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UniStar
NUCLEAR ENERGY

10 CFR 50.4
10 CFR 52.79

March 16, 2011

UN#11-090

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: UniStar Nuclear Energy, NRC Docket No. 52-016
Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3,
RAI 290, Liquid Waste Management System, and
RAI 291, Gaseous Waste Management System

References:

1) Surinder Arora (NRC) to Robert Poche (UniStar Nuclear Energy), "FINAL RAI 290 CHPB 5320" email dated January 13, 2011

2) Surinder Arora (NRC) to Robert Poche (UniStar Nuclear Energy), "FINAL RAI 291 CHPB 5322" email dated January 13, 2011

3) UniStar Nuclear Energy Letter UN#11-076, from Greg Gibson to Document Control Desk, U.S. NRC, Submittal of Response to RAI 290, Liquid Waste Management System, and RAI 291, Gaseous Waste Management System, dated February 7, 2011

The purpose of this letter is to respond to the requests for additional information (RAIs) identified in the NRC e-mail correspondence to UniStar Nuclear Energy, dated January 13, 2011 (References 1 and 2). These RAIs address the Liquid and Gaseous Waste Management Systems, as discussed in Sections 11.2 and 11.3 of the Final Safety Analysis Report (FSAR), as submitted in Part 2 of the Calvert Cliffs Nuclear Power Plant (CCNPP) Unit 3 Combined License Application (COLA), Revision 7.

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Reference 3 provided a March 16, 2011 response schedule. The enclosure provides our responses to RAI 290, Question 11.02-5, and RAI 291, Question 11.03-3, and includes revised COLA FSAR content. A Licensing Basis Document Change Request has been initiated to incorporate these changes into a future revision of the COLA. Conforming changes to the environmental report will also be provided in a future revision of the COLA.

Our response does not include any new regulatory commitments. This letter does not contain any sensitive or proprietary information.

If there are any questions regarding this transmittal, please contact me at (410) 470-4205, or Mr. Wayne A. Massie at (410) 470-5503.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on March 16, 2011

Greg Gibson

Enclosure: Response to NRC Request for Additional Information RAI 290, Question 11.02-5, Liquid Waste Management System, and RAI 291, Question 11.03-3, Gaseous Waste Management System, Calvert Cliffs Nuclear Power Plant, Unit 3

cc: Surinder Arora, NRC Project Manager, U.S. EPR Projects Branch
Laura Quinn, NRC Environmental Project Manager, U.S. EPR COL Application
Getachew Tesfaye, NRC Project Manager, U.S. EPR DC Application (w/o enclosure)
Charles Casto, Deputy Regional Administrator, NRC Region II (w/o enclosure)
Silas Kennedy, U.S. NRC Resident Inspector, CCNPP, Units 1 and 2
U.S. NRC Region I Office

GTG/RDS/mdf

Enclosure

Response to NRC Request for Additional Information
RAI 290, Question 11.02-5, Liquid Waste Management System, and
RAI 291, Question 11.03-3, Gaseous Waste Management System,
Calvert Cliffs Nuclear Power Plant, Unit 3

RAI 290

Question 11.02-5

Supplemental question to the response of RAI 254, Question 11.02-3

THIS RAI CONSTITUTES AN OPEN ITEM FOR CHAPTER 11

In the response dated Nov. 16, 2010, the applicant provides a revision of FSAR Section 11.2 addressing the staff's concerns on the approach used in determining doses to the members of the public due to liquid effluents and confirming compliance with NRC regulations and guidance. The response presents a complete revision of FSAR Section 11.2 and includes information supporting a revised site-specific dose assessment for liquid effluent releases to the Chesapeake Bay, a cost-benefit analysis, and a deletion of previously proposed revisions to the departures and exemption reports (Part 7 of the application).

In part, the staff finds the revision adequate, as it was able to independently confirm the dose results to the maximally exposed individual and population, and cost-benefit analysis, and removal of prior departures. However, the staff noted a number of inconsistencies in the presentation of the revised results, statements of compliance with NRC regulations and guidance, and proposed revisions to the FSAR given the concerns identified in RAI 254, Questions 11.02-3. Based on the staff's review of responses to RAI 254, Question 11.02-3, the applicant is requested to address the following items in the proposed revision of FSAR Section 11.2.

A. FSAR Section 11.2.3.3

Regarding the total discharge rate to the Chesapeake, the staff notes that there are three sets of data for the same parameter:

1. ER Table 5.4-1: 19,426 gpm
2. ER Table 3.3-1: 21,019 gpm
3. FSAR Table 10.4-1: 19,696 gpm
4. FSAR Table 11.2-1: 21,019 gpm or 46.8 ft^3/sec

The applicant is requested to confirm which value is the proper one to use in assessing offsite doses, confirm its basis given the system description of FSAR Section 10.4.5 and Table 10.4-1, and properly qualify the chosen value in the text and/or FSAR Table 11.2-1.

Based on the information presented in the body of the response (Part A, p.5 of 72) and revised FSAR Section 11.2.3.3, the applicant is requested to provide the appropriate references supporting the stated dilution factors used in assessing offsite doses.

B. FSAR Section 11.2.3.7

Regarding the radiological impacts of a postulated radioactive waste tank failure, the discussion states that the results presented in U.S. EPR FSAR Section 11.2.3.7 are bounding and the resulting conclusion of acceptability also applies to CCNPP Unit 3. The staff disagrees with this conclusion given that the applicant has presented a site-specific analysis for CCNPP Unit 3 in FSAR Section 2.4.13. The applicant is requested to revise the current conclusion in CCNPP Unit 3 FSAR Section 11.2.3.7 by referring to CCNPP Unit 3 FSAR Section 2.4.13 instead for the details of the analysis, and provide a summary conclusion of these results in FSAR Section 11.2.3.7 in confirming compliance with the acceptance criteria of SRP Section 11.2 and BTP 11-6 (NUREG-0800).

C. FSAR Section 11.2.4

While the discussion refers to Regulatory Guide 1.110 in structuring the cost-benefit analysis, the guidance is not listed in the reference section. The applicant is requested to add Regulatory Guide 1.110 as a full reference in FSAR Section 11.2.5.

D. FSAR Section 11.2.3.4.2 and Table 11.2-4

FSAR Table 11.2-4 presents the results demonstrating compliance with 40 CFR Part 190 (as implemented under Part 20.1301(e)) for CCNPP Units 1 and 2. This information is used to support the conclusion that all three plants would comply with 40 CFR Part 190. In reviewing the listed dose results, the applicant is requested to address and revise the tabulation by:

1. Including current results published by Constellation (May 14, 2010) for calendar year 2009 and update the related conclusions described in the text.

2. While the dose results of CCNPP Units 1 and 2 FSAR Table 11.2-4 have been rounded off, confirm that the tabulated doses represent the sum of doses from liquid and gaseous effluents and not liquid effluent releases only.

3. Adding another column to CCNPP Unit 3 FSAR Table 11.2-4 to include doses due to external radiation since 40 CFR Part 190 includes dose criteria for all sources of radioactivity, liquid and gaseous effluents and doses from external radiation. Revise the related discussion addressing compliance with 40 CFR Part 190 and Part 20.1301(e) accordingly in the text for CCNPP Unit 3.

E. FSAR Section 11.2.3.5

Regarding compliance with the effluent concentration limits of Part 20, Appendix B, Table 2, Column 2, the discussion notes that the results presented in U.S. EPR Table 11.2-7 are bounding and the resulting conclusion of acceptability also apply to CCNPP-3 Unit 3. The staff disagrees with this conclusion as the applicant must demonstrate compliance for the site-specific condition of CCNPP Unit 3. The applicant is requested to review and revise the current conclusions in FSAR Section 11.2.3.5 and confirm compliance with the requirements of Part 20.1301 and 20.1302, and Part 20, Appendix B (Table 2, Column 2) effluent concentration limits, and unity rule summed up over all nuclides reported in liquid effluents contained in routine effluent releases and anticipated operational occurrences.

F. FSAR Table 11.2-5

FSAR Table 11.2-5 presents the results demonstrating compliance with 40 CFR Part 190. In reviewing the listed dose results, the applicant is requested to address and revise the tabulation by adding another column to this table to include CCNPP Unit 3 dose projections due to external radiation since 40 CFR Part 190 includes dose criteria from all sources of radioactivity, liquid and gaseous effluents and external radiation. While footnote 5 to Table 11.2-5 refers to dose projections based on information presented in U.S. EPR FSAR Section 12.3.5.3, this information is not specific to the CCNPP Unit 3 site. A more realistic estimate of bounding external radiation exposures and doses should be drawn from CCNPP Units 1 and 2 reports supporting the presentation of doses listed in CCNPP Unit 3 FSAR Table 11.2-4 (see footnote 1).

Response to Question 11.02-5(A):

The discharge flow rate value used in assessing offsite doses due to liquid effluents is 21,019 gpm, or 46.8 ft^3/sec. The discharge flow rate reported in ER Table 5.4-1 has been updated to reflect this value as part of Revision 7 of the COLA. The values reported in FSAR Table 10.4-1 represent only the cooling tower blowdown rather than the total effluent discharge to the Chesapeake Bay, which includes additional components such as the discharge from the retention basin, sanitary waste and liquid radwaste.

The dilution factors provided in FSAR Table 11.2-1 come from a CORMIX report titled "CORMIX Thermal Mixing Zone Analysis and Dilution Study." The liquid effluent environmental dilution factors were calculated using the Cornell Mixing Expert System (CORMIX) and FLOW-3D® computer codes along with average flow conditions in the Chesapeake Bay, and information on the configuration, placement, and operation of the multi-port diffuser. The CORMIX computer program was used to determine the size of the plume and to calculate near-field dilution factors. More information regarding the inputs used in the modeling can be found in ER Section 5.3.2. The FLOW-3D computer program was used to construct a depth-averaged tidal flow model of the estuary for the determination of far-field dilution factors. The following conservative assumptions were applied in calculating the time averaged dilution factors:

- The drift velocity is based on inflows from upstream locations only, not accounting for water that enters the bay at downstream locations,
- The bay cross-section used is conservatively low compared to the actual cross section of the Chesapeake Bay,
- The effect of winds to increase mixing was not explicitly included in the tidal model, and
- The approach used in calculating the 50-mile dilution factor of 296 does not include the effect of tides.

FSAR Section 11.2.3.3 is being revised to include the above explanation regarding the calculation of the dilution factors.

Response to Question 11.02-5(B):

FSAR Section 11.2.3.7 is being revised to reference FSAR Section 2.4.13 and provide a summary of the results.

Response to Question 11.02-5(C):

Reference to Regulatory Guide 1.110 is being added to FSAR Section 11.2.5.

Response to Question 11.02-5(D):

The annual radiological environmental operating reports for Calvert Cliffs Units 1&2 covering the years of 1999 – 2009 state that there is no plant-related contribution from direct radiation to the offsite dose.

FSAR Table 11.2-4 is being updated as follows:

- Dose results from the 2009 Annual Radiological Environmental Operating Report for Calvert Cliffs Units 1 and 2 are being added to FSAR Table 11.2-4 and
- Additional text is being added to footnote 1 clarifying that the dose values reported reflect the sum of the liquid and gaseous effluent doses and that there is no plant-related contribution from direct radiation for Calvert Cliffs Units 1 and 2.

Response to Question 11.02-5(E):

FSAR Section 11.2.3.5 is being updated to provide a comparison of the liquid effluent concentrations to the effluent concentration limits of 10 CFR Part 20, Appendix B, Table 2, Column 2 in order to demonstrate compliance with 10 CFR 20.1301 and 20.1302.

Response to Question 11.02-5(F):

FSAR Table 11.2-5 is being revised to include CCNPP3 Unit 3 dose projections due to external radiation.

COLA Impact

Supplemental information is being added to the end of FSAR Section 11.2.3.3 as follows:

11.2.3.3 Release Points and Dilution Factors

. . .

Treated liquid radwaste effluent is released to the Chesapeake Bay at a flow rate of 11 gpm via the CCNPP Unit 3 discharge line situated downstream of the waste water retention basin. The average discharge flow rate from the seal well for waste water streams other than treated liquid radwaste is 21,008 gpm, resulting in a total average flow of 21,019 gpm for liquid effluents discharged to the bay. Retention basin flow provides dilution flow to discharged treated liquid radwaste. As shown in Table 11.2-1, a near-field dilution factor of 13.3 was utilized for calculating the maximum individual dose to man for exposures associated with fish and invertebrate ingestion and boating pathways. For swimming and shoreline exposure pathways, an environmental dilution factor of 58 was applied for the nearest shore with the minimum tidal average mixing. For members of the public under Appendix I to 10 CFR 50 who may be associated with ships in the Chesapeake Bay that use desalinization of sea water to create drinking water, a conservative discharge dilution factor of 296 to 1 was applied to the annual consumption quantities for four ages groups (730, 510, 510 and 330 liters/year for adults, teens, children and infants, respectively). These dilution factors are based on a submerged, multi-port diffuser (with three nozzles), with a discharge line situated approximately 550 ft off the near shoreline with the nozzles directed out into the Chesapeake Bay and into the overhead water column.

The liquid effluent environmental dilution factors were calculated using the Cornell Mixing Expert System (CORMIX) (Jirka, 1996) and FLOW-3D® (Flow Science, 2007) computer codes along with average flow conditions in the Chesapeake Bay, and information on the configuration, placement, and operation of the multi-port diffuser. The CORMIX computer program was used to determine the size of the plume and to calculate near-field dilution factors. The FLOW-3D computer program was used to construct a depth-averaged tidal flow model of the estuary for the determination of far-field dilution factors. The following conservative assumptions were applied calculating the time averaged dilution factors:

- The drift velocity is based on inflows from upstream locations only, not accounting for water that enters the bay at downstream locations,
- The bay cross-section used is conservatively low compared to the actual cross section of the Chesapeake Bay,
- The effect of winds to increase mixing was not explicitly included in the tidal model and
- The approach used in calculating the 50-mile dilution factor of 296 does not include the effect of tides.}

FSAR Section 11.2.3.4.2 is being revised as follows (only the impacted portion is shown):

11.2.3.4.2 Liquid Pathway Doses

. . .

In addition to the CCNPP Unit 3 dose impacts assessed for the maximum exposed individual and general population, the combined historical dose impacts of CCNPP Units 1 and 2 are added to the CCNPP Unit 3 projected impacts to compare to the uranium fuel cycle dose standard of 40 CFR 190. Since there are no other fuel cycle facilities within 5 mi of the CCNPP site, the combined impacts for three units can be used to determine the total impact from liquid and gaseous effluents, along with direct radiation from fixed radiation sources onsite to determine compliance with the dose limits of the standard (25 mrem/yr whole body, 75mrem/yr thyroid, and 25 mrem/yr for any other organ). Table 11.2-4 illustrates the impact from CCNPP Units 1 and 2 over a recent ~~seven~~ eleven year historical period. Using the highest observed annual dose impact from CCNPP Units 1 and 2, Table 11.2-5 shows the combined impact along with the projected contributions from CCNPP Unit 3.}

FSAR Section 11.2.3.5 is being revised as follows:

11.2.3.5 Maximum Release Concentrations

The U.S. EPR FSAR includes the following COL Item in Section 11.2.3.5:

> 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.

The COL Item is addressed as follows:

~~{The maximum liquid effluent release concentrations provided in U.S. EPR FSAR Table 11.2-7 were calculated using a conservatively low dilution flow of 9000 gpm. As described in Section 11.2.3.3, the discharge flow rate for CCNPP Unit 3 is 21,019 gpm. Therefore, the resulting liquid effluent release concentrations for CCNPP Unit 3 are bounded by those reported in U.S. EPR FSAR Table 11.2-7 and are thereby less than the limits of 10 CFR Part 20, Appendix B, Table 2.}~~

{The annual average concentrations of radioactive materials released in liquid effluents to the discharge point have been determined by dividing the annual liquid effluent release rates (Ci/yr) as calculated using GALE (NRC, 1985) and presented in U.S. EPR FSAR Table 11.2-4, by the discharge flow rate of 21,019 gallons per minute. Annual average concentrations were determined in the immediate vicinity of the discharge point. No further mixing, dilution, or transport was assumed to occur.

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 11.2-8 presents the results of this comparison. For the annual average radionuclide release concentrations for expected releases, the sum of the fractions of the effluent concentration limits is 0.04, 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 that represents the ratio of design basis fuel failure primary coolant activity to expected fuel failure primary coolant activity. (Note: For calculated multiplication factors less than 1, a value of 1 was conservatively used. For primary coolant activities reported by GALE that were less than 1.0E-05 μCi/ml (and therefore displayed by GALE as zero), a conservative value of 1,000 was used for the multiplication factor.) Table 11.2-8 presents the results of this comparison. For the annual average radionuclide release concentrations for design basis releases, the sum of the fractions of the effluent concentration limits is 0.21, which is below the allowable value of 1.0.}

FSAR Section 11.2.3.7 is being revised as follows:

11.2.3.7 Postulated Radioactive releases due to Liquid-Containing Tank Failure

The U.S. EPR FSAR includes the following COL Item in Section 11.2.3.7:

> 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.

The COL Item is addressed as follows:

~~{The analysis performed in support of Section 11.2.3.7 of the U.S. EPR FSAR uses input values that bound the site-specific values for CCNPP Unit 3.}~~

{Results of the radiological impacts associated with a postulated radioactive waste tank failure are presented in FSAR Section 2.4.13. The results show that although tritium (H-3) and iodine (I-131) concentrations could potentially exceed the 10 CFR Part 20, Appendix B, Table 2 Effluent Concentration Limit (ECL) given the accidental liquid release of effluents to groundwater for the pathways to Branch 2 and to Chesapeake Bay, the resulting annual dose is below the allowable total exposure level to individual members of the public of 100 millirem per year required in 10 CFR 20.1301.}

FSAR Section 11.2.4 is being revised as follows (only the impacted portion is shown):

11.2.4 Liquid Waste Management System Cost-Benefit Analysis

The U.S. EPR FSAR includes the following COL Item in Section 11.2.4:

> A COL applicant that references the U.S. EPR design certification will perform a site-specific liquid waste management system cost-benefit analysis.

This COL Item is addressed as follows:

{10 CFR Part 50, Appendix I, Section II.D requires that plant designs consider additional items based on a cost-benefit analysis. Specifically, the design must include 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. The threshold used to make this decision is $1000 per person-rem or person-thyroid rem annual cost to reduce the cumulative dose to a population within a 50-mile radius of the reactor site. The methodology of Regulatory Guide 1.110 (NRC, 1976) was used to perform a site-specific cost benefit analysis to satisfy these requirements. Regulatory Guide 1.110 provides values in 1975 dollars and instructs that these values not be adjusted for inflation.

. . .

FSAR Section 11.2.5 is being revised as follows:

11.2.5 References

{**CFR, 2007.** Title 10, Code of Federal Regulations, Part 20, Appendix B, Table 2, Radionuclides, Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage, 2007.

Flow Science, 2007. "FLOW-3D User's Manual Version 9.0," Flow Science, Santa Fe, NM.

Jirka, 1996. User's Manual for CORMIX: A Hydro-Dynamic Mixing Zone Model and Decision Support System for Pollutant Discharges into Surface Waters, G. Jirka, R. Doneker and S. Hinton, EPA #823/B-97-006, U.S. Environmental Protection Agency, Website: http://www.epa.gov/waterscience/models/cormix/users.pdf, Date accessed: June 02, 1997.

NEI, 2009. NEI 08-08A, Generic FSAR Template Guidance for Life Cycle Minimization of Contamination, Revision 0, Nuclear Energy Institute, October 2009.

NRC, 1976. Regulatory Guide 1.110, Cost-Benefit Analysis for Radwaste Systems for Light Water-Cooled Nuclear Power Reactors (For Comment), Nuclear Regulatory Commission, March, 1976.

NRC, 1977. Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluent for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I, Revision 1, U.S. Nuclear Regulatory Commission, October 1977.

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

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

NRC, 2004. NUREG/BR-0058, "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission," Revision 4, September, 2004.}

FSAR Table 11.2-3 is being revised as follows:

Table 11.2-3 - {Dose Commitment Due To Liquid Releases}

Type of Dose ~~1~~	Calculated (mrem/yr)	10 CFR Part 50, Appendix I ALARA Design Objective (mrem/yr)
Total Body Dose	~~1.32~~1.31E-02 (adult)	3
Maximum Organ Dose	7.72E-02 (adult, GI-LLI)	10
Thyroid Dose	6.81E-02 (child)	N/A

FSAR Table 11.2-4 is being revised as follows:

Table 11.2-4 - {Annual Historical Dose Compliance with 40 CFR 190 for CCNPP Units 1 and 2[1]}

Year	Whole Body (mrem)	Thyroid (mrem)	Maximum Organ (mrem)
2009	0.002	0.040	0.003
2008	0.004	0.035	0.010
2007 ~~{Annual Historical Dose Compliance with 40 CFR 190 for CCNPP Units 1 and 2}~~	0.002	0.010	0.005
2006	0.004	0.052	0.010
2005	0.005	0.006	0.095
2004	0.002	0.007	0.006
2003	0.004	0.006	0.023
2002	0.007	0.003	0.1740
2001	0.010	0.005	0.351
2000	0.018	0.018	0.211
1999	0.013	0.011	0.686
Max value any year	0.018	0.052	0.686

Note 1: Historical doses for CCNPP Units 1 and 2 were obtained from the annual radiological environmental operating reports for years 2000-~~2009~~2010. Doses above represent total dose from liquid and gaseous effluents. There was no plant-related contribution from direct radiation during the periods of interest.

FSAR Table 11.2-5 is being revised as follows:

Table 11.2-5 - {40 CFR 190 Annual Site Dose Compliance}

CCNPP Unit 3		Whole Body (mrem)	Thyroid (mrem)	Max. Organ[~~7~~][8] (mrem)
CCNPP Unit 3 Liquids[1]		1.31E-02	6.81E-02	7.72E-02
CCNPP Unit 3 Gaseous External	Plume[2]	2.24E-01	2.24E-01	2.24E-01
	Ground Plane[3]	1.67E-03	1.67E-03	1.67E-03
Ingestion	Meat[4]	2.74E-02	3.20E-02	1.33E-01
	Vegetable[4]	1.87E-01	5.42E-01	9.08E-01
Inhalation[4]		4.47E-03	1.26E-02	1.12E-04
CCNPP Unit 3 Direct[5]		4.86E-05	4.86E-05	4.86E-05
Total (CCNPP Unit 3)[~~5~~][6]		4.58E-01	8.80E-01	1.34E+00
Total (CCNPP Units 1 and 2)[~~6~~][7]		1.8E-02	5.2E-02	6.86E-01
CCNPP Site Total		4.76E-01	9.32E-01	2.03E+00

Notes:

1. Values from Table 11.2-2 and Table 11.2-3.
2. External dose from plume is calculated at the SE site boundary (0.88 mi) only for noble gases and is used for assessment of compliance with 40 CFR 190. (See Table 11.3-6)
3. Exposure pathway assumed to exist at maximum site boundary (S, 0.86 mi) (See Table 11.3-1 and Table 11.3-6).
4. Exposure pathway assumed to exist at maximum site boundary (SE, 0.88 mi) (See Table 11.3-1 and Table 11.3-~~6~~5).
5. Direct dose based on exposure to the Fuel Building (See Section 11.3.3.4).

~~5~~6. Unit 3 doses projected based on design performance calculations using the GALE code, and both real and potential maximum pathway locations. ~~Direct radiation exposure from containment and other plant buildings is negligible based on information in U.S. EPR FSAR Section 12.3.5.3.~~

~~6~~7. Unit 1 & 2 doses based on actual plant recorded effluents and exposure pathways (different basis from that applied to Unit 3 projected assessments). - see Table 11.2-4

~~7~~8. For Unit 3, the liquid effluent critical organ is adult GI-LLI (gastro-intestinal-lower large intestine); for gaseous effluents, critical organ is Child bone. These are conservatively added to represent maximum dose.

FSAR Table 11.2-8 is being added as follows:

Table 11.2-8 {Comparison of Annual Average Liquid Release Concentrations with 10 CFR Part 20 Concentration Limits}
(Page 1 of 2)

Nuclide	Expected Release Concentration (µCi/ml)	Design Basis Relese Concentration (µCi/ml)	10 CFR 20 Appendix B Table 2, Col. 2 Limit (µCi/ml)	Fraction of Limit	
				Expected Release Concentration	Design Basis Release Concentration
Na-24	1.46E-10	1.90E-10	5.00E-05	2.92E-06	3.80E-06
Cr-51	2.39E-11	3.44E-11	5.00E-04	4.78E-08	6.88E-08
Mn-54	1.29E-11	1.82E-11	3.00E-05	4.30E-07	6.07E-07
Fe-55	9.80E-12	1.40E-11	1.00E-04	9.80E-08	1.40E-07
Fe-59	2.39E-12	3.39E-12	1.00E-05	2.39E-07	3.39E-07
Co58	3.58E-11	5.10E-11	2.00E-05	1.79E-06	2.55E-06
Co-60	4.30E-12	6.22E-12	3.00E-06	1.43E-06	2.07E-06
Zn-65	4.06E-12	5.75E-12	5.00E-06	8.13E-07	1.15E-06
W-187	1.10E-11	1.43E-11	3.00E-05	3.66E-07	4.78E-07
Np-239	1.39E-11	4.49E-11	2.00E-05	6.93E-07	2.25E-06
Sr-89	1.19E-12	4.80E-11	8.00E-06	1.49E-07	5.99E-06
Sr-91	1.91E-12	1.22E-11	2.00E-05	9.56E-08	6.11E-07
Y-91m	1.19E-12	4.93E-12	2.00E-03	5.97E-10	2.46E-09
Y-93	8.60E-12	8.60E-12	2.00E-05	4.30E-07	4.30E-07
Zr-95	3.11E-12	6.64E-12	2.00E-05	1.55E-07	3.32E-07
Nb-95	2.39E-12	7.07E-12	3.00E-05	7.97E-08	2.36E-07
Mo-99	4.30E-11	5.95E-09	2.00E-05	2.15E-06	2.97E-04
Tc-99m	4.06E-11	2.18E-09	1.00E-03	4.06E-08	2.18E-06
Ru-103	5.97E-11	5.97E-11	3.00E-05	1.99E-06	1.99E-06
Rh-103m	5.97E-11	5.97E-08	6.00E-03	9.96E-09	9.96E-06
Ru-106	7.41E-10	7.41E-10	3.00E-06	2.47E-04	2.47E-04
Ag-110m	1.05E-11	1.05E-11	6.00E-06	1.75E-06	1.75E-06
Te-129m	1.43E-12	9.81E-11	7.00E-06	2.05E-07	1.40E-05
Te-129	9.56E-13	9.56E-13	4.00E-04	2.39E-09	2.39E-09
Te-131m	7.41E-12	1.39E-10	8.00E-06	9.26E-07	1.74E-05
Te-131	1.43E-12	1.59E-12	8.00E-05	1.79E-08	1.98E-08
I-131	8.13E-10	2.90E-08	1.00E-06	8.13E-04	2.90E-02

Table 11.2-8 {Comparison of Annual Average Liquid Release Concentrations with 10 CFR Part 20 Concentration Limits}
(Page 2 of 2)

Nuclide	Expected Release Concentration (µCi/ml)	Design Basis Relese Concentration (µCi/ml)	10 CFR 20 Appendix B Table 2, Col. 2 Limit (µCi/ml)	Fraction of Limit	
				Expected Release Concentration	Design Basis Release Concentration
Te-132	1.15E-11	2.25E-09	9.00E-06	1.27E-06	2.50E-04
I-132	2.87E-11	5.36E-11	1.00E-04	2.87E-07	5.36E-07
I-133	8.36E-10	1.37E-08	7.00E-06	1.19E-04	1.96E-03
Cs-134	6.21E-11	1.22E-08	9.00E-07	6.90E-05	1.36E-02
I-135	3.58E-10	1.49E-09	3.00E-05	1.19E-05	4.97E-05
Cs-136	7.41E-12	3.55E-09	6.00E-06	1.23E-06	5.92E-04
Cs-137	8.36E-11	7.87E-09	1.00E-06	8.36E-05	7.87E-03
Ba-140	1.00E-10	1.00E-10	8.00E-06	1.25E-05	1.25E-05
La-140	1.82E-10	1.82E-10	9.00E-06	2.02E-05	2.02E-05
Ce-141	1.19E-12	6.24E-12	3.00E-05	3.98E-08	2.08E-07
Ce-143	1.46E-11	1.46E-11	2.00E-05	7.29E-07	7.29E-07
Pr-143	1.19E-12	1.19E-09	2.00E-05	5.97E-08	5.97E-05
Ce-144	3.11E-11	3.11E-11	3.00E-06	1.04E-05	1.04E-05
Pr-144	3.11E-11	3.11E-08	6.00E-04	5.18E-08	5.18E-05
H-3	3.97E-05	1.59E-04	1.00E-03	3.97E-02	1.59E-01
			Sum of Fractions	**4.11E-02**	**2.13E-01**

RAI 291

Question 11.03-3

Supplemental question to the response of NRC Letter RAI 255, Question 11.03-2

THIS RAI CONSTITUTES AN OPEN ITEM FOR CHAPTER 11

In the response dated Nov. 16, 2010, the applicant provides a revision of FSAR Section 11.3 addressing the staff's concerns on the approach used in determining doses to the members of the public due to gaseous effluents and confirming compliance with NRC regulations and guidance. The response presents a complete revision of FSAR Section 11.3 and includes information supporting a revised site-specific dose assessment for gaseous effluent releases to the Chesapeake Bay, a cost-benefit analysis, and a deletion of previously proposed revisions to the departures and exemption reports (Part 7 of the application). The response also provides proposed revisions to FSAR Sections 11.4 and 11.5 even though RAI 255 did not address these two FSAR sections.

In part, the staff finds the revision adequate, as it was able to independently confirm the dose results to the maximally exposed individual and population, and cost-benefit analysis, and removal of prior departures. However, the staff noted a number of inconsistencies in the presentation of the revised results, statements of compliance with NRC regulations and guidance, and proposed revisions to the FSAR, given the concerns identified in RAI 255, Questions 11.03-2. In addition, this supplemental RAI also identifies issues on the proposed revisions of FSAR Sections 11.4 and 11.5 given that they were submitted for staff review as part of a single package prepared in response to RAI No. 254 and 255.

Based on the staff's review of responses to RAI 255, Question 11.03-2, the applicant is requested to address the following items in the proposed revision of FSAR Sections 11.3 to 11.5.

I. FSAR Chapter 11.3

A. FSAR Section 11.3.3.3

The listing of expected sources of radioactivity in gaseous process streams and gaseous effluents presented in FSAR Section 11.3.3.3 should be revised to include the turbine gland seals system as another significant contributor.

Provide the respective FSAR sections, as references, for the cited plant stack exhaust flow rate of 260,000 CFM as the sum of flow rates for several plant buildings.

B. FSAR Section 11.3.3.4

In FSAR Section 11.3.3.4, the discussion presenting the dose result of 1.47 mrem/yr (child bone) should be qualified as this result includes an exposure pathway and locations that are different than those forming the basis of the MEI dose results presented in FSAR Tables 11.3-5, 11.3-6 and 11.3-7. Specifically, the dose result of 1.47 mrem/yr is the sum of five exposure pathways. The dose of 1.47 mrem/yr is derived as the sum of: 1.67E-03 + 1.12E-04 + 1.33E-01 + 9.08E-01 + 4.23E-01. When using the maximum organ dose (0.868 mrem/yr, child bone) result presented in FSAR Table 11.3-7, the dose results of 1.47 mrem/yr cannot be duplicated since the sum of 0.868 and 0.423 mrem /yr equates to 1.29 mrem/yr. The applicant is requested to assess whether the dose of 0.868 mrem/yr (child bone) listed in FSAR Table 11.3-7 should be 1.043 mrem/yr instead. The dose of 1.043 mrem/year is based on the sum of: 1.67E-03 + 1.12E-04 + 1.33E-01 + 9.08E-01. The applicant is also requested to qualify the basis of the dose summation in that discussion and in FSAR Table 11.3-7, Footnote 2.

FSAR Section 11.3.3.4 refers to details in FSAR Table 11.2-5 in demonstrating compliance with 40 CFR Part 190 from gaseous and liquid effluent releases. In reviewing the dose results presented in FSAR Table 11.2-5, the applicant is requested to integrate its response on doses due to gaseous effluents to the parallel supplemental RAI on liquid effluents such that when doses from liquid and gaseous effluents and external radiation are combined, the aggregated dose results will confirm compliance with 40 CFR Part 190 criteria, as implemented under Part 20.1301(e).

C. FSAR Section 11.3.3.5

Regarding compliance with the effluent concentration limits of Part 20, Appendix B, Table 2, Column 1, the discussion notes that the results presented in U.S. EPR Table 11.3-6 are bounding and the resulting conclusion of acceptability also applies to CCNPP Unit 3. The staff disagrees with this conclusion as the applicant has to demonstrate compliance for the site-specific condition of CCNPP Unit 3. The applicant is requested to review and revise the current conclusions in FSAR Section 11.3.3.5 and confirm compliance with the requirements of Part 20.1301 and 20.1302, and Part 20, Appendix B (Table 2, Column 1) effluent concentration limits, and unity rule summed up over all nuclides reported in gaseous effluents contained in routine effluent releases and anticipated operational occurrences.

D. FSAR Section 11.3.4

The discussion describing the results of the cost-benefit analysis and conclusion erroneously refer to “doses for liquid effluents.” The text should be revised to refer instead to gaseous effluents given that the analysis addresses the gaseous waste management system.

While the discussion refers to Regulatory Guide 1.110 in structuring the cost-benefit analysis, the guidance is not listed in the reference section. The applicant is requested to add Regulatory Guide 1.110 as a full reference in FSAR Section 11.3.5. Also, the applicant should determine whether the reference to NUREG-0017 (NRC 1985) is still needed given the restructured approach used in the updated cost-benefit analysis.

E. FSAR Table 11.3-2

FSAR Table 11.3-2 presents the origins of atmospheric dispersion and deposition parameters used in calculating population doses. A review of the cited references in FSAR Section 2.3.5 indicates that citations of supporting met data tabulations are incomplete. Specifically, the applicant is requested to review and correct the following observations:

1. The reference to FSAR Table 2.3-124 should include Table 2.3-125 for the full set of met data, since FSAR Table 2.3-124 presents met data only out to 5 miles from the plant, and FSAR Table 2.3-125 presents the balance of the met data out to 50 miles. The

same correction should be made to the citation of FSAR Table 2.3-127 by adding Table 2.3-128 for the complete set of met data.

2. The reference to FSAR Table 11.3-10 for one set of met data is confusing since the atmospheric dispersion parameters listed in that table are the same as that given in FSAR 2.3-119. Note that FSAR Table 2.3-119 is also cited as a reference for undecayed and undepleted met data in FSAR Table 11.3-2. It is not clear as to why such a distinction is being made as to their references while the met data are the same. An explanation is warranted for technical clarification and use of met data.

3. FSAR Table 11.3-2 presents the source of atmospheric dispersion and deposition parameters used in calculating population doses. A review of Footnote 2 to this table qualifying the use of FSAR Sections 2.3.5 and 11.3 as supporting met data is confusing given the proposed substitutions of met data. Specifically, the applicant is requested to breakout Footnote 2 for each set of met data and provide the basis for the use and substitution of each, given that the cost-benefit analysis and dose calculations are stated to rely on Regulatory Guide 1.109 and NUREG/CR-4653 (GASPAR II computer code). The expanded series of footnotes should clearly address the basis and use of undecayed and undepleted χ/Q data; decayed and undepeleted χ/Q data; decayed and depleted χ/Q data; and ground deposition D/Q data.

II. FSAR Chapter 11.4

A. FSAR Section 11.4.3

The discussion refers to two EPRI reports (Nov. 2007 and April 2007), but this guidance on low-level radioactive storage is not listed in the reference section. It is noted that these two references are important to the strategy being proposed in minimizing the generation of Class B and C wastes and in stretching out the storage capacity of the radwaste processing building. The applicant is requested to add both EPRI reports as full references in FSAR Section 11.4.7.

III. FSAR Chapter 11.5

There are no comments on the proposed revision to FSAR Section 11.5.

Response to Question 11.03-3I(A):

Per Section 10.4.3 of the U.S. EPR FSAR, steam and non-condensable gases from the turbine gland steam exhausters are routed to the nuclear auxiliary building ventilation system. Therefore, this waste stream is covered by the third bullet in Section 11.3.3.3, which includes ventilation from the Nuclear Auxiliary Building.

The 260,000 cfm cited in COLA FSAR Section 11.3.3.3 is an estimate of the plant stack exhaust flow rate based on design analyses for the ventilation systems for various buildings. The purpose of this estimate was to demonstrate that the value of 242,458 cfm used in the development of dispersion factors was a conservatively low value. The stack flow rate of 242,458 cfm used in the atmospheric dispersion factor calculations can be found in FSAR Section 2.3.5.2. FSAR Section 2.3.5.2 states that 242,458 cfm is a conservative value, since the stack flow rate for normal operations will be higher. Therefore, FSAR Section 11.3.3.3 is being revised to remove the statement citing the plant exhaust flow rate of 260,000 cfm.

Response to Question 11.03-3I(B):

The maximum exposed individual (MEI) dose of 0.868 mrem and the hypothetical dose of 1.47 mrem represent two distinct dose scenarios, with the MEI dose taking into account known land use characteristics and the hypothetical dose representing a bounding dose estimate that could not be exceeded, considering that future land use within the site vicinity is likely to change over the course of plant operation.

The MEI dose of 0.868 (child, bone) is calculated for a postulated individual who is conservatively assumed to reside at the limiting site boundary (i.e., site boundary location with the maximum dose for the pathway of interest), and consume vegetables from the nearest actual garden location (0.98 miles SE) and meat from the site boundary. (The meat pathway is assumed to exist at the most limiting site boundary location since the use of beef cattle within 5 miles of the CCNPP site was identified through the land use census, but specific locations were not available). There are no milk animals within 5 miles of CCNPP3, so this pathway is not included for the MEI.

The dose of 1.47 mrem/yr represents the dose for a hypothetical individual who is assumed to be exposed to the potential exposure pathways at the limiting site boundary. This is meant to be a bounding dose that does not take into account actual land use within the site vicinity. This hypothetical individual dose summation differs from the MEI dose summation in that the milk pathway is included, although no milk animals were identified within 5 miles, and the garden is assumed to exist at the site boundary rather than at the nearest actual garden as provided by the land use census information.

The table below further summarizes the dose contributions for each of these dose scenarios using the doses by pathway as presented in FSAR Table 11.3-5:

Exposure Pathway	Maximum Exposed Individual		Hypothetical Individual	
	Location	**Dose (mrem/yr)**	**Location**	**Dose (mrem/yr)**
Ground Plane	Limiting site boundary location – 0.86 miles S	1.67E-03	Limiting site boundary location – 0.86 miles S	1.67E-03
Inhalation	Limiting site boundary location – 0.88 miles S	1.12E-04	Limiting site boundary location – 0.88	1.12E-04
Vegetables	Nearest vegetable garden at 0.98 miles SE	7.33E-01	Limiting site boundary location – 0.88 miles S	9.08E-01
Meat	Limiting site boundary location – 0.88 miles S	1.33E-01	Limiting site boundary location – 0.88 miles S	1.33E-01
Milk	N/A – no milk identified within 5 miles	N/A	Limiting site boundary location – 0.88 miles S	4.23E-01
	Total	0.868		1.47

Additional text is being added to FSAR Section 11.3.3.4 and Table 11.3-5 clarifying the distinction between these two dose scenarios.

A direct dose component is being added to FSAR Table 11.2-5 and associated text is being added to FSAR Section 11.3.3.4 describing the estimated direct dose component for CCNPP Unit 3.

Response to Question 11.03-3I(C):

FSAR Section 11.3.3.5 is being updated to provide a comparison of the gaseous effluent concentrations for CCNPP Unit 3 to the effluent concentration limits of 10 CFR Part 20, Appendix B, Table 2, Column 1 in order to demonstrate compliance with 10 CFR 20.1301 and 20.1302.

Response to Question 11.03-3I(D):

The erroneous reference in Section 11.3.4 to liquid effluents is being corrected to refer to gaseous effluents and a reference to Regulatory Guide 1.110 is being added to FSAR Section 11.3.5. The reference to NUREG-0017 is maintained as it is referenced in Section 11.3.3.5.

Response to Question 11.03-3I(E):

The table references in Table 11.3-2 for the meteorological dispersion factors contained in FSAR Section 2.3 are being expanded to encompass the full data set. It is noted that the table numbers in Section 2.3 have changed in Revision 7 of the COLA. Therefore, the referenced tables reflect the updated table numbers.

As discussed in footnote 2 to Table 11.3-2, Table 11.3-10 reports a bounding set of dispersion factors which reflect the more limiting (i.e., higher) value of the undecayed/undepleted χ/Q and the gamma χ/Q. Although most of the values are the undecayed/undepleted χ/Qs, some of the values are the gamma χ/Qs. This bounding set of dispersion factors was conservatively used as input to the GASPARII file for the undecayed/undepleted, decayed/undepleted and decayed/depleted atmospheric dispersion factors.

Footnote 2 to Table 11.3-2 is being separated into separate footnotes addressing the use of a single set of bounding dispersion factors for the undecayed/undepleted, decayed/undepleted and decayed/depleted atmospheric dispersion factors, individually, with a statement clarifying the basis for this substitution.

Response to Question 11.03-3II(A):

The reference to the two EPRI reports is being added to FSAR Section 11.4.7.

COLA Impact

FSAR Section 11.3.3.3 is being revised as follows (only the impacted portion is shown):

11.3.3.3 Release Points

The U.S. EPR FSAR includes the following COL Item in Section 11.3.3.3:

> 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.

The COL Item is addressed as follows:

{All gaseous effluents are released at the top of the plant stack. The stack height is approximately 197 ft above plant grade, or about 6.56 ft above the height of the adjacent Reactor Building. ~~The normal stack flow rate is conservatively estimated at 260,000 cfm (sum of exhaust ventilation flow rates from the Nuclear Auxiliary Building 157,000, Radioactive Waste Processing Building 94,000 and Access Building 9,000) with no credit for thermal buoyancy of the exit gas assumed (ambient temperature) and the low flow purge system assumed to not be operating.~~ For the purpose of analyzing the effective stack height, a conservative stack flow rate of 242,458 cfm was utilized in the atmospheric dispersion calculations. The stack diameter is 12.5 ft. The releases of radioactive effluent to the plant stack include contributions from:

FSAR Section 11.3.3.4 is being revised as follows (only the impacted portions are shown):

11.3.3.4 Estimated Doses

. . .

The release of radioactive materials in gaseous effluents from CCNPP Unit 3 to the environment results in minimal radiological impacts. Annual radiation exposures to the maximum exposed individual near the CCNPP site via the pathways of submersion, ground contamination, inhalation and ingestion are provided in Tables 11.3-5 and 11.3-6 for the four age groups of interest. Table 11.3-7 provides a summary of the dose to the MEI compared to the dose limits of 10 CFR 50, Appendix I. Table 11.3-7 shows that the critical organ dose to the MEI is 0.868 mrem/yr to a child's bone ~~via the identified exposure pathways in the CCNPP site vicinity~~. This maximum exposed individual is assumed to reside at the limiting site boundary and consume beef raised at the limiting site boundary and garden vegetables from the nearest garden at 0.98 miles SE. Table 11.3-7 also provides the beta and gamma air dose at the site boundary. Projected dose impacts are well within the design objectives of Appendix I. ~~If a hypothetical individual is postulated to be exposed to all potential pathways (ground plane, inhalation, vegetable gardens, goat's milk and meat) at the same limiting CCNPP site boundary location, the maximum critical organ (child bone) dose increases to 1.47 mrem/yr, which is still below the dose objective of 10 CFR 50, Appendix I, Section II.C.~~ In order to bound any future changes in land use over the operating life of the plant, a second analysis was performed for a "hypothetical MEI." This hypothetical individual is assumed to be exposed to the same pathways, at the same receptor locations as the MEI, with the following exceptions: a) the vegetable pathway is assumed to exist at the limiting site boundary, rather than at the real vegetable garden location used for the MEI, and b) a milk pathway is assumed, where none exists for the MEI. Using these conservative assumptions, the maximum critical organ (child bone) dose increases to 1.47 mrem/yr which is still below the dose objective of 10 CFR 50, Appendix I, Section II.C. (Note: The dose of 1.47 mrem represents a summation of the following values from Table 11.3-5: 1.67E-03 mrem from ground plane, 1.12E-04 mrem from inhalation, 0.908 mrem from vegetables, 0.423 mrem from milk and 0.133 mrem from meat.)

. . .

In addition to the CCNPP Unit 3 dose impacts assessed for the maximum exposed individual and general population, the combined historical dose impacts of CCNPP Units 1 and 2 are added to the CCNPP Unit 3 projected impacts to compare to the uranium fuel cycle dose standard of 40 CFR 190. Since there are no other fuel cycle facilities within 5 mi of the CCNPP site, the combined impacts for three units can be used to determine the total impact from liquid and gaseous effluents along with direct radiation from fixed radiation sources onsite to determine compliance with the dose limits of the standard (25 mrem/yr whole body, 75 mrem/yr thyroid, and 25 mrem/yr for any other organ). Table 11.2-4 illustrates the impact from CCNPP Units 1 and 2 over a recent ~~ten~~ eleven year historical period. Using the highest observed annual dose impact from CCNPP Units 1 and 2, 11.2-5 shows the combined impact along with the projected contributions from CCNPP Unit 3. The projected direct dose component for Unit 3 is based on a projected dose rate to the site boundary from the Fuel Building. The Fuel Building is the only structure which contains significant radiation sources that could contribute to direct dose at the boundary line. This is due to the shielding effect of other plant structures that are situated between buildings with radiation sources and the CCNPP site boundary line. The exterior walls of the Fuel Building provide sufficient shielding to limit the exterior dose rate to 0.25 mrem/hr at 1 foot from the exterior walls. Therefore, the projected direct annual dose at the site boundary (approximately 5400 ft) from CCNPP Unit 3 would not exceed 4.86E-05 mrem/yr.}

FSAR Section 11.3.3.5 is being revised as follows:

11.3.3.5 Maximum Release Concentrations

The U.S. EPR FSAR includes the following COL Item in Section 11.3.3.5:

> 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.

The COL Item is addressed as follows:

~~{The maximum liquid effluent release concentrations provided in U.S. EPR FSAR Table 11.2-7 were calculated using a conservatively low dilution flow of 9000 gpm. As described in Section 11.2.3.3, the discharge flow rate for CCNPP Unit 3 is 21,019 gpm. Therefore, the resulting liquid effluent release concentrations for CCNPP Unit 3 are bounded by those reported in U.S. EPR FSAR Table 11.2-7 and are thereby less than the limits of 10 CFR Part 20, Appendix B, Table 2.}~~

{The annual average concentrations of radioactive materials released in gaseous effluents to the discharge point have been determined by multiplying the annual gaseous effluent release rates (Ci/yr) as calculated using the GALE (NRC, 1985) code and presented in U.S. EPR FSAR Table 11.3-3, by the maximum annual average site boundary dispersion factor of 1.076E-06 sec/m^3.

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 11.3-18 presents the results of this comparison. For the annual average radionuclide release concentrations for expected releases, the sum of the fractions of the effluent concentration limits is 0.004, which is well below the allowable value of 1.0.

Average gaseous 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. 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 other isotopes is conservatively adjusted upward by a factor of 1,000. The results of the design basis case are also presented in Table 11.3-18. For the annual average radionuclide release concentrations for design basis (one percent failed fuel) releases, the sum of the fractions of the effluent concentration limits is 0.02, which is well below the allowable value of 1.0.}

FSAR Section 11.3.4 is being revised as follows (only the impacted portions are shown):

11.3.4 Gaseous Waste Management System Cost-Benefit Analysis

. . .

If it is conservatively assumed that each radwaste system augment is a "perfect" technology that would reduce the effluent dose by 100 percent, the annual cost of the augment can be determined and the lowest annual cost can be considered a threshold value. The lowest cost option for the gaseous radwaste treatment system was determined to be the steam generator flash tank vent to main condenser augment at $6,650 per year. Dividing this cost by $1000 per person-rem results in a threshold value of 6.65 person-rem total body or thyroid dose from ~~liquid~~ gaseous effluents.

Population dose impacts within a 50 mile radius of the CCNPP site are listed in Table 11.3-8. The input parameters used in calculating the population doses are provided in Table 11.3-2 and Tables 11.3-9 through 11.3-17. As shown by the results in Table 11.3-8, the total body and thyroid population doses for ~~liquid~~ gaseous effluents are lower than the threshold value of 6.65 person-rem. It is therefore concluded that no further cost-benefit analysis is needed to demonstrate compliance with 10 CFR Part 50, Appendix I, Section II.D.}

FSAR Section 11.3.5 is being revised as follows (only the impacted portion is shown):

11.3.5 References

{**CCNPP, 2005.** "Land Use Census around Calvert Cliffs Nuclear Power Plant," Calvert Cliffs Nuclear Power Plant, August, 2005.

DEDO, 2000. Delaware Population Projection Series, Delaware Economic Development Office, Website: www.state.de.us.dedo/information/demographic_data/population.dpc1.shtml, Date accessed: June 22, 2007.

MDP, 2005. Historical and Projected Total Population for Maryland's Jurisdictions, Maryland Department of Planning, September 2005, Website: www.mdp.state.md.us/msdc/dw_popproj.htm, June 22, 2007.

NEI, 2009. NEI 08-08A, Generic FSAR Template Guidance for Life Cycle Minimization of Contamination, Revision 0, Nuclear Energy Institute, October 2009.

NRC, 1976. Regulatory Guide 1.110, Cost-Benefit Analysis for Radwaste Systems for Light Water-Cooled Nuclear Power Reactors (For Comment), Nuclear Regulatory Commission, March, 1976.

NRC, 1985. 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.

FSAR Table 11.3-2 is being revised as follows:

Table 11.3-2 - {Gaseous Pathway Parameters}

Parameter Description	Value
Growing season, fraction of year (April – October)[(1)]	0.583
Fraction time animals on pasture per year	0.583
Intake from Pasture when on Pasture	1.0
Fraction of the maximum individual's vegetable intake that is from his own garden	0.76
Absolute Humidity, g/m^3	8.4
50-mile Population Distribution	Table 11.3-9
50-mile distribution of normal effluent undecayed/undepleted ~~χ/Q values~~ atmospheric dispersion factors [(2)]	Table ~~2.3-86~~ 11.3-10
50-mile distribution of normal effluent ~~gamma χ/Q values~~ decayed/undepleted atmospheric dispersion factors [~~(2)~~ (3)]	Table ~~2.3-92~~ 11.3-10
50-mile distribution of normal ~~bounding~~ effluent decayed/depleted atmospheric dispersion factors [~~(2)~~ (4)]	Table 11.3-10
50-mile distribution of normal effluent deposition (D/Q) values	Table 2.3-94 – Table 2.3-95
Milk Production within 50 mi (kg/yr)[~~(3)~~ (5)]	Table 11.3-11
Meat Production within 50 mi (kg/yr)[~~(3)~~ (5)]	Table 11.3-14
Vegetable/Grain Production within 50 mi (kg/yr)[~~(3)~~ (5)]	Table 11.3-17

Notes:

1. The growing season is the span of months when the temperature is above freezing for all days during the month. Based on local climatological data, this occurs from April through October. (NOAA, 2002)
2. A bounding set of dispersion factors (see Table 11.3-10) representing the more limiting (i.e., higher) value of the undecayed/undepleted χ/Q (Tables 2.3-85 and Table 2.3-86) and gamma χ/Q (Table 2.3-91 and Table 2.3-92) for each distance and sector is used as a bounding input to the GASPAR II population dose input file for the undecayed/undepleted atmospheric dispersion factors~~, decayed/undepleted atmospheric dispersion factors, decayed/depleted atmospheric dispersion factors~~. This approach is conservative ~~since no credit is taken for either decay or depletion~~ as it results in a bounding dose estimate.
3. A bounding set of dispersion factors (see Table 11.3-10) representing the more limiting (i.e., higher) value of the undecayed/undepleted χ/Q (Table 2.3-85 and Table 2.3-86) and gamma χ/Q (Table 2.3-91 and Table 2.3-92) for each distance and sector is used as a bounding input to the GASPAR II population dose input file for the decayed/undepleted atmospheric dispersion factors. This approach is conservative since no credit is taken for either decay, resulting in a conservative dose estimate.
4. A bounding set of dispersion factors (see Table 11.3-10) representing the more limiting (i.e., higher) value of the undecayed/undepleted χ/Q (Table 2.3-85 and Table 2.3-86) and gamma χ/Q (Table 2.3-91 and Table 2.3-92) for each distance and sector is used as a bounding input to the GASPAR II population dose input file for the decayed/depleted atmospheric dispersion factors. This approach is conservative since no credit is taken for either decay or depletion, resulting in a conservative dose estimate.

~~3.~~ 5. Data for 50-mile food and crop production obtained from the U.S. Department of Agriculture statistics for Delaware, Maryland, and Virginia, the states within 50 miles of CCNPP. (USDA, 2002)

FSAR Table 11.3-5 is being revised as follows:

Table 11.3-5 – {Detailed Dose Commitment Results By Age Group and Organs Due to Gaseous Effluent Releases}

Pathway	Total Body (mrem/yr)	GI-Tract (mrem/yr)	Bone (mrem/yr)	Liver (mrem/yr)	Kidney (mrem/yr)	Thyroid (mrem/yr)	Lung (mrem/yr)	Skin (mrem/yr)
Plume (0.88 mi SE)[3]	2.24E-01							2.11E+00
Ground (0.86 mi S)[3]	1.67E-03	1.67E-03	1.67E-03	1.67E-03	1.67E-03	1.67E-03	1.67E-03	1.96E-03
Inhalation (0.88 mi SE)[3]								
Adult	4.42E-03	4.43E-03	7.55E-05	4.44E-03	4.46E-03	1.01E-02	4.48E-03	4.41E-03
Teen	4.47E-03	4.47E-03	9.21E-05	4.49E-03	4.51E-03	1.17E-02	4.55E-03	4.45E-03
Child	3.95E-03	3.94E-03	1.12E-04	3.97E-03	3.99E-03	1.26E-02	4.02E-03	3.93E-03
Infant	2.27E-03	2.26E-03	5.90E-05	2.30E-03	2.30E-03	1.02E-02	2.32E-03	2.26E-03
Vegetables (0.98 mi SE)[3]								
Adult	4.09E-02	4.09E-02	1.85E-01	4.08E-02	4.08E-02	1.50E-01	4.02E-02	4.01E-02
Teen	6.48E-02	6.48E-02	3.04E-01	6.50E-02	6.50E-02	2.10E-01	6.40E-02	6.39E-02
Child	1.51E-01	1.50E-01	7.33E-01	1.51E-01	1.51E-01	4.27E-01	1.50E-01	1.49E-01
Vegetables (0.88 mi SE)[1]								
Adult	5.05E-02	5.06E-02	2.30E-01	5.05E-02	5.05E-02	1.91E-01	4.96E-02	4.96E-02
Teen	8.02E-02	8.01E-02	3.77E-01	8.04E-02	8.04E-02	2.67E-01	7.91E-02	7.90E-02
Child	1.87E-01	1.86E-01	9.08E-01	1.87E-01	1.87E-01	5.42E-01	1.85E-01	1.85E-01
Milk (0.88 mi SE)~~[2]~~[1]								
Adult	2.45E-02	2.37E-02	9.38E-02	2.49E-02	2.46E-02	1.68E-01	2.36E-02	2.35E-02
Teen	4.17E-02	4.08E-02	1.73E-01	4.30E-02	4.25E-02	2.69E-01	4.07E-02	4.05E-02
Child	9.50E-02	9.39E-02	4.23E-01	9.79E-02	9.68E-02	5.47E-01	9.39E-02	9.36E-02
Meat (0.88 mi SE)[3]								
Adult	1.79E-02	1.80E-02	8.39E-02	1.79E-02	1.79E-02	2.21E-02	1.78E-02	1.78E-02
Teen	1.48E-02	1.49E-02	7.09E-02	1.48E-02	1.48E-02	1.79E-02	1.48E-02	1.48E-02
Child	2.74E-02	2.74E-02	1.33E-01	2.74E-02	2.74E-02	3.20E-02	2.74E-02	2.74E-02
Totals[2,3]								
Adult	2.26E-01	6.50E-02	2.71E-01	6.48E-02	6.48E-02	1.84E-01	6.42E-02	2.11E+00
Teen	2.26E-01	8.58E-02	3.77E-01	8.60E-02	8.60E-02	2.41E-01	8.50E-02	2.11E+00
Child	2.26E-01	1.83E-01	8.68E-01	1.84E-01	1.84E-01	4.73E-01	1.83E-01	2.11E+00
Infant	2.26E-01	3.93E-03	1.73E-03	3.97E-03	3.97E-03	1.19E-02	3.99E-03	2.11E+00

Notes:

1. Doses for hypothetical individual located at the maximum site boundary location (SE, 0.88 mi) for 40 CFR 190 compliance in Table 11.2-5. Values for the hypothetical individual are not included in the total.
2. Totals for total body and skin are external doses from the plume and the ground plane (i.e., they do not include inhalation or ingestion pathways).
3. Doses represent the dose to the maximally exposed individual (MEI) or nearest resident, who is assumed to reside at the limiting site boundary and consume meat from cattle raised at the site boundary and vegetables grown at the nearest garden at 0.98 miles SE.

FSAR Table 11.3-6 is being revised as follows:

Table 11.3-6 – {Gaseous Pathway Doses for Maximally Exposed Individuals (MEI)[(1)(2)]}

Location	Pathway	Total Body (mrem/yr)	Max Organ (Bone) (mrem/yr)	Thyroid (mrem/yr)	Skin (mrem/yr)
Site Boundary					
0.88 mi SE	Plume	2.24E-01			2.11E+00
0.86 mi S	Ground Plane	1.67E-03	1.67E-03	1.67E-03	1.96E-03
0.88 mi SE	Inhalation				
	Adult	4.42E-03	7.55E-05	1.01E-02	4.41E-03
	Teen	4.47E-03	9.21E-05	1.17E-02	4.45E-03
	Child	3.95E-03	1.12E-04	1.26E-02	3.93E-03
	Infant	2.27E-03	5.90E-05	1.02E-02	2.26E-03
Nearest Garden	Vegetable				
0.98 mi SE	Adult	4.09E-02	1.85E-01	1.50E-01	4.01E-02
	Teen	6.48E-02	3.04E-01	2.10E-01	6.39E-02
	Child	1.51E-01	7.33E-01	4.27E-01	1.49E-01
Nearest Beef	Meat				
0.88 mi SE	Adult	1.79E-02	8.39E-02	2.21E-02	1.78E-02
	Teen	1.48E-02	7.09E-02	1.79E-02	1.48E-02
	Child	2.74E-02	1.33E-01	3.20E-02	2.74E-02

Note:

1. Results for milk ingestion are not presented as there are no milk producing animals for human consumption within 5 miles. Nearest meat animal assumed to be at limiting site boundary location since actual location of animals within 5 miles is not available (CCNPP, 2005).
2. Doses represent the dose to the maximally exposed individual (MEI) or nearest resident, who is assumed to reside at the limiting site boundary consume meat from cattle raised at the site boundary and vegetables grown at the nearest garden at 0.98 miles SE.

FSAR Table 11.3-18 is being added as follows:

Table 11.3-18 - {Comparison of Annual Average Gaseous Release Concentrations with 10 CFR Part 20 Concentration Limits}
(Page 1 of 2)

Nuclide	10CFR20 App. B, Table 2, Col. 1 Effluent Conc. (µCi/ml)	Site Boundary Concentration (µCi/ml)		Fraction of Allowable 10CFR20 App. B, Table 2, Col. 1 Concentration	
		Expected Releases	Releases for Maximum Fuel Defect	Normal Releases	Releases for Maximum Fuel Defect
H-3	1E-07	6.14E-12	2.45E-11	6.14E-05	2.45E-04
C-14	3E-09	2.49E-13	2.49E-13	8.30E-05	8.29E-05
Ar-41	1E-08	1.16E-12	1.16E-12	1.16E-04	1.16E-04
I-131	2E-10	3.00E-16	1.07E-14	1.50E-06	5.37E-05
I-133	1E-09	1.09E-15	1.80E-14	1.09E-06	1.80E-05
Kr-85m	1E-07	5.46E-12	1.54E-11	5.46E-05	1.54E-04
Kr-85	7E-07	1.16E-09	9.00E-10	1.66E-03	1.29E-03
Kr-87	2E-08	1.91E-12	3.34E-12	9.55E-05	1.67E-04
Kr-88	9E-09	6.48E-12	1.84E-11	7.20E-04	2.04E-03
Xe-131m	2E-06	1.19E-10	1.07E-10	5.97E-05	5.37E-05
Xe-133m	6E-07	6.48E-12	9.68E-11	1.08E-05	1.61E-04
Xe-133	5E-07	2.93E-10	7.41E-09	5.87E-04	1.48E-02
Xe-135m	4E-08	5.12E-13	6.26E-13	1.28E-05	1.57E-05
Xe-135	7E-08	4.09E-11	1.29E-10	5.85E-04	1.84E-03
Xe-137	1E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-138	2E-08	4.09E-13	4.35E-13	2.05E-05	2.17E-05
Cr-51	3E-08	3.31E-18	3.31E-18	1.10E-10	1.10E-10
Mn-54	1E-09	1.94E-18	1.95E-18	1.94E-09	1.95E-09
Co-57	9E-10	2.80E-19	2.80E-19	3.11E-10	3.11E-10
Co-58	1E-09	1.64E-17	1.64E-17	1.64E-08	1.64E-08
Co-60	5E-11	3.75E-18	3.76E-18	7.51E-08	7.51E-08
Fe-59	5E-10	9.55E-19	9.55E-19	1.91E-09	1.91E-09
Sr-89	2E-10	5.46E-18	5.46E-15	2.73E-08	2.73E-05
Sr-90	6E-12	2.15E-18	2.15E-15	3.58E-07	3.59E-04
Zr-95	4E-10	3.41E-19	3.41E-16	8.53E-10	8.53E-07
Nb-95	2E-09	1.43E-18	1.43E-15	7.17E-10	7.16E-07

Table 11.3-18 - {Comparison of Annual Average Gaseous Release Concentrations with 10 CFR Part 20 Concentration Limits}

(Page 2 of 2)

Nuclide	10CFR20 App. B, Table 2, Col. 1 Effluent Conc. (µCi/ml)	Site Boundary Concentration (µCi/ml)		Fraction of Allowable 10CFR20 App. B, Table 2, Col. 1 Concentration	
		Expected Releases	Releases for Maximum Fuel Defect	Normal Releases	Releases for Maximum Fuel Defect
Ru-103	9E-10	5.80E-19	5.80E-16	6.44E-10	6.44E-07
Ru-106	2E-11	2.66E-20	2.66E-17	1.33E-09	1.33E-06
Sb-125	7E-10	2.08E-20	2.08E-17	2.97E-11	2.97E-08
Cs-134	2E-10	1.64E-18	1.64E-15	8.19E-09	8.18E-06
Cs-136	9E-10	1.13E-18	1.13E-15	1.25E-09	1.26E-06
Cs-137	2E-10	3.07E-18	3.07E-15	1.54E-08	1.53E-05
Ba-140	2E-09	1.43E-19	1.43E-16	7.17E-11	7.16E-08
Ce-141	8E-10	4.44E-19	4.43E-16	5.54E-10	5.54E-07
		Sum of Fractions:		4.07E-03	2.15E-02

FSAR Section 11.4.3 is being revised as follows (only the impacted portion is shown):

11.4.3 Radioactive Effluent Releases

. . .

In the event that no offsite disposal facility is available to accept Class B and C waste from CCNPP Unit 3 when it commences operation, additional waste minimization measures could be implemented to reduce or eliminate the generation of Class B and C waste. These measures include: reducing the service run length for resin beds; short loading media volumes in ion exchange vessels; and other techniques discussed in the EPRI Class B/C Waste Reduction Guide (~~Nov. 2007~~ EPRI, 2007a) and EPRI Operational Strategies to Reduce Class B/C Wastes (~~April 2007~~ EPRI, 2007b). These measures would extend the capacity of the Solid Waste Storage System to store Class B and C waste to over ten years. This would provide additional time for offsite disposal capability to be developed or additional onsite capacity to be added. Continued storage of Class B and C waste in the Solid Waste Storage System would be in accordance with procedures that maintain occupational exposures within permissible limits and result in no additional environmental impacts.

FSAR Section 11.4.7 is being revised as follows:

11.4.7 References

{**EPRI, 2007a.** "Waste Class B/C Reduction Guide," Electric Power Research Institute, 2007.

EPRI 2007b. "Operational Strategies to Reduce Class B/C Wastes," Electric Power Research Institute, 2007.

NEI, 2009a. NEI 07-10A, "Generic FSAR Template Guidance for Process Control Program (PCP)", Nuclear Energy Institute, March, 2009.

{**NEI, 2009b.** NEI 08-08A, Generic FSAR Template Guidance for Life Cycle Minimization of Contamination, Revision 0, Nuclear Energy Institute, October 2009.}