Greg Gibson
Vice President, Regulatory Affairs

750 East Pratt Street, Suite 1600
Baltimore, Maryland 21202

UniStar
NUCLEAR ENERGY

10 CFR 50.4
10 CFR 52.79

November 16, 2010

UN#10-287

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 254, Liquid Waste Management, and
RAI 255, Gaseous Waste Management

References:

1) Surinder Arora (NRC) to Robert Poche (UniStar Nuclear Energy), "FINAL RAI 254 CHPB 4782" email dated August 3, 2010

2) Surinder Arora (NRC) to Robert Poche (UniStar Nuclear Energy), "FINAL RAI 255 CHPB 4819" email dated August 3, 2010

3) UniStar Nuclear Energy Letter UN#10-280, from Greg Gibson to Document Control Desk, U.S. NRC, Submittal of Response to RAI 254, Liquid Waste Management, and RAI 255, Gaseous Waste Management, dated November 12, 2010

4) UniStar Nuclear Energy Letter UN#10-275, from Greg Gibson to Document Control Desk, U.S. NRC, Submittal of Advance Copy of Part 3 to the Combined License Application for the Calvert Cliffs Nuclear Power Plant, Unit 3, dated November 1, 2010

The purpose of this letter is to respond to the requests for additional information (RAI) identified in the NRC e-mail correspondence to UniStar Nuclear Energy, dated August 3, 2010 (References 1 and 2). These RAIs address Liquid Waste Management and Gaseous Waste Management, 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 6.

D096
NRO

Reference 3 provided a November 16, 2010 schedule for the response date for RAI 254, Question 11.02-3 and RAI 255, Question 11.03-2. The enclosure provides our responses to RAI 254, Question 11.02-3 and RAI 255, Question 11.03-2, and includes revised COLA content. COLA FSAR Table 1.8-2 and Sections 11.2 through 11.5 have also been revised to incorporate new COL Items included in U.S. EPR FSAR Chapter 11, Revision 2. Incorporation of these new FSAR Chapter 11 COL Items is provided to assist in the review and results in more extensive changes to the COLA FSAR than would be required to respond solely to the RAI 254 and RAI 255 questions. A Licensing Basis Document Change Request has been initiated to incorporate these changes into a future revision of the COLA.

Reference 4 stated that the Environmental Report (ER) related changes resulting from responses to RAI 254 and RAI 255 would be provided under separate cover with the RAI 254 and RAI 255 responses. The ER-related changes resulting from the RAI 254 and RAI 255 responses will be provided to the NRC by December 15, 2010.

Our responses do 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 November 16, 2010

Greg Gibson

Enclosure: Response to NRC Request for Additional Information, RAI 254, Question 11.02-3 and RAI 255, Question 11.03-2, 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)
Loren Plisco, 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 Summary for Request for Additional Information RAI 254, Question 11.02-3 and RAI 255, Question 11.03-2, Calvert Cliffs Nuclear Power Plant Unit 3

RAI 254

Question 11.02-3

Supplemental question to the response of RAI 209, Question 11.02-1

In the response dated April 24, 2010, the applicant provides information 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 site-specific dose assessment for liquid effluent releases to the Chesapeake Bay, a cost-benefit analysis, and a revision to the departures and exemption reports (Part 7 of the application).

The additional information appears generally acceptable, but the staff was unable to independently confirm some of the dose results, approach and results used in the cost-benefit analysis, and noted a number of inconsistencies in the presentation of the new information and proposed revisions to the FSAR, given the concerns identified in RAI 209, Questions 11.02-1(1) and 11.02-1(2). The response to RAI 209, Question 11.02-1(3) addressing a revision of FSAR Section 2.1.1.3, as it relates to FSAR Section 11.2 and compliance with 10 CFR 20.1301 and 20.1302 and Part 50 Appendix I, appears acceptable.

Based on the staff's review of responses to RAI 209, Questions 11.02-1(1) and 11.02-1(2), the applicant is requested to address the following items in the proposed revision of FSAR Section 11.2 and Part 7:

A. FSAR Sections 11.2.3.3

Provide the appropriate FSAR references (sections or tables) supporting the basis for the:

1. blowdown discharge rate of 21,008 gallons per minute (gpm) (79,500 liters per minute) and liquid waste management system discharge flow rate of 11 gpm (41.6 L/min).
2. dilution factors of 13.3 for fish and invertebrates, 58 for swimming and shoreline exposures, and 296 for desalinization of brackish water to create drinking water.
3. distance of 550 ft (168 m) as the offshore location of the diffuser discharge point.

B. FSAR Section 11.2.3.4.1

In the discussion justifying the exclusion of irrigation as an exposure pathway because of the brackish nature of the Chesapeake Bay, confirm whether this is the case for drinking water within the flow and tidal flux of the Chesapeake Bay that might be drawn and impacted by discharges from the proposed plant.

The information presented in FSAR 11.2.3.4.1 and supporting text do not discuss, nor reference the results of a land-use census and how its results were justified for the analysis presented in FSAR Section 11.2.3.4. The applicant is requested to provide information supporting the selection of the applied offsite dose receptors and exposure pathways and provide a reference for a land-use census.

C. FSAR Section 11.2.3.5

The text states that liquid effluent releases comply with 10 CFR Part 20, Appendix B, Table 2 limits, but does not provide results demonstrating that conclusion. The discussion relies on the results presented in U.S. EPR FSAR Table 11.2-7 as supporting documentation. It should be noted that the results presented in U.S. EPR FSAR Table 11.2-7 are based on a different set of assumptions applied to a hypothetical site. Consequently, these results and underlying assumptions do not apply to the CCNPP-3 plant and site-specific conditions. The applicant is requested to provide site-specific information demonstrating compliance with 10 CFR Part 20, Appendix B, Table 2, Column 2 limits for liquid effluents and unity-rule for the sum-of-the-ratios for discharges associated with normal operation and maximum fuel defects.

D. FSAR Table 11.2-1

Include a footnote providing the basis of the stated shoreline, swimming, and boating usage times of 200, 100, and 200 hrs per year, respectively.

E. FSAR Table 11.2-2

Based on an independent analysis of dose results presented in FSAR Table 11.2-2, the staff confirmed the results for all but the potable exposure pathway. For potable water, the staff's results for the thyroid are about a factor of 1.8 times higher for all four age groups, while in agreement for all other organs.

F. FSAR Table 11.2-3

In FSAR Table 11.2-3, a third line entry should be added to include the thyroid dose and identify the corresponding limiting age group.

G. FSAR Table 11.2-4

In FSAR Table 11.2-4, provide references for the stated historical whole body, thyroid, and maximum organ doses for CCNPP Units 1 and 2 in confirming compliance with 40 CFR Part 190 for the entire site with all three CCNPP units.

H. FSAR Table 11.2-5

Confirm and correct accordingly the following observations for the footnotes cited in FSAR Table 11.2-5:

1. For footnote 1, confirm that table citations should be FSAR Tables 11.2-2 and 11.2-3 and not Tables 11.2-6 and 11.2-7.

2. For footnotes 3 and 4, provide FSAR table citations for the stated sector and boundary distances from the site.

3. Staff comments on results characterizing doses from gaseous effluents presented in this table will be addressed as part of the review of the applicant's response to RAI 210, Question 11.03-1.

I. FSAR Tables 11.2-6, 11.2-7, 11.2-8, and 11.2-9

For the information supporting the results of the cost-benefit analysis (CBA), confirm and correct accordingly the following observations on results and footnotes presented in FSAR Tables 11.2-6, 11.2-7, 11.2-8, and 11.2-9 and supporting FSAR text:

1. Based on a review of U.S. EPR FSAR Section 11.2-3, the derivation of the liquid effluent source term considers the use of an evaporator, centrifuge, and demineralizer in treating liquid wastes before being released to the environment. A review of CCNPP-3 FSAR Section 11.2.4 and Table 11.2-6 (footnotes 1 and 2) indicates that the descriptions of the reference and alternate configurations used in the CBA seem to be reversed in their applications. As described, the alternate configuration appears to use the current design features of the liquid waste management system.

2. For population dose results that reflect shoreline, boating, and swimming activities, provide in FSAR Table 11.2-7 the values assumed in the LADTAP II code for transient times for each mode of exposure.

3. In CCNPP-3 FSAR Table 11.2-7, confirm that the citation of Table 11.2-4 (column headed "Value") should be corrected to reflect that the corresponding information instead is in U.S. EPR FSAR Section 11.2. As presented, the entry implies that the GALE normal operation source term can be found in CCNPP-3 FSAR Table 11.2-4, which is not correct.

4. A review of the population dose results presented in CCNPP-3 FSAR Table 11.2-8 indicates that the estimated doses assigned to the case where an additional demineralizer is used is the base case and not the alternate case. The staff's evaluation confirmed that the projected population doses of 0.105 total body person–rem and 0.199 thyroid person-rem reflect the base case configuration of the liquid waste management system as described in U.S. EPR FSAR Section 11.2.3 and Table 11.2-7 using the normal operation source term. In FSAR Table 11.2-8, the results for the case without a demineralizer, the population doses are 0.159 total body person–rem and 0.625 thyroid person-rem. If the CBA analysis were to assume a system augmentation with another demineralizer added to the basic system design features, the resulting population doses would be expected to be lower than the base case of 0.105 total body person–rem and 0.199 thyroid person-rem. The applicant is requested to address this inconsistency in formulating the conditions and parameters applied to the base and alternate cases.

5. Based on a review of the CBA assumptions listed in FSAR Table 11.2-9, the staff was unable to confirm the assumed total cost of $296,000 for the system augmentation using 30 years for operation and maintenance. Based on the information presented in Regulatory Guide 1.110 and applied to the least costly demineralizer option (rated at 50 gpm), the staff used a direct cost of $72,000 (RG 1.110,Table A-1), an operating cost of $5,000 per year (RG 1.110, Table A-2), and a maintenance cost of $5,000 per year (RG 1.110, Table A-3). The total cost is estimated to be $372,000, derived as: $72,000 + [($5,000 + $5,000) x 30].

6. In determining whether the system augmentation complies with Section II.D of Appendix I to 10 CFR Part 50, the methodology applied a process other than described in RG 1.110, Regulatory Position C.5 and Appendix A, while stating in FSAR Section 11.2.4.2

that the method applies RG 1.110. The applicant is requested to describe the equivalency of the method applied in the CCNPP-3 FSAR.

J. Departures and Exemption Report (FSAR Part 7)

For the proposed revisions to Section 1.1.X (Liquid Effluent Discharge Design) and Section 1.1.Y (Estimated Doses for Liquid and Gaseous pathways) of the departures and exemption report, the applicant is requested to address and resolve the following observations:

1. In light of the above, the applicant is requested to update the proposed revisions to the Departure Report Section 1.1.X (Liquid Effluent Discharge Design) and Section 1.1.Y (Estimated Doses for Liquid and Gaseous pathways) of the departures and exemption report to reflect the disposition and closure of the above observations.
2. In Departure Report Sections 1.1.X and 1.1.Y, the applicant should refer the regulatory methodology and process applied in screening out the proposed departures in concluding that the changes do not adversely affect any safety-related system or safety-related portion of a system and does not conflict with applicable regulatory guidance.

In Departure Report Section 1.1.Y, the applicant states that doses to maximally exposed individuals from liquid and gaseous effluents are conservative and "bounding for all sites" based on the information presented in U.S. EPR FSAR Sections 11.2.3.4 and 11.3.3.4. This conclusion is incorrect since the assumptions and parameters used in U.S. EPR FSAR Sections 11.2 and 11.3 in assessing doses to maximally exposed individuals and populations rely on characteristics assigned to a hypothetical site and the U.S. EPR FSAR does not present a comparative evaluation of its hypothetical site parameters against the characteristics of potential candidate sites.

Response

Part A

A physical description of the cooling water discharge system is provided in COLA FSAR Section 10.4.5.

Design analyses indicate that the average effluent discharge flow rate from the seal well for normal operating conditions is 21,019 gpm and the average flow rate for treated liquid radwaste effluent is 11 gpm. The difference in these two values results in an average discharge flow rate of 21,008 for waste streams other than treated liquid radwaste.

The liquid effluent dilution factors were based on a study using the 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 distance of 550 ft as the offshore location of the diffuser discharge point can be found in COLA FSAR Sections 2.4.7.3, 2.4.11.1 and 10.4.5.2.2.

Part B

The potential use of the Chesapeake Bay as a source of plant makeup water, including use as a potable water source onsite, has been considered in assessing the possible dose impact from liquid effluents. A desalinization plant using filtration and reverse osmosis (RO) treatment is the selected option for providing purified water to CCNPP Unit 3. As such, the impact from recirculating radioactive effluents discharged from the plant back to the shoreline cooling water intakes could result in internal exposures from drinking water created by this treatment of Chesapeake Bay water. The doses associated with the ingestion of potable water are included in COLA FSAR Table 11.2-2.

The calculation of liquid effluent dose which is reported in the COLA FSAR did not utilize land use census information. Rather, the inputs and assumptions are conservatively selected to represent a bounding condition for all pathways. These bounding parameters consist of including potential exposure pathways which could exist at the site, minimum near field and far field dilution credits and bounding usage factors.

Part C

The following equation is used to calculate the expected concentration of liquid effluent at the plant discharge point that are used in demonstrating compliance with the concentration limits of 10 CFR Part 20, Appendix B, Table 2:

$$C(i) = \frac{R(i) \times CF}{D \times C_{ap}}$$

Where:

$C(i)$ = concentration at the plant discharge of the ith isotope (μCi/ml)
$R(i)$ = total annual release rate of the ith isotope (Ci/yr) from the GALE output
D = dilution flow rate (gpm)
C_{ap} = capacity factor = 0.80
CF = conversion factor

$$CF = (1E6\ \mu Ci/Ci) \times (1\ yr/5.259E5\ min) \times (1.0\ gal/3785\ ml) = 5.024E\text{-}4\ \frac{(\mu Ci)(year)(gallon)}{(Ci)(min)(ml)}$$

The single parameter in the above formula that would differ between the U.S. EPR FSAR analysis and the COLA FSAR analysis is the dilution flow rate (D) used in calculating the discharged liquid effluent concentrations. As identified in U.S. EPR FSAR Section 11.2.3.5, the dilution flow rate used in the analysis is a conservatively low value of 9000 gpm as compared to the site-specific discharge flow rate for CCNPP Unit 3 of 21,019 gpm. Since the calculation of the off-site liquid effluent concentrations involves dividing by this parameter, calculations using the lower dilution flow rate of 9000 gpm would result in higher and thus, conservative discharge concentrations as compared to calculations using the higher site-specific discharge flow rate. Therefore, the U.S. EPR FSAR analysis is incorporated by reference, as it is a bounding analysis. A sample calculation is provided below for H-3 using the expected release concentration to demonstrate this conclusion.

Using the U.S. EPR FSAR dilution flow rate of 9000 gpm:

$$C(H\text{-}3) = 1660\ Ci/yr \times 5.024E\text{-}04\ \frac{(\mu Ci)(year)(gallon)}{(Ci)(min)(ml)} \times \frac{1}{9000gpm} \times \frac{1}{0.8} = 1.2E\text{-}04\ \mu Ci/ml$$

Using the site-specific dilution flow rate of 21,019 gpm:

$$C(H\text{-}3) = 1660\ Ci/yr \times 5.024E\text{-}04\ \frac{(\mu Ci)(year)(gallon)}{(Ci)(min)(ml)} \times \frac{1}{21{,}019gpm} \times \frac{1}{0.8} = 5.0E\text{-}05\ \mu Ci/ml$$

Part D

The following footnote(s) are being added to COLA FSAR Table 11.2-1, providing the basis for the stated usage values:

1) The shoreline usage values used in the maximum exposed individual (MEI) dose calculation are conservative compared to the default values cited in Regulatory Guide 1.109, Table E-5.

2) The usage values for swimming and boating were selected to bound data for actual usage values for the population within the site vicinity (See COLA FSAR Table 11.2-6).

Part E

The LADTAP II dose conversion factors were used in the calculation of the dose from potable water. Initially, it was thought that the difference noted was a result of the difference in dose conversion factors between those provided in Regulatory Guide 1.109 and those used by the LADTAP II code. The table below provides a comparison of the dose conversion factors for H-3, which is the nuclide providing the highest dose contributors to the child, thyroid dose. The ratio of the dose conversion factor correlates with the difference in doses that were observed by the staff.

Nuclide	Child, Thyroid Ingestion Dose Conversion Factors		Ratio (R.G. 1.109/LADTAP II)
	R.G. 1.109	LADTAP II	
H-3	2.03E-07	1.16E-07	1.75

However, during discussion with the NRC on September 13, 2010, it was communicated that the NRC used the NRCDose code, which uses the LADTAP II dose conversion factors. UniStar was able to reproduce the thyroid dose results using the NRCDose code. Therefore, it is unclear what would cause the difference in thyroid dose as observed by the staff.

Part F

The maximum thyroid dose is being added to COLA FSAR Table 11.2-3 along with the corresponding limiting age group.

Part G

A footnote is being added to COLA FSAR Table 11.2-4 stating that the historical whole body, thyroid, and maximum organ doses for CCNPP Units 1 and 2 were obtained from the annual radiological environmental operating reports for the years 2000-2009.

Part H

COLA FSAR Table 11.2-5 footnote 1 is being corrected to cite FSAR Tables 11.2-2 and 11.2-3, instead of FSAR Tables 11.2-6 and 11.2-7. A reference to Table 11.3-1 is being added to FSAR Table 11.2-5, footnotes 3 and 4, to indicate the source of the stated sector and boundary distances from the site.

Part I

This response, the associated mark-up to the FSAR Section 11.2.4, and the associated tables, supersede the response and associated mark-ups dealing with the liquid waste management cost-benefit evaluation provided in the response to RAI 209[1]:

The cost benefit evaluation has been revised to follow the approach described in Regulatory Guide 1.110 and to assess all possible liquid radwaste system augments. FSAR Section 11.2 has been updated accordingly. The total annual costs of all potential liquid radwaste system augments listed in Regulatory Guide 1.110 were determined and compared against the site-specific population doses in determining if any liquid radwaste system augments should be selected based on a favorable cost-benefit ratio. 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. Regulatory Guide 1.110 provides values in 1975 dollars and instructs that these values not be adjusted for inflation.

The following parameters used in determining the Total Annual Cost (TAC) for the cost-benefit analysis are fixed and are provided in Regulatory Guide 1.110 for each radwaste system augment: the Direct Cost of Equipment, Materials and Labor (Table A-1 of Regulatory Guide 1.110), the Annual Operating Cost (AOC) (Table A-2 of Regulatory Guide 1.110), and the Annual Maintenance Cost (AMC) (Table A-3 of Regulatory Guide 1.110). The following variable parameters were used in the cost-benefit analysis:

- Labor Cost Correction Factor (LCCF) – This factor accounts for the differences in relative labor costs between geographical regions and is taken from Table A-4 of Regulatory Guide 1.110. The lowest LCCF value of 1.0 was conservatively used in the analysis.

- Indirect Cost Factor (ICF) – This factor takes into account whether the radwaste system is unitized or shared (in the case of a multi-unit site) and is taken from Table A-5 of Regulatory Guide 1.110. A value of 1.75 was used for the ICF since the radwaste system for CCNPP Unit 3 is for a single unit site.

---

1 G. Gibson (UniStar Nuclear Energy) to Document Control Desk (U.S. NRC), "Responses to RAI No. 209, Liquid Waste Management System, and RAI No. 210, Gaseous Waste Management System," letter UN#10-103, dated April 14, 2010.

- Capital Recovery Factor (CRF) – This factor reflects the cost of money for capital expenditures. A cost-of-money value of 7% per year was assumed in the analysis, consistent with NUREG/BR-0058. From Table A-6 of Regulatory Guide 1.110, the corresponding CRF is 0.0806.

The annual costs associated with the liquid radwaste system augments are provided in Table 1. Table 1 shows that the lowest-cost option for liquid radwaste treatment system augments is a 20-gpm cartridge filter at $11,390 per year. Dividing this value by the dollar value for estimated impact of $1000 per person-rem results in a threshold value of 11.39 person-rem total body or thyroid dose from liquid effluents. Therefore, for U.S. EPR sites with population dose estimates less than 11.39 person-rem total body or thyroid dose from liquid effluents, no further cost-benefit analysis is needed to demonstrate compliance with 10 CFR Part 50, Appendix I, Section II.D. Since the total body and thyroid population doses for liquid effluents for CCNPP Unit 3 (0.168 and 0.712 person-rem, respectively) are a small fraction of the threshold dose of 11.39 person-rem, no further cost-benefit analysis is needed.

Part I – 1. Given the change in the methodology used to perform the cost-benefit analysis as discussed above, this question no longer applies.

Part I – 2. The values used for the transit times associated with the shoreline, boating and swimming exposure pathways in calculating the population dose are the LADTAP II default values. A footnote will be added to the table noting that other input values are LADTAP II default values. (Note that FSAR Table 11.2-7 is now FSAR Table 11.2-6 due to the change in the cost benefit evaluation.)

Part I – 3. The words "U.S. EPR FSAR" will be added prior to the citation of Table 11.2-4 in FSAR Table 11.2-7 to clarify the location for the GALE normal operation source term. (Note that FSAR Table 11.2-7 is now FSAR Table 11.2-6 due to the change in the cost benefit evaluation).

Part I – 4. Given the change in the methodology used to perform the cost-benefit analysis as discussed above, this question no longer applies.

Part I – 5. Given the change in the methodology used to perform the cost-benefit analysis as discussed above, this question no longer applies.

Part I – 6. Given the change in the methodology used to perform the cost-benefit analysis as discussed above, this question no longer applies.

Table 1: Annual Costs (1975 $1000) Associated with Liquid Radwaste System Augments

Equipment	Direct Costs[1]			Corrected Labor Cost[2]	Total Direct Cost[3]	Total Capital Cost[4]	Annual Fixed Cost[5]	Annual Operating Cost[6]	Annual Maintenance Cost[7]	Total Annual Cost[8]
	Equipment /Material	Labor	Total							
15-gpm Evaporator	386	201	587	201.00	587.00	1027.25	82.80	50	30	162.80
30-gpm Evaporator	540	223	763	223.00	763.00	1335.25	107.62	50	30	187.62
50-gpm Evaporator	655	233	888	233.00	888.00	1554.00	125.25	50	30	205.25
Evaporator Distillate Demineralizer	36	24	60	24.00	60.00	105.00	8.46	5	2	15.46
50-gpm Demineralizer	43	29	72	29.00	72.00	126.00	10.16	5	5	20.16
100-gpm Demineralizer	64	31	95	31.00	95.00	166.25	13.40	5	5	23.40
200-gpm Demineralizer	94	35	129	35.00	129.00	225.75	18.20	5	5	28.20
400-gpm Demineralizer	102	44	146	44.00	146.00	255.50	20.59	5	5	30.59
20-gpm Cartridge Filter	13	11	24	11.00	24.00	42.00	3.39	7	1	11.39
2-gpm Reverse Osmosis	100	38	138	38.00	138.00	241.50	19.46	7	9	35.46
10,000-gal Tank	55	43	98	43.00	98.00	171.50	13.82	1	2	16.82

[1] Direct Cost from Table A-1 of Regulatory Guide 1.110
[2] Corrected Labor Cost = Labor Cost x Labor Cost Correction Factor
[3] Total Direct Cost = Equipment/Material Cost + Corrected Labor Cost
[4] Total Capital Cost = Total Direct Cost x Indirect Cost Factor
[5] Annual Fixed Cost = Total Capital Cost x Capital Recovery Factor
[6] Annual Operating Cost from Table A-2 of Regulatory Guide 1.110
[7] Annual Maintenance Cost from Table A-3 of Regulatory Guide 1.110
[8] Total Annual Cost = Annual Fixed Cost + Annual Operating Cost + Annual Maintenance Cost

Part J

This response supersedes the response and associated mark-ups dealing with the Departures (Part 7 of the COLA) as provided in the response to RAIs 209 and 210[1].

COLA Part 7, Departures and Exemptions, uses a 10 CFR 50.59 approach in screening the proposed departures to conclude that changes do not adversely affect any safety-related portion of a system and do not conflict with applicable regulatory guidance.

The departures previously discussed in response to RAIs 209 and 210[1], as marked-up in COLA FSAR Chapter 11 and COLA Part 7, are no longer needed given the incorporation of the U.S. EPR FSAR Chapter 11, Revision 2 COL Items into COLA FSAR Chapter 11. The COL items are addressed in the attached FSAR mark-ups.

COLA Impact

FSAR Chapter 1 and Chapter 11, and COLA Part 10 impacts are provided in the response to RAI 255, Question 11.03-2 (this enclosure).

COLA Part 7, Departures and Exemption Requests, will be revised to remove the departures added in the response to RAIs 209 and 210[1] as follows:

1.1 DEPARTURES

This Departure Report includes deviations in the CCNPP Unit 3 COL application FSAR from the information in the U.S. EPR FSAR, pursuant to 10 CFR Part 52. The U.S. EPR Design Certification Application is currently under review with the NRC. However, for the purposes of evaluating these deviations from the information in the U.S. FSAR, the guidance provided in Regulatory Guide 1.206, Section C.IV.3.3, has been utilized.

The following Departures are described and evaluated in detail in this report:

. . .

~~X. Liquid Effluent Discharge Design~~

~~Y. Estimated Doses for Liquid and Gaseous Pathways~~

~~*(Note: The final numbering will be established when the information is added to the COLA)*~~

~~**1.1.X Liquid Effluent Discharge Design**~~

~~Affected U.S. EPR FSAR Sections: Tier 2, Section 11.2.3~~

~~**Summary of Departure:**~~

~~The U.S. EPR FSAR Section 11.2.3 describes that 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 U.S. EPR FSAR uses a conservative flow rate of 100 cfs with no further dilution when calculating doses from liquid effluents.~~

~~The CCNPP Unit 3 liquid effluent discharge design utilizes a waste water retention basin and a seal well. For the CCNPP Unit 3 liquid effluent discharge, the 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 approximately 21,008 gpm, resulting in a total average flow of 21,019 gpm for all liquid effluents discharged to the bay. Retention basin flow provides dilution flow to discharged treated liquid radwaste. 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 age 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.~~

~~**Scope/Extent of Departure:**~~

~~This Departure is identified in CCNPP Unit 3 FSAR Section 11.2.3.~~

~~**Departure Justification:**~~

~~The site-specific characteristics of the CCNPP Unit 3 site and the site-specific liquid effluent discharge design are presented where differences from the U.S. EPR FSAR exist. This Departure is acceptable because it meets the design objective of providing a monitored release path for treated liquid radwaste effluent. The change does not adversely affect any safety-related system or safety-related portion of a system, nor does it conflict with applicable regulatory guidance.~~

~~**Departure Evaluation:**~~

~~This Departure, associated with the CCNPP Unit 3 site-specific liquid effluent discharge design, does not:~~

1. ~~Result in more than a minimal increase in the frequency of occurrence of an accident previously evaluated in the plant-specific FSAR;~~
2. ~~Result in more than a minimal increase in the likelihood of occurrence of malfunction of a structure, system, or component (SSC) important to safety and previously evaluated in the plant-specific FSAR;~~

3. Result in more than a minimal increase in the consequences of an accident previously evaluated in the plant-specific FSAR;
4. Result in more than a minimal increase in the consequences of a malfunction of an SSC important to safety previously evaluated in the plant-specific FSAR;
5. Create a possibility for an accident of a different type than any evaluated previously in the plant-specific FSAR;
6. Create a possibility for a malfunction of an SSC important to safety with a different result than any evaluated previously in the plant-specific FSAR;
7. Result in a design basis limit for a fission product barrier as described in the plant-specific FSAR being exceeded or altered; or
8. Result in a departure from a method of evaluation described in the plant-specific FSAR used in establishing the design bases or in the safety analyses.

This Departure does not affect resolution of a severe accident issue identified in the plant-specific FSAR.

Therefore, this Departure has no safety significance.

1.1.Y Estimated Doses for Liquid and Gaseous Pathways

Affected U.S. EPR FSAR Sections: Tier 2, Section 11.2.3.4 and 11.3.3.4

Summary of Departure:

The U.S. EPR FSAR Sections 11.2.3.4 and 11.3.3.4 report doses to the maximally exposed individuals from liquid and gaseous effluents based on conservatively selected inputs and assumptions selected to be bounding for all sites.

The CCNPP Unit 3 calculations of dose to the maximally exposed individual from CCNPP Unit 3 liquid and gaseous effluents are based CCNPP Unit 3 site-specific inputs and assumptions. These inputs are as described in CCNPP Unit 3 FSAR, Sections 11.2.3.4 and 11.3.3.4.

Scope/Extent of Departure:

This Departure is identified in CCNPP Unit 3 FSAR Section 11.2.3.4 and 11.3.3.4.

Departure Justification:

The site-specific characteristics of the CCNPP Unit 3 site and the site-specific liquid effluent discharge design are considered in the calculation of liquid and gaseous effluent doses to the maximally exposed individual where differences from the U.S. EPR FSAR exist. This Departure is acceptable because the doses meet the 10 CFR Part 50, Appendix I, and ALARA design objectives. The change does not adversely affect any safety-related system or safety-related portion of a system, nor does it conflict with applicable regulatory guidance.

Departure Evaluation:

This Departure, associated with the CCNPP Unit 3 site-specific liquid and gaseous dose calculations, does not:

1. Result in more than a minimal increase in the frequency of occurrence of an accident previously evaluated in the plant-specific FSAR;
2. Result in more than a minimal increase in the likelihood of occurrence of malfunction of a structure, system, or component (SSC) important to safety and previously evaluated in the plant-specific FSAR;
3. Result in more than a minimal increase in the consequences of an accident previously evaluated in the plant-specific FSAR;
4. Result in more than a minimal increase in the consequences of a malfunction of an SSC important to safety previously evaluated in the plant-specific FSAR;
5. Create a possibility for an accident of a different type than any evaluated previously in the plant-specific FSAR;
6. Create a possibility for a malfunction of an SSC important to safety with a different result than any evaluated previously in the plant-specific FSAR;
7. Result in a design basis limit for a fission product barrier as described in the plant-specific FSAR being exceeded or altered; or
8. Result in a departure from a method of evaluation described in the plant-specific FSAR used in establishing the design bases or in the safety analyses.

This Departure does not affect resolution of a severe accident issue identified in the plant-specific FSAR.

Therefore, this Departure has no safety significance.

RAI 255

Question 11.03-2

Supplemental question to the response of RAI 210, Question 11.03-1

In the response dated April 24, 2010, the applicant provides information 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 site-specific dose assessment for gaseous effluent releases, a cost-benefit analysis, and a revision to the departures and exemption reports (Part 7 of the application).

The additional information appears generally acceptable. The staff confirmed the dose results for the maximally exposed individual, but was unable to independently confirm population doses results lacking specific information on parameters and approach used in the cost-benefit analysis. The staff also noted a number of inconsistencies in the presentation of the new information and proposed revisions to the FSAR given the concerns identified in RAI 210, Questions 11.03-1(1) and 11.03-1(2). Based on the staff's review of responses to RAI questions, the applicant is requested to address the items listed below and provide sufficient information for the staff to conduct an independent evaluation of the approach and results presented in the proposed revision of FSAR Section 11.3:

A. FSAR Section 11.3.3.4

1. In FSAR Section 11.3.3.4, the discussion presenting the dose result of 1.47 mrem/yr 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. The applicant is requested to qualify the differences in exposure pathway locations in that discussion.
2. A new paragraph should be added to this section addressing the requirements of 10 CFR Part 50, Appendix I, Section II.B.1 in complying with the beta and gamma air dose design objectives. The discussion should refer the results listed in FSAR Table 11.3-7.
3. The applicant is requested to add a reference for Regulatory Guide 1.109 since it forms the basis of the dose calculation methodology and for consistency with references listed in FSAR Section 11.2 on dose calculations for liquid effluent discharges.

B. FSAR Section 11.3.3.5

In FSAR Section 11.3.3.5, the text states that gaseous effluent releases comply with 10 CFR Part 20, Appendix B, Table 2 limits, but does not provide results demonstrating that conclusion. The discussion relies on the results presented in U.S. EPR FSAR Table 11.3-6 as supporting documentation. It should be noted that the results presented in U.S. EPR FSAR Table 11.3-6 are based on a different set of assumptions applied to a hypothetical site. Consequently, these results and underlying assumptions do not apply to the CCNPP-3 plant and site-specific conditions. The applicant is requested to provide site-specific information demonstrating compliance with 10 CFR Part 20, Appendix B, Table 2, Column 1 limits for gaseous effluents and unity-rule for the sum-of-the-ratios for plant stack releases associated with normal operation and maximum fuel defects.

C. FSAR Table 11.3-1

The response to RAI 210, Question 11.3-1 (Encl. 2, p.3) states that the selection of dose receptors and exposure pathways is based on the results of the 2007 land-use census. However, the information presented in FSAR Table 11.3-1 and supporting text do not discuss, nor reference the results of a land-use census and how its results were justified for the analysis presented in FSAR Section 11.3.3.4. The applicant is requested to provide information supporting the selection of the applied offsite dose receptors and exposure pathways and provide a reference for the 2007 land-use census.

D. FSAR Tables 11.3-1, 11.3-5, and 11.3-6

1. A review of FSAR Section 2.3.5 and FSAR Table 2.3-130 indicates that a nearest resident is listed among other dose receptor locations. FSAR Tables 11.3-1, 11.3-5, and 11.3-6 do not identify the nearest resident under the location and dose receptor table headings, while Table 11.3-4 identifies locations only. The applicant is requested to identify the nearest resident location and doses in FSAR Tables 11.3-1, 11.3-5, and Table 11.3-6.

2. Footnote b to FSAR Table 11.3-1 states that specific locations for the beef cattle exposure pathway are not available. Similarly, Footnote c to FSAR Table 11.3-1 states that there are no milk animals within 5 miles (8 km) of the proposed plant site. The applicant is requested to provide specific references for these statements in table footnotes. These observations also apply to the information and footnotes presented in FSAR Tables 11.3-4, 11.3-6, and 11.3-7.

E. FSAR Table 11.3-2

1. Footnote 1 to FSAR Table 11.3-1 states that the crop growing and animal grazing seasons occur from April to October. The applicant is requested to provide a reference for this statement.

2. Under the "Value" column heading indicates whether all table citations are from the CCNPP-3 FSAR.

F. FSAR Table 11.3-3

For the information presented in FSAR Table 11.3-3, the applicant is requested to cite a reference for the listed regional food and crop production rates.

G. FSAR Table 11.3-6

In FSAR Table 11.3-6, the applicant is requested to include thyroid doses for the inhalation, vegetable, and meat exposure pathways given that the thyroid, along with bone, are the organs with the highest projected dose estimates.

H. FSAR Tables 11.3-8 to 11.3-19 and Supporting FSAR Section 11.3.4

For the information supporting the results of the cost-benefit analysis (CBA), confirm and correct the following observations on results and footnotes presented in FSAR Tables 11.3-8 to 11.3-19 and supporting discussions in FSAR Section 11.3.4:

1. FSAR Section 11.3.4.1 states that that CBA relies on an additional charcoal delay bed for the system augmentation; however, FSAR Section 11.3.4.1 and Table 11.3-8 do not specify its size. The applicant is requested to qualify the results presented in FSAR Table 11.3-8 for the alternate case by noting that the increased noble gases holdup time reflects the use of a 3-ton charcoal delay tank.

2. In FSAR Section 11.3.4.2, confirm that the reference to FSAR Table "11.2-19" should be changed instead to FSAR Table 11.3-19 in the last line of the second paragraph.

3. In FSAR Section 11.3.4.2, the last paragraph acknowledges that sources of airborne radioactivity from building ventilation systems do not benefit from the holdup afforded by the additional charcoal delay tank as a system augmentation. The sources of radioactivity from plant buildings is characterized as being significantly higher than the source term processed and treated via the gaseous waste processing system. For the gaseous effluent source term shown in U.S. EPR FSAR Table 11.3-3, the radioiodine source term is two to three orders of magnitude higher than any of the particulate radionuclides, and the particulate source term, in the aggregate, is comparable to that of I-131 or I-132. Given the above, the CBA should consider another case with a system augmentation that includes a system augmentation applying a HEPA/charcoal filtration system for particulates and radioiodines. The applicant is requested to evaluate the source term presented in U.S. EPR FSAR Table 11.3-3 and update the assumptions for the base and alternate cases and CBA results presented in FSAR Tables 11.3-8, 11.3-18, and 11.3-19.

4. FSAR Table 11.3-10 lists atmospheric dispersion parameters used in calculating population doses within a 50-mile (80 km) radius. While not stated in Table 11.3-10, a review of the data and Table 11.3-2 indicates that they represent undecayed and undepleted X/Q values. FSAR Table 11.3-10 and the balance of the information supporting the CBA do not present the other set of atmospheric parameters, namely: decayed and undepleted, and decayed and depleted out to 50 miles (80 km). Given that the CBA analysis and dose calculations are stated to rely on Regulatory Guides (RG) 1.109 and 1.110, the applicant is requested to include in FSAR Section 11.3.4 the missing meteorological dispersion parameters.

5. For the food production data presented in FSAR Tables 11.3-9 to 11.3-17, provide references supporting the listed population distributions and production rates for milk, beef, poultry, grain, and vegetable within the 50-mile (80 km) radius.

6. In determining whether the system augmentation complies with Section II.D of Appendix I to 10 CFR Part 50, the methodology summarized in FSAR Table 11.3-19 describes a process other than noted in RG 1.110, Regulatory Position C.5 and Appendix A, while stating in FSAR Section 11.3.4 that the method applies RG 1.110. The applicant is requested to describe the equivalency of the method applied in the CCNPP-3 FSAR.

7. In FSAR Table 11.3-19, the applicant is requested to confirm that RG 1.110, Table A-3 should be added to the entry listing the annual operating and maintenance costs of $67,000 for the system augmentation.

Response

Part A

1) With respect to qualifying the exposure pathways and locations which resulted in the dose value of 1.47, it was conservatively assumed that the gaseous effluent exposure pathways of plume, ground plane, inhalation, vegetable garden, goat milk and meat existed at the site boundary location. The doses from goat milk are being added to COLA FSAR Table 11.3-5 in order to be able to trace the exposure pathway components of this dose value.

2) With respect to addressing the requirements of 10 CFR Part 50, Appendix I, Section II.B.1 in complying with beta and gamma air dose design objectives, a sentence is being added to COLA FSAR Section 11.3.3.4 addressing compliance with the beta and gamma air dose design objectives.

3) With respect to adding a reference to Regulatory Guide 1.109, this is currently included in COLA FSAR Section 11.3.3.4, which states "The GASPAR II computer program (NRC, 1987) was used to calculate doses to the maximally exposed individual (MEI) from gaseous releases. GASPAR II implements the exposure methodology described in RG 1.109, Rev. 1 for estimated dose associated with the radioactive releases in gaseous effluent."

Part B

The following equation is used to calculate the expected concentration of gaseous effluents at the site boundary that are used in demonstrating compliance with the concentration limits of 10 CFR Part 20, Appendix B, Table 2 :

$C(i)$ (µCi/ml, or Ci/m^3) = $Q(i)$(Ci/yr) * (χ/Q) (sec/m^3) x 3.171E-08 (yr/sec)

Where:

$C(i)$ = concentration at the site boundary of the ith isotope (µCi/ml)
$Q(i)$ = total annual release rate of the ith isotope (Ci/yr) from the GALE output and
χ/Q = the atmospheric dispersion factor (χ/Q) for transport of the released radioactivity from the release point to the site boundary

The single parameter in the above formula that would differ between the U.S. EPR FSAR analysis and the COLA FSAR analysis is the atmospheric dispersion factor (χ/Q) used in calculating the site boundary gaseous effluent concentrations. As described in U.S. EPR FSAR Section 11.3.3.5, the atmospheric dispersion factor is a conservatively high value of 5.0E-06 sec/m^3 as compared to the limiting land-based site-specific atmospheric dispersion factor for CCNPP Unit 3 of 1.08E-06 sec/m^3 given in COLA FSAR Table 2.3-120. Since the calculation of the off-site gaseous effluent concentrations involves multiplying by this parameter, the concentrations calculated using the higher atmospheric dispersion factor of 5.0E-06 sec/m^3 would result in higher concentrations as compared to those calculated using the lower site-specific atmospheric dispersion factor. Therefore, the U.S. EPR FSAR analysis is incorporated by reference as it is a bounding analysis. A sample calculation is provided below for Kr-85 using the expected release concentration to demonstrate this conclusion.

Using the U.S. EPR FSAR atmospheric dispersion factor of 5.0E-06 sec/m^3:

C(Kr-85) = 3.4E4 Ci/yr x 5.0E-06 (sec/m^3) x 3.171E-08 (yr/sec) = 5.39E-09 Ci/m^3

Using the site-specific atmospheric dispersion factor of 1.08E-06 sec/m^3:

C(Kr-85) = 3.4E4 Ci/yr x 1.08E-06 (sec/m^3) x 3.171E-08 (yr/sec) = 1.16E-09 Ci/m^3

Part C

This response supersedes the RAI 210, Question 11.3-1 response[2] indicating that the receptor locations were based on the 2007 land-use census.

Receptor locations were selected according to the dose pathway being evaluated. The most limiting site boundary location was chosen for the individual and meat animal receptors, and the nearest garden location was chosen for the vegetable receptor. Only sectors where populations or gardens would be expected to exist were evaluated. Therefore, the following sectors that border or extend over water were not considered: NNW, N, NNE, NE, ENE, E, and ESE.

The locations of nearest residences, gardens, milk, and meat animals were identified via a land-use census conducted in 2005. The locations of the site boundary and vegetable garden chosen for the analysis represent the respective locations with the most limiting atmospheric dispersion and deposition factors, not necessarily the site boundary location or garden closest to the reactor centerline. Specific locations for beef cattle were not available, although there was use of beef cattle identified within 5 miles of CCNPP. Therefore, it was conservatively assumed that beef cattle exists at the most limiting site boundary location (excluding sectors bordering or extending over water).

This information is being added to COLA FSAR Section 11.3.3.4 and Table 11.3-1.

Part D

1) In determining dose to the maximally exposed individual, the most conservative location was selected for each of the applicable dose pathways. The nearest residence is conservatively assumed to be located at the most limiting site boundary, and would be the dose receptor location for doses from the plume, ground plane, and inhalation. A footnote is being added to FSAR Table 11.3-5 to provide this information.

---

2 G. Gibson (UniStar Nuclear Energy) to Document Control Desk (U.S. NRC), "Responses to RAI No. 209, Liquid Waste Management System, and RAI No. 210, Gaseous Waste Management System," letter UN#10-103, dated April 14, 2010.

2) A reference to the 2005 land-use census is being added to COLA FSAR Tables 11.3-1, 11.3-4, 11.3-6 and 11.3-7 to support the identification of receptor locations and statements regarding beef cattle and milk animals.

Part E

1) The growing season for vegetables and animal feed crops is the span of months when the temperature is above freezing for all days during the month. Based on local climatological data, the growing season is April through October. A reference is being added to COLA FSAR Table 11.3-2 footnote 1 to provide the source of this information.

2) All table citations refer to tables within the COLA FSAR unless otherwise preceded by the words "U.S. EPR FSAR."

Part F

For calculation of the dose to the maximum exposed individual from gaseous effluents, the food consumption values from Table E-5 of Regulatory Guide 1.109 were used. For calculation of population doses from gaseous effluents, the principal data source for food and crop production rates was the U.S. Department of Agriculture statistics for Delaware, Maryland, and Virginia (the states within 50 miles of CCNPP). A footnote is being added to the tables containing the data providing the supporting reference.

Part G

COLA FSAR Table 11.3-6 is being revised to include thyroid doses for the inhalation, vegetable, and meat exposure pathways.

Part H

This response and the associated mark-up to COLA FSAR Section 11.3.4 and associated tables supersedes the response and associated mark-ups dealing with the gaseous waste management cost benefit evaluation provided in the response to RAI 210[2]:

The cost benefit evaluation has been revised to follow the approach described in Regulatory Guide 1.110 and to assess all possible gaseous radwaste system augments and FSAR Section 11.3 has been updated accordingly. The revised evaluation considers all possible gaseous radwaste system augments and determines the lowest annual cost associated with the possible augments. This lowest cost is considered a threshold value and is compared against the gaseous effluent population dose in determining whether a system augment is warranted based on the cost-benefit ratio. 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. Regulatory Guide 1.110 provides values in 1975 dollars and instructs that these values not be adjusted for inflation.

The following parameters used in determining the Total Annual Cost (TAC) for the cost-benefit analysis are fixed and are provided in Regulatory Guide 1.110 for each radwaste system augment: the Direct Cost of Equipment, Materials and Labor (Table A-1 of Regulatory Guide 1.110), the Annual Operating Cost (AOC) (Table A-2 of Regulatory Guide 1.110), and the

Annual Maintenance Cost (AMC) (Table A-3 of Regulatory Guide 1.110). The following variable parameters were used in the cost-benefit analysis:

- Labor Cost Correction Factor (LCCF) – This factor accounts for the differences in relative labor costs between geographical regions and is taken from Table A-4 of Regulatory Guide 1.110. The lowest LCCF value of 1.0 was conservatively used in the analysis.
- Indirect Cost Factor (ICF) – This factor takes into account whether the radwaste system is unitized or shared (in the case of a multi-unit site) and is taken from Table A-5 of Regulatory Guide 1.110. A value of 1.75 was used for the ICF since the radwaste system for CCNPP Unit 3 is for a single unit site.
- Capital Recovery Factor (CRF) – This factor reflects the cost of money for capital expenditures. A cost-of-money value of 7% per year was assumed in the analysis, consistent with NUREG/BR-0058. From Table A-6 of Regulatory Guide 1.110, the corresponding CRF is 0.0806.

The annual costs associated with the gaseous radwaste system augments are provided in Table 2. Table 2 shows that the lowest-cost option for gaseous radwaste treatment system augments is the steam generator flash tank vent to main condenser augment at $6,650 per year. Dividing this value by the dollar value for estimated impact of $1000 per person-rem, results in a threshold value of 6.65 person-rem total body or thyroid dose from gaseous effluents. Therefore, for U.S. EPR sites with population dose estimates less than 6.65 person-rem total body or thyroid dose from gaseous effluents, no further cost-benefit analysis is needed to demonstrate compliance with 10 CFR Part 50, Appendix I, Section II.D. Since the total body and thyroid population doses for gaseous effluents for CCNPP Unit 3 (3.70 and 3.96 person-rem, respectively) are below the threshold dose of 6.65 person-rem, no further cost-benefit analysis is needed.

Part H – 1. Given the change in the methodology used to perform the cost-benefit analysis as discussed above, this question no longer applies.

Part H – 2. Given the change in the methodology used to perform the cost-benefit analysis as discussed above and the supporting FSAR markup, this question no longer applies.

Part H – 3. Given the change in the methodology used to perform the cost-benefit analysis as discussed above, this question no longer applies.

Part H – 4. The values for the bounding 50-mile dispersion factors presented in Table 11.3-10 reflect the more limiting (i.e., higher) values of the regular undecayed/undepleted χ/Q and gamma χ/Q for each distance and sector, which are used as a bounding input to the GASPAR II population dose input file for the Site Annual χ/Q, Site Annual Decayed χ/Q for Xe-133m and Site Annual Decayed (for I-131) and Depleted χ/Q Data.

Part H – 5. The 50-mile population production was determined using the method described in ER Section 2.5.1.1.3.2 and the data source for food and crop production rates was the U.S. Department of Agriculture statistics for Delaware, Maryland, and Virginia (the states within 50 miles of CCNPP). A footnote is being added to Table 11.3-9 providing the references for the 50-mile population distribution and to Table 11.3-2 providing the supporting reference for the production rates.

Part H – 6. Given the change in the methodology used to perform the cost-benefit analysis as discussed above and the supporting FSAR markup, this question no longer applies.

Part H – 7. Given the change in the methodology used to perform the cost-benefit analysis as discussed above and the supporting FSAR markup, this question no longer applies.

Table 2: Annual Costs (1975 $1000) Associated with Liquid Radwaste System Augments

Equipment	Direct Costs[1]			Corrected Labor Cost[2]	Total Direct Cost[3]	Total Capital Cost[4]	Annual Fixed Cost[5]	Annual Operating Cost[6]	Annual Maint. Cost[7]	Total Annual Cost[8]
	Equipment /Material	Labor	Total							
3-ton-Charcoal Adsorber	53	14	67	14.00	67.00	117.25	9.45	neg	neg	9.45
Desiccant Dryer	218	176	394	176.00	394.00	689.50	55.57	3.00	6.00	64.57
Charcoal Vault Refrigeration	116	38	154	38.00	154.00	269.50	21.72	4.00	3.00	28.72
Main Condenser Vacuum Pump Charcoal/HEPA Filtration System	40	8	48	8.00	48.00	84.00	6.77	0.40	1.00	8.17
Clean Steam to Turbine Glands	81	215	296	215.00	296.00	518.00	41.75	24.00	4.00	69.75
Clean Steam to Steam Valves, 24" and Larger	137	110	247	110.00	247.00	432.25	34.84	3.00	4.00	41.84
Clean Steam to Steam Valves 2-1/2" and Less than 24"	183	55	238	55.00	238.00	416.50	33.57	3.00	12.00	48.57
15,000 cfm HEP Filtration System	52(49)*	16(14)*	68(63)*	16(14)*	68(63)*	119(110)	9.59(8.89)	6.00	2.00	17.59(16.89)
1,000-cfm Charcoal/HEPA Filtration System	28	10	38	10.00	38.00	66.50	5.36	2.00	0.60	7.96
15,000-cfm Charcoal/HEPA Filtration System	97(93)	31(26)	128(119)	31(26)	128(119)	224(208)	18.05(16.78)	7.00	9.00	34.05(32.78)
30,000-cfm Charcoal/HEPA Filtration System	157(152)	51(41)	208(193)	51(41)	208(193)	364(338)	29.34(27.22)	9.00	18.00	56.34(54.22)
Turbine Bldg. Chilled Water HVAC System	614	374	988	374.00	988.00	1729.00	139.36	49.00	20.00	208.36
600-ft3 Gas Decay Tank	33	24	57	24.00	57.00	99.75	8.04	neg	neg	8.04
PWR Hydrogen Recombiner	419	147	566	147.00	566.00	990.50	79.83	4.00	10.00	93.83
PWR Air Ejector Charcoal/HEPA Filtration Unit	14	10	24	10.00	24.00	42.00	3.39	4.00	2.00	9.39
Steam Generator Flash Tank Vent to Main Condenser	19	14	33	14.00	33.00	57.75	4.65	1.00	1.00	6.65

[1] Direct Cost from Table A-1 of Regulatory Guide 1.110
[2] Corrected Labor Cost = Labor Cost x Labor Cost Correction Factor
[3] Total Direct Cost = Equipment/Material Cost + Corrected Labor Cost
[4] Total Capital Cost = Total Direct Cost x Indirect Cost Factor
[5] Annual Fixed Cost = Total Capital Cost x Capital Recovery Factor
[6] Annual Operating Cost from Table A-2 of Regulatory Guide 1.110
[7] Annual Maintenance Cost from Table A-3 of Regulatory Guide 1.110
[8] Total Annual Cost = Annual Fixed Cost + Annual Operating Cost + Annual Maintenance Cost

COLA Impact

COLA FSAR Table 1.8-2 will be revised as follows:

Table 1.8-2—FSAR Sections that Address COL Items

Item No.	Description	Section
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
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
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
11.2-6	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.	11.2.1.2.4
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
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
11.3-3	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

Table 1.8-2—FSAR Sections that Address COL Items

Item No.	Description	Section
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
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
11.3-6	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 GWMS processing equipment will include plant and site-specific information describing how design features and implementation of operating procedures for the GWMS will address the requirements of 10 CFR Part 20.1406(b) and guidance of SRP Section 11.3, RG 4.21, RG, 1.143, IE Bulletin 80-10, and NEI 08-08.	11.3.1.2.4
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 Part 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
11.4-2	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 solid waste management system (SWMS) processing equipment will include plant and site-specific information describing how design features and implementation of operating procedures for the SWMS will address the requirements of 10 CFR Part 20.1406(b) and guidance of SRP Section 11.4, Regulatory Guides 4.21 and 1.143, IE Bulletin 80-10, industry standards, and NEI 08-08.	11.4.1
11.4-3	A COL applicant that references the U.S. EPR design certification will address plant-specific commitments to address the long-term storage of LLRW beyond the provisions described in the U.S. EPR design certification when such storage capacity is exhausted and describe how additional onsite LLRW storage or alternate LLRW storage will be integrated in plant operations. To address the need for additional storage, the commitment will address the requirements of 10 CFR Part 20, Appendix B (Table 2, Column 1 and 2); dose limits of 10 CFR 20.1301, 20.1302, and 20.1301(e) in unrestricted areas; Part 20.1406(b) in minimizing the contamination of plant facilities and environs; and design objectives of Sections II.A, II.B, II.C, and II.D of Appendix I to 10 CFR Part 50. The design and operations of additional onsite storage capacity will be integrated in the plant-specific process control program and consider the guidance of SRP Section 11.4 and Appendix 11.4-A, Regulatory Guides 1.206, 4.21 and 1.143, IE Bulletin 80-10, industry standards, and NEI 08-08.	11.4.1
11.5-1	A COL applicant that references the U.S. EPR design certification will fully describe, at the functional level, elements of the process and effluent monitoring and sampling programs required by 10 CFR Part 50 Appendix I, and 10 CFR 52.79 (a)(16). This program description, Offsite Dose Calculation Manual (ODCM), will specify how a licensee controls, monitors, and performs radiological evaluations of releases. The program will also document and report radiological effluents discharged to the environment. NEI 07-09A is an alternate means of demonstrating compliance with GL 89-01 and SECY 05-0197 until a plant and site-specific ODCM is developed under a license condition.	11.5.2

Table 1.8-2—FSAR Sections that Address COL Items

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

COLA FSAR Chapter 11 will be revised as follows:

11.0 RADIOACTIVE WASTE MANAGEMENT

This chapter of the U.S. EPR Final Safety Analysis Report (FSAR) is incorporated by reference with supplements ~~{and departures}~~ as identified in the following sections.

11.1 SOURCE TERMS

{This section of the U.S. EPR FSAR is incorporated by reference.}

11.2 LIQUID WASTE MANAGEMENT SYSTEM

{This section of the U.S. EPR FSAR is incorporated by reference with the following ~~departures and~~ supplements.}

11.2.1 DESIGN BASIS

{No departures or supplements.}

11.2.1.1 Design Objective

No departures or supplements.

11.2.1.2 Design Criteria

No departures or supplements.

11.2.1.2.1 Capacity

No departures or supplements.

11.2.1.2.2 Quality Group Classification

No departures or supplements.

11.2.1.2.3 Controlled Releases of Radioactivity

No departures or supplements.

11.2.1.2.4 Mobile Systems

The U.S. EPR FSAR includes the following COL Item in Section 11.2.1.2.4:

> 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.

The COL Item is addressed as follows:

Should {Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operation Services, LLC} choose to install and operate mobile skid-mounted equipment to connect to the permanently installed LWMS, then this section of the FSAR will be revised to include plant and site-specific information describing how design features and implementation of operating procedures for the LWMS 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.

11.2.2 SYSTEM DESCRIPTION

{No departures or supplements.}

11.2.3 RADIOACTIVE EFFLUENT RELEASES

{~~This section of the U.S. EPR FSAR is incorporated by reference with the following departure:~~ No departures or supplements.

~~After the isolation valves of the liquid waste storage system, the treated wastewater travels through a double-walled pipe to the discharge line. The waste water discharge line connects to the cooling tower retention basin discharge line downstream of the basin for added dilution flow before release in the Chesapeake Bay via an off-shore submerged multi-port (three) discharge nozzle arrangement. The discharges from the liquid waste storage system do not interact with the Circulating Water System (CWS).~~}

11.2.3.1 Discharge Requirements

{No departures or supplements.}

11.2.3.2 Estimated Annual Releases

{No departures or supplements.}

11.2.3.3 Release Points And Dilution Factors

~~This section of the U.S. EPR FSAR is incorporated by reference with the following departures:~~

The U.S. EPR FSAR includes the following COL Item in Section 11.2.3.3:

> 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.

The COL Item is addressed as follows:

{After the isolation valves of the liquid waste storage system, the treated wastewater travels through a double-walled pipe to the discharge line. The waste water discharge line connects to the cooling tower retention basin discharge line downstream of the basin for added dilution flow before release in the Chesapeake Bay via an off-shore submerged multi-port (three) discharge nozzle arrangement. The discharges from the liquid waste storage system do not interact with the Circulating Water System (CWS).

Prior to discharge into the Chesapeake Bay, CWS cooling tower and ESWS cooling tower blowdown, and miscellaneous low volume waste are directed to the waste water retention basin. Wastes resulting from the Desalination Plant membrane filtration and reverse osmosis equipment will also collect in the waste water retention basin. The waste water retention basin serves as an intermediate discharge reservoir. During plant startup, start-up flushes and chemical cleaning wastes will first collect in temporary tanks or bladders, and will then be discharged into the waste water retention basin. Waste water retention basin effluents and treated sanitary waste and liquid radwaste collect in the seal well. The seal well is a collection point for all effluents. It is used to prevent waste water backflow, and allows solid particles to settle and liquids to be discharged back into the Chesapeake Bay.

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 approximately 21,008 gpm, resulting in a total average flow of 21,019 gpm for all 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 age 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), 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.}

11.2.3.4 Estimated Doses

11.2.3.4.1 Liquid Pathways

~~This section of the U.S. EPR FSAR is incorporated by reference with the following departures:~~ {No departures or supplements.}

~~The LADTAP II computer program (NRC, 1986) 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 (NRC, 1977). The following exposure pathways were considered:~~

- ~~Ingestion of aquatic foods (fish and invertebrates)~~
- ~~External exposure to shoreline~~
- ~~External exposure to water through boating and swimming~~
- ~~Ingestion of drinking water (via desalinization treatment)~~

~~Due to the brackish nature of Chesapeake Bay, liquid pathways for irrigation are not considered significant. The input parameters for the liquid pathway are presented in Table 11.2-1 in addition to default maximum individual food consumption factors from Regulatory Guide 1.109 (Table E-5).~~

11.2.3.4.2 Liquid Pathway Doses

~~{This section of the U.S. EPR FSAR is incorporated by reference with the following departures:}~~
The U.S. EPR FSAR includes the following COL Item in Section 11.2.3.4.2:

> 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.

The COL Item is addressed as follows:

{The LADTAP II computer program (NRC, 1986) 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 (NRC, 1977). The following exposure pathways were considered:

- Ingestion of aquatic foods (fish and invertebrates)
- External exposure to shoreline
- External exposure to water through boating and swimming
- Ingestion of drinking water (via desalinization treatment)

Due to the brackish nature of Chesapeake Bay, liquid pathways for irrigation are not considered significant. The input parameters for the liquid pathway are presented in Table 11.2-1 in addition to default maximum individual food consumption factors from Regulatory Guide 1.109 (Table E-5).

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 discharge flow rate of 46.8 cfs. Table 11.2-2 provides individual doses by pathway and organ. Table 11.2-3 summarizes the total body and maximum organ dose commitment and regulatory requirements.

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 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.}

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.}

11.2.3.6 Radioactive Liquid Waste System Leak or Failure

{No departures or supplements.}

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.}

11.2.3.8 Quality Assurance

{No departures or supplements.}

11.2.4 LIQUID WASTE MANAGEMENT SYSTEM COST-BENEFIT ANALYSIS

The US EPR FSAR includes the following COL item in Section 11.2.4:

> A COL applicant that references the U.S. EPR design certification will ~~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 cost-benefit analysis~~ 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 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.

The following parameters used in determining the Total Annual Cost (TAC) for the cost-benefit analysis are fixed and are provided in Regulatory Guide 1.110 for each radwaste system augment: the Direct Cost of Equipment, Materials and Labor (Table A-1 of Regulatory Guide 1.110), the Annual Operating Cost (AOC) (Table A-2 of Regulatory Guide 1.110), and the Annual Maintenance Cost (AMC) (Table A-3 of Regulatory Guide 1.110). The following variable parameters were used in the cost-benefit analysis:

- Labor Cost Correction Factor (LCCF) – This factor accounts for the differences in relative labor costs between geographical regions and is taken from Table A-4 of Regulatory Guide 1.110. The lowest LCCF value of 1.0 was conservatively used in the analysis.

- Indirect Cost Factor (ICF) – This factor takes into account whether the radwaste system is unitized or shared (in the case of a multi-unit site) and is taken from Table A-5 of Regulatory Guide 1.110. A value of 1.75 was used for the ICF since the radwaste system for CCNPP Unit 3 is for a single unit site.

- Capital Recovery Factor (CRF) – This factor reflects the cost of money for capital expenditures. A cost-of-money value of 7% per year was assumed in the analysis, consistent with NUREG/BR-0058 (NRC, 2004). From Table A-6 of Regulatory Guide 1.110, the corresponding CRF is 0.0806.

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 liquid radwaste treatment system augments was determined to be a 20-gpm cartridge filter at $11,390 per year. Dividing this cost by $1000 per person-rem results in a threshold value of 11.39 person-rem total body or thyroid dose from liquid effluents.

Population dose impacts within a 50 mile radius of the CCNPP site are listed in Table 11.2-7. The input parameters used in calculating the population doses are provided in Table 11.2-6. As shown by the results in Table 11.2-7, the total body and thyroid population doses for liquid effluents are a small fraction of the threshold value of 11.39 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.}

~~The liquid waste processing base system case evaluated for the U.S. EPR is an evaporator processing Group I wastes and a centrifuge processing Group II wastes. The treated wastewater from these two components is directed to the monitoring tanks where it is eventually released for discharge to the environment.~~

~~The augmented case evaluated in the cost-benefit analysis adds a waste demineralizer subsystem to the liquid waste processing equipment from the base system case. The system is aligned so that, for Group I wastes, the evaporator distillate is routed to the waste demineralizer for further treatment, and for Group II wastes, the treated wastewater from the centrifuge is routed to the waste~~

demineralizer for further treatment prior to being routed to the monitoring tanks for eventual discharge to the environment.

11.2.4.1 Calculation of Population Doses

The source term for each equipment configuration option in the analysis for this addition was generated using the GALE code (NRC, 1985) and system parameters from U.S. EPR FSAR Table 11.2-3. The only GALE input parameters that differ between the base system case and the augmented case are the decontamination factors for the applicable waste streams. The augmented case uses typical values for waste demineralizer decontamination factors, which are multiplied by the decontamination of the other component in series (either the evaporator or centrifuge) to determine the overall decontamination factor for each waste stream. The decontamination factors that were used in each of the configurations for the applicable waste streams are provided in Table 11.2-6. Other input values into the GALE code remain the same as those provided in U.S. EPR FSAR Table 11.2-3.

The LADTAP II code (NRC, 1986) was used to provide population dose results using the inputs shown in Table 11.2-7. The source term entered into LADTAP II is the unadjusted release rate from GALE, unadjusted by the 0.16 Ci/yr that is added to account for anticipated operational occurrences. This entry was necessary so that an adequate and unskewed comparison could be made between the base system and augmented cases. As such, the dose values reported are based on the GALE unadjusted source term, and should not be used to project actual population doses. The dose benefit (i.e., the difference in doses between the two cases) is the objective of the analysis.

11.2.4.2 Dose Benefit and Augment Costs

The cost-benefit analysis uses a value of $1000 per person-rem as a favorable cost benefit threshold based on 10 CFR Part 50, Appendix I. The cost basis for the additional equipment option is taken from RG 1.110 and reported in 1975 non-escalated dollars, which provides a conservatively low estimate of the equipment cost compared to present dollars. The analysis uses a 30-year operating period.

The dose reduction effects for the sequential addition of the next logical liquid waste processing component (i.e., waste demineralizer) results in a reduction in the 50-mile population total body exposure of 0.05 person-rem as shown in Table 11.2-8. The total body dose reduction has a dollar equivalent benefit value of $1,500. However, the estimated cost to purchase, operate and maintain this equipment over its operating life is conservatively estimated (low) as $296,000. This calculation results in a total body effective benefit to cost ratio of less than 1.0 (and therefore not justified on an ALARA basis of dose savings to the public). The favorable benefit in reduced thyroid dose associated with the addition of a waste demineralizer system is 0.43 person-thyroid-rem and has a dollar equivalent benefit value of $12,900. The estimated cost to purchase, operate and maintain this equipment over its operating life is the same as for the total body dose assessment, $296,000. This calculation results in a thyroid effective benefit to cost ratio of less than 1.0, and therefore it is not justified on an ALARA basis of dose savings to the public. Table 11.2-9 summarizes the cost-benefit evaluation.}

11.2.5 REFERENCES

{**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, "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.~~

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.}

Table 11.2-1 {LADTAP II Input Parameters used in Maximum Exposed Individual Dose Calculation}

Parameter[1]	Value
Source Term	GALE (U.S. EPR FSAR Table 11.2-4) (Total as Adjusted)
Site Type	Saltwater
Shore-Width Factor	1.0
Discharge Flow Rate	46.8 cfs (1.33 m^3/s)
Impoundment Reconcentration Model	None
Shoreline usage (all age groups)[2]	200 hr/yr
Swimming usage (all age groups)[3]	100 hr/yr
Boating usage (all age groups)[3]	200 hr/yr
Dilution factor for fish, invertebrate, boating pathways	13.3
Dilution factor for swimming and shoreline activity	58
Dilution factor for potable water	296
Decontamination factor for potable water treated via the reverse osmosis unit	10 for all nuclides except H-3
Transit time for all pathways	0 hr

Notes:

1) All other values are LADTAP II default values.
2) The shoreline usage values used in the maximum exposed individual (MEI) dose calculation are conservative compared to the default values cited in Regulatory Guide 1.109, Table E-5.
3) The usage values for swimming and boating were selected to bound data for actual usage values for the population within the site vicinity (See Table 11.2-6).

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

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

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)
2008	0.004	0.035	0.010
2007	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	0.174
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.

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

CCNPP Unit 3		Whole Body (mrem)	Thyroid (mrem)	Max. Organ[7] (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
Total (CCNPP Unit 3)[5]		4.58E-01	8.80E-01	1.34E+00
Total (CCNPP Units 1 and 2)[6]		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 Tables 11.2-~~6~~2 and 11.2-~~7~~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 Tables 11.3-1 and 11.3-6).
4. Exposure pathway assumed to exist at maximum site boundary (SE, 0.88 mi) (See Tables 11.3-1 and 11.3-5).
5. 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. 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. 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.

Table 11.2-6 {Decontamination Factors used in the GALE Computer Code for the Liquid Waste Cost Benefit Analysis}

GALE Input Parameter	Reference Configuration1 Decontamination Factor	Alternate Configuration2 Decontamination Factor
Shim Bleed DF for Iodine	2.0E+03	1.0E+04
Shim Bleed DF for Cesium and Rubidium	1.0E+05	1.0E+07
Shim Bleed DF for Other Nuclides	1.0E+05	1.0E+07
Equipment Drains DF for Iodine	2.0E+03	1.0E+04
Equipment Drains DF for Cesium and Rubidium	1.0E+05	1.0E+07
Equipment Drains DF for Other Nuclides	1.0E+05	1.0E+07
Clean Waste DF for Iodine	2.0E+01	1.0E+02
Clean Waste DF for Cesium and Rubidium	2.0E+01	1.0E+02
Clean Waste DF for Iodine Other Nuclides	2.0E+01	1.0E+02

Notes:
1. Reference configuration uses an evaporator and centrifuge to process liquid wastes.
2. Alternate configuration uses an evaporator, centrifuge and demineralizer to process liquid wastes.

Table 11.2-~~7~~6 {Input Parameters for the LADTAP II Computer Code used in Calculation of Population Doses}

Parameter	Value[1]
Source Term	GALE (U.S. EPR FSAR Table 11.2-4 ~~"Total Unadjusted"~~)
50-Mile Population	6.42E+06
Shoreline Activity (person-hours per year)	3.8E+07
Boating (person-hours per year)	4.4E+07
Swimming (person-hours per year)	3.0E+07
Commercial Fishing Harvest (kg per year)	1.5E+08
Commercial Invertebrate Harvest (kg per year)	2.6E+07
Sport Fishing Harvest (kg per year)	1.3E+06
Sport Invertebrate Harvest (kg per year)	1.6E+06
Shore-Width Factor	1.0
Discharge Flow Rate (cfs)	46.8
Impoundment Reconcentration Model	None
Site Type	Saltwater
Dilution factor (for all pathways)	296

Note 1: All other input values are LADTAP II default values.

Table 11.2-7 {Population Doses from Liquid Effluents[1]}

Total Body Dose (person-rem)	Thyroid Dose (person-rem)
0.168	0.712

Note 1: Includes dose contribution from commercial and sport harvest of fish and shellfish, shoreline, swimming and boating exposures to the 50-mile population.

Table 11.2-8 {Obtainable Dose Benefits for Liquid Waste System Augment1}

Augment	Population Total Body Dose Person-rem	Population Thyroid Dose Person-rem
Demineralizer not used	0.159	0.625
Demineralizer used	0.105	0.199
Obtainable dose benefit	0.05	0.43

1. Because the source term used in obtaining the doses does not include the 0.16 Ci/yr adjustment factor for Anticipated Operational Occurrences, the population dose reported in the above table is used only for the cost benefit analysis for purposes of obtaining a dose benefit achieved by the augmented liquid waste processing system.

Table 11.2-9 {Liquid Waste Management Cost-Benefit Analysis}

Calculation	Whole Body Dose	Thyroid Dose
Annual dose reduction to the population within 50 miles of site due to addition of a waste demineralizer subsystem	0.05 person-rem	0.43 person-rem
Nominal dose over 30 years of operation	1.5 person-rem	12.9 person-rem
Obtainable benefit from addition of radwaste processing and control option	$1,500	$12,900
Total cost over 30 years of operation (direct cost + O&M×30 years)	$296,000	$296,000
Benefit/Cost Ratio (values greater than 1.0 should be included in plant system design)	0.005	0.04

11.3 GASEOUS WASTE MANAGEMENT SYSTEMS

{This section of the U.S. EPR FSAR is incorporated by reference with the following ~~departures and~~ supplements.}

11.3.1 DESIGN BASIS

{No departures or supplements.}

11.3.1.1 Design Objectives

{No departures or supplements.}

11.3.1.2 Design Criteria

{No departures or supplements.}

11.3.1.2.1 Quality Group Classification

{No departures or supplements.}

11.3.1.2.2 Seismic Design Classification

{No departures or supplements.}

11.3.1.2.3 Controlled Releases of Radioactivity

{No departures or supplements.}

11.3.1.2.4 Mobile Systems

The U.S. EPR FSAR includes the following COL Item in Section 11.3.1.2.4:

> 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 GWMS processing equipment will include plant and site-specific information describing how design features and implementation of operating procedures for the GWMS will address the requirements of 10 CFR Part 20.1406(b) and guidance of SRP Section 11.3, RG 4.21, RG, 1.143, IE Bulletin 80-10, and NEI 08-08.

The COL Item is addressed as follows:

Should {Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operation Services, LLC} choose to install and operate mobile skid-mounted equipment to connect to the permanently installed GWMS, then this section of the FSAR will be revised to include plant and site-specific information describing how design features and implementation of operating procedures for the GWMS address the requirements of 10 CFR Part 20.1406(b) and guidance of SRP Section 11.3, RG 4.21, RG, 1.143, IE Bulletin 80-10, and NEI 08-08.

11.3.2 SYSTEM DESCRIPTION

{No departures or supplements.}

11.3.3 RADIOACTIVE EFFLUENT RELEASES

~~{This section of the U.S. EPR FSAR is incorporated by reference with the following departures and supplements.~~ {No departures or supplements.}

11.3.3.1 Discharge Requirements

{No departures or supplements.}

11.3.3.2 Estimated Annual Releases

{No departures or supplements.}

11.3.3.3 Release Points

~~{No departures or supplements.}~~ 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:

- Gaseous Waste Processing System discharges via the carbon delay beds for noble gas holdup and decay,
- Containment purge ventilation discharges,
- Ventilation discharges from (1) the four Safeguards and Access Building controlled areas, (2) the Fuel Pool Building, (3) the Radwaste Building and (4) the Nuclear Auxiliary Building, and

- Main Condenser air evacuation exhaust.}

11.3.3.4 Estimated Doses

{This section of the U.S. EPR FSAR is incorporated by reference with the following departures:}The U.S. EPR FSAR includes the following COL Item in Section 11.3.3.4:

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.

The COL Item is addressed as follows:

{The GASPAR II computer program (NRC, 1987) was used to calculate doses to the maximally exposed individual (MEI) from gaseous releases. GASPAR II implements the exposure methodology described in RG 1.109, Rev. 1 for estimated dose associated with the radioactive releases in gaseous effluent. The following exposure pathways were considered:

- External exposure to contaminated ground.
- External exposure to noble gas radionuclides in the airborne plume.
- Exposure from inhalation of radioactivity.
- Exposure from ingestion of farm products grown in contaminated soil.
- Exposure from ingestion of meat from animals fed with contaminated feed. (Milk animals are not considered as there are no animals producing milk for human consumption within a 5-mile radius of the site.

The gaseous effluent is transported and diluted in a manner determined by the prevailing meteorological conditions. Section 2.3 discusses the meteorological modeling which has been used for all dose estimates, including estimated dispersion values for the 50-mile radius of the CCNPP site. Dilution factors due to atmospheric dispersion are deduced from historical onsite meteorological data and are summarized for the maximum exposed individual in Table 11.3-1. The gaseous source term for CCNPP Unit 3 expected routine operations is provided in US. EPR FSAR Table 11.3-3. The CCNPP Unit 3 stack is located adjacent to the reactor building and qualifies as a mixed mode release point. All ventilation air from areas of significant potential contamination, along with waste gas processing effluents, is released through the plant stack.

The input parameters for the gaseous pathway are presented in Tables 11.3-2 and Table 11.3-3, and the receptor locations are shown in Table 11.3-4. The locations of nearest residences, gardens, milk and meat animals were identified via a land-use census conducted in 2005. The locations of the site boundary and vegetable garden chosen for the analysis represent the respective locations with the most limiting atmospheric dispersion and deposition factors, not necessarily the site boundary location or garden closest to the reactor centerline. Although the use of beef cattle within 5 miles of CCNPP was identified in the land-use census, specific locations for beef cattle were not available. Therefore, it is conservatively assumed that beef cattle exist at the most limiting site boundary location (excluding sectors bordering or extending over water).

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. 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 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 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.}

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 release concentrations provided in Table 11.3-6 of the U.S. EPR FSAR were calculated using an atmospheric dispersion factor of 5.0E-06 sec/m^3. This dispersion factor bounds the dispersion factor for site boundary locations at CCNPP Unit 3 as shown in Table 11.3-4. Therefore, the resulting gaseous effluent release concentrations for CCNPP Unit 3 are bounded by those reported in US EPR FSAR Table 11.3-6 and are thereby less than the limits of 10 CFR Part 20, Appendix B, Table 2.}

11.3.3.6 Radioactive Gaseous Waste System Leak or Failure

The U.S. EPR FSAR includes the following COL Item in Section 11.3.3.6:

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.

The COL Item is addressed as follows:

{The evaluation performed in support of the US EPR FSAR sSection 11.3.3.6 used an atmospheric dispersion factor of 1.0E-03 sec/m^3. This dispersion factor bounds the accident dispersion factors for CCNPP Unit 3 as shown in Table 2.3-110. Therefore, the resulting dose associated with a gaseous waste system leak or failure at CCNPP Unit 3 would be less than 0.1 rem, in accordance with BTP 11-5. (NRC, 2007)}

11.3.3.7 Quality Assurance

{No departures or supplements.}

11.3.4 GASEOUS WASTE MANAGEMENT SYSTEM COST-BENEFIT ANALYSIS

The U.S. EPR FSAR includes the following COL item in Section 11.3.4:

A COL applicant that references the U.S. EPR design certification will ~~confirm that the gaseous waste management system cost-benefit analysis for the typical site is applicable to their site; if it is not, provide a site-specific~~ perform a site-specific gaseous waste management system cost-benefit analysis.

The 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 all items of reasonably demonstrated cleanup technology that, when added to the gaseous 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 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.

~~The next logical gaseous waste processing component for the U.S. EPR is the addition of a charcoal delay bed to the waste gas holdup subsystem. The original design contains three delay bed vessels, and the augmented design contains four delay bed vessels. Other features and parameters of the system are assumed to remain the same.~~

The following parameters used in determining the Total Annual Cost (TAC) for the cost-benefit analysis are fixed and are provided in Regulatory Guide 1.110 for each radwaste system augment: the Direct Cost of Equipment, Materials and Labor (Table A-1 of Regulatory Guide 1.110), the Annual Operating Cost (AOC) (Table A-2 of Regulatory Guide 1.110), and the Annual Maintenance Cost (AMC) (Table A-3 of Regulatory Guide 1.110). The following variable parameters were used in the cost-benefit analysis:

- Labor Cost Correction Factor (LCCF) – This factor accounts for the differences in relative labor costs between geographical regions and is taken from Table A-4 of Regulatory Guide 1.110. The lowest LCCF value of 1.0 was conservatively used in the analysis.

- Indirect Cost Factor (ICF) – This factor takes into account whether the radwaste system is unitized or shared (in the case of a multi-unit site) and is taken from Table A-5 of Regulatory Guide 1.110. A value of 1.75 was used for the ICF since the radwaste system for CCNPP Unit 3 is for a single unit site.

- Capital Recovery Factor (CRF) – This factor reflects the cost of money for capital expenditures. A cost-of-money value of 7% per year was assumed in the analysis, consistent with NUREG/BR-0058 (NRC, 2004). From Table A-6 of Regulatory Guide 1.110, the corresponding CRF is 0.0806.

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 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 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.}

~~11.3.4.1 Calculation of Population Doses~~

~~The source term for each equipment configuration option in this analysis was generated using the NUREG-0017 GALE code (NRC, 1985) and system parameters from U.S. EPR FSAR Table 11.2-3. Input parameters to the GALE code are the same for the base and augmented cases except for those parameters affected by the addition of a delay bed. The only GALE input parameters affected by the design change are the holdup times for krypton and xenon. Holdup times are increased in proportion to the increase in mass of charcoal adsorber. The holdup times used in the GALE analysis for each of the gaseous waste system equipment configurations are shown in Table 11.3-8.~~

~~The GASPAR II code (NRC, 1987) was used to provide population dose results using the inputs shown in Table 11.3-2 and Table 11.3-9 through Table 11.3-17.~~

~~11.3.4.2 Dose Benefits and Augment Cost~~

~~The cost-benefit analysis uses a value of $1000 per person-rem as a favorable cost benefit threshold based on 10 CFR Part 50, Appendix I. The cost basis for the additional equipment option is taken from RG 1.110 and reported in 1975 non-escalated dollars, which provides a conservatively low estimate of the equipment cost compared to present dollars. The analysis uses a 30-year operating period.~~

~~The dose reduction effects for the sequential addition of the next logical gaseous waste processing component (i.e., additional delay bed) results in a reduction in the 50-mile population total body and thyroid dose of 0.03 person-rem as shown in Table 11.3-18. The total body dose reduction has a dollar equivalent benefit value of $900. However, the estimated cost to purchase, operate and maintain this equipment over its operating life is conservatively estimated low as $67,000. This calculation results in a total body effective benefit to cost ratio of less than 1.0 and therefore not justified on an ALARA basis of dose savings to the public. Table 11.2-19 summarizes the cost-benefit evaluation.~~

~~The sources of gaseous effluents to the environment include waste streams processed through the gaseous waste processing system, containment purge exhaust, condenser air ejector exhaust, and building ventilation exhaust from the Safeguard Building, Nuclear Auxiliary Building, Radioactive Waste Processing Building, and Fuel Building. The gaseous waste processing system is designed such~~

that little activity is released to the environment. The gaseous effluent source term is based upon a specified amount of primary coolant leakage. Radioactivity in this leakage is released to the environment via the building ventilation systems.

Unlike the effluents from the gaseous waste processing system, which have the opportunity to decay through the charcoal delay beds before being released, the building ventilation releases do not benefit from holdup. Therefore, these building ventilation waste streams contain a significantly higher amount of activity than releases from the gaseous waste processing system. As such, an augment to the gaseous waste processing system provides little reduction to the overall activity released from all sources of gaseous effluents.}

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.

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.

NRC, 1987. NUREG/CR-4653, "GASPAR II – Technical Reference and User Guide," U.S. Nuclear Regulatory Commission, March 1987.

NRC, 2003. SECPOP 2000: Sector Population, Land Fraction, and Economic Estimation Program, Nuclear Regulatory Commission, August 2003.

NRC, 2007. NUREG-0800, BTP 11-5, "Postulated Radioactive Releases Due To A Waste Gas System Leak or Failure," Revision 3, U.S. Nuclear Regulatory Commission, March 2007.

NOAA, 2002. "2002 Local Climatological Data, Annual Summary with Comparitive Data," Baltimore, MD (BWI), ISSN 0198-2397, National Climatic Data Center, Ashville, NC.

USCB, 2005. 2005 American FactFinder, U.S. Bureau of Census, 2005.

USCB, 2000c. 2000 Decennial Census, Table DP-1: Profile of General Demographic Characteristics, U.S. Bureau of Census, 2000.

USDA, 2002. USDA, National Agricultural Statistics Service (NASS), 2002 Census of Agriculture for Delaware, Maryland and Virginia.

VEC, 2006. State Demographer Projections Population Data, Virginia Employment Commission, Website: http://velma.virtuallmi.com, Date accessed: June 22, 2007.}

Table 11.3-1 – {Locations and Atmospheric Dispersion/Deposition Factors for Gaseous Effluent Maximum Dose Evaluations[c]}

Location (Distance, Sector)	Dose Pathways Evaluated ~~[c]~~	Undecayed χ/Q (sec/m^3)	Depleted χ/Q (sec/m^3)	D/Q (1/m^2)
Site Boundary (0.88 mi SE)	Plume Ground Inhalation Meat[b]	1.076E-06	9.733E-07	1.060E-08
Site Boundary (0.86 mi S)	Plume Ground Inhalation Meat[b]	8.681E-07	7.939E-07	1.186E-08
Nearest Garden[a] (0.98 mi SE)	Vegetables	8.707E-07	7.859E-07	8.234E-09

Notes:

a. The term nearest garden refers to the most limiting locations.
b. Assumed to exist at the site boundary with most limiting atmospheric dispersion (excluding sectors bordering or extending over water). Specific locations for beef cattle are not available. Therefore, it is conservatively assumed that beef cattle exist at the site boundary.
c. The locations of nearest garden and cattle were identified via a land-use census (CCNPP, 2005). No milk animals were identified within 5 miles.

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[(2)]	Table 2.3-119
50-mile distribution of normal effluent gamma χ/Q values[(2)]	Table 2.3-124
50-mile distribution of bounding dispersion factors [(2)]	Table 11.3-10
50-mile distribution of normal effluent deposition (D/Q) values	Table 2.3-127
Milk Production within 50 mi (kg/yr)[(3)]	Table 11.3-11
Meat Production within 50 mi (kg/yr)[(3)]	Table 11.3-14
Vegetable/Grain Production within 50 mi (kg/yr) [(3)]	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 ~~This~~ occurs from April through October. (NOAA, 2002)
2. The more limiting (i.e., higher) value of the ~~normal effluent annual average~~ undecayed/undepleted χ/Q and gamma χ/Q ~~was used in the analysis~~ for each ~~sector and~~ 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, and decayed/depleted atmospheric dispersion factors. This approach is conservative since no credit is taken for either decay or depletion.
3. 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)

Table 11.3-3 - {Gaseous Pathway Consumption Factors for MEI[1]}

Consumption Factor	Adult	Teen	Child	Infant
Leafy vegetables: kg/yr	64	42	26	0
Meat Consumption: kg/yr	110	65	41	0
Milk Consumption: liter/yr	310	400	330	330
Vegetable/fruit consumption: kg/yr	520	630	520	0

[1] Values from Table E-5 of Regulatory Guide 1.109

Table 11.3-4 - {Distance to Nearest Gaseous Dose Receptors[(1)(3)]}

Sector	Site Boundary (m/mi)	Residence (km/mi)	Vegetable Garden (km/mi)
N [(2)]	623/0.39	-	-
NNE[(2)]	429/0.27	-	-
NE[(2)]	443/0.28	-	-
ENE[(2)]	471/0.29	-	-
E[(2)]	554/0.34	-	-
ESE[(2)]	693/0.43	-	-
SE	1413/0.88	1.6/1.0	1.6/1.0
SSE	1607/1.0	2.0/1.2	2.1/1.3
S	1385/0.86	2.2/1.4	2.2/1.4
SSW	1371/0.85	-	-
SW	1759/1.09	1.9/1.2	2.3/1.4
WSW	1745/1.08	1.6/1.0	1.6/1.0
W	1732/1.08	2.1/1.3	2.5/1.6
WNW	2313/1.44	2.5/1.5	2.8/1.7
NW	1662/1.03	4.1/2.5	4.1/2.5
NNW[(2)]	762/0.47	-	-

Notes:

1. Distance measure from the center of containment to site boundary based on the 2005 Land-Use Census (CCNPP, 2005).
2. Sector includes portions bordering or over water; distance measured are to the nearest shoreline property boundary.
3. No milk cows or goats identified within 5 miles of the site during the 2005 Land-Use Census (CCNPP, 2005). Meat animals assumed to be at location of critical receptor for dose assessment projections.

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)								
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]								
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)								
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]								
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.

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	~~2.24E-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.

Table 11.3-7 - {CCNPP Unit 3 Gaseous Effluent MEI Dose Summary}

10 CFR 50; Appendix I Section	Type of Dose	Calculated Dose	10 CFR 50; Appendix I Limit
II.B.1	Beta Air Dose mrad/yr	2.87	20
	Gamma Air Dose mrad/yr	0.356	10
II.B.2	External Total Body Dose mrem/yr(1)	0.226	5
	External Skin Dose mrem/yr(1)	2.11	15
II.C	Organ Dose mrem/yr(2)	0.868 (child bone)	15

Notes:

1. Exposure from plume and ground plane pathways at site boundary.
2. Exposure from ground plane, inhalation and meat pathways at site boundary; vegetable pathway at location of nearest garden (CCNPP, 2005).

~~Table 11.3-8 - {Holdup Times used in GALE Computer Code for the Gaseous Waste Cost Benefit Analysis}~~

	~~Reference Configuration Holdup Time (days)~~	~~Alternate Configuration Holdup Time (days)~~
~~Xenon~~	~~27.7~~	~~36.9~~
~~Krypton~~	~~1.67~~	~~2.23~~

Table 11.3-8 {Population Doses from Gaseous Effluents[1]}

Total Body Dose (person-rem)	Thyroid Dose (person-rem)
3.70	3.96

Note 1: Includes dose contribution from ingestion of milk, meat and vegetables.

Table 11.3-9 - {Population within 50 mi of the CCNPP Site for Year 2080 (Projected)[1]}

Sector	Distance (Miles)										
	0-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50	Total
N	0	0	0	0	0	0	0	15,715	182,399	289,551	**487,665**
NNE	0	0	0	0	0	0	807	12,969	27,008	18,816	**59,600**
NE	0	0	0	0	0	2	2,042	17,916	39,078	28,341	**87,379**
ENE	0	0	0	0	0	396	3,338	35,028	18,041	58,405	**115,208**
E	0	0	0	0	0	70	472	936	9,480	155,142	**166,100**
ESE	0	0	0	0	0	0	1,420	1,188	7,275	30,489	**40,372**
SE	0	0	0	0	377	0	366	0	2,062	14,333	**17,138**
SSE	0	0	66	880	6,497	9,349	955	1,591	2,273	3,713	**25,324**
S	0	134	56	379	3,014	11,698	41,024	4,561	10,858	14,438	**86,162**
SSW	0	86	415	286	409	10,657	32,348	8,689	17,538	13,653	**84,081**
SW	0	660	0	330	114	4,766	17,003	5,979	6,835	10,054	**45,741**
WSW	0	1,715	1,226	130	170	4,589	15,150	8,436	27,947	15,714	**75,077**
W	60	866	578	351	716	2,665	23,177	17,956	16,728	50,219	**113,316**
WNW	0	110	118	170	1,015	4,702	23,764	109,939	135,130	694,298	**969,246**
NW	0	866	2,014	2,079	574	4,842	23,172	38,106	546,610	2,577,585	**3,195,848**
NNW	0	0	0	0	0	1,436	41,128	45,609	191,174	570,966	**850,313**
Totals	**60**	**4,437**	**4,473**	**4,605**	**12,886**	**55,172**	**226,166**	**324,618**	**1,240,436**	**4,545,717**	**6,418,570**

[1] 50-mile population projections estimated using the SECPOP 2000 code in conjunction with U.S. census data and county census projection data for Delaware, Maryland, Virginia and the District of Columbia (NRC, 2003, USCB, 2005, USCB, 2000c, DEDO, 2000, MDP, 2005, VEC, 2006).

Table 11.3-18 - {Obtainable Dose Benefits for Gaseous Waste System Augment}

	Population Total Body Dose (Person-rem)	Population Thyroid Dose (Person-rem)
Baseline Configuration	3.70	3.96
Extra Carbon Delay Bed	3.67	3.93
Obtainable dose benefit by augment	0.03	0.03

Table 11.3-19 {Gaseous Waste System Augment Total-Body/Thyroid Dose Cost Benefit Analysis[(1)]}

Parameter	Value
Annual whole-body / thyroid collective dose benefit to the population within 50 miles of the CCNPP site.	0.03 person-rem
Nominal total collective dose over 30 years of operation (0.03 person-rem x 30 yr = 0.9 person-rem)	0.9 person-rem
Obtainable benefit from addition of radwaste processing and control option (0.9 person-rem x $1000/person-rem =$900)	$900
Cost Options for radwaste processing and control technology upgrade from Regulatory Guide 1.110	3-ton charcoal absorber
Direct cost for option using methodology in Regulatory Guide 1.110, Table A-1 (based on 1975 Dollars)	$67,000
Total O&M Annual Cost From Regulatory Guide 1.110, Table A-2 (based on 1975 Dollars)	Negligible
Total cost over 30 years of operation (direct cost + O&M×30 years)	$67,000
Benefit/Cost Ratio (Values greater than 1 should be included in plant system design) ($900 / $67,000 = 0.01)	0.01

Note:
1. Since the dose reduction benefit for both the total body and the thyroid give the same collective dose savings, the cost benefit results are directly applicable to both the total body and thyroid evaluations.

11.4 SOLID WASTE MANAGEMENT SYSTEM

This section of the U.S. EPR FSAR is incorporated by reference with the following supplements.

11.4.1 DESIGN BASIS

No departures or supplements.

11.4.1.1 Design Objective

No departures or supplements.

11.4.1.2 Design Criteria

No departures or supplements.

11.4.1.2.1 Capacity

The U.S. EPR FSAR includes the following COL Item in Section 11.4.1.2.1:

> A COL applicant that references the U.S. EPR design certification will address plant-specific commitments to address the long-term storage of LLRW beyond the provisions described in the U.S. EPR design certification when such storage capacity is exhausted and describe how additional onsite LLRW storage or alternate LLRW storage will be integrated in plant operations. To address the need for additional storage, the commitment will address the requirements of 10 CFR Part 20, Appendix B (Table 2, Column 1 and 2); dose limits of 10 CFR 20.1301, 20.1302, and 20.1301(e) in unrestricted areas; Part 20.1406(b) in minimizing the contamination of plant facilities and environs; and design objectives of Sections II.A, II.B, II.C, and II.D of Appendix I to 10 CFR Part 50. The design and operations of additional onsite storage capacity will be integrated in the plant-specific process control program and consider the guidance of SRP Section 11.4 and Appendix 11.4-A, Regulatory Guides 1.206, 4.21 and 1.143, IE Bulletin 80-10, industry standards, and NEI 08-08.

The COL Item is addressed as follows:

Should {Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operation Services, LLC} require additional LLRW storage capacity, then this section of the FSAR will be revised to describe how additional onsite LLRW storage or alternate LLRW storage will be integrated in plant operations. Any additional LLRW storage capacity required will address the requirements of 10 CFR Part 20, Appendix B (Table 2, Column 1 and 2); dose limits of 10 CFR 20.1301, 20.1302, and 20.1301(e) in unrestricted areas; Part 20.1406(b) in minimizing the contamination of plant facilities and environs; and design objectives of Sections II.A, II.B, II.C, and II.D of Appendix I to 10 CFR Part 50. Should additional onsite storage LLRW capacity be used, it will be integrated in the plant specific process control program and consider the guidance of SRP Section 11.4 and Appendix 11.4-A, Regulatory Guides 1.206, 4.21 and 1.143, IE Bulletin 80-10, industry standards, and NEI 08-08.

11.4.1.2.2 Quality Group Classification

No departures or supplements.

11.4.1.2.3 Seismic Design Classification

No departures or supplements.

11.4.1.2.4 Controlled Releases

No departures or supplements.

11.4.1.2.5 Mobile Systems

The U.S. EPR FSAR includes the following COL Item in Section 11.4.1:

> 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 solid waste management system (SWMS) processing equipment will include plant and site-specific information describing how design features and implementation of operating procedures for the SWMS will address the requirements of 10 CFR Part 20.1406(b) and guidance of SRP Section 11.4, Regulatory Guides 4.21 and 1.143, IE Bulletin 80-10, industry standards, and NEI 08-08.

The COL Item is addressed as follows:

Should {Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operation Services, LLC} choose to install and operate mobile skid-mounted equipment to connect to the permanently installed SWMS, then this section of the FSAR will be revised to include plant and site-specific information describing how design features and implementation of operating procedures for the SWMS address the requirements of 10 CFR Part 20.1406(b) and guidance of SRP Section 11.4, Regulatory Guides 4.21 and 1.143, IE Bulletin 80-10, industry standards, and NEI 08-08.

11.4.2 SYSTEM DESCRIPTION

No departures or supplements.

11.4.3 RADIOACTIVE EFFLUENT RELEASES

{This section of the U.S. EPR FSAR is incorporated by reference with the following supplement.

Solid wastes will be shipped from the site for burial at a NRC licensed burial site or to a licensed radioactive waste processing facility.

As of July 1, 2008, the Barnwell LLRW disposal facility in Barnwell, South Carolina no longer accepts Class Band C waste from sources in states outside of the Atlantic Compact. The only other operating disposal site in Richland, Washington, does not currently accept Class Band C wastes from outside the Northwest or Rocky Mountain LLRW Compacts. Maryland is affiliated with the Appalachian Compact.

CCNPP Unit 3 expects to enter into an agreement prior to initial criticality with an NRC-licensed facility that will process or otherwise accept Class Band C LLRW. For example, a site in Andrews County, Texas was recently licensed to accept Class Band C waste. For now, however, the site will only accept waste from Texas and Vermont.

In the event that no offsite disposal facility is available to accept Class Band 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 Band 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) and EPRI Operational Strategies to Reduce Class B/C Wastes (April 2007). These measures would extend the capacity of the Solid Waste Storage System to store Class Band 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 Band 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.

If additional onsite storage capacity for Class Band C were necessary, CCNPP Unit 3 could elect to construct a new temporary storage facility. The facility would meet applicable NRC guidance, including Appendix 11.4-A of the Standard Review Plan, "Design Guidance for Temporary Storage of Low-Level Waste." Such a facility would be located in an appropriate onsite location. The environmental impacts of constructing such a facility would be minimal and would be addressed at the time the facility was announced. The operation of a storage facility meeting the standards in Appendix 11.4-A would provide appropriate protection against releases, maintain exposures to workers and the public below applicable limits, and result in no significant environmental impact.

As an alternative to onsite storage, CCNPP Unit 3 could enter into a commercial agreement with a third-party contractor to process, store, own, and ultimately dispose of low-level waste generated as a result of CCNPP Unit 3 operations. Activities associated with the transportation, processing, and ultimate disposal of low level waste by the third-party contractor would necessarily comply with applicable laws and regulations in order to assure public health and safety and protection of the environment. In particular, the third-party contractor would conduct its operations consistent with applicable Agreement State or NRC regulations (e.g., 10 CFR Part 20), which assure that the radiological impacts from these activities would be acceptable. Environmental impacts resulting from management of low-level wastes are expected to be bounded by the NRC findings in 10 CFR 51.51(b) (Table S-3).

Table S-3 assumes that solid, low-level waste from reactors will be disposed of through shallow land burial, and concludes that this kind of disposal will not result in the release of any significant effluent to the environment.}

The U.S. EPR FSAR includes the following COL Item in Section 11.4.3:

> A COL applicant that references the U.S. EPR 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 Part 61 licensed low level waste (LLW) 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, BTP 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.

This COL Item is addressed as follows:

{CCNPP Unit 3} will adopt NEI 07-10A, "Generic FSAR Template Guidance for Process Control Program (PCP)," (NEI, 2009~~a~~). The milestone for development and implementation of the PCP is addressed in Table 13.4-1.

11.4.4 SOLID WASTE MANAGEMENT SYSTEM COST-BENEFIT ANALYSIS

No departures or supplements.

11.4.5 FAILURE TOLERANCE

No departures or supplements.

11.4.6 QUALITY ASSURANCE

No departures or supplements.

11.4.~~6~~7 REFERENCES

{~~No departures or supplements.~~ **NEI, 2009.** NEI 07-10A, "Generic FSAR Template Guidance for Process Control Program (PCP)", Nuclear Energy Institute, March, 2009.}

11.5 PROCESS AND EFFLUENT RADIOLOGICAL MONITORING AND SAMPLING SYSTEMS

This section of the U.S. EPR FSAR is incorporated by reference with the following supplements.

11.5.1 DESIGN BASIS

~~No departures or supplements.~~
The U.S. EPR FSAR includes the following COL Item in Section 11.5.1:

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

The COL Item is addressed as follows:

Should {Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operation Services, LLC} choose to install and operate mobile skid-mounted radiation monitoring and sampling systems connect to the permanently installed radioactive process and waste management systems, then this section of the FSAR will be revised to include plant and site-specific information describing how design features and implementation of operating procedures for the PERMSS address the requirements of 10 CFR Part 20.1406(b) and guidance of SRP Section 11.5, Regulatory Guides 4.21 and 1.143, IE Bulletin 80-10, ANSI/HPS-13.1-1999 and ANSI N42.18-2004, and NEI 08-08.

11.5.1.1 Design Objective

No departures or supplements.

11.5.1.2 Design Criteria

No departures or supplements.

11.5.2 SYSTEM DESCRIPTION

The U.S. EPR FSAR includes the following COL Item in Section 11.5.2:

> A COL applicant that references the U.S. EPR design certification will fully describe, at the functional level, elements of the process and effluent monitoring and sampling programs required by 10 CFR 50 Appendix I, and 10 CFR 52.79 (a)(16). This program description, Offsite Dose Calculation Manual (ODCM), will specify how a licensee controls, monitors, and performs

radiological evaluations of releases. The program will also document and report radiological effluents discharged to the environment.

This COL Item is addressed as follows:

{CCNPP Unit 3} will adopt NEI 07-09A, "Generic FSAR Template Guidance for Offsite Dose Calculation Manual (ODCM) Program Description," (NEI, 2009b). The milestone for development and implementation of the ODCM is addressed in Table 13.4-1.

{Additionally, a notification process that shares release and release rates information between CCNPP Units 1 and 2 and CCNPP Unit 3 will be established between the two licensees on the property to ensure the site dose and dose rate limits will not be exceeded. The notification requirements and cross company information exchange and tracking will be incorporated into the respective licensees' implementing procedures. This process will ensure that each organization is aware of the overall site releases for normal as well as Anticipated Operational Occurrences and each plant will have the ability to ensure that site wide releases will not exceed the applicable limits of 40CFR190 and 10CFR20.}

The U.S. EPR FSAR includes the following COL Item in Section 11.5.2:

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

The COL Item is addressed as follows:

{Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operation Services, LLC} will develop PERMSS subsystem's LLDs or detection sensitivities, and set-points (alarms and process termination/diversion) for liquid and gaseous process radiation monitoring equipment not covered by the ODCM based on plant and site specific conditions and operating characteristics of each installed radiation monitoring subsystem.

The U.S. EPR FSAR includes the following COL Item in Section 11.5.2:

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

The COL Item is addressed as follows:

{Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operation Services, LLC} will develop a plant-specific process and effluent radiological sampling and analysis plan for systems not covered by the ODCM, including provisions describing sampling and analytical frequencies, and radiological analyses for the expected types of liquid and gaseous samples and waste media generated by the LWMS, GWMS, and SWMS.

11.5.3 EFFLUENT MONITORING AND SAMPLING

No departures or supplements.

11.5.4 PROCESS MONITORING AND SAMPLING

No departures or supplements.

11.5.5 REFERENCES

{**CFR, 2008a**. Domestic Licensing of Production and Utilization Facilities, Title 10, Code of Federal Regulations, Part 50, U.S. Nuclear Regulatory Commission, 2008.

CFR, 2008b. Contents of Applications; Technical Information in Final Safety Analysis Report, Title 10, Code of Federal Regulations, Part 52.79, U.S. Nuclear Regulatory Commission, 2008.

~~**NEI, 2009a.** NEI 07-10A, Generic FSAR Template Guidance for Process Control Program (PCP), Revision 0, Nuclear Energy Institute, March 2009.~~

NEI, 2009~~b~~. NEI 07-09A, Generic FSAR Template Guidance for Offsite Dose Calculation Manual (ODCM) Program Description, Revision 0, Nuclear Energy Institute, March 2009.}

COLA Part 10 will be revised as follows:

. . .

COL Item 10.3-2 in Section 10.3.6.3

{Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operating Services, LLC} will develop and implement a FAC condition monitoring program that is consistent with Generic Letter 89-08 and NSAC-202L-R3 for the carbon steel portions of the steam and power conversion systems that contain water or wet steam prior to initial fuel loading.

COL Item 11.5-3 in Section 11.5.2

{Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operation Services, LLC} will develop PERMSS subsystem's LLDs or detection sensitivities, and setpoints (alarms and process termination/diversion) for liquid and gaseous process radiation monitoring equipment not covered by the ODCM based on plant and site specific conditions and operating characteristics of each installed radiation monitoring subsystem prior to initial fuel load.

COL Item 14.2-2 in Section 14.2.11

{Calvert Cliffs 3 Nuclear Project, LLC and UniStar Nuclear Operating Services, LLC} shall develop a test program that considers the components identified in FSAR Section 14.2.11 and shall provide copies of approved test procedures to the NRC at least 60 days prior to their scheduled performance date.

. . .