ArevaEPRDCPEm Resource

From: BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]
Sent: Wednesday, July 28, 2010 5:10 PM
To: Tesfaye, Getachew
Cc: DELANO Karen (AREVA); ROMINE Judy (AREVA); BENNETT Kathy (AREVA); WILLIFORD Dennis (AREVA)
Subject: Response to U.S. EPR Design Certification Application RAI No. 301, FSAR Ch. 11, Supplement 5
Attachments: RAI 301 Supplement 5 Response US EPR DC.pdf

Getachew,

AREVA NP Inc. (AREVA NP) provided responses to the 2 questions in RAI No. 301 on November 5, 2009. These responses also provided a commitment to provide the FSAR markups associated with the responses by March 31, 2010. AREVA NP Inc. provided a revised schedule for transmitting the FSAR markups for these questions via RAI 301 Supplement 1 sent to the NRC on March 31, 2010. The responses to both questions in RAI 301 were revised and draft responses and accompanying FSAR markups were reviewed with the NRC staff during the Chapter 11 audit conducted on March 24, 2010 and a follow-up audit on April 22 nd. Clarification and changes were required to the responses and to address an issue presented by NRC staff during the April 22nd audit and subsequently issued in the form of Draft RAI 405, Question 11.02-22. RAI 301 Supplement 3 and Supplement 4 revised the schedule to allow time to interact with the NRC staff on these responses. Draft responses were transmitted to the NRC on June 8th and discussed with NRC staff during a telecon on June 23rd. We believe that we have addressed all the NRC staff comments on these questions. The attached file, "RAI 301 Supplement 5 Response US EPR DC.pdf" provides technically correct and complete responses to all of the remaining 2 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 301 Questions 11.02-17, and 11.03-15.

The following table indicates the respective pages in the response document, "RAI 301 Supplement 5 Response US EPR DC.pdf" that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 301 — 11.02-17	2	12
RAI 301 — 11.03-15	13	18

This concludes the formal AREVA NP response to RAI 301, and there are no questions from this RAI for which AREVA NP has not provided responses.

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, July 08, 2010 3:43 PM

To: 'Tesfaye, Getachew'
Cc: DELANO Karen V (AREVA NP INC); ROMINE Judy (AREVA NP INC); BENNETT Kathy A (OFR) (AREVA NP INC); NOXON David B (AREVA NP INC); WILLIFORD Dennis C (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 301, FSAR Ch. 11, Supplement 4

Getachew,

AREVA NP Inc. (AREVA NP) provided responses to the 2 questions in RAI No. 301 on November 5, 2009. These responses also provided a commitment to provide the FSAR markups associated with the responses by March 31, 2010. AREVA NP Inc. provided a revised schedule for transmitting the FSAR markups for these questions via RAI 301 Supplement 1 sent to the NRC on March 31, 2010. The responses to both questions in RAI 301 were revised and draft responses and accompanying FSAR markups were reviewed with the NRC staff during the Chapter 11 audit conducted on March 24, 2010 and a follow-up audit on April 22 nd. Clarification and changes are required to the responses and to address an issue presented by NRC staff during the April 22nd audit and subsequently issued in the form of Draft RAI 405, Question 11.02-22. On June 8, 2010, RAI 301 Supplement 3 revised the schedule to allow time to interact with the NRC staff on these responses. Additional time is required to interact with the NRC staff on the response.

The schedule for providing revised complete responses and associated FSAR markups has been changed and is provided below:

Question #	Response Date
RAI 301—11.02-17	July 28, 2010
RAI 301—11.03-15	July 28, 2010

Sincerely,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
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From: BRYAN Martin (EXT)
Sent: Tuesday, June 08, 2010 3:42 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)
Subject: Response to U.S. EPR Design Certification Application RAI No. 301, FSAR Ch. 11, Supplement 3

Getachew,

AREVA NP Inc. (AREVA NP) provided responses to the 2 questions in RAI No. 301 on November 5, 2009. These responses also provided a commitment to provide the FSAR markups associated with the responses by March 31, 2010. AREVA NP Inc. provided a revised schedule for transmitting the FSAR markups for these questions via RAI 301 Supplement 1 sent to the NRC on March 31, 2010 and a subsequent schedule revision on May 19 via RAI 301 Supplement 2. The responses to both questions in RAI 301 were revised and draft responses and accompanying FSAR markups were reviewed with the NRC staff during the Chapter 11 audit conducted on March 24, 2010 and a follow-up audit on April 22nd. Clarification and changes are required to the responses and to address an issue presented by NRC staff during the April 22nd audit and subsequently issued in the form of Draft RAI 405, Question 11.02-22. Additional time is required to interact with the NRC

staff on these responses prior to formal transmittal of the revised responses with FSAR markups. The schedule for providing revised complete responses and associated FSAR markups has been changed and is provided below.

Question #	Response Date
RAI 301—11.02-17	July 8, 2010
RAI 301—11.03-15	July 8, 2010

Sincerely,

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

From: BRYAN Martin (EXT)
Sent: Wednesday, May 19, 2010 3:04 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)
Subject: Response to U.S. EPR Design Certification Application RAI No. 301, FSAR Ch. 11, Supplement 2

Getachew,

AREVA NP Inc. (AREVA NP) provided responses to the 2 questions in RAI No. 301 on November 5, 2009. These responses also provided a commitment to provide the FSAR markups associated with the responses by March 31, 2010. AREVA NP Inc. provided a revised schedule for transmitting the FSAR markups for these questions via RAI 301 Supplement 1 sent to the NRC on March 31, 2010.

The responses to both questions in RAI 301 were revised and draft responses and accompanying FSAR markups were reviewed with the NRC staff during the Chapter 11 audit conducted on March 24, 2010 and a follow-up audit on April 22nd. Clarification and changes are required to the responses and to address an issue presented by NRC staff during the April 22nd audit and subsequently issued in the form of Draft RAI 405, Question 11.02-22. Additional time is required to review new COL items with Unistar and to review the responses with NRC staff prior to formal transmittal of the revised responses with FSAR markups. The schedule for providing revised complete responses and associated FSAR markups has been changed and is provided below:

Question #	Response Date
RAI 301—11.02-17	June 8, 2010
RAI 301—11.03-15	June 8, 2010

Sincerely,

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

From: BRYAN Martin (EXT)
Sent: Wednesday, March 31, 2010 12:51 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)
Subject: Response to U.S. EPR Design Certification Application RAI No. 301, FSAR Ch. 11, Supplement 1

Getachew,

AREVA NP Inc. (AREVA NP) provided responses to the 2 questions in RAI No. 301 on November 5, 2009. The prior responses to RAI 301, Questions 11.02-17 and 11.03-15 provided a commitment to provide the FSAR markups associated with the responses by March 31, 2010.

The schedule for providing the FSAR markups for these responses has been changed based on the audit of Chapter 11 conducted with the NRC staff last week (March 24th). The responses to these 2 questions will be revised. The schedule for providing revised complete responses and associated FSAR markups has been changed and is provided below:

Question #	Response Date
RAI 301—11.02-17	May 19, 2010
RAI 301—11.03-15	May 19, 2010

Sincerely

Martin (Marty) C. Bryan
Licensing Advisory Engineer
AREVA NP Inc.
Tel: (434) 832-3016
Martin.Bryan.ext@areva.com

From: Pederson Ronda M (AREVA NP INC)
Sent: Thursday, November 05, 2009 8:11 PM
To: 'Tesfaye, Getachew'
Cc: BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC); WILLIFORD Dennis C (AREVA NP INC); SLIVA Dana (AREVA NP INC)
Subject: Response to U.S. EPR Design Certification Application RAI No. 301, FSAR Ch. 11

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 301 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 in redline-strikeout format which support the response to RAI 301 Question11.03-15(a) and (c).

A complete FSAR markup is not provided for Question 11.02-17 and 11.03-15. 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 301 — 11.02-17	March 31, 2010
RAI 301 — 11.03-15	March 31, 2010

The following table indicates the respective pages in the response document, "RAI 301 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 301 — 11.02-17	2	12
RAI 301 — 11.03-15	13	28

This concludes the formal AREVA NP response to RAI 301, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

Ronda Pederson
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Licensing Manager, U.S. EPR Design Certification
AREVA NP Inc.
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From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Tuesday, October 06, 2009 6:12 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. 301 (3802,3803),FSAR Ch. 11

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on September 24, 2009, and discussed with your staff on October 6, 2009. 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: 1742

Mail Envelope Properties (BC417D9255991046A37DD56CF597DB7107074172)

Subject: Response to U.S. EPR Design Certification Application RAI No. 301, FSAR Ch. 11, Supplement 5
Sent Date: 7/28/2010 5:09:35 PM
Received Date: 7/28/2010 5:09:42 PM
From: BRYAN Martin (EXTERNAL AREVA)

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

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"DELANO Karen (AREVA)" <Karen.Delano@areva.com>
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MESSAGE	12252	7/28/2010 5:09:42 PM
RAI 301 Supplement 5 Response US EPR DC.pdf	233652	

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

Response to

Request for Additional Information No. 301 (3802), Supplement 5, Revision 1

10/6/2009

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 11.02-17:

In its evaluation, the staff cannot duplicate the estimates of doses due to radioactive liquid effluent releases, as presented in FSAR Rev. 1, Tables 11.2-6 and 11.2-10. The evaluation identified a number of inconsistencies associated with assumptions and parameters used in the calculations described in FSAR Rev. 1, Sections 11.2.3.4 and 11.2.4.1. 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, and design objectives of Appendix I to Part 50. The following observations should be reviewed by the applicant and corrected or justified in the next revision of the FSAR. Specifically, the observations include:

1. A review of Table 11.2-5 indicates that a number of parameters used in the LADTAP II code are not listed. While the FSAR references LADTAP II as a source of information, the applicant is responsible for documenting and justifying all input parameters in calculating doses. At a minimum, the applicant is requested to expand the tabulation to include the following parameters:

   a. ALARA analysis:

      i) dilution factors for the following exposure pathways: aquatic food, boating, swimming, shoreline, and drinking water for the maximum individual.

      ii) Transit times for drinking water, and "other pathways," as a category.

   b. Irrigated food pathways:

      i) fraction of animal feed and water provided from non-contaminated irrigation water, as they relate to the meat and milk exposure pathways.

      ii) water usage transit times for the leafy vegetables, vegetables, milk, and meat exposure pathways.

2. A review of Table 11.2-5 indicates that the results are based on a discharge flow rate of 100 ft^3/s. In demonstrating compliance with the effluent concentration limits of Appendix B to Part 20, FSAR Section 11.2.3.5 applies a dilution flow rate of 20 ft^3/s. In calculating population doses for the same effluents and discharge path, FSAR Table 11.2-9 uses a discharge flow rate of 39.3 ft^3/s. The applicant is requested to describe in the FSAR the underlying assumptions and justify the use of different values in estimating doses from the same effluent and discharge path.

3. A review of Table 11.2-6 indicates that dose results are presented only for the total body and thyroid, with only one reference identifying the infant as the critical age group for thyroid exposure. Also, the age group is not specified for the reported total body dose listed in the table. It is not possible from this information to compare doses among the four age groups of Regulatory Guide 1.109 and confirm that the infant is the limiting age group for the thyroid and that no other age group and organ are limiting. The applicant is requested to expand the presentation of the results in Table 11.2-6 to include all four age groups and eight organs of Regulatory Guide 1.109, and provide a summation of doses given that the LADTAP II code automatically provide all such results.

4. A review of Table 11.2-9 indicates that a number of parameters used in the LADTAP II code are presented without any supporting assumptions and justifications. For example, Table 11.2-9 list values for population distributions, time spent as recreational activities in

surrounding locations impacted by liquid effluent releases, commercial and sport fishing production rates, and other supporting parametric values. While the FSAR references LADTAP II as a source of information, the applicant is responsible for documenting and justifying all input parameters in calculating doses. The applicant is requested to describe in the FSAR the underlying assumptions and justify the use of different values in estimating population doses. Note that the information on population doses is also needed by the staff in confirming the results of the cost-benefit analysis presented in FSAR Section 11.2.4. At a minimum, the applicant is requested to:

a. provide justifications or appropriate references supporting the values listed in Table 11.2-9.

b. explain the rationale for applying a “saltwater site” (see Table 11.2-9) in estimating population doses and using a “freshwater site” (see Table 11.2-5) in estimating doses for Part 50, Appendix I compliance. Provide a description of exposure pathways and usage or consumption parameters that would characterize a saltwater site.

c. explain the basis for a single dilution value of 365, listed in Table 11.2-9, in estimating population doses. Confirm that a single dilution factor is adequate in characterizing exposures for the various listed activities, including shoreline, boating, swimming, commercial fishing (fish and invertebrate), and sport fishing (fish and invertebrate).

d. provide the transit times for the listed activities, including shoreline, boating, swimming, commercial fishing (fish and invertebrate, if different), and sport fishing (fish and invertebrates, if different).

Note that the requested clarification on the basis of population doses is also needed by the staff in confirming the results of the cost-benefit analysis presented in FSAR Rev. 1, Section 11.2.4.

5. On an associated topic on liquid effluent releases and offsite impacts, a review of FSAR Rev. 1, Section 11.2.3.7 indicates that there is insufficient information for the staff to conduct an independent evaluation of the results presented in Table 11.2.8. At a minimum, the applicant is requested to describe the radioactive source term contained in the radwaste tank assumed to have failed; explain why other long-lived radionuclides (e.g., Cs-137, Sr-90, etc.) and environmentally mobile radionuclides (e.g., C-14, Tc-99, I-129, etc.) were not considered in the analysis; describe the application of design features, if any, used in mitigating such releases; and provide information describing the groundwater flow regime characterizing the movement, retardation, and dilution of the release from the selected plant building to the unrestricted area.

Response to Question 11.02-17:

This response supersedes in its entirety the prior response to RAI 301, Question 11.02-17.

Response to Question 11.02-17(1)(a):

The requested ALARA analysis input parameters used in LADTAP II for the maximally exposed individual (MEI) are summarized in Table 11.02-17-1. The default LADTAP II usage factor values for swimming and boating of 0 hours/year were used in the analysis. There are no doses associated with the swimming and boating pathways.

Response to Question 11.02-17(1)(b):

The requested irrigated food pathways input parameters used in LADTAP II for MEI are summarized in Table 11.02-17-2.

U.S. EPR FSAR Tier 2, Table 11.2-5 and Section 11.2.3.4.1 will be updated to include the additional LADTAP II input parameters used in the calculation of MEI doses along with a clarifying statement regarding the swimming and boating doses.

Response to Question 11.02-17(2):

The discharge flow rate used for the dose analysis for the MEI, 100 cfs, was coupled with a downstream dilution of unity (i.e., no dilution) for the aquatic food, drinking water, and shoreline activity pathways to provide a conservative overall dilution and mixing value for a generic site. This value allows the COL applicant to provide discharge flow via cooling tower blowdown, dilution pumps, other plant discharges, or a combination of these discharge streams. If a COL applicant's design discharge flow is less than 100 cfs, the applicant could compensate by applying site-specific dilution factors that would confirm the effective dilution is equal to or greater than that provided by 100 cfs discharge and no downstream dilution.

A value of 20 cfs (9,000 gpm) was used in the analysis to determine effluent concentrations to compare with the limits in 10 CFR Part 20, Appendix B. This analysis used a conservative low discharge volumetric flow rate to demonstrate that the limits in Appendix B could be met with the lowest discharge expected for any site, even without further dilution. The value chosen represents the lowest expected cooling tower blowdown rate.

The cost-benefit analysis and supporting population doses have been removed from the 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.

U.S. EPR FSAR Tier 2, Table 11.2-5 will be updated to include the basis for the discharge flow rates. In addition, COL items will be added to U.S. EPR FSAR Tier 2 Table 1.8-2 and Section 11.2 requiring a COL applicant that references the U.S. EPR design certification to describe site-specific data including the liquid effluent release pathway, discharge flow rate and dilution factors at or beyond the point of discharge, and to confirm that site-specific parameters used in the calculation of off-site liquid effluent concentrations and doses to the members of the public are bounded by those provided in the U.S. EPR FSAR Section 11.2. For site-specific parameters that exceed the values provided in U.S. EPR FSAR Section 11.2, a COL applicant will need to provide site-specific analyses to demonstrate compliance with the effluent concentration limits of 10 CFR Part 20, Appendix B, Table 2 in unrestricted areas, dose limits of 10 CFR Part 20.1301, 20.1302 and 20.1301(e) and 40 CFR Part 190 in unrestricted areas and design objectives of Sections II.A and II.D of Appendix I to 10 CFR Part 50.

Response to Question 11.02-17(3):

The limiting total body dose of 2.18 mrem/yr in U.S. EPR FSAR Tier 2, Table 11.2-6 is for the child age group.

Table 11.02-17-3 shows the dose results for all four age groups and all organs of RG 1.109. The LADTAP II code does not include the infant age group when calculating doses to

individuals from the irrigated food pathways. A separate calculation was performed to determine the dose for the infant age group from the milk pathway using the total body dose and thyroid dose for the child as calculated using LADTAP II along with the ratio of infant to child ingestion dose factors. This was added to the dose from the only other non-zero pathway (i.e., drinking water) to determine the overall infant dosage for both total body and thyroid. The thyroid is the only organ analyzed for the infant, which was based on relatively high thyroid dose from drinking water relative to the other organs.

As noted in this response, the default LADTAP II usage factor values for swimming and boating of 0 hours/year were used in the analysis. There are no doses associated with the swimming and boating pathways.

U.S. EPR FSAR Tier 2, Table 11.2-6 will be updated to include the age group associated with the limiting total body dose. U.S. EPR FSAR Tier 2, Table 11.2-13 will be added to provide a breakdown of dose results for the four age groups and eight organs.

Response to Questions 11.02-17(4)(a) – 11.02-17(4)(d):

The cost-benefit analysis and supporting tables have been removed from the U.S. EPR FSAR Tier 2, Section 11.2 and a COL item has been added requiring a COL applicant to perform a site-specific cost-benefit analysis.

Response to Question 11.02-17(5):

A postulated liquid storage tank failure resulting in the release of radioactive materials into the unrestricted area was evaluated using the guidance provided in SRP Section 11.2, Branch Technical Position (BTP) 11-6.

The U.S. EPR general arrangement drawings were reviewed to determine which component in each of the main areas of the Nuclear Island (NI) outside the Reactor Building (RB) could contain the maximum radionuclide concentration/volume. This review also determined that the proposed design includes no buildings, facilities, or tanks containing radionuclides outside of the NI. Components were evaluated based on their respective volumes and whether they could contain reactor coolant activity. Except for the RB, there is no secondary containment in the NI compartments/buildings. The tanks and components that are designed to contain or process radioactive liquids are located within the NI. These components include:

- Reactor coolant storage tanks (total of six, each 4061 ft^3) in the Nuclear Auxiliary Building.
- Liquid waste storage tanks (total of five, each approximately 495 ft^3) in the Radioactive Waste Building.
- Volume control tank (350 ft^3) in the Fuel Building (FB).
- Low head safety injection (LHSI) heat exchanger (total of four, each 33 ft^3) in the Safeguards Building.

As defined by NUREG-0800, Section 2.4.13, the source term is determined from a postulated release from a single tank or pipe rupture outside of the containment. The postulated source of the liquid effluent is a tank rupture in a reactor coolant storage tank in the Nuclear Auxiliary Building, because these tanks contain the largest volume of reactor coolant water. An instantaneous release from a tank would discharge the contents faster than from a pipe rupture

that is connected to the tank and, based on the piping configuration, discharge more contents to the environment. The piping configuration may cause more contents to be held up in the tank by the nozzle locations and pipe routing than a tank failure. Modeling a tank failure will result in a more conservative analysis.

The scenario evaluated involves the instantaneous unmitigated release and mixing into groundwater of the entire contents of the reactor coolant storage tank, which is located in the Nuclear Auxiliary Building. The radionuclides chosen for the radioactive source term were selected based on the guidance provided in draft Interim Staff Guidance (ISG) DC/COL-ISG-013 and include those radionuclides having the highest potential exposure consequences to potential users, including long-lived fission and activation products and environmentally mobile radionuclides. The radionuclide concentrations for the fission products are conservatively based on a 0.25 percent failed fuel fraction, exceeding the 0.12 percent fraction prescribed in BTP 11-6. The radioiodine concentrations are based on the technical specification dose equivalent I-131 limit of 1.0 µCi/g.

The release scenario assumes no credit for building or system design features in mitigating the impact of the spill. The groundwater pathway includes the processes of advection, decay, and retardation during transport and dilution within the receiving body of water, prior to reaching a hypothetical user of potable water assumed to be located at about 1200 feet. The radionuclide concentrations, half-lives, and partition coefficients are provided in Table 11.02-17-4. These input parameters used in the liquid waste tank failure evaluation will be added to the U.S. EPR FSAR Tier 2 as Table 11.2-14. A travel period of 200 days is assumed, along with a soil density of 1.75 g/cm^3, an effective soil porosity of 0.37 and a dilution factor of 5.0E-04 to account for mixing within the receiving body of water. Without the benefit of site-specific conditions, the applied parameters are assumed to be conservatively bounding for various site conditions.

Table 11.02-17-5 shows the resulting radionuclide concentrations at the potable water supply in comparison to the effluent concentration limits of 10 CFR Part 20 Appendix B, Table 2 for a postulated rupture and unmitigated release of the entire contents of the Reactor Coolant Storage Tank. The resulting sum-of-the-ratios is 0.6, which is below the allowable value of 1.0 in accordance with the acceptance criteria of BTP 11-6.

U.S. EPR FSAR Tier 2, Section 11.2.3.7 will be updated as discussed in the response and indicated on the enclosed markup. In addition, a COL item will be added to U.S. EPR FSAR Tier 2 Table 1.8-2 and Section 11.2.3.7 requiring a COL applicant that references the U.S. EPR design certification to confirm that the site-specific data (such as distance from release location to unrestricted area, contaminant migration time and dispersion and dilution in surface or ground water) are bounded by those specified in Section 11.2.3.7. For site-specific parameters that exceed the values provided in Section 11.2.3.7, a COL applicant that references the U.S. EPR design certification will provide a site-specific analysis to demonstrate that the resulting water concentrations in the unrestricted area would meet the concentration limits of 10 CFR Part 20, Appendix B, Table 2 using the guidance provided in SRP Sections 2.4.12, 2.4.13, 11.2 and BTP 11-6.

FSAR Impact:

U.S. EPR FSAR Tier 2, Sections 1.8, 11.2.1, 11.2.3, 11.2.4, 11.2.5 and Tables 11.2-5, 11.2-6, 11.2-8, 11.2-9, 11.2-10 and 11.2-11 will be revised as discussed in the response and indicated on the enclosed markup. U.S. EPR FSAR Tier 2, Tables 11.2-13 and 11.2-14 will be added as

discussed in the response and indicated on the enclosed markup. Note that AREVA NP is currently processing Revision 2 of the U.S. EPR FSAR for submittal. The work to process some of the associated U.S. EPR FSAR Section(s) has already been accepted and completed prior to formal submittal of this response. As a result, a portion of the U.S. EPR FSAR changes associated with this response have already been processed for inclusion in Revision 2. These changes are not denoted by “redline-strikeout” on the enclosed markup of U.S. EPR FSAR Interim Revision 3.

Table 11.02-17-1—Additional LADTAP II Input Parameters for ALARA Analysis for MEI Dose

Exposure Pathway	Dilution Factor	Transit Time (hr)
Aquatic food	1	24
Boating	1	0
Swimming	1	0
Shoreline	1	0
Drinking water	1	12

Table 11.02-17-2—Additional LADTAP II Input Parameters for Irrigated Food Pathways for MEI Dose

Irrigated Food Pathway	Fraction of Animal Feed from Non-contaminated Irrigation Water	Fraction of Animal Drinking Water from Non-contaminated Irrigation Water	Water Usage Transit Time (hr)
Vegetable	na	na	0
Leafy Vegetable	na	na	0
Milk	0	0	0
Meat	0	0	0

Table 11.02-17-3—Detailed Dose Commitment Results By Age Group and Organs Due to Liquid Effluent Releases

Pathway	Skin	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
Fish								
Adult		2.10E-01	3.87E-01	2.90E-01	2.56E-01	1.46E-01	6.10E-02	6.74E-02
Teen		2.21E-01	3.92E-01	1.70E-01	2.37E-01	1.44E-01	6.35E-02	5.13E-02
Child		2.74E-01	3.42E-01	7.41E-02	2.45E-01	1.21E-01	5.07E-02	2.71E-02
Drinking								
Adult		6.61E-03	8.21E-01	8.18E-01	1.40E+00	8.20E-01	8.13E-01	8.68E-01
Teen		6.44E-03	5.80E-01	5.76E-01	1.08E+00	5.79E-01	5.73E-01	6.14E-01
Child		1.87E-02	1.12E+00	1.10E+00	2.35E+00	1.11E+00	1.10E+00	1.14E+00
Infant		2.20E-02	1.10E+00	1.08E+00	3.05E+00	1.09E+00	1.08E+00	1.10E+00
Shoreline								
Adult	1.75E-03	1.50E-03	1.50E-03	1.50E-03	1.50E-03	1.50E-03	1.50E-03	1.50E-03
Teen	9.79E-03	8.35E-03	8.35E-03	8.35E-03	8.35E-03	8.35E-03	8.35E-03	8.35E-03
Child	2.05E-03	1.75E-03	1.75E-03	1.75E-03	1.75E-03	1.75E-03	1.75E-03	1.75E-03
Irrigated Foods								
Vegetables								
Adult		6.99E-03	2.98E-01	2.96E-01	3.77E-01	2.94E-01	2.90E-01	3.56E-01
Teen		1.18E-02	3.69E-01	3.59E-01	4.84E-01	3.62E-01	3.55E-01	4.39E-01
Child		2.82E-02	5.86E-01	5.65E-01	8.19E-01	5.74E-01	5.62E-01	6.28E-01
Leafy Vegetables								
Adult		9.50E-04	3.69E-02	3.65E-02	6.96E-02	3.64E-02	3.57E-02	4.43E-02
Teen		8.69E-04	2.47E-02	2.40E-02	5.09E-02	2.43E-02	2.37E-02	2.96E-02
Child		1.56E-03	2.94E-02	2.84E-02	6.86E-02	2.89E-02	2.82E-02	3.16E-02
Milk								
Adult		5.36E-03	1.82E-01	1.79E-01	3.35E-01	1.76E-01	1.73E-01	1.74E-01
Teen		9.57E-03	2.40E-01	2.31E-01	4.82E-01	2.31E-01	2.26E-01	2.26E-01
Child		2.27E-02	3.82E-01	3.61E-01	8.65E-01	3.66E-01	3.58E-01	3.57E-01
Infant				5.45E-01	1.78E+00			
Meat								
Adult		1.11E-02	6.22E-02	6.33E-02	6.68E-02	8.18E-02	6.13E-02	7.39E-01
Teen		9.30E-03	3.73E-02	3.79E-02	4.05E-02	5.38E-02	3.66E-02	4.59E-01

Table 11.02-17-3—Detailed Dose Commitment Results By Age Group and Organs Due to Liquid Effluent Releases

Pathway	Skin	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
Child		1.75E-02	4.52E-02	4.65E-02	5.03E-02	6.70E-02	4.43E-02	3.02E-01
Total								
Adult	1.75E-03	2.43E-01	1.79E+00	1.68E+00	2.51E+00	1.56E+00	1.44E+00	2.25E+00
Teen	9.79E-03	2.67E-01	1.65E+00	1.41E+00	2.38E+00	1.40E+00	1.29E+00	1.83E+00
Child	2.05E-03	3.64E-01	2.51E+00	2.18E+00	4.40E+00	2.27E+00	2.14E+00	2.49E+00
Infant				1.63E+00	4.83E+00			

Table 11.02-17-4—Input Parameters for Postulated Releases Due to Liquid-Containing Tank Failure

Radionuclide	Half-life (days)	Partition Coefficient (L/kg)	Activity Concentration in Reactor Coolant Storage Tank ($\mu Ci/cm^3$)
H-3	4510	N/A	1
Cr-51	27.7	30	2.0E-03
Mn-54	313	50	1.0E-03
Mn-56	0.107	50	N/A
Fe-55	986	165	7.6E-04
Fe-59	44.5	165	1.9E-04
Co-58	70.8	60	2.9E-03
Co-60	1.93E+03	60	3.4E-04
Zn-65	244	200	3.2E-04
Br-84	2.21E-02	15	1.7E-02
Rb-88	1.24E-02	55	1.0E+00
Sr-89	5.05E+01	15	6.4E-04
Sr-90	1.06E+04	15	3.3E-05
Sr-91	3.96E-01	15	1.0E-03
Y-91	5.85E+01	170	8.1E-05
Y-92	1.48E-01	170	1.4E-04
Y-93	4.21E-01	170	6.5E-05
Y-91m	3.45E-02	170	5.2E-04
Zr-95	6.40E+01	600	9.3E-05
Nb-95	3.52E+01	160	9.4E-05
Mo-99	2.75E+00	10	1.1E-01
Tc-99m	2.51E-01	0.1	4.6E-02
Tc-99	7.78E+07	0.1	1.1E-09
Ru-103	3.93E+01	55	7.8E-05
Ru-106	3.68E+02	55	2.7E-05
Ag-110m	2.50E+02	90	2.0E-07
Te-129m	3.36E+01	125	1.5E-03
Te-129	4.83E-02	125	2.4E-03
Te-131	1.74E-02	125	2.6E-03
Te-131m	1.25E+00	125	3.7E-03
Te-132	3.26E+00	125	4.1E-02
I-129	5.73E+09	1	4.6E-08
I-131	8.04E+00	1	7.4E-01
I-132	9.58E-02	1	3.7E-01
I-133	8.67E-01	1	1.3E+00
I-134	3.65E-02	1	2.4E-01
I-135	2.75E-01	1	7.9E-01
Cs-134	7.53E+02	270	1.7E-01

Radionuclide	Half-life (days)	Partition Coefficient (L/kg)	Activity Concentration in Reactor Coolant Storage Tank ($\mu Ci/cm^3$)
Cs-136	1.31E+01	270	5.3E-02
Cs-137	1.10E+04	270	1.1E-01
Ba-140	1.27E+01	N/A	6.2E-04
La-140	1.68E+00	N/A	1.6E-04
Ce-141	3.25E+01	500	8.9E-05
Ce-143	1.38E+00	500	7.6E-05
Ce-144	2.84E+02	500	6.9E-05
W-187	9.96E-01	N/A	1.8E-03
Np-239	2.36E+00	5	8.7E-04

Table 11.02-17-5—Unrestricted Area Water Concentration from Unmitigated Liquid Release

Nuclide[1]	Critical Receptor Concentration (uCi/ml)	10 CFR Part 20 Appendix B, Table 2 Effluent Concentration Limit (uCi/ml)	Fraction of Concentration Limit
H-3	4.8E-04	1.E-03	4.8E-01
Cs-134	5.6E-08	9.E-07	6.2E-02
Cs-137	4.2E-08	1.E-06	4.2E-02
		Total	**0.6**

Notes :

1. Nuclides less than 1.0E-03 in fraction of concentration limit are excluded.

Question 11.03-15:

In its evaluation, the staff duplicated the estimates of yearly doses to the maximally exposed individual (MEI) due to radioactive airborne effluent releases, but could not duplicate the results for population doses. Also, the evaluation identified a number of inconsistencies in the presentation of the results and assumptions and parameters used in the calculations described in FSAR Rev. 1, Sections 11.3.3.4 and 11.3.4.1. 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, and design objectives of Appendix I to Part 50. These observations should be reviewed by the applicant and corrected or justified in the next revision of the FSAR. Specifically, the observations include:

a. A review of Table 11.3-4 indicates that a number of parameters used in the GASPAR II code are presented without any supporting assumptions and justifications. For example, Table 11.3-4 list values for the atmospheric dispersion and deposition parameters, but does not specify as the basis for the parameters nor references FSAR Rev. 1, Section 2.3.5 on the development of long-term atmospheric dispersion estimates for routine airborne effluent releases. The scope of exposure locations should be expanded to include the nearest residence. The reference of Table 11.2-4 for the airborne source term is wrong since this table presents the source term for liquid effluents - the proper citation is Table 11.3-3. At a minimum, the applicant is requested to describe in the FSAR the underlying assumptions, provide all appropriate references or identify the source of the information within the FSAR for all parameters presented in Table 11.3-4, add the missing exposure location for the MEI, and provide the proper citation for the table listing the airborne effluent source term.

b. While the staff duplicated the dose results presented in Table 11.3-5, a review indicates that results for the MEI are presented only for the total body and thyroid, with only one reference identifying the infant as the critical age group for thyroid exposure. Also, the age group is not specified for the reported total body dose listed in the table. It is not possible from this information to compare doses among the four age groups of Regulatory Guide 1.109 and confirm that the infant is the limiting age group for the thyroid and that no other age group and organ are limiting. The applicant is requested to expand the presentation of the results in Table 11.3-5 to include all four age groups and eight organs of Regulatory Guide 1.109, and provide a summation of doses given that the GASPAR II code automatically provide all such results.

c. A review of Table 11.3-7 indicates that a number of parameters used in the GASPAR II code are presented without any supporting assumptions and justifications. In addition, the table and FSAR Rev. 1, Section 11.3.4.1 do not include information for the staff to conduct an independent evaluation of population dose results. For example, Table 11.3-7 list values for a population within a 50-mile radius of the plant, an atmospheric dispersion parameter, and agricultural production data, but does not specify as the basis for the parameters nor references the applicable FSAR sections on the development of these parameters. In addition, the entries for the average humidity and temperature are inconsistent with the code input requirements, as the code requires that the relative humidity (%) be specified whenever a temperature value is inserted over

the code default value. Finally, FSAR Section 11.3.4.1 and Table 11.3-7 do not provide any information as to how population data and agricultural production data were distributed against long-term atmospheric dispersion parameters by sectors in the 50-mile radius. At a minimum, the applicant is requested to describe in the FSAR the underlying assumptions, insert all appropriate references or identify the source of the information within the FSAR for all parameters presented in Table 11.3-7, provide the missing information for the staff to conduct its own analysis, revise the citation for the table referencing the basis of the airborne effluent source term, and change in Section 11.3.4.1 the table citation from 11.3-4 to 11.3-7 since Table 11.3-4 is for MEI doses and Table 11.3-7 is for population doses. Note that the requested clarification on the basis of population doses is also needed by the staff in confirming the results of the cost-benefit analysis presented in FSAR Rev. 1, Section 11.3.4.2.

Response to Question 11.03-15:

This response supersedes in its entirety the prior response to RAI 301, Question 11.03-15.

Response to Question 11.03-15(a):

The GASPAR parameters are provided in Table 11.03-15-1.

In determining doses, the most conservative location was selected for each of the applicable dose pathways. The nearest residence is conservatively assumed to be located just outside the site boundary, and would be the dose receptor location for doses from the plume, ground, and inhalation. This assumption was made in the dose analysis.

The reference to U.S. EPR FSAR Tier 2, Table 11.2-4 in U.S. EPR FSAR Tier 2, Table 11.3-4 will be corrected to reference U.S. EPR FSAR Tier 2, Table 11.3-3.

U.S. EPR FSAR Tier 2, Table 11.3-4 will be updated to include the references and assumptions for the GASPAR II input parameters used in calculating doses to the maximally exposed individual, plus the added parameter for the nearest residence. In addition, COL items will be added to U.S. EPR FSAR Tier 2 Table 1.8-2 and Section 11.3 requiring a COL applicant that references the U.S. EPR design certification to describe site-specific data including the onsite vent stack design, gaseous effluent release point(s) and atmospheric dispersion/deposition factors and to confirm that site-specific parameters used in the calculation of off-site gaseous effluent concentrations and doses to the members of the public are bounded by those provided in the U.S. EPR FSAR Section 11.3. For site-specific parameters that exceed the values provided in U.S. EPR FSAR Section 11.3, a COL applicant will need to provide site-specific analyses to demonstrate compliance with the effluent concentration limits of 10 CFR Part 20, Appendix B, Table 2 in unrestricted areas, dose limits of 10 CFR Part 20.1301, 20.1302 and 20.1301(e) and 40 CFR Part 190 in unrestricted areas and design objectives of Sections II.B and II.C, and II.D of Appendix I to 10 CFR Part 50.

Response to Question 11.03-15 (b):

Table 11.03-15-2 presents results for all age groups and all organs of RG 1.109. As shown in the table, the total body dose and the skin dose are the same for all age groups.

U.S. EPR FSAR Tier 2, Table 11.3-11 will be added to provide a dose breakdown by age group and organs.

Response to Question 11.03-15 (c):

The cost-benefit analysis and supporting population doses have been removed from the 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.

FSAR Impact:

U.S. EPR FSAR Tier 2, Sections 1.8, 11.3.1, 11.3.3, 11.3.4 and 11.3.5 and Tables 11.3-4, 11.3-7, 11.3-8 and 11.3-9 will be revised as described in the response and indicated on the enclosed markup. U.S. EPR FSAR Tier 2, Table 11.3-11 will be added as discussed in the response and indicated on the enclosed markup. The work to process some of the associated FSAR Section(s) has already been accepted and completed prior to formal submittal of this response. As a result, a portion of the FSAR changes associated with this RAI response have already been processed for inclusion in Revision 2. These changes are not denoted by “redline-strikeout” on the enclosed markup of U.S. EPR FSAR Interim Revision 3.

Table 11.03-15-1—Source References/Justification for GASPAR II Input Parameters Used in Calculating Annual Offsite Does to MEI from Gaseous Releases

Parameter	Value	Justification
Distance from reactor centerline to site boundary	0.5 miles	Represents a conservative location for a site boundary (other than a boundary adjacent to a water body). This distance is expected to bound site boundary distances for potential COL applicants.
Distance from reactor centerline to nearest vegetable garden	0.5 miles	Assumes the most conservative (closest) location possible (i.e., just outside the site boundary)
Distance from reactor centerline to nearest meat animal	0.5 miles	Assumes the most conservative (closest) location possible (i.e., just outside the site boundary)
Distance from reactor centerline to nearest milk animal	0.5 miles	Assumes the most conservative (closest) location possible (i.e., just outside the site boundary)
Milk animal considered	Goat	Choices are goat or cow. Because consumption of goat milk results in higher doses than consumption of cow milk (based on higher dose conversion factors) for the same consumption volume, goat was selected.
Annual average atmospheric dispersion factor	5.0E-06 sec/m^3	Conservative estimate based on a mixed-mode release
Annual average ground deposition factor	5.0E-08 m^{-2}	Conservative estimate based on a mixed-mode release
Distance from reactor centerline to nearest residence	0.5 miles	Assumes the most conservative (closest) location possible (i.e., just outside the site boundary)

Table 11.03-15-2—Detailed Dose Commitment Results By Age Group and Organs Due to Gaseous Effluent Releases[1]

(2 Sheets)

PATHWAY	TOTAL BODY (external exposure)	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN (external exposure)
	mrem/yr	mrem/yr	mrem/yr	mrem/yr	mrem/yr	mrem/yr	mrem/yr	mrem/yr
PLUME	1.04E+00							9.79E+00
GROUND	7.06E-03	7.06E-03	7.06E-03	7.06E-03	7.06E-03	7.06E-03	7.06E-03	8.28E-03
VEGETABLES								
ADULT		2.52E-01	1.13E+00	2.51E-01	2.51E-01	1.03E+00	2.47E-01	
TEEN		3.88E-01	1.82E+00	3.89E-01	3.89E-01	1.36E+00	3.82E-01	
CHILD		8.89E-01	4.33E+00	8.96E-01	8.95E-01	2.71E+00	8.85E-01	
MEAT								
ADULT		8.46E-02	3.90E-01	8.35E-02	8.34E-02	1.18E-01	8.31E-02	
TEEN		6.97E-02	3.30E-01	6.92E-02	6.91E-02	9.39E-02	6.89E-02	
CHILD		1.28E-01	6.19E-01	1.28E-01	1.28E-01	1.65E-01	1.27E-01	
COW MILK[2]								
ADULT		9.86E-02	4.32E-01	1.02E-01	1.03E-01	1.07E+00	9.76E-02	
TEEN		1.74E-01	7.96E-01	1.82E-01	1.83E-01	1.72E+00	1.73E-01	
CHILD		4.12E-01	1.95E+00	4.26E-01	4.28E-01	3.48E+00	4.11E-01	
INFANT		8.45E-01	3.81E+00	8.78E-01	8.74E-01	8.31E+00	8.45E-01	
GOAT MILK								
ADULT		1.12E-01	4.41E-01	1.20E-01	1.19E-01	1.28E+00	1.11E-01	
TEEN		1.92E-01	8.09E-01	2.07E-01	2.05E-01	2.05E+00	1.91E-01	
CHILD		4.39E-01	1.98E+00	4.67E-01	4.62E-01	4.12E+00	4.40E-01	

PATHWAY	TOTAL BODY (external exposure)	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN (external exposure)
INFANT		8.86E-01	3.86E+00	9.47E-01	9.26E-01	9.84E+00	8.88E-01	
INHALATION								
ADULT		2.06E-02	3.84E-04	2.06E-02	2.07E-02	4.80E-02	2.08E-02	
TEEN		2.08E-02	4.67E-04	2.09E-02	2.10E-02	5.59E-02	2.12E-02	
CHILD		1.83E-02	5.70E-04	1.85E-02	1.86E-02	6.04E-02	1.87E-02	
INFANT		1.05E-02	2.97E-04	1.07E-02	1.07E-02	4.92E-02	1.08E-02	
TOTALS[3]								
ADULT	1.05E+00	4.76E-01	1.97E+00	4.82E-01	4.81E-01	2.48E+00	4.69E-01	9.80E+00
TEEN	1.05E+00	6.78E-01	2.97E+00	6.93E-01	6.91E-01	3.57E+00	6.70E-01	9.80E+00
CHILD	1.05E+00	1.48E+00	6.94E+00	1.52E+00	1.51E+00	7.06E+00	1.48E+00	9.80E+00
INFANT	1.05E+00	9.04E-01	3.87E+00	9.65E-01	9.44E-01	9.90E+00	9.06E-01	9.80E+00

Notes:

1. Doses represent the offsite dose to the maximally exposed individual (MEI) or nearest resident, who is assumed to reside at a distance of 0.5 mile from the reactor centerline.
2. The cow milk dose pathway is not included in the totals. The goat milk ingestion path is used instead because it results in a higher calculated dose.
3. Totals represent the external dose to total body, internal organ dose (from radioiodine, particulate, tritium, and C-14) and external dose to skin.

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Table 1.8-2—U.S. EPR Combined License Information Items
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Item No.	Description	Section	~~Action Required by COL Applicant~~	~~Action Required by COL Holder~~
11.2-1	A COL applicant that references the U.S. EPR design certification will perform ~~confirm that the liquid waste management system cost-benefit analysis for the typical site is applicable to their site; if it is not, provide~~ a site-specific liquid waste management system cost-benefit analysis.	11.2.4	~~Y~~ 11.02-17	
11.2-2	A COL applicant that references the U.S. EPR design certification will provide site-specific information on the release pathway, including a detailed description of the discharge path and plant sources of dilution, the discharge flow rate, and dilution factors at or beyond the point of discharge.	11.2.3.3		
11.2-3	A COL applicant that references the U.S. EPR design certification will confirm that the site-specific parameters are bounded by those provided in Table 11.2-5 and the dose pathways provided in Section 11.2.3.4.1. For site-specific parameters that are not bounded by the values provided in Table 11.2-5 and dose pathways other than those provided in Section 11.2.3.4.1, a COL applicant that references the U.S. EPR design certification will perform a site-specific liquid pathway dose analysis following the guidance provided in RG 1.109 and RG 1.113, and compare the doses to the numerical design objectives of 10 CFR Part 50, Appendix I and demonstrate compliance with requirements of 10 CFR Part 20.1302 and 40 CFR Part 190.	11.2.3.4.2		

Table 1.8-2—U.S. EPR Combined License Information Items
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Item No.	Description	Section	~~Action Required by COL Applicant~~	~~Action Required by COL Holder~~
11.2-4	A COL applicant that references the U.S. EPR design certification will confirm that the site-specific annual average liquid effluent concentrations are bounded by those specified in Table 11.2-7. For site-specific annual average liquid effluent concentrations that exceed the values provided in Table 11.2-7, a COL applicant that references the U.S. EPR design certification will demonstrate that the annual average liquid effluent concentrations for expected and design basis conditions meet the limits of 10 CFR Part 20, Appendix B, Table 2 in unrestricted areas.	11.2.3.5		
11.2-5	A COL applicant that references the U.S. EPR design certification will confirm that the site-specific data (such as distance from release location to unrestricted area, contaminant migration time, and dispersion and dilution in surface or ground water) are bounded by those specified in Section 11.2.3.7. For site-specific parameters that exceed the values provided in Section 11.2.3.7, a COL applicant that references the U.S. EPR design certification will provide a site-specific analysis to demonstrate that the resulting water concentrations in the unrestricted area would meet the concentration limits of 10 CFR Part 20, Appendix B, Table 2 using the guidance provided in SRP Sections 2.4.12, 2.4.13, 11.2 and BTP 11-6.	11.2.3.7	← 11.02-17	
11.2-6	A COL applicant that references the U.S. EPR design certification and that chooses to install and operate mobile skid-mounted processing systems connected to permanently installed LWMS processing equipment will include plant and site-specific information describing how design features and implementation of operating procedures for the LWMS will address the requirements of 10 CFR Part 20.1406(b) and guidance of SRP Section 11.2, RG 4.21 and 1.143, IE Bulletin 80-10, and NEI 08-08.			

Table 1.8-2—U.S. EPR Combined License Information Items
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Item No.	Description	Section	~~Action Required by COL Applicant~~	~~Action Required by COL Holder~~
11.3-1	A COL applicant that references the U.S. EPR design certification will ~~confirm that the~~perform a site-specific gaseous waste management system cost-benefit analysis ~~for the typical site is applicable to their site; if not, provide a site-specific cost-benefit analysis~~.	11.3.4	~~Y~~	
11.3-2	A COL applicant that references the U.S. EPR design certification will provide a discussion of the onsite vent stack design parameters and site-specific release point characteristics.	11.3.3.3	← 11.03-15	
11.3-3	A COL applicant that references the U.S. EPR design certification will confirm that the site-specific parameters are bounded by those provided in Table 11.3-4 and the dose pathways provided in Section 11.3.3.4. For site-specific parameters that are not bounded by the values provided in Table 11.3-4 and dose pathways other than those provided in Section 11.3.3.4, a COL applicant that references the U.S. EPR design certification will perform a site-specific gaseous pathway dose analysis following the guidance provided in RG 1.109 and RG 1.111, and compare the doses to the numerical design objectives of 10 CFR Part 50, Appendix I and demonstrate compliance with requirements of 10 CFR Part 20.1302 and 40 CFR Part 190.	11.3.3.4		
11.3-4	A COL applicant that references the U.S. EPR design certification will confirm that the site-specific annual average gaseous effluent concentrations are bounded by those specified in Table 11.3-6. For site-specific annual average gaseous effluent concentrations that exceed the values provided in Table 11.3-6, a COL applicant that references the U.S. EPR design certification will demonstrate that the annual average gaseous effluent concentrations for expected and design basis conditions meet the limits of 10 CFR Part 20, Appendix B, Table 2 in unrestricted areas.	11.3.3.5		

Table 1.8-2—U.S. EPR Combined License Information Items
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Item No.	Description	Section	~~Action Required by COL Applicant~~	~~Action Required by COL Holder~~
11.3-5	A COL applicant that references the U.S. EPR design certification will confirm that the site-specific accident atmospheric dispersion data is bounded by the values provided in Table 2.1-1. For site-specific accident atmospheric dispersion data that exceed the values provided in Table 2.1-1, a COL applicant that references the U.S. EPR design certification will provide a site-specific analysis demonstrating that the resulting dose at the exclusion area boundary associated with a radioactive release due to gaseous waste system leak or failure does not exceed 0.1 rem in accordance with SRP Section 11.3, BTP 11-5.	11.3.3.6	11.03-15	
11.4-1	A COL Applicant that references the U.S. EPR design certification will fully describe, at the functional level, elements of the Process Control Program (PCP). This program description will identify the administrative and operational controls for waste processing process parameters and surveillance requirements which demonstrate that the final waste products meet the requirements of applicable federal, state, and disposal site waste form requirements for burial at a 10 CFR 61 licensed low level disposal site, toxic or hazardous waste requirements per 10 CFR 20.2007, and will be in accordance with the guidance provided in RG 1.21, NUREG-0800 Branch Technical Position 11-3, ANSI/ANS-55.1-1992, and Generic Letters 80-09, 81-38, and 81-39. NEI 07-10A PCP Template is an alternate means of demonstrating compliance with GL 89-01 and SECY 05-0197 until a plant specific PCP is developed under license conditions.	11.4.3	~~Y~~	

RG 1.143 acknowledges that although the impact of the liquid waste storage and processing systems on safety is limited, the design for these systems includes some functions to limit the uncontrolled releases of radioactivity to the environment. The guidance identifies a radwaste classification for differentiation of applicable radwaste system design requirements based on the total design basis unmitigated radiological release (considering the maximum inventory of a given radwaste system) at the boundary of the unprotected area. Based on calculation of the total design basis unmitigated radiological release from either the liquid waste storage or liquid waste processing systems, these systems are assigned to RG 1.143 classification RW-IIa (High Hazard).

Calculations of doses and radioactive releases are performed consistent with the methodologies described in SRP Section 11.2, BTP-11-6 and RGs 1.109, 1.112, and 1.113.

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Design features are provided to control and collect radioactive material spills from liquid tanks outside containment. The tanks are housed in rooms with drains to collect any spills and to prevent any uncontrolled release to the environment. In addition, these rooms have no doors leading directly to the outside environment.

Consistent with the requirements of 10 CFR 20.1406, the U.S. EPR, including the liquid waste management system, is designed to minimize, to the extent practicable, contamination of the facility and the environment; facilitate eventual decommissioning; and minimize, to the extent practicable, the generation of radioactive waste. The LWMS design also incorporates features which address NRC concerns identified in IE Bulletin 80-10. Minimization of contamination and radioactive waste generation is described in Section 12.3.6.

11.2.1.1 Design Objectives

In addition to fulfilling their primary design functions, the liquid waste storage and liquid waste processing systems meet the following design objectives:

- Selectively segregate influent liquid wastes according to chemical composition and radioactivity of the source stream.
- Allow analysis of the contents of each liquid waste storage tank.
- Discharge sludge and concentrated wastes to the radioactive concentrates processing system. The radioactive concentrates processing system is an element of solid waste management and is addressed in Section 11.4.
- Prevent unintentional discharge of clean wastewater. Locked discharge valves subject to administrative control prevent discharge of treated wastewater from the monitoring tanks unless the radionuclide concentration of that wastewater has been demonstrated to be within administrative limits.

the laboratory results have been reviewed and confirmed to be within release limits, release is authorized. During the release, two radiation sensors in the activity-measurement tank and two flow sensors downstream of the tank continually monitor and record the discharge. If the sensors detect activity or an activity release rate in excess of release limits, or if a significant discrepancy exists between the two activity measurements or the two flow measurements, the sensors signal automatic valve closure, which terminates the release. After the isolation valves of the liquid waste storage system, the treated wastewater travels through a double-walled pipe to the discharge canal. The treated waste water is diluted with water from the lined retention pond. The treated wastewater environmental interface occurs at the discharge structure. The discharges from the liquid waste storage system do not interact with the Circulating Water System (CWS).

The physical release location and discharge configuration for treated effluent are site-specific and plant-specific. Refer to Section 11.2.3.3 for the related COL item.

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11.2.3.1 Discharge Requirements

Discharge requirements consist of liquid radioactive waste activity, flow monitor alarm settings, and automatic isolation settings. These requirements are established for each batch of monitoring tank treated wastewater to meet the ALARA design objectives.

11.2.3.2 Estimated Annual Releases

The GALE Code (Reference 1) was used to provide an estimate of annual releases from the U.S. EPR. Input parameters used in the GALE code model for the U.S. EPR are presented in Table 11.2-3—Liquid and Gaseous Effluent Input Parameters for the GALE Computer Code. Liquid releases (for a single plant unit) in units of Curies/year at the liquid effluent discharge point are presented in Table 11.2-4—Releases to Liquid Effluent Discharge Point (Ci/yr) Calculated by GALE Code.

11.2.3.3 Release Points and Dilution Factors

The liquid waste storage system has a single release point. The release is further diluted to meet the ALARA design objectives of 10 CFR Part 50, Appendix I. This regulation specifies maximum annual values for dose and dose commitment for individuals in an unrestricted area from the pathways of exposure. The U.S. EPR complies with these values with a dilution flow of 100 cubic feet per second (cfs) without additional downstream dilution. Since dilution is site dependent, discharge flow rates vary for each release.

The activity in the liquid effluent is diluted by two potential means prior to reaching a given dose receptor. The first is the mixing that occurs in the discharge canal, prior to the effluent reaching the plant outfall. The flowrate for this discharge dilution is site-

specific, and may be provided by cooling tower blowdown, dilution pumps, and/or other plant discharges. The second dilution source is the mixing with, and subsequent dilution by, the receiving water body prior to reaching the dose receptor (e.g., fish, drinking water supply intake). The value of this dilution is also site-specific and varies with factors such as distance between the outfall and the dose receptor, hydrological mixing characteristics of the receiving body, and design and location of the outfall structure.

The combination of pre-outfall dilution from the discharge flowrate and the post-outfall mixing after the liquid effluent reaches the receiving water body determines the effective dilution of the radioactive effluents. For the generic design calculation of doses from liquid effluents, it is assumed that the discharge flow rate is 100 cfs and that no further mixing or dilution occurs beyond the plant outfall. However, equivalent effective dilution may be achieved by various combinations of pre-outfall dilution from the discharge flowrate and post-outfall mixing, where a reduction in discharge flowrate is offset by a proportional increase in post-outfall dilution.

The physical release location and dilution factors for treated effluent are site-specific. A COL applicant that references the U.S. EPR design certification will provide site-specific information on the release pathway including a detailed description of the discharge path and plant sources of dilution, the discharge flow rate and dilution factors at or beyond the point of discharge.

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11.2.3.4 Estimated Doses

11.2.3.4.1 Liquid Pathways

The LADTAP II computer program (Reference 2) was used to calculate doses to the maximally exposed individual (MEI) from liquid effluents. LADTAP II implements the exposure methodology described in RG 1.109. The program considers the following exposure pathways:

- Ingestion of aquatic foods.
- External exposure to shoreline.
- External exposure to water through boating and swimming.
- Ingestion of drinking water.
- Ingestion of irrigated terrestrial food crops.

Inputs and assumptions are conservatively selected to represent a bounding condition for all pathways. Input parameters used by the LADTAP II code (Reference 2) are presented in Table 11.2-5—Input Parameters for LADTAP II Computer Code.

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Note that the default LADTAP II usage factor values for swimming and boating of 0 hours/year are used in the analysis. Therefore, there are no doses associated with the swimming and boating pathways. However, if a specific site has these dose pathways, the pathways would be identified as part of COL Item 11.2-3 and included in the liquid effluent dose analysis.

11.2.3.4.2 Liquid Pathway Doses

The doses calculated by the LADTAP II code meet the 10 CFR Part 50, Appendix I, ALARA design objectives. The dose calculation is based on a dilution flow rate of 100 cfs. The detailed dose commitment results by age group and organs due to liquid effluent releases are provided in Table 11.2-13—Detailed Dose Commitment Results by Age Group and Organ due to Liquid Effluent Releases. Table 11.2-6—Dose Commitment Due to Liquid Effluent Releases summarizes the dose commitment calculation and regulatory requirements.

A COL applicant that references the U.S. EPR design certification will confirm that the site-specific parameters are bounded by those provided in Table 11.2-5 and the dose pathways provided in Section 11.2.3.4.1. For site-specific parameters that are not

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bounded by the values provided in Table 11.2-5 and ~~the~~ dose pathways other than those provided in Section 11.2.3.4.1, a COL applicant that references the U.S. EPR design certification will perform a site-specific liquid pathway dose analysis following the guidance provided in RG 1.109 and RG 1.113, and compare the doses to the numerical design objectives of 10 CFR Part 50, Appendix I and demonstrate compliance with requirements of 10 CFR Part 20.1302 and 40 CFR Part 190.

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 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.

A COL applicant that references the U.S. EPR design certification will confirm that the site-specific annual average liquid effluent concentrations are bounded by those specified in Table 11.2-7. For site-specific annual average liquid effluent concentrations that exceed the values provided in Table 11.2-7, a COL applicant that references the U.S. EPR design certification will demonstrate that the annual average liquid effluent concentrations for expected and design basis conditions meet the limits of 10 CFR Part 20, Appendix B, Table 2 in unrestricted areas. 11.02-17

11.2.3.6 Radioactive Liquid Waste System Leak or Failure

The U.S. EPR liquid waste management system receives degasified liquids in the storage tanks. These tanks are continuously vented to the radioactive waste processing building ventilation system (refer to Section 9.4.8) so that any generation of gaseous activity is continually removed. Thus, no significant levels of gaseous activity from a liquid waste system leak or failure is expected. An evaluation later in this section addresses the radiological consequences of the leak or failure of a tank containing radioactive liquids from the liquid waste management system.

11.2.3.7 Postulated Radioactive Releases due to Liquid-Containing Tank Failures

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A postulated liquid storage tank failure resulting in the release of radioactive materials into the unrestricted area was evaluated using the guidance provided in SRP Section 11.2, Branch Technical Position (BTP) 11-6. BTP 11-6 applies the effluent concentration limits of 10 CFR Part 20, Appendix B, Table 2 as acceptance criteria in assessing the radiological impacts of a tank failure. The results shown in Table 11.2-8 indicate that a release of radioactive materials due to a postulated failure of liquid-containing tanks outside of containment during normal operations or anticipated

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.

operational occurrences would not result in release concentrations exceeding the effluent concentration limits specified in 10 CFR Part 20, Appendix B, Table 2 using the unity rule and sum-of-the-fractions.

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The U.S. EPR general arrangement drawings were reviewed to determine which component in each of the main areas of the Nuclear Island outside the Reactor Building could contain the maximum radionuclide concentration/volume. This review also determined that the proposed design includes no buildings, facilities, or tanks containing radionuclides outside of the Nuclear Island. Components were evaluated based on their respective volumes and whether they could contain reactor coolant activity. Except for the Reactor Building, there is no secondary containment in the Nuclear Island compartments/buildings. The tanks and components that are designed to contain or process radioactive liquids are located within the Nuclear Island. These components include:

- Reactor coolant storage tanks (total of six, each 4061 ft^3) in the Nuclear Auxiliary Building.
- Liquid waste storage tanks (total of five, each approximately 495 ft^3) in the Radioactive Waste Building.
- Volume control tank (350 ft^3) in the Fuel Building.
- LHSI heat exchanger (total of four, each 33 ft^3) in the Safeguards Building.

As defined by NUREG-0800, Section 2.4.13, the source term is determined from a postulated release from a single tank or pipe rupture outside of the containment. The postulated source of the liquid effluent is a tank rupture in a reactor coolant storage tank in the Nuclear Auxiliary Building, because these tanks contain the largest volume of reactor coolant water. An instantaneous release from a tank would discharge the contents faster than from a pipe rupture that is connected to the tank and based on the piping configuration discharge more contents to the environment. The piping configuration may cause more contents to be held up in the tank by the nozzle locations and pipe routing than a tank failure. Therefore, modeling a tank failure will result in a more conservative analysis.

The scenario evaluated involves the instantaneous unmitigated release and mixing into groundwater of the entire contents of the reactor coolant storage tank, which is located in the Nuclear Auxiliary Building. The radionuclides chosen for the radioactive source term were selected based on the guidance provided in draft Interim Staff Guidance (ISG) DC/COL-ISG-013 (Reference 5) and include those radionuclides having the highest potential exposure consequences to potential users, including long-lived fission and activation products and environmentally mobile radionuclides. The radionuclide concentrations for the fission products are conservatively based on a 0.25

percent failed fuel fraction, exceeding the 0.12 percent fraction prescribed in BTP 11-6. The radioiodine concentrations are based on the technical specification dose equivalent I-131 limit of 1.0 µCi/g.

The release scenario assumes no credit for building or system design features in mitigating the impact of the spill. The groundwater pathway includes the processes of advection, decay and retardation during transport and dilution within the receiving body of water, prior to reaching a hypothetical user of potable water assumed to be located at about 1200 feet. The radionuclide concentrations, half-lives and partition coefficients are provided in Table 11.2-14. A travel period of 200 days is assumed along with a soil density of 1.75 g/cm^3, an effective soil porosity of 0.37 and a dilution factor of 5.0E-04 to account for mixing within the receiving body of water. Without the benefit of site-specific conditions, the applied parameters are assumed to be conservatively bounding for various site conditions.

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~~The scenario evaluated involves the instantaneous unmitigated release into groundwater of the entire contents of the reactor coolant storage tank. This tank has a total volume of 4061 ft^3 and is assumed to be filled with primary coolant. The radionuclides chosen for the radioactive source term were selected based on the guidance provided in draft Interim Staff Guidance (ISG) DC/COL-ISG-013 and include those radionuclides having the highest potential exposure consequences to potential users, including long-lived fission and activation products and environmentally mobile radionuclides. The radionuclide concentrations for the fission products are conservatively based on a 0.25 percent failed fuel fraction, exceeding the 0.12 percent fraction prescribed in BTP 11-6. The groundwater pathway includes the processes of advection, decay and retardation during transport, and dilution within the receiving body of water, prior to reaching the potable water supply location. The radionuclide concentrations, half-lives, and partition coefficients are provided in Table 11.2-14. A travel period of 200 days is assumed along with a soil density of 1.75 g/cm^3, an effective soil porosity of 0.37, and a dilution factor of 5.0E-04 to account for mixing within the receiving body of water. These parameters were selected to bound the conditions of actual sites.~~

Table 11.2-8 shows the resulting radionuclide concentrations at the potable water supply in comparison to the effluent concentration limits of 10 CFR Part 20, Appendix B, Table 2 for a postulated rupture and unmitigated release of the entire contents of the reactor coolant storage tank. The resulting sum-of-the-ratios is 0.6, which is below the allowable value of 1.0 in accordance with ~~10 CFR Part 20~~ the acceptance criteria of BTP 11-6..

A COL applicant that references the U.S. EPR design certification will confirm that the site-specific data (such as distance from release location to unrestricted area, contaminant migration time, and ~~discharge flow rate~~dispersion and dilution in surface or ground water) are bounded by those specified in Section 11.2.3.7. For site-specific

parameters that exceed the values provided in Section 11.2.3.7, a COL applicant that references the U.S. EPR design certification will provide a site-specific analysis to demonstrate that the resulting water concentrations in the unrestricted area would meet the concentration limits of 10 CFR Part 20, Appendix B, Table 2 using the guidance provided in SRP Sections 2.4.12, 2.4.13, 11.2 and BTP 11-6. In addition, as addressed in Section 11.5.2, the COL applicant will fully describe the elements of the radioactive effluent monitoring program (REMP) as part of the Offsite Dose Calculation Manual (ODCM). The REMP will reflect ~~recent~~current nuclear industry ground water initiatives and NRC assessments of existing nuclear reactors related to groundwater contamination and monitoring and compliance with NRC regulations.

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11.2.3.8 Quality Assurance

The quality assurance program governing design, fabrication, procurement, and installation of the liquid waste storage and processing systems conform to RG 1.143, as indicated in Table 3.2.2-1. Implementation of the quality assurance program is described in Chapter 17.

11.2.4 Liquid Waste Management System Cost-Benefit Analysis

10 CFR Part 50, Appendix I requires that plant designs consider additional items based on a cost-benefit analysis. Specifically, the design must include all items of reasonably demonstrated cleanup technology that, when added to the liquid waste processing system sequentially and in order of diminishing cost-benefit return, can, at a favorable cost-benefit ratio, reduce the dose to the population reasonably expected to be within 50 miles of the reactor. A COL applicant that references the U.S. EPR design certification will perform a site-specific liquid waste management system cost-benefit analysis.

11.2.5 References

1. NUREG-0017, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors PWR-GALE Code," Revision 1, U.S. Nuclear Regulatory Commission, April 1985.

2. NUREG/CR-4013, "LADTAP II – Technical Reference and User Guide," U.S. Nuclear Regulatory Commission, April 1986.

3. NUREG-0800, BTP 11-6, "Postulated Radioactive Releases Due To Liquid-Containing Tank Failures," Revision 3, U.S. Nuclear Regulatory Commission, March 2007.

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4. Deleted.

5. DC/COL-ISG-013, Interim Staff Guidance on NUREG-0800 Standard Review Plan Section 11.2 and Branch Technical Position 11-6, "Assessing the Consequences of an Accdiental Release of Radioactive Materials from Liquid Waste Tanks for

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Combined License Applications Submitted Under 10 CFR Part 52," Draft Issued for Comments, U.S. Nuclear Regulatory Commission, Federal Register Volume 75, No. 36, February 2010.

6. Health Physics Journal, Vol. 59, No. 4, "Default Soil Solid/Liquid Partition Coefficients, Kds, for Four Major Soil Types: A Compendium," October 1990, p. 471-482.

Table 11.2-14—Parameters used in Liquid Tank Failure Evaluation
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Radionuclide	Half-life (days)	Partition Coefficient[1] (L/kg)	Activity Concentration in Reactor Coolant Storage Tank ($\mu Ci/cm^3$)
H-3	4510	N/A[2]	1
Cr-51	27.7	30	2.0E-03
Mn-54	313	50	1.0E-03
Mn-56	0.107	50	N/A
Fe-55	986	165	7.6E-04
Fe-59	44.5	165	1.9E-04
Co-58	70.8	60	2.9E-03
Co-60	1.93E+03	60	3.4E-04
Zn-65	244	200	3.2E-04
Br-84	2.21E-02	15	1.7E-02
Rb-88	1.24E-02	55	1.0E+00
Sr-89	5.05E+01	15	6.4E-04
Sr-90	1.06E+04	15	3.3E-05
Sr-91	3.96E-01	15	1.0E-03
Y-91	5.85E+01	170	8.1E-05
Y-92	1.48E-01	170	1.4E-04
Y-93	4.21E-01	170	6.5E-05
Y-91m	3.45E-02	170	5.2E-04
Zr-95	6.40E+01	600	9.3E-05
Nb-95	3.52E+01	160	9.4E-05
Mo-99	2.75E+00	10	1.1E-01
Tc-99m	2.51E-01	0.1	4.6E-02
Tc-99	7.78E+07	0.1	1.1E-09
Ru-103	3.93E+01	55	7.8E-05
Ru-106	3.68E+02	55	2.7E-05
Ag-110m	2.50E+02	90	2.0E-07
Te-129m	3.36E+01	125	1.5E-03
Te-129	4.83E-02	125	2.4E-03
Te-131	1.74E-02	125	2.6E-03

Table 11.2-14—Parameters used in Liquid Tank Failure Evaluation
Sheet 2 of 2

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Radionuclide	Half-life (days)	Partition Coefficient[1] (L/kg)	Activity Concentration in Reactor Coolant Storage Tank ($\mu Ci/cm^3$)
Te-131m	1.25E+00	125	3.7E-03
Te-132	3.26E+00	125	4.1E-02
I-129	5.73E+09	1	4.6E-08
I-131	8.04E+00	1	7.4E-01
I-132	9.58E-02	1	3.7E-01
I-133	8.67E-01	1	1.3E+00
I-134	3.65E-02	1	2.4E-01
I-135	2.75E-01	1	7.9E-01
Cs-134	7.53E+02	270	1.7E-01
Cs-136	1.31E+01	270	5.3E-02
Cs-137	1.10E+04	270	1.1E-01
Ba-140	1.27E+01	N/A[2]	6.2E-04
La-140	1.68E+00	N/A[2]	1.6E-04
Ce-141	3.25E+01	500	8.9E-05
Ce-143	1.38E+00	500	7.6E-05
Ce-144	2.84E+02	500	6.9E-05
W-187	9.96E-01	N/A[2]	1.8E-03
Np-239	2.36E+00	5	8.7E-04

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Notes:

1. Partition coefficients taken from Reference 6.
2. Partition coefficient not available for this radionuclide in Reference 6. A retardation factor of 1.0 was conservatively applied.

waste processing system is designed to fulfill these primary design functions under modes of normal plant operation. The gaseous waste processing system is not designed to mitigate DBAs.

Using the methodology contained in RG 1.143, the gaseous waste processing system is classified as RW-IIa (High Hazard). This classification is based on calculation of the limiting total design basis unmitigated radiological release and considers the maximum inventory of a given radwaste system at the boundary of the unprotected area.

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Calculations of doses and radioactive releases are performed consistent with the methodologies of SRP Section 11.3, BTP-11-5 and of Regulatory Guides 1.109, 1.111, and 1.112.

The GWMS is designed in compliance with the regulatory position contained in RG 1.140 as it pertains to the design, testing, and maintenance of normal ventilation exhaust system air filtration and adsorption units. Further description of the U.S. EPR design as it relates to RG 1.140 can be found in Section 9.4.

Consistent with the requirements of 10 CFR 20.1406, the U.S. EPR, including the gaseous waste management system, is designed, to the extent practicable, to minimize contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, the generation of radioactive waste. The GWMS design also incorporates features consistent with the applicable guidance of RG 4.21 and which address NRC concerns identified in IE-BL-80-10. Minimization of contamination and radioactive waste generation is described in Section 12.3.6.

11.3.1.1 Design Objectives

In addition to fulfilling its primary design functions, the gaseous waste processing system meets the following design objectives:

- Compensate for level deviations in the free gas atmosphere of tanks that are connected to the system by adding or removing the free gas.
- Maintain a negative system pressure to prevent the escape of radioactive gases from components connected to the building air.
- Limit the hydrogen and oxygen concentrations in the system and connected systems to less than the flammability limits of the respective gas mixtures.
- Minimize the release of radioactive gases to the environment by injecting the processed purge gas back into the quasi-closed loop.
- Handle excess gas flow rates due to the movement of reactor coolant during plant startup and shutdown.

charcoal holdup bed into the nuclear auxiliary building ventilation system for discharge via the stack.

A COL applicant that references the U.S. EPR design certification will provide a discussion of the onsite vent stack design parameters and site-specific release point characteristics.

11.3.3.4 Estimated Doses

The GASPAR II computer program (Reference 2) was used to calculate doses to the maximally exposed individual (MEI) from gaseous releases. GASPAR II (Reference 2) implements the exposure methodology described in RG 1.109 for radioactive releases in gaseous effluent. The program considers the following exposure pathways:

- External exposure to contaminated ground.
- External exposure to noble gas radionuclides in the airborne plume.
- Inhalation of air.
- Ingestion of farm products grown in contaminated soil.

Inputs and assumptions are conservatively selected to represent a bounding condition for all dose pathways. The site boundary (where the MEI is assumed to reside for external exposure doses and inhalation doses) is assumed to be located at a distance of 0.5 miles from the reactor centerline. The dose receptors for the farm products (i.e., the nearest garden, nearest meat animal, and nearest milk animal) are also assumed to be located at a distance of 0.5 miles from the reactor centerline. The atmospheric dispersion and ground deposition factors are based on conservative values for a distance of 0.5 miles and a mixed-mode release from the plant stack. Inputs used by 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 detailed dose commitment results by age group and organ due to gaseous effluent releases are provided in Table 11.3-11—Detailed Dose Commitment Results by Age Group and Organ due to Gaseous Effluent Releases. A summary of 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.

A COL applicant that references the U.S. EPR design certification will confirm that the site-specific parameters are bounded by those provided in Table 11.3-4 and the dose pathways provided in Section 11.3.3.4. For site-specific parameters that are not bounded by the values provided in Table 11.3-4 and ~~the~~ dose pathways other than

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those provided in Section 11.3.3.4, a COL applicant that references the U.S. EPR design certification will perform a site-specific gaseous pathway dose analysis following the guidance provided in RG 1.109 and RG 1.111, and compare the doses to the numerical design objectives of 10 CFR Part 50, Appendix I and demonstrate compliance with requirements of 10 CFR Part 20.1302 and 40 CFR Part 190.

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.

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 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.

For both normal and maximum defined fuel failure cases, individual site boundary concentrations for the U.S. EPR are less than the applicable limits specified in 10 CFR Part 20, Appendix B, Table 2.

A COL applicant that references the U.S. EPR design certification will confirm that the site-specific annual average gaseous effluent concentrations are bounded by those specified in Table 11.3-6. For site-specific annual average gaseous effluent concentrations that exceed the values provided in Table 11.3-6, a COL applicant that references the U.S. EPR design certification will demonstrate that the annual average gaseous effluent concentrations for expected and design basis conditions meet the limits of 10 CFR Part 20, Appendix B, Table 2 in unrestricted areas. 11.03-15

11.3.3.6 Radioactive Gaseous Waste System Leak or Failure

The purge system of the gaseous waste processing system operates at sub-atmospheric pressures, thus preventing leakage from the purge section to the building atmosphere. The positive pressure section of the system is designed to be leak tight, thus limiting the potential for leakage. The leak tightness of the system is verified by pre-operational testing as described in Section 11.3.2.5.2.

The gaseous waste processing system is capable of detecting leaks by monitoring the system operating parameters for abnormalities. For example, if a leak were to exist in the purge section of the system. the upstream O_2 instrument would detect a higher than normal oxygen concentration due to building air ingress. If a leak were to exist in the positive pressure section, the system instrumentation would indicate flow rates and pressures outside the normal operating range. Once identified through system instrumentation and controls (I&C), the operator can take appropriate action to isolate the leak.

A bounding analysis was performed for the hypothetical event where an operator error leads to an inadvertent bypass of the delay beds and the exhaust from the coolant degasification system is released directly to the environment. Based on a one-hour release to the environment, the exposure at the exclusion area boundary is less than 0.1 rem, in accordance with BTP 11-5 (Reference 3).

A COL applicant that references the U.S. EPR design certification will confirm that the site-specific accident atmospheric dispersion data is bounded by the values provided in Table 2.1-1. For site-specific accident atmospheric dispersion data that exceed the values provided in Table 2.1-1, a COL applicant that references the U.S. EPR design certification will provide a site-specific analysis demonstrating that the resulting dose at the exclusion area boundary associated with a radioactive release due to gaseous waste system leak or failure does not exceed 0.1 rem in accordance with SRP Section 11.3, BTP 11-5.

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11.3.3.7 Quality Assurance

The quality assurance program governing design, fabrication, procurement, and installation of the gaseous waste processing system conforms to RG 1.143 as indicated in Table 3.2.2-1. Implementation of the quality assurance program is described in

Table 11.3-11—Detailed Dose Commitment Results by Age Group and Organ due to Gaseous Effluent Releases[1]

11.03-15

Sheet 1 of 2

Pathway	Total Body (External Exposure)	Gi-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin (External Exposure)
	mrem/yr	mrem/yr	mrem/yr	mrem/yr	mrem/yr	mrem/yr	mrem/yr	mrem/yr
Plume	1.04E+00							9.79E+00
Ground	7.06E-03	7.06E-03	7.06E-03	7.06E-03	7.06E-03	7.06E-03	7.06E-03	8.28E-03
Vegetables								
Adult		2.52E-01	1.13E+00	2.51E-01	2.51E-01	1.03E+00	2.47E-01	
Teen		3.88E-01	1.82E+00	3.89E-01	3.89E-01	1.36E+00	3.82E-01	
Child		8.89E-01	4.33E+00	8.96E-01	8.95E-01	2.71E+00	8.85E-01	
Meat								
Adult		8.46E-02	3.90E-01	8.35E-02	8.34E-02	1.18E-01	8.31E-02	
Teen		6.97E-02	3.30E-01	6.92E-02	6.91E-02	9.39E-02	6.89E-02	
Child		1.28E-01	6.19E-01	1.28E-01	1.28E-01	1.65E-01	1.27E-01	
Cow Milk[2]								
Adult		9.86E-02	4.32E-01	1.02E-01	1.03E-01	1.07E+00	9.76E-02	
Teen		1.74E-01	7.96E-01	1.82E-01	1.83E-01	1.72E+00	1.73E-01	
Child		4.12E-01	1.95E+00	4.26E-01	4.28E-01	3.48E+00	4.11E-01	
Infant		8.45E-01	3.81E+00	8.78E-01	8.74E-01	8.31E+00	8.45E-01	
Goat Milk								
Adult		1.12E-01	4.41E-01	1.20E-01	1.19E-01	1.28E+00	1.11E-01	
Teen		1.92E-01	8.09E-01	2.07E-01	2.05E-01	2.05E+00	1.91E-01	
Child		4.39E-01	1.98E+00	4.67E-01	4.62E-01	4.12E+00	4.40E-01	

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Table 11.3-11—Detailed Dose Commitment Results by Age Group and Organ due to Gaseous Effluent Releases[1]

11.03-15

Sheet 2 of 2

Pathway	Total Body (External Exposure)	Gi-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin (External Exposure)
Infant		8.86E-01	3.86E+00	9.47E-01	9.26E-01	9.84E+00	8.88E-01	
Inhalation								
Adult		2.06E-02	3.84E-04	2.06E-02	2.07E-02	4.80E-02	2.08E-02	
Teen		2.08E-02	4.67E-04	2.09E-02	2.10E-02	5.59E-02	2.12E-02	
Child		1.83E-02	5.70E-04	1.85E-02	1.86E-02	6.04E-02	1.87E-02	
Infant		1.05E-02	2.97E-04	1.07E-02	1.07E-02	4.92E-02	1.08E-02	
Totals[3]								
Adult	1.05E+00	4.76E-01	1.97E+00	4.82E-01	4.81E-01	2.48E+00	4.69E-01	9.80E+00
Teen	1.05E+00	6.78E-01	2.97E+00	6.93E-01	6.91E-01	3.57E+00	6.70E-01	9.80E+00
Child	1.05E+00	1.48E+00	6.94E+00	1.52E+00	1.51E+00	7.06E+00	1.48E+00	9.80E+00
Infant	1.05E+00	9.04E-01	3.87E+00	9.65E-01	9.44E-01	9.90E+00	9.06E-01	9.80E+00

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Notes:

1. Doses represent the offsite dose to the maximally exposed individual (MEI) or nearest resident, who is assumed to reside at a distance of 0.5 miles from the reactor centerline.
2. The cow milk dose pathway is not included in the totals. The goat milk ingestion path is used instead because it results in a higher calculated dose.
3. Totals represent the external dose to total body, internal organ dose (from radioiodine, particulate, tritium, and C-14) and external dose to skin.

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