIONS for Health Physics Branch (CHPB)

Question 11.02-16:

While the staff duplicated the estimates of yearly radioactive liquid effluent releases (Ci/yr) and offsite concentrations (uCi/ml), the evaluation identified a number of inconsistencies associated with assumptions and parameters used in calculations. Without such clarifications and corrections, the staff cannot complete its evaluation and conclude, with reasonable assurance, that the design features and supporting analyses demonstrate compliance with Part 20.1301 and 20.1302, effluent concentration limits of Appendix B, Table 2 of Part 20, and design objectives of Appendix I to Part 50. These observations should be evaluated by the applicant and corrected or justified in the next revision of the FSAR. Specifically, the observations include:

a. FSAR Table 11.2-3 – The table should state that the basis of the source term assumes an 80% capacity factor, being the default value in the PWR-GALE code, and provide the expected capacity factor for the U.S. EPR. In qualifying the expected capacity factor for the U.S. EPR, the discussion should acknowledge that the current fleet of operating reactors is operating at factors in excess of 90%, and discuss the rationale as to whether the estimated radioactive liquid effluent releases (Ci/yr) and offsite concentrations (uCi/ml) need to be scaled up in light of an expected higher capacity factor.

b. FSAR Table 11.2-3 – The table should note that the cited mass of primarily coolant does not include the mass of coolant contained in the pressurizer.

c. FSAR Table 11.2-3 – A review of the FSAR indicates that there are three values for the total steam flow rate: 2.07E+07 lbs/hr in Table 11.1-3; 1.9E+07 lbs/hr in Table 11.1-6; and 2.171E+07 lbs/hr in Table 11.2-3. Provide a justification for the use of 2.171E+07 lbs/hr in Table 11.2-3.

d. FSAR Table 11.2-3 – The table applies a value of 2.184E+05 lbs/hr as the SG blowdown rate. Table 11.1-6 lists a value of 1.9E+05 lbs/hr and Table 11.1-3 lists a value of 2.08E+05 lbs/hr. Provide a justification for the use of 2.184E+05 lbs/hr in Table 11.2-3.

e. FSAR Table 11.2-3 – The table applies a value of 0.33 as the fraction of condensate flow going to the condensate demineralizer. In Table 11.1-6, this fraction is listed as zero, and in Table 11.1-3, it is shown as 100% of the condensate. Provide a justification for the use of 0.33 in Table 11.2-3.

f. FSAR Table 11.2-3 – The table applies a value of 110 gpd as the shim bleed flow rate. Table 11.1-6 lists a value of 500 lbs/hr, which is equivalent to a flow rate of 2055 gpd, using the specific volume of Table 11.1-1. Provide a justification for the use of 110 gpd in Table 11.2-3.

g. FSAR Table 11.2-3 – The table applies a value of 1728 gpd for the equipment drain input and 9428 gpd for the clean waste input. However, these input rates could not be inferred from the design values listed in Table 11.2-1 or Group I, II, and III waste streams. Provide the basis and justification for these two input rates.

h. FSAR Table 11.2-3 – The table applies a DF of 10^7 for cesium and other nuclides for the processing of shim bleed and equipment drain. However, these DFs could not be inferred from the values listed in NUREG-0017. Provide the basis and justification for the use of a DF of 10^7.

i. FSAR Table 11.2-3 – The table applies a value of 27.7 days as the holdup time for xenon and 1.67 days for krypton, with the values being imported from FSAR Table 11.3-

1. See staff comments on Table 11.3-1 about holdup times. Update Table 11.2-3 accordingly in light of the resolution of comments generated on this topic for Table 11.3-1.

j. FSAR Table 11.2-3 – The table applies a value of 4100 CFM for the containment internal cleanup rate and 2970 CFM for the containment low volume purge rate. However, these input rates could not be found in FSAR Rev. 1, Section 9.4. Table 12.2-19 provides values of 3210 CFM for the normal operation purge flow rate and 4100 CFM for the equipment area recirculation flow rate, and FSAR Section 6.5.1.3 provides only operational ranges. Provide the basis and justification for the values used in Table 11.2-3.

k. A review of FSAR Rev. 1, Section 11.2.2.1.1 and Table 11.2-4 indicates that the grouping of liquid effluent streams listed in Table 11.2-4 is inconsistent with that of Section 11.2.2.1.1. For example, turbine building floor drain, miscellaneous wastes, and shim bleed waste inputs shown in Table 11.2-4 are not listed in Section 11.2.2.1.1. Similarly, the category of “Misc. Wastes” shown in Table 11-2-4 is not explained as to which waste input streams it includes given the grouping scheme of Section 11.2.2.1.1. Review and revise for consistency the information presented in Section 11.2.2.1.1 and Table 11.2-4. Also, provide in Table 11.2-4 appropriate notations describing how the grouping scheme of Section 11.2.2.1.1 was translated into the one shown in Table 11.2-4.

l. A review of FSAR Rev. 1, Section 11.2.3.5 and Table 11.2-7 indicates that the basis of the adjustment factor applied in estimating releases characterized by maximum fuel defects is not described in Section 11.2.3.5. A review of the results presented in Table 11.2-7 indicates that the scaling factor (max/normal) ranges from 1 to 10^3. For example, the results for corrosion and activation products and tritium are greater than one, which should not be the case since their production is insensitive to the assumed fraction of failed fuel. The scaling factor is presumed to be four, i.e., 1.0% vs 0.25% assumed failed fuel fraction given the information presented in Section 11.1. However, the factors were found to be much higher and variable in many instances. For example, the ratio is 3.8 for H-3, 131 for Mo-99, 1000 for Rh-103m, 69 for Te-129m, 35 for I-131, 1.9 for I-132, 16.7 for I-133, 4.4 for I-135, and 96 for Cs-137, among others. Review and revise the basis of the scaling factor and describe the rationale and application of the scaling factor in FSAR Section 11.2.3.5 and presentation of the results in Table 11.2-7.

Response to Question 11.02-16(a):

Although the minimum capacity factor for the US EPR is assumed to be 92%, the offsite concentration analysis does not need to be scaled up based on a capacity factor other than the 80 percent default value in the calculation. The amount of dilution flow, used to determine the annual average concentration, is assumed to be provided only from circulating water blowdown. The circulating water blowdown, and therefore dilution water, is assumed to be zero when the plant is not operating. Thus, the total amount of dilution available in determining the annual concentration is proportional to capacity factor, and assuming a higher capacity factor would be non-conservative (i.e., would result in lower annual concentrations).

The annual release rates generated by the GALE code are based on operating plant primary coolant concentration data that are over 30 years old. Significant improvements have been made in the number of occurrences and the severity of fuel defects, resulting in lower fission product concentrations in the primary coolant. Scaling up the estimated radioactive liquid effluent releases would result in artificially high release estimates.

A footnote will be added to U.S. EPR FSAR Tier 2, Table 11.2-3 to indicate that the built-in GALE capacity factor of 80 percent will be used.

Response to Question 11.02-16(b):

The U.S. EPR FSAR Tier 2, Table 11.2-3 will be revised to include a note that the cited mass of primarily coolant does not include the mass of coolant contained in the pressurizer.

Response to Question 11.02-16(c):

The U.S. EPR nominal steam flow rate is 2.07E+07 lbm/hr as indicated in U.S. EPR FSAR Tier 2, Table 11.1-3. The steam flow rate of 1.9E+07 lbm/hr in U.S. EPR FSAR Tier 2, Table 11.1-6 was based on 2.07E+07 lbm/hr, but reduced to 1.9E+07 lbm/hr for conservatism in application of the ANSI/ANS 18.1-1999 standard. Reducing the steam flow from 2.07E+07 to 1.9E+07 lbm/hr, the noble gas concentrations increase by a factor of 2.07E7/1.9E7 = 1.09. The U.S. EPR FSAR Tier 2, Table 11.2-3 steam flow rate of 2.171E+07 lbm/hr is the nominal value of 2.07E+07 times 1.05 to bound a potential increase in steaming rate. The GALE application of a 5 percent higher steaming rate is conservative as more activity in the steam generator is transported to the balance of plant.

Response to Question 11.02-16(d):

The U.S. EPR nominal total steam generator blow-down flow rate is 2.08E+05 lbm/hr as indicated in the U.S. EPR FSAR Tier 2, Table 11.1-3. The steam generator blow-down flow rate of 1.9E+05 lbm/hr in the U.S. EPR FSAR Tier 2, Table 11.1-6 was based on 2.08E+05 lbm/hr, but reduced to 1.9E+05 lbm/hr for conservatism in application of the ANSI/ANS 18.1-1999 standard. Reducing the steam generator blow-down flow rate from 2.08E+05 to 1.9E+05 lbm/hr, the nuclide concentrations increase by a factor of 2.08E5/1.9E5 = 1.09. The U.S. EPR FSAR Tier 2, Table 11.2-3 steam generator blow-down flow rate of 2.184E+05 lbm/hr is the nominal value of 2.08E+05 times 1.05 to bound a potential increase in steaming rate and corresponding increase in steam generator blow-down flow rate.

Response to Question 11.02-16(e):

U.S. EPR FSAR Tier 2, Table 11.1-6 includes an entry of zero for the ratio of condensate demineralizer flow rate to steam flow rate. This is a conservative assumption in the application of the ANSI/ANS 18.1-1999 standard. U.S. EPR FSAR Tier 2, Table 11.2-3 included a value of 0.33 for condensate demineralizer flow fraction. The value of 0.33 is used in GALE as the nominal and realistic value of this parameter.

In addition, the U.S. EPR FSAR Tier 2, Table 11.1-3 value of 100 percent was reported incorrectly; the value should have been 0 percent because no credit is taken for purification flow through the condensate demineralizers. U.S. EPR FSAR Tier 2, Table 11.1-3 will be revised.

Response to Question 11.02-16(f):

Two adjustments are made to the value of 2055 gpd:

(1) Multiplication by 1.05 to account for a higher power level, and

(2) Multiplication by 0.05. Since it is assumed that the effluent from the boron treatment system is recycled, it is conservatively assumed that 5 percent of the treated primary coolant is discharged to liquid waste.

Therefore, the amount discharged to liquid waste is 0.05 x 2055 gpd x 1.05 = 110 gpd.

Response to Question 11.02-16(g):

The equipment drain input is based on maximum technical specification leakage from the primary coolant system. The input is then 1 gpm with 20 percent added for conservatism.

The clean waste input is conservatively based on the maximum Group II waste water volume expected, only three or four times per year, which is 66,000 gal/week. U.S. EPR FSAR Tier 2, Table 11.2-3 reflects the weekly average Group II waste water volume expected, 19,000 gal/week.

Response to Question 11.02-16(h):

The overall system DFs were based on vendor-supplied information.

DF (Cs/Rb and other nuclides) = DF (evap) x DF (demin) = 1.0E+04 x 1.0E+03

Response to Question 11.02-16(i):

U.S. EPR FSAR Tier 2, Table 11.2-3 lists noble gas hold-up time values of 27.7 days for xenon and 1.67 days for krypton. These hold-up times are consistent with the values in U.S. EPR FSAR Tier 2, Table 11.3-1. Therefore, no changes are required. Please see additional information in the Response to Question 11.03-14(b).

Response to Question 11.02-16(j):

U.S. EPR FSAR Tier 2, Table 11.2-3 contains values of 4100 cfm for the containment internal cleanup rate and 2970 cfm for the containment low volume purge rate. The containment internal cleanup nominal volumetric flow rate is 4120 cfm and 4100 cfm was conservatively used in the GALE analysis. The containment internal cleanup is for the inner compartment of the two zone containment. The containment low volume exhaust flow rate is 3210 cfm as shown in U.S. EPR FSAR Tier 2, Table 12.2-19. The GALE gaseous analysis incorrectly used the containment low volume purge circuit supply air flow of 2970 cfm instead of the exhaust air flow of 3210 cfm. U.S. EPR FSAR Tier 2, Table 11.2-3 will be revised to provide the correct containment low volume purge exhaust flow rate of 3210 cfm. The change in the containment low flow purge flow rate from 2970 cfm to 3210 cfm results in an insignificant change in the annual gaseous releases from the purge system, with a slight change in the noble gas releases and no change in the total noble gas release of 4.8E+04 curies per year. The analyses will be updated using the correct containment low volume purge exhaust flow rate and U.S. EPR FSAR Tier 2, Tables 11.3-3 and 11.3-6 will be updated.

Response to Question 11.02-16(k):

U.S. EPR FSAR Tier 2, Table 11.2-4 is a summary of results from the PWR-GALE code. The headings in U.S. EPR FSAR Tier 2, Table 11.2-4 are taken from the PWR-GALE output, and are a function of the code output. There is no direct correlation between the input streams listed in U.S. EPR FSAR Tier 2, Section 11.2.2.1.1 and U.S. EPR FSAR Tier 2, Table 11.2-4. The U.S. EPR Group I waste streams include the GALE waste inputs “shim bleed” and “equipment drains.” Group I waste streams are processed by the evaporator. The U.S. EPR Group II waste streams include the GALE waste input “clean waste.” Group II wastes are processed by the centrifuge.

Response to Question 11.02-16(l):

Releases characterized by maximum fuel defects are estimated by taking the expected releases and adjusting them by a multiplication factor. The multiplication factor, calculated for each nuclide, is the ratio of the primary coolant activity based on 1 percent fuel cladding defects to the primary coolant activity as given in the PWR-GALE code. For calculated multiplication factors less than one, a value of 1 was conservatively used. For primary coolant activities reported by GALE that were less than 1.0E-05 μCi/ml (and therefore displayed by GALE as zero), a conservative value of 1,000 was used for the multiplication factor. U.S. EPR FSAR Tier 2, Section 11.2.3.5 will be revised to provide the basis for the multiplication factor used in U.S. EPR FSAR Tier 2, Table 11.2-7.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 11.2.3.5, and Tables 11.1-3 and 11.2-3 will be revised as described in the response and indicated on the enclosed markup.

U.S EPR FSAR Tier 2, Tables 11.3-3 and 11.3-6 will be updated as discussed in the response to Question 11.02-16(j) and the FSAR markups provided by March 31,2010.

Question 11.03-14:

While the staff duplicated the estimates of yearly radioactive gaseous effluent releases (Ci/yr) and offsite concentrations (uCi/ml), the evaluation identified a number of inconsistencies associated with assumptions and parameters used in calculations. Without such clarifications and corrections, the staff cannot complete its evaluation and conclude, with reasonable assurance, that the design features and supporting analyses demonstrate compliance with Part 20.1301 and 20.1302, effluent concentration limits of Appendix B, Table 2 of Part 20, and design objectives of Appendix I to Part 50. These observations should be evaluated by the applicant and corrected or justified in the next revision of the FSAR. Specifically, the observations include:

a. A review of FSAR Rev. 1, Section 11.3.3.5 indicates that the discussion and results do not include the sum-of-the-ratios in demonstrating compliance with Part 20, Appendix B, Table 2, Column 1 concentrations for both types of gaseous effluent releases, normal and maximum failed fuel. In contrast, compliance with Part 20, Appendix B, Table 2, sum-of-the-ratios was provided for liquid effluent releases in Section 11.2.3.5. Provide this information for gaseous effluent releases in a revision of Table 11.3-6.

b. FSAR Table 11.3-1 – The table applies a value of 27.7 days as the holdup time for xenon and 1.67 days for krypton. The basis for these values is also presented in Table 11.3-1. First, it is noted that the values for dynamic absorption coefficients of Xe and Kr are reversed in Table 11.3-1, given that the FSAR adopts the default values of NUREG-0017. Second, the staff was unable to confirm these holding times using a design flow rate of 0.0765 lbs/sec (about 61.1 ft^3/min at NTP) and a charcoal mass of 16,320 lbs, as listed in Table 11.3-1. Confirm the above findings, provide the basis and justification for these holdup times, and revise Table 11.3-1 accordingly.

c. FSAR Table 11.3-2 - A review of Tables 11.3-1 and 11.3-2 indicates that the useable volume of charcoal is about 89% of the actual volume of each charcoal delay bed. The inventory of charcoal in each delay beds is reported to be 5440 lbs. However, it is not clear if this inventory reflects the actual or useable volume of each delay bed. Confirm the basis of the amount of charcoal in each delay bed, qualify the value presented in Table 11.3-1 as to whether the amount of 5440 lbs reflects the useable volume of charcoal, and revise the Xe and Kr holdup times as needed in Table 11.3-1.

d. A review of FSAR Rev. 1, Section 11.3.3.5 and Table 11.3-6 indicates that the basis of the adjustment factor applied in estimating releases characterized by maximum fuel defects is not described in Section 11.3.3.5. A review of the results presented in Table 11.3-6 indicates that the scaling factor (max/normal) ranges from 0.8 to 10^3. For example, the results for corrosion and activation products and tritium are greater than one, which should not be the case as their production is insensitive to the assumed fraction of failed fuel. The scaling factor is presumed to be four, i.e., 1.0% vs 0.25% assumed failed fuel fraction given the information presented in Section 11.1. However, the factors were found to be much higher and variable in many instances. For example, the ratio is 4 for H-3, 1.8 for Kr-87, 2.8 for Kr-88, 1000 for Sr-90, 36 for I-131, 16 for I-133, and 1000 for Cs-137, among others. Review and revise the basis of the scaling factor and describe the rationale and application of the scaling factor in Section 11.3.3.5 and presentation of the results in Table 11.3-6.

Response to Question 11.03-14(a):

Table 11.03-14(a)-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. U.S. EPR FSAR Tier 2, Section 11.3.3.5 will be revised to include the results of the sum-of-the-ratios.

Table 11.03-14(a)-1—Comparison of Annual Average Gaseous Release Concentrations with 10 CFR Part 20 Concentration Limits

	Normal Releases	Maximum Fuel Defect	Appendix B Allowable Concentration	Fraction of Allowable Conc. at Site Boundary	
NUCLIDE	µCi/ml		µCi/ml	Normal Operation	Maximum Fuel Defect
I131	1.40E-15	4.99E-14	2.00E-10	6.98E-06	2.49E-04
I133	5.07E-15	8.33E-14	1.00E-09	5.07E-06	8.33E-05
KR 85M	2.38E-11	6.71E-11	1.00E-07	2.38E-04	6.71E-04
KR 85	5.39E-09	4.18E-09	7.00E-07	7.70E-03	5.97E-03
KR 87	8.40E-12	1.47E-11	2.00E-08	4.20E-04	7.34E-04
KR 88	2.85E-11	8.08E-11	9.00E-09	3.17E-03	8.98E-03
XE131M	5.55E-10	5.00E-10	2.00E-06	2.77E-04	2.50E-04
XE133M	2.85E-11	4.26E-10	6.00E-07	4.76E-05	7.11E-04
XE133	1.36E-09	3.45E-08	5.00E-07	2.73E-03	6.89E-02
XE135M	2.22E-12	2.72E-12	4.00E-08	5.55E-05	6.79E-05
XE135	1.90E-10	5.99E-10	7.00E-08	2.72E-03	8.56E-03
XE137	0.00E+00	0.00E+00	1.00E-09	0.00E+00	0.00E+00
XE138	1.90E-12	2.02E-12	2.00E-08	9.51E-05	1.01E-04
C14	1.16E-12	1.16E-12	3.00E-09	3.86E-04	3.86E-04
AR41	5.39E-12	5.39E-12	1.00E-08	5.39E-04	5.39E-04
H3	2.85E-11	1.14E-10	1.00E-07	2.85E-04	1.14E-03
CR 51	1.54E-17	1.54E-17	3.00E-08	5.13E-10	5.13E-10
MN 54	9.04E-18	9.04E-18	1.00E-09	9.04E-09	9.04E-09
CO 57	1.30E-18	1.30E-18	9.00E-10	1.44E-09	1.44E-09
CO 58	7.61E-17	7.61E-17	1.00E-09	7.61E-08	7.61E-08
CO 60	1.74E-17	1.74E-17	5.00E-11	3.49E-07	3.49E-07
FE 59	4.44E-18	4.44E-18	5.00E-10	8.88E-09	8.88E-09
SR 89	2.54E-17	2.54E-14	2.00E-10	1.27E-07	1.27E-04
SR 90	9.99E-18	9.99E-15	6.00E-12	1.66E-06	1.66E-03
ZR 95	1.59E-18	1.59E-15	4.00E-10	3.96E-09	3.96E-06
NB 95	6.66E-18	6.66E-15	2.00E-09	3.33E-09	3.33E-06
RU103	2.70E-18	2.70E-15	9.00E-10	2.99E-09	2.99E-06
RU106	1.24E-19	1.24E-16	2.00E-11	6.18E-09	6.18E-06
SB125	9.67E-20	9.67E-17	7.00E-10	1.38E-10	1.38E-07
CS134	7.61E-18	7.61E-15	2.00E-10	3.81E-08	3.81E-05
CS136	5.23E-18	5.23E-15	9.00E-10	5.81E-09	5.81E-06
CS137	1.43E-17	1.43E-14	2.00E-10	7.13E-08	7.13E-05
BA140	6.66E-19	6.66E-16	2.00E-09	3.33E-10	3.33E-07
CE141	2.06E-18	2.06E-15	8.00E-10	2.58E-09	2.58E-06
			Total	**0.02**	**0.10**

Response to Question 11.03-14(b):

Part 1

The dynamic absorption coefficients are 1160 cm^3/gm for Xe and 70 cm^3/gm for Kr. These are the values used in the hold-up time analysis, which were incorrectly listed in reverse order. U.S. EPR FSAR Tier 2, Table 11.3-1 will be revised to correct the reversed values.

Part 2

The charcoal delay bed holdup times were calculated using a carrier gas flow rate of 7.33 cfm based on the thermodynamic conditions of the system and a charcoal bed mass of 5.3E3 lb/bed, which is approximately 97 percent of the design value of 5440 lb/bed. The carrier gas flow rate of 7.33 cfm is based on a conservative flow rate of 0.079 lb/second and a carrier gas density of 0.647 lb/ft^3.

Response to Question 11.03-14(c):

U.S. EPR FSAR Tier 2, Table 11.3-1 lists the delay bed charcoal mass system requirement of 5440 lbm. U.S. EPR FSAR Tier 2, Table 11.3-2 indicates that the useable delay bed volume is 167.4 ft^3 per bed and corresponds to the charcoal mass in each delay bed.

Response to Question 11.03-14(d):

Releases characterized by maximum fuel defects are estimated by taking the expected releases and multiplying them by a scaling factor. For noble gases and iodine isotopes, this scaling is performed by calculating the ratio of the primary coolant activity for the maximum expected fuel failure to the expected primary coolant activity. The maximum primary coolant activity for noble gases and iodine isotopes is controlled by Technical Specifications. Corrosion products are not affected by the percentage of fuel defects and are not corrected. Carbon-14 and Argon-41 release rates are also independent of fuel defect level. Tritium is adjusted using the ratio of the primary coolant activity for maximum failed fuel defect (1 percent failed fuel) to expected primary coolant concentration. The release rate for all other isotopes is conservatively adjusted upward by a factor of 1,000. U.S. EPR FSAR Tier 2, Section 11.3.3.5 will be revised to provide the basis for the multiplication factor used in U.S. EPR FSAR Tier 2, Table 11.3-6.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 11.3.3.5 and Table 11.3-1 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

Table 11.1-3—Parameters Used to Calculate Secondary Coolant Design Basis Source Terms

PARAMETER	VALUE
Total steam generator secondary side water inventory	6.79E+05 lb_m total (1.698E+05 lb_m/SG)
Secondary side steam generator steam mass	4.808E+04 lb_m total (1.202E+04 lb_m/SG)
Total steam flow rate	2.07E+07 lb_m/hr (5.17E+06 lb_m/hr/SG)
Steam generator blowdown flow rate (4 SGs)	14.4 lb/s/SG (2.08E+05 lb_m/hr total)
Primary to secondary leak rate	600 gpd
Fraction of radioactivity in blowdown stream which is not returned to the secondary coolant system	0%
Ratio of condensate demineralizer flow rate to the total steam flow	~~10~~0%
Fraction of activity removed in passing through the steam generator blowdown demineralizers:	Noble Gases, N-16, H-3: 0.0 Anion: 0.90 Cs, Rb: 0.50 Others: 0.90
Ratio of concentration in steam to that in the steam generator	Noble Gases: N/A Br, I: 0.01 Cs, Rb: 0.005 N-16: N/A H-3: 1.0 Others: 0.005

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cfs. Table 11.2-6—Dose Commitment Due to Liquid Effluent Releases summarizes the dose commitment calculation and regulatory requirements.

11.2.3.5 Maximum Release Concentrations

Using annual release data generated by the GALE code and presented in Table 11.2-4, annual average concentrations of radioactive materials released in liquid effluents to the discharge point have been determined by dividing the release rates (Ci/yr) by the annual average dilution flow. Annual average concentrations were determined in the immediate vicinity of the discharge point. No further mixing, dilution, or transport was assumed to occur.

A dilution flow of 9000 gallons per minute (gpm) was used in performing the maximum release concentration analysis. This flowrate is based on the dilution flow being provided by cooling tower blowdown, which operates continuously during plant operation. A capacity factor of 80 percent is used to determine the annual duration of cooling tower blowdown operation, and therefore annual dilution flow.

For each radionuclide released, the average concentration has been compared to the limiting value for that radionuclide specified in 10 CFR Part 20, Appendix B, Table 2. Table 11.2-7—Comparison of Annual Average Liquid Release Concentrations with 10 CFR Part 20 Concentration Limits, presents the results of this comparison. For the annual average radionuclide release concentrations for expected releases, the overall fraction of the effluent concentration limit is 0.12, which is well below the allowable value of 1.0.

Average liquid effluent concentrations for each radionuclide based on design basis conditions (one percent failed fuel fraction) have also been determined and compared to the limiting value for that radionuclide specified in 10 CFR Part 20, Appendix B, Table 2. The expected release concentrations were upwardly adjusted by a

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multiplication factor[1] that represents the ratio of design basis fuel failure primary coolant activity to expected fuel failure primary coolant activity. Table 11.2-7 presents the results of this comparison. For the annual average radionuclide release concentrations for design basis releases, the overall fraction of the effluent concentration limit is 0.62, which is below the allowable value of 1.0.

[1] For any calculated multiplication factors less than one, a value of 1 was conservatively used. For primary coolant activities reported by GALE that were less than 1.0E-05 µCi/ml (and therefore displayed by GALE as zero), a conservative value of 1,000 was used for the multiplication factor.

Table 11.2-3—Liquid and Gaseous Effluent Input Parameters for the GALE Computer Code
Sheet 1 of 3

GALE Input Parameter	Value
Thermal power level[2]	4612 MW_t
Mass of coolant in primary system (excluding the pressurizer)	5.937E+05 lb_m
Primary system letdown rate	226.7 gpm
Letdown cation demineralizer flow rate	0 gpm
Number of steam generators	4
Total steam flow	2.171E+07 lb_m/hr
Mass of liquid in each steam generator	1.6977E+05 lb_m
SG blowdown rate	2.184E+05 lb_m/hr
Blowdown treatment method (Full blowdown flow processed by blowdown system and recycled to condensate system.)	0
Condensate demineralizer regeneration time (regeneration not used)	0 days
Condensate demineralizer flow fraction	0.33
Shim bleed flow rate	110 gpd
Shim bleed DF for iodine (Evaporator and demineralizer in series)	1.0E+04
Shim bleed DF for cesium and rubidium (Evaporator and demineralizer in series)	1.0E+07
Shim bleed DF for other nuclides (Evaporator and demineralizer in series)	1.0E+07
Shim bleed collection time	8.1 days
Shim bleed processing and discharge times	0.589 days
Shim bleed average fraction of waste to be discharged	1.0
Equipment drains input	1728 gpd
Equipment drains PCA	1.0
Equipment drains DF for iodine (Evaporator and demineralizer in series)	1.0E+04
Equipment drains DF for cesium and rubidium (Evaporator and demineralizer in series)	1.0E+07
Equipment drains DF for other nuclides (Evaporator and demineralizer in series)	1.0E+07
Equipment drains collection time	8.1 days
Equipment drains processing and discharge times	0.589 days

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Table 11.2-3—Liquid and Gaseous Effluent Input Parameters for the GALE Computer Code Sheet 3 of 3

GALE Input Parameter	Value
Is there continuous stripping of full letdown flow?	No
Holdup time for xenon	27.7 days
Holdup time for krypton	1.67 days
Fill time of decay tanks for the gas stripper	0 days
Waste gas system particulate releases HEPA efficiency	99 %
Fuel Handling Building releases: charcoal efficiency	90 %
Fuel Handling Building releases: HEPA efficiency	99 %
Auxiliary Building releases: charcoal efficiency	90 %
Auxiliary Building releases: HEPA efficiency	99 %
Containment free volume	2.8E+06 ft^3
Containment internal cleanup system: charcoal efficiency	90 %
Containment internal cleanup system: HEPA efficiency	99 %
Containment internal cleanup system: flow rate	4.1E+03 cfm
Containment high volume purge: charcoal efficiency	90 %
Containment high volume purge: HEPA efficiency	99 %
Containment high volume purges at operation: purges per year (GALE code accounts for 2 purges at cold shutdown)	0
Containment low volume purge: charcoal efficiency 11.02-16(j)	90 %
Containment low volume purge: HEPA efficiency	99 %
Containment low volume purge: Flow rate	~~2970~~3210 cfm
Percent of iodine released from blowdown tank vent	0.0 %
Percent of iodine removed from air ejector release	0.0 %
Detergent waste PF	0.0
SG blowdown flash tank gases vented via main condenser air ejector?	No
Condenser air ejector offgas released without treatment?	Yes
Condenser air ejector offgas processed via charcoal adsorbers prior to release?	No

Note:

1. Dirty waste decontamination factor (DF) has no impact on results since dirty waste input is 0 gpd.

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2. Basis of source term assumes an 80 percent capacity factor, the default value in the GALE code. Significant improvements have been made in fuel performance, resulting in lower fission product concentrations in the primary coolant. ~~.~~

the GASPAR II code are presented in 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.

The U.S. EPR offsite dose to the MEI in an unrestricted area from gaseous effluent releases is presented in Table 11.3-5—Dose Commitment Due to Gaseous Effluent Releases. This table also compares these results to the limits specified in the 10 CFR Part 50 ALARA design objectives. U.S. EPR values are less than limiting values.

11.3.3.5 Maximum Release Concentrations

Using annual release data generated with the GALE code (Reference 1) and presented in Table 11.3-3, annual average concentrations of radioactive materials released in gaseous effluents to the discharge point have been determined. This analysis was based on an annual average atmospheric dispersion factor of 5.0E-06 sec/m^3. This value represents a conservative value for a distance of 0.5 miles from the reactor centerline, based on a mixed-mode release. For each radionuclide released, the average concentration has been compared to the limiting value for that radionuclide specified in 10 CFR Part 20, Appendix B, Table 2. The results of this comparison are presented in Table 11.3-6—Comparison of Annual Average Gaseous Release Concentrations with 10 CFR Part 20 Concentration Limits. For the annual average radionuclide release concentrations for expected releases, the overall fraction of the effluent concentration limit is 0.02, which is well below the allowable value of 1.0.

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Average gaseous effluent concentrations for each radionuclide based on one percent failed fuel fraction have also been determined and compared to the limiting value for that radionuclide specified in 10 CFR Part 20, Appendix B, Table 2. The concentrations for the expected failed fuel case were upwardly adjusted by a multiplication factor. For noble gases and iodine isotopes, the multiplication factor is the ratio of the primary coolant activity for the maximum expected fuel failure to the expected primary coolant activity. The maximum primary coolant activity for noble gases and iodine isotopes is controlled by Technical Specifications (TS). Corrosion products are not affected by the percentage of fuel defects and do not need a multiplication factor. Similarly, Carbon-14 and Argon-41 release rates are also independent of fuel defect level. Tritium is adjusted using the ratio of the primary coolant activity for maximum failed fuel defect (1 percent failed fuel) to expected primary coolant concentration. The release rate for all other isotopes is conservatively adjusted upward by a factor of 1,000.~~the ratio of design basis fuel failure primary coolant activity to expected fuel failure primary coolant activity, except for specific radionuclides in which Technical Specifications (TS) limit the maximum primary coolant activity~~. The results of the design basis case are also presented in Table 11.3-6. For the annual average radionuclide release concentrations for design basis (one percent failed fuel) releases, the overall fraction of the effluent concentration limit is 0.10, which is well below the allowable value of 1.0.

11.03-14(d)

11.03-14(a)

Table 11.3-1—Gaseous Waste Processing System Parameters

Normal Operation Parameter	Value
Design pressure: waste gas compressors to reducing stations	0.2–315 psia
Design temperature: waste gas compressors to reducing stations	212°F
Design pressure: reducing stations to upstream measuring circuit	0.2–189 psia
Design temperature: reducing stations to upstream measuring circuit	212°F
Design pressure: recombiner to waste gas compressor	0.2–315 psia
Design temperature: recombiner to waste gas compressor	775°F
Design pressure: drying subsection	0.2–315 psia
Design temperature: drying subsection	400°F
Design pressure: delay line	0.2–315 psia
Design temperature: delay line	212°F
Design circulation flow	0.190 lb_m/s
Design release flow	0.0765 lb_m/s
Palladium based catalyst inventory in recombiner	308.7 lb_m
Type I desiccant inventory in gel drier	121.3 lb_m
Type II desiccant inventory in gel drier	33.1 lb_m
Activated charcoal inventory per delay bed	5440 lb_m
Xenon dynamic adsorption coefficient	~~70~~1160 cc/gm
Krypton dynamic adsorption coefficient	~~1160~~70 cc/gm
Xenon holdup time	27.7 days
Krypton holdup time	40 hours

11.03-14(b)