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UniStar
NUCLEAR ENERGY

10 CFR 50.4
10 CFR 52.79

April 14, 2010

UN#10-103

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,
Responses to RAI No. 209, Liquid Waste Management System, and
RAI No. 210, Gaseous Waste Management System

References:
1) Surinder Arora (NRC) to Robert Poche (UniStar Nuclear Energy), "Final RAI No. 209 CHPB 4193," email dated February 5, 2010
2) Surinder Arora (NRC) to Robert Poche (UniStar Nuclear Energy), "Final RAI No. 210 CHPB 4194," email dated February 5, 2010
3) UniStar Nuclear Energy Letter UN#10-054, from Greg Gibson to Document Control Desk, U.S. NRC, RAI No. 209, Question 11.02-1, Liquid Waste Management System, RAI No. 210, Question 11.03-1, Gaseous Waste Management System, dated March 3, 2010

The purpose of this letter is to respond to the requests for additional information (RAIs) identified in the NRC e-mail correspondence to UniStar Nuclear Energy, dated February 5, 2010 (References 1 and 2). RAI 209 addresses the Liquid Waste Management System, as discussed in Section 11.2 of the Final Safety Analysis Report (FSAR), and RAI 210 addresses the Gaseous Waste Management Systems, as discussed in Section 11.3 of the FSAR, as submitted in Part 2 of the Calvert Cliffs Nuclear Power Plant (CCNPP) Unit 3 Combined License Application (COLA), Revision 6. Reference 3 indicated that the response to RAI 209, Question 11.02-1 and RAI 210, Question 11.03-1 would be provided by April 16, 2010.

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Enclosure 1 provides our response to RAI No. 209, Question 11.02-1. Enclosure 2 provides our response to RAI No. 210, Question 11.03-1. The responses to both RAIs include revised COLA content. Based on the extent of the changes, Enclosure 3 is provided as a complete replacement for FSAR Chapter 11, Radioactive Waste Management. A Licensing Basis Document Change Request has been initiated to incorporate these changes into a future revision of the COLA.

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

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

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

Executed on April 14, 2010

Greg Gibson

Enclosures:
1) Response to NRC Request for Additional Information, RAI No. 209, Liquid Waste Management System, Question 11.02-1, Calvert Cliffs Nuclear Power Plant, Unit 3
2) Response to NRC Request for Additional Information, RAI No. 210, Gaseous Waste Management System, Question 11.03-1, Calvert Cliffs Nuclear Power Plant, Unit 3
3) Calvert Cliffs Nuclear Power Plant, Unit 3, FSAR Chapter 11, Radioactive Waste Management

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
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GTG/VWH/mdf

Enclosure 1

**Response to NRC Request for Additional Information,
RAI No. 209, Liquid Waste Management System, Question 11.02-1,
Calvert Cliffs Nuclear Power Plant, Unit 3**

RAI No 209

Question 11.02-1

CCNPP-3 FSAR Tier 2, Rev. 6, Sections 11.2.2 and 11.2.3 present information on liquid effluent discharges and doses to members of the public by incorporating by reference the corresponding FSAR sections of the U.S. EPR design certification. A comparison of the information presented in CCNPP-3 FSAR Tier 2, Rev. 6, Sections 11.2.2, 11.2.3, 10.4.5 and 2.1.1.3, and FSAR Figure 10.4-6 indicates that the information presented in the corresponding sections of the U.S. EPR is different and inconsistent with the characteristics of the Calvert Cliffs site used in confirming compliance with NRC regulations. Specifically, the following items were noted:

a. CCNPP-3 FSAR Tier 2, Section 11.2.3 does not address site-specific conditions in confirming that routine liquid effluent releases will comply with Part 20 (App. B, Table 2, Col. 2) effluents concentration limits. The CCNPP-3 FSAR should compare all design features and assumptions applied in Section 11.2 of the U.S. EPR Tier 2 FSAR and identify those features that are applicable to the Calvert Cliffs site and, for those that are not, provide site specific parameters with appropriate justifications. For example, a review of U.S. EPR, Rev. 1, FSAR Tier 2, Section 11.2.3 and Tables 11.2-5 and 11.2-9 indicates that dose results are based on different assumptions, such as discharge flow rates of 100 ft3/s, 20 ft3/s, and 39.3 ft3/s under different conditions; use of irrigation pathway; use of fresh water site condition for individual dose estimates and salt water site conditions for population doses; and use of a dilution factor of 365 in estimating population doses. In CCNPP-3 FSAR Tier 2, Section 11.2.3, the applicant has not included a comparative analysis to confirm that assumptions and parameters used in dose modeling described in the U.S. EPR Rev. 1, FSAR, Tier 2, Section 11.2.3 apply to the specific conditions of the Calvert Cliffs site, including confirmation of offsite dose receptors based on the results of the most current the land-use census. In addition, Sections 5.4.1 and 5.4.2 of the CCNPP-3 ER presents assumptions and parameters that are different than that described in Section 11.2.3 of the U.S. EPR FSAR. As a result, the staff concludes that the regulatory compliance analyses presented in U.S. EPR Rev.1, FSAR Section 11.2 cannot be incorporated by reference in CCNPP-3 FSAR Tier 2, Section 11.2.3 as a substitute evaluation of radiological impacts associated with liquid effluent releases and compliance with NRC regulations.

b. CCNPP-3 FSAR Tier 2, Rev. 6, Section 10.4.5 and FSAR Figure 10.4-6 present information on the liquid effluent discharge path. A review of this information indicates that the description of the liquid effluent path is incomplete, starting from the boundary of the Radioactive Waste Processing Building (RWB) to the point of actual discharge into the environment. CCNPP-3 FSAR, Tier 2, Section 11.2.2 does not define the boundary of the discharge path beyond the LWMS effluent radiation monitor and isolation valve to the point of controlled discharge into the Chesapeake Bay for those portions of the balance-of-plant system that are site-specific, given the guidance of Regulatory Guides 1.143 and 1.206 and acceptance criteria of SRP Section 11.2. CCNPP-3 FSAR Tier 2, Section 11.2.2 should be revised to include descriptions of all design features and assumptions that are applicable to the Calvert Cliffs site and provide a complete description of the liquid effluent discharge path to the Chesapeake Bay.

c. A comparison of U.S. EPR, Rev. 1, FSAR Tier 2, Section 11.2.3.3 and Figures 11.2-1 and 9.2.5-1 against CCNPP-3 FSAR Sections 9.2.4, 9.2.5, 10.4.5, and 11.2 and Figures 9.2-2, 9.2-3, and 10.4-6 indicates that dilution streams from other plant systems are not fully accounted in the descriptions of the discharge path. It is not clear if the discharge from the sanitary waste water treatment plant is before or after the connection of the LWMS effluent discharge line to the piping going to the seal well. CCNPP-3 FSAR Sections 9.2.5 and 10.4.5 and Figures 9.2-3 and 10.4-6 do not describe the impact on plant blowdown rates and dilution factors in the event that the "alternate blowdown path" is selected during plant operation, and other plant process effluents (e.g., Turbine Building Plant Drainage). As result, the FSAR does not account for all balance-of-plant dilution streams going to the retention basin and seal well, does not provide an estimate of the blowdown rate out of the retention basin, does not describe the "alternate blowdown path" and its expected flow rates, and does not list the flow rate from the sanitary waste water treatment plant with which liquid radioactive effluent are mixed prior discharge to the Chesapeake Bay via the CWS outfall. As a result, the description of the liquid effluent discharge path and site-specific conditions are different for CCNPP-3 than that described in the U.S. EPR FSAR and, consequently, the staff concludes that the regulatory compliance analyses presented in U.S. EPR FSAR Rev. 1, Section 11.2 cannot be incorporated by reference in CCNPP-3 FSAR Tier 2, Section 11.2.3 as a substitute description of effluent releases and basis of associated dilution factors in assessing radiological impacts associated with liquid effluent releases and compliance with NRC regulations.

d. Under CCNPP-3 FSAR Tier 2, Section 2.1.1.3, the definition of the plant boundary for radioactive effluent releases does not identify the location of the CWS outfall in the Chesapeake Bay for liquid effluents. Rather, the discussion addresses compliance with Parts 34(a)(1)(ii)(D)(1) and Part 100 regulations associated with gaseous effluent releases during accident conditions and not during routine effluent releases. The commitment to demonstrate compliance with NRC regulations is incomplete as it does not identify the requirements of Part 20 (App. B, Table 2, Col. 2) for liquid effluents released during routine operation; and offsite dose limits to members of the public under Parts 20.1301 and 20.1302; Part 20.1301(e) in complying with 40 CFR Part 190; and design objectives of Sections II.A and II.D of Appendix I to Part 50.

In light of the above, the applicant is requested to evaluate the following and revise the CCNPP-3 COLA by:

1. presenting in FSAR Tier 2, Section 11.2.2 descriptions of design features that are applicable to the Calvert Cliffs site, including balance-of-plant features, definition of the effluent discharge path from the boundary of the RWB to the point of release in the Chesapeake Bay, descriptions of plant blowdowns and other plant process effluents with which radioactive liquid effluents are mixed before discharge into the environment, associated plant blowdown and effluent flow rates used in assessing radiological impacts, change of the in-plant dilution rate whenever the plant operates in the "alternate blowdown path," confirm that radioactive liquid effluents will not be routed to the retention basin before discharge into the Chesapeake bay under specific operating conditions, and provide information supporting the applied Chesapeake Bay dilution factor.

2. using Calvert Cliffs balance-of-plant design features and site-specific information, revise CCNPP-3 FSAR Tier 2, Section 11.2.3 and describe the evaluation and present results demonstrating compliance with the effluent concentration limits of Part 20 (App. B, Table 2,

Col. 2); and dose limits to members of the public under Parts 20.1301 and 20.1302; Part 20.1301(e) in complying with 40 CFR Part 190 for all exposure pathways; design objectives of Section II.A of Appendix I to Part 50 for dose receptors based on the current land-use census; and cost-benefit analysis of Section II.D of Appendix I to Part 50 and COL Information Item 11.2-1 using updated collective population doses. The applicant is requested to provide sufficient information for the staff to conduct an independent evaluation of the applicant's analyses in complying with NRC regulations and confirm consistency with the corresponding results presented in Section 5.4 of the CCNPP Unit 3 ER. The information should include assumptions used in calculating doses to maximally exposed individuals and collective population doses, and site-specific information on dose receptors and exposure pathways and default parameters used to calculate doses using Regulatory Guide 1.109 and the LADTAP II computer code (NUREG/CR-4013).

3. updating the regulatory description of the plant boundary for radioactive liquid effluents in CCNPP-3 FSAR Tier 2, Section 2.1.1.3 by including the requirements of Part 20 (App. B, Table 2, Col. 2), Parts 20.1301 and 20.1302, Part 20.1301(e), and Appendix I to Part 50. (Note: This observation also applies to gaseous effluents. It is recommended that as part of this RAI, the applicant extends the revision of FSAR Section 2.1.1.3 to address as well gaseous effluents generated during routine plant operation.).

Response

1. CCNPP Unit 3 FSAR Section 11.2, Liquid Waste Management System, will be updated to include the site-specific balance-of-plant features related to the effluent discharge path from the boundary of the radioactive waste building (RWB) to the point of release in the Chesapeake Bay. Section 11.2 provides descriptions of plant blowdown paths and other plant process effluents with which radioactive liquid effluents are mixed before discharge into the environment, including effluent flow rates. Radioactive liquid effluents are not routed to the retention basin before discharge into the Chesapeake Bay. RWB effluents flow to a seal well where the effluent mixes with other plant effluents immediately prior to the environmental release. The discharge path and flow rates will be described in CCNPP Unit 3 FSAR Section 11.2.3, Radioactive Effluent Releases. The applied Chesapeake Bay dilution factors described in this section are based on a thermal mixing zone analysis and dilution study for the Chesapeake Bay at the Calvert Cliffs Nuclear Power Plant site.

2. The CCNPP Unit 3 FSAR Section 11.2.3 will be updated using Calvert Cliffs balance-of-plant design features and site-specific information as shown in Enclosure 3. The revised CCNPP Unit 3 FSAR Section 11.2.3 describes the evaluations and presents the results that demonstrate compliance with 10 CFR 20 Parts 20.1301 and 20.1302 for doses to members of the public in the unrestricted area. Compliance with 40 CFR Part 190 in accordance with 10 CFR Part 20.1301(e) is also demonstrated in Section 11.2.3. The results demonstrate CCNPP Unit 3 meets the ALARA design objectives of 10 CFR Part 50 Appendix I. CCNPP Unit 3 site-specific maximally exposed individual and population dose analyses have been performed together with a site-specific cost-benefit analysis. The analyses in the revised Section 11.2.3 are consistent with Section 5.4 of the CCNPP Unit 3 ER except for the following input values.

Parameter	FSAR Section 11.2.3	ER Section 5.4
Population (50 miles)[1]	6.42E+06	8.12E+06
Plant Liquid Effluent (gpm)[2]	21,019	19,426
Far-Field Dilution Factor	296	365

Notes:

1. The population, plant liquid effluent and far-field dilution factor values for CCNPP Unit 3 have been updated since the calculations for ER Section 5.4 were performed. CCNPP Unit 3 COLA ER Section 5.4 will be revised to reflect that the populations used to calculate doses in ER Section 5.4 are conservative with respect to the populations presented in CCNPP Unit 3 COLA ER Section 2.5.1. The CCNPP Unit 3 FSAR Section 11.2.3 analyses are based on the most recent input values.
2. CCNPP Unit 3 COLA ER Table 5.4-1 will be revised to add a footnote specifying that a conservative effluent discharge flow rate of 17,632 gpm (which does not include the discharge from the desalination plant) was used in the liquid effluent dose analyses.

The maximum liquid effluent release concentrations reported in U.S. EPR FSAR Table 11.2-7, Comparison of Annual Average Liquid Release Concentrations with 10 CFR Part 20 Concentration Limits, are incorporated by reference with the following justification:

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 revised CCNPP Unit 3 FSAR 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.

3. The CCNPP Unit 3 FSAR Section 2.1.1.3 will be revised to include the requirements for liquid and gaseous radionuclide effluent concentrations at the plant interface with the environment, to meet the concentration limits of 10 CFR Part 20, Appendix B, Table 2. The section will also be revised to include the dose limits for individual members of the public required by 10 CFR Parts 20.1301 and 20.1302 and the EPA environmental radiation standards in 40 CFR Part 190 as described in 10 CFR Part 20.1301(e). The ALARA dose objectives of 10 CFR Part 50, Appendix I are also included in the update.

COLA Impact

CCNPP Unit 3 FSAR Section 2.1.1.3 will be revised as follows:

The exclusion area is considered the restricted area. The exclusion area boundary (EAB) for CCNPP Unit 3 is a circle with a radius of 3,324 ft (1,013 m) or approximately 0.6 mi (1.0 km) as depicted on Figure 2.1-1. The EAB establishes a radius of at least 0.5 mi (0.8 km) from the potential release points. CCNPP Unit 3 liquid and gaseous radionuclide effluent concentrations at the plant interface with the environment from routine operation meet the concentrations limits of 10 CFR Part 20, Appendix B, Table 2. The dose to individual members of the public in the unrestricted area from routine operations meet the limits of 10 CFR Part 20.1301, 10 CFR Part 20.1302 and the EPA environmental radiation standards in 40 CFR Part 190 as described in 10 CFR Part 20.1301(e). CCNPP Unit 3 also meets the ALARA dose objectives of 10 CFR Part 50, Appendix I. In accordance with 10 CFR Part 50.34(a)(1)(ii)(D)(1), an individual assumed to be located at any point on the EAB will not receive a radiation dose in excess of 25 rem TEDE over any two hour period following a postulated fission product release into the containment (CFR, 2007b). The EAB is established in accordance with 10 CFR 100.21(a) and 10 CFR 100.3 (CFR, 2007c).

This area will be conspicuously posted and administrative procedures, including security patrols will be imposed to control ~~assess~~ access to the area. Section 2.1.2.1 provides additional discussion regarding the control of access to the EAB.

CCNPP Unit 3 FSAR Section 11.2, Liquid Waste Management System, will be replaced with Enclosure 3 of this document.

CCNPP Unit 3 ER Table 5.4-1, Liquid Pathway Parameters, will be revised to add a footnote specifying that a conservative effluent discharge flow rate of 17,632 gpm (which does not include the discharge from the desalination plant) was used in the liquid effluent dose analyses, as shown:

Table 5.4-1—Liquid Pathway Parameters

Description	Parameter
Effluent Discharge Flow (normal)[1][10]	19,426 gpm (73,535 lpm)
Source Term[2]	See Section 3.5
Mixing Ratios (in Chesapeake Bay)	See Tables 5.4-22 and 5.4-23
Shore Width factor[3]	1.0
Transit Time; shoreline, boating swimming	0.0 (assumed in calculations) See Table 5.4-AA for transit times
Commercial Fish harvest[4]	152.2E+06 kg/yr (3.36E+08 lbs/yr)
Commercial invertebrate harvest[5]	26.4E+06 kg/yr (5.82E+07 lbs/yr)
Sport Fishing harvest[6]	1.29E+06 kg/yr (2.84E+06 lbs/yr)
Sport Invertebrate harvest[7]	1.58E+06 kg/r (3.48E+06 lbs/yr)
Recreational Usage for 50 mi (80 km) population : Shoreline[8]	37,843,909 Person-hrs/yr
Recreational Usage for 50 mi (80 km) population : Boating[9]	44,285,377 Person-hrs/yr
Recreational Usage for 50 mi (80 km) population : Swimming[8]	30,133,372 Person-hrs/yr

Notes:

1. See Section 3.3.
2. See Section 3.5 for annual expected effluent releases per the GALE code.
3. From Regulatory Guide 1.109, Table A-2 for a tidal basin.
4. Projected Maryland and Virginia edible total commercial fish landings from Table 2.2-8.
5. Projected Maryland and Virginia edible total commercial shellfish (invertebrate) landings from Table 2.2-8.
6. Projected Maryland and Virginia edible total recreational fish landings from Table 2.2-9.
7. Projected Maryland and Virginia edible total recreational shellfish (invertebrate) landings from Table 2.2-9.
8. Derived from NOAA National Ocean Survey data and average individual usage factors plus age distributions from Regulatory Guide 1.109.
9. Derived from Virginia and Maryland boat registrations and U.S. Coast Guard usage statistics.
10. A conservative flow rate of 17,632 gpm (which does not include the discharge from the desalination plant) was used in the liquid effluent dose analyses.

CCNPP Unit 3 COLA ER Table 5.4-4, Gaseous Pathway Parameters, will be revised to add a footnote clarifying that the populations used to calculate doses in ER Section 5.4 are conservative with respect to the populations presented in CCNPP Unit 3 COLA ER Section 2.5.1, as shown.

Table 5.4-4—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
Absolute Humidity (g/m^3)	8.4
Average Temperature in growing Season: °F (°C)(1)	66.8 (19.3)
Population Distribution(5)	Section 2.5.1
Milk Production within 50 mi (80 km): kg/yr (lbs/yr)(2)	2.34E+08 (5.16E+08)
Meat Production within 50 mi (80 km): kg/yr (lbs/yr)(3)	3.58E+07 (7.89E+07)
Vegetable/Grain Production within 50 mi (80 km): kg/yr (lbs/yr)(4)	5.62E+11 (1.24E+12)

Notes:

1. The growing season is the span of months when the temperature is above freezing for all days during the month. This occurs from April through October.
2. From 50 mi (80 km) cow and goat milk production shown on Table 2.2-1 and Table 2.2-2.
3. From 50 mi (80 km) meat and poultry production shown on Table 2.2-3 and Table 2.2-4.
4. From 50 mi (80 km) grain and leafy vegetable production shown on Table 2.2-5 and Table 2.2-6.
5. The dose calculations were performed using population distributions that are conservative with respect to the population distributions presented in Section 2.5.1.

CCNPP Unit 3 COLA Part 7, Departures and Exemption Requests, will be revised to add the departures identified in Section 11.2 and 11.3 as shown.

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:

1. Maximum Ground Water Level
2. Maximum Differential Settlement (across the basemat)
3. Maximum Annual Average Atmospheric Dispersion Factor (0.5 mile – limiting sector)
4. Accident Atmospheric Dispersion Factor (0-2 hour, Low Population Zone, 1.5 miles)

:

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.

Enclosure 2

**Response to NRC Request for Additional Information,
RAI No. 210, Gaseous Waste Management System, Question 11.03-1,
Calvert Cliffs Nuclear Power Plant, Unit 3**

RAI No 210

Question 11.02-1

CCNPP-3 FSAR Tier 2, Rev. 6, Section 11.3.3 presents information on gaseous effluent releases and doses to members of the public by incorporating by reference the corresponding FSAR sections of the U.S. EPR design certification. A comparison of the information presented in CCNPP-3 FSAR Tier 2, Rev. 6, Sections 11.3.2, 2.3.5, and 2.1.1.3, and FSAR Figure 2.1-1 indicates that the information presented in the corresponding sections of the U.S. EPR is different and inconsistent with the characteristics of the Calvert Cliffs site used in confirming compliance with NRC regulations. Specifically, the following observations were noted:

a. CCNPP-3 FSAR Tier 2, Section 11.3.3 does not address site-specific conditions in confirming that routine gaseous effluent releases will comply with Part 20 (App. B, Table 2, Col. 1) gaseous effluents concentration limits. The CCNPP-3 FSAR should compare all assumptions used in Section 11.3 of the U.S. EPR Tier 2 FSAR and identify conditions and assumptions that are applicable to the Calvert Cliffs site and, for those that are not, provide site specific parameters with appropriate justifications. A review of U.S. EPR, Rev. 1, FSAR Tier 2, Section 11.3.3 and Tables 11.3-4 and 11.3-7 indicates that dose results are based on different assumptions. Such differences include locations and distances for the nearest garden, nearest animal (milk and meat), and nearest resident; different EAB atmospheric dispersion and deposition parameters; different annual vegetable and grain production rates within 50 miles of the site; different 50-mile population projections; and U.S EPR FSAR Tier 2, Section 11.3.3 does not provide atmospheric dispersion and deposition parameters for population within 50 miles of the site.

b. In CCNPP-3 FSAR Tier 2, Section 11.3.3, the applicant has not included a comparative analysis to confirm that the assumptions and parameters used in dose modeling described in the U.S. EPR Rev. 1, FSAR, Tier 2, Section 11.3.3 apply to the specific conditions of the Calvert Cliffs site, including confirmation of offsite dose receptors based on the current land-use census. In addition, Sections 5.4.1 and 5.4.2 of the CCNPP-3 ER presents assumptions and parameters that are different than that describe in Section 11.3.3 of the U.S. EPR FSAR. As a result, the description of the gaseous effluent discharges and site-specific conditions are different for CCNPP-3 than that described in the U.S. EPR FSAR and, consequently, the staff concludes that the regulatory compliance analyses presented in U.S. EPR FSAR Rev. 1, Section 11.3 cannot be incorporated by reference in CCNPP-3 FSAR Tier 2, Section 11.3.3 as a substitute assessment of radiological impacts associated with gaseous effluent releases and compliance with NRC regulations.

In light of the above, the applicant is requested to evaluate the following and revise the CCNPP-3 COLA by:

1. presenting in FSAR Tier 2, Section 11.3.3 descriptions of Calvert Cliffs site-specific features used to estimate doses to members of the public and populations, including descriptions of offsite dose receptors and exposure pathways based on the current land-use census; locations and distances of dose receptors and exposure pathways from CCNPP-3; sources and estimates of direct radiation exposures from CCNPP-3 building and facilities and materials to members of the public; annual average atmospheric dispersion and deposition parameters for all identified offsite dose receptors and population within a 50-mile radius of CCNPP-3; assumptions used in calculating doses to maximally exposed individuals and

collective population doses; and site-specific and default parameters used to calculate doses using Regulatory Guides 1.109 and 1.111 and the GASPAR II computer code (NUREG/CR-4653).

2. using Calvert Cliffs site-specific information, revise CCNPP-3 FSAR Tier 2, Section 11.3.3 and describe the evaluation and present results demonstrating compliance with the effluent concentration limits of Part 20 (App. B, Table 2, Col. 1); and dose limits to members of the public under Parts 20.1301 and 20.1302; Part 20.1301(e) in complying with 40 CFR Part 190 for all exposure pathways; design objectives of Sections II.B and II.C of Appendix I to Part 50 for dose receptors based on the current land-use census; and cost-benefit analysis of Section II.D of Appendix I to Part 50 and COL Information Item 11.3-1 using updated collective population doses. The applicant is requested to provide sufficient information for the staff to conduct an independent evaluation of the applicant's analyses in complying with NRC regulations and confirm consistency with the corresponding results presented in Section 5.4 of the CCNPP Unit 3 ER. The information should include assumptions used in calculating doses to maximally exposed individuals and collective population doses, and site-specific information on dose receptors and exposure pathways and default parameters used to calculate doses using Regulatory Guides 1.109 and 1.111 and the GASPAR II computer code (NUREG/CR-4653).

Response

1. CCNPP Unit 3 FSAR Section 11.3.3, Radioactive Effluent Releases, will be revised as shown in Enclosure 3 to include the site-specific features and calculated doses to members of the public and populations related to the gaseous effluent discharges.

   The changes to FSAR Section 11.3.3 include the following Calvert Cliffs site-specific features used to estimate doses to members of the public and populations:

   - Descriptions (including sector and distance relative to CCNPP Unit 3) of offsite dose receptors and exposure pathways used in the gaseous effluent dose analysis based on the 2007 land-use census
   - sources and estimates of direct radiation exposures from CCNPP Unit 3 building and facilities and materials to members of the public
   - annual average atmospheric dispersion and deposition parameters for identified offsite dose receptors and population within a 50-mile radius of CCNPP Unit 3
   - assumptions used in calculating doses to maximally exposed individuals and collective population doses, and
   - site-specific and default parameters used to calculate doses using Regulatory Guide 1.109, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I, and Regulatory Guide 1.111, Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors and the GASPAR II computer code (NUREG/CR-4653).

2. The CCNPP Unit 3 FSAR Tier 2, Section 11.3.3 will be revised to include Calvert Cliffs balance-of-plant design features and site-specific information. As shown in Enclosure 3, Section 11.3.3 describes the evaluations and presents results demonstrating compliance with the dose limits to members of the public in the unrestricted area under 10 CFR 20

Parts 20.1301 and 20.1302 and 10 CFR Part 20.1301(e) in accordance with 40 CFR Part 190 for all exposure pathways. The results demonstrate that CCNPP Unit 3 meets the ALARA design objectives of 10 CFR Part 50, Appendix I. CCNPP Unit 3 site maximally exposed individual and population doses have been performed together with a site-specific cost-benefit analysis. The analyses in Section 11.3.3 are consistent with Section 5.4 of the CCNPP Unit 3 ER except for the following input values:

Parameter	FSAR Section 11.2.3		ER Section 3.5 / 5.4
Kr-85m annual release rate[a]	1.6E+02		1.5E+02
Kr-87 annual release rate[a]	5.6E+01		5.3E+01
Kr-88 annual release rate[a]	1.9E+02		1.8E+02
Xe-133m annual release rate[a]	1.9E+02		1.8E+02
Xe-135m annual release rate[a]	1.5E+01		1.4E+01
Population (50 miles)[b]	6.42E+06		8.12E+06
Site boundary dispersion/deposition factors[c]	Undecayed χ/Q (sec/m^3)	1.08E-06	1.05E-06
	Depleted χ/Q (sec/m^3)	9.73E-07	9.49E-07
	D/Q (1/m^2)	1.06E-08	1.05E-08
Nearest Garden dispersion/deposition factors[c]	Undecayed χ/Q (sec/m^3)	8.71E-07	4.97E-07
	Depleted χ/Q (sec/m^3)	7.86E-07	4.58E-07
	D/Q (1/m^2)	8.23E-09	5.51E-09
Nearest Meat dispersion/deposition factors[c]	Undecayed χ/Q (sec/m^3)	1.08E-06	1.05E-06
	Depleted χ/Q (sec/m^3)	9.73E-07	9.49E-07
	D/Q (1/m^2)	1.06E-08	1.05E-08
50-mile meat production[d]	3.02E+08		3.58E+07
50-mile milk production[d]	2.48E+08		2.34E+08
50-mile vegetable production[d]	9.49E+08		5.62E+11

[a] Noble gas release rates updated based on updated containment low flow purge rate.
[b] The population values for CCNPP Unit 3 have been updated since the calculations for ER Section 5.4 were performed. CCNPP Unit 3 COLA ER Table 5.4-4 will be revised to reflect that the populations used to calculate doses in ER Section 5.4 are conservative with respect to the populations presented in CCNPP Unit 3 COLA ER Section 2.5.1.
[c] Dispersion/deposition factors updated to include most recent meteorological data.
[d] 50-mile production values updated to reflect corrected values.

The CCNPP Unit 3 FSAR Section 11.3.3 analyses are based on the most recent input values.

The maximum gaseous effluent release concentrations reported in U.S. EPR FSAR Table 11.2-6, Dose Commitment Due to Liquid Effluent Releases, are incorporated by reference with the following justification:

The maximum release concentrations provided in U.S. EPR FSAR Table 11.3-6, Comparison of Annual Average Gaseous Release Concentrations with 10 CFR Part 20 Concentration Limits, 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 CCNPP Unit 3 FSAR Table 11.3-1, Locations and Atmospheric Dispersion/Deposition Factors for Gaseous Effluent Maximum Dose Evaluations, (Enclosure 3). Therefore, the resulting gaseous effluent release concentrations for CCNPP

Unit 3 are bounded by those reported in U.S. EPR FSAR Table 11.3-6 and are thereby less than the limits of 10 CFR Part 20, Appendix B, Table 2.

COLA Impact

CCNPP Unit 3 FSAR Section 11.3, Gaseous Waste Management System, will be revised as shown in Enclosure 3.

CCNPP Unit 3 Part 7, Departures and Exemption Requests, will be revised as shown in the response to RAI 209, Question 11.02-1 (Enclosure 1).

Enclosure 3

Calvert Cliffs Nuclear Power Plant, Unit 3,
FSAR Chapter 11, Radioactive Waste Management

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}

11.2.3 RADIOACTIVE EFFLUENT RELEASES

{This section of the U.S. EPR FSAR is incorporated by reference with the following departure: 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: 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 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 21,008 gpm, resulting in a total average flow of 21,019 gpm for liquid effluents discharged to the bay. Retention basin flow provides dilution flow to discharged treated liquid radwaste. As shown in Table 11.2-1, a near-field dilution factor of 13.3 was utilized for calculating the maximum individual dose to man for exposures associated with fish and invertebrate ingestion and boating pathways. For swimming and shoreline exposure pathways, an environmental dilution factor of 58 was applied for the nearest shore with the minimum tidal average mixing. For members of the public under Appendix I to 10 CFR 50 who may be associated with ships in the Chesapeake Bay that use desalinization of sea water to create drinking water, a conservative discharge dilution factor of 296 to 1 was applied to the annual consumption quantities for four ages groups (730, 510, 510 and 330 liters/year for adults, teens, children and infants, respectively). These dilution factors are based on a submerged, multi-port diffuser (with three nozzles), with a discharge line situated

approximately 550 ft off the near shoreline with the nozzles directed out into the Chesapeake Bay and into the overhead water column.

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:
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 doses calculated by the LADTAP II code meet the 10 CFR 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 seven 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

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

This section of the U.S. EPR FSAR is incorporated by reference with the following supplements: 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 U.S. EPR FSAR includes the following COL item in Section 11.2.4:

> A COL applicant that references the U.S. EPR design certification will 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.

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 methodology of Regulatory Guide 1.110 was used to perform a site-specific cost benefit analysis to satisfy these requirements.

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

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

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.}

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)	200 hr/yr
Swimming usage (all age groups)	100 hr/yr
Boating usage (all age groups)	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
Transit time for all pathways	0 hr

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

Table 11.2-2 {Detailed Dose Commitment Results By Age Group and Organs Due to Liquid Effluent Releases}

Pathway	Skin (mrem/yr)	Bone (mrem/yr)	Liver (mrem/yr)	Total Body (mrem/yr)	Thyroid (mrem/yr)	Kidney (mrem/yr)	Lung (mrem/yr)	GI-LLI (mrem/yr)
Fish								
Adult		1.02E-03	5.10E-03	4.47E-03	2.85E-02	4.11E-03	3.59E-03	1.12E-02
Teen		1.06E-03	4.36E-03	3.32E-03	2.62E-02	3.33E-03	2.84E-03	8.18E-03
Child		1.31E-03	3.68E-03	2.59E-03	2.70E-02	2.77E-03	2.35E-03	4.18E-03
Invertebrates								
Adult		1.67E-03	2.63E-03	1.78E-03	3.08E-02	3.36E-03	9.79E-04	5.91E-02
Teen		1.72E-03	2.44E-03	1.55E-03	2.87E-02	3.25E-03	8.13E-04	4.71E-02
Child		2.20E-03	2.09E-03	1.53E-03	3.11E-02	2.88E-03	6.99E-04	2.06E-02
Shoreline								
Adult	1.08E-03	9.18E-04	9.18E-04	9.18E-04	9.18E-04	9.18E-04	9.18E-04	9.18E-04
Teen	1.08E-03	9.18E-04	9.18E-04	9.18E-04	9.18E-04	9.18E-04	9.18E-04	9.18E-04
Child	1.08E-03	9.18E-04	9.18E-04	9.18E-04	9.18E-04	9.18E-04	9.18E-04	9.18E-04
Infant	1.08E-03	9.18E-04	9.18E-04	9.18E-04	9.18E-04	9.18E-04	9.18E-04	9.18E-04
Swimming								
Adult		9.60E-06	9.60E-06	9.60E-06	9.60E-06	9.60E-06	9.60E-06	9.60E-06
Teen		9.60E-06	9.60E-06	9.60E-06	9.60E-06	9.60E-06	9.60E-06	9.60E-06
Child		9.60E-06	9.60E-06	9.60E-06	9.60E-06	9.60E-06	9.60E-06	9.60E-06
Infant		9.60E-06	9.60E-06	9.60E-06	9.60E-06	9.60E-06	9.60E-06	9.60E-06
Boating								
Adult		4.19E-05	4.19E-05	4.19E-05	4.19E-05	4.19E-05	4.19E-05	4.19E-05
Teen		4.19E-05	4.19E-05	4.19E-05	4.19E-05	4.19E-05	4.19E-05	4.19E-05
Child		4.19E-05	4.19E-05	4.19E-05	4.19E-05	4.19E-05	4.19E-05	4.19E-05
Infant		4.19E-05	4.19E-05	4.19E-05	4.19E-05	4.19E-05	4.19E-05	4.19E-05
Potable Water								
Adult		5.01E-06	5.91E-03	5.91E-03	6.38E-03	5.91E-03	5.91E-03	5.95E-03
Teen		4.88E-06	4.17E-03	4.16E-03	4.57E-03	4.17E-03	4.16E-03	4.19E-03
Child		1.42E-05	8.00E-03	7.99E-03	9.01E-03	8.00E-03	7.99E-03	8.02E-03
Infant		1.67E-05	7.86E-03	7.85E-03	9.45E-03	7.86E-03	7.84E-03	7.86E-03
Total								
Adult	1.08E-03	3.66E-03	1.46E-02	1.31E-02	6.66E-02	1.43E-02	1.14E-02	7.72E-02
Teen	1.08E-03	3.75E-03	1.19E-02	1.00E-02	6.04E-02	1.17E-02	8.78E-03	6.04E-02
Child	1.08E-03	4.49E-03	1.47E-02	1.31E-02	6.81E-02	1.46E-02	1.20E-02	3.38E-02
Infant	1.08E-03	9.86E-04	8.83E-03	8.82E-03	1.04E-02	8.83E-03	8.81E-03	8.83E-03

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	1.32E-02 (adult)	3
Organ Dose	7.72E-02 (adult, GI-LLI)	10

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

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

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 and 11.2-7.
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).
4. Exposure pathway assumed to exist at maximum site boundary (SE, 0.88 mi).
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 Configuration[1] Decontamination Factor	Alternate Configuration[2] 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 {Input Parameters for the LADTAP II Computer Code used in Liquid Waste Cost-Benefit Analysis}

Parameter	Value
Source Term (Unadjusted)	GALE (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

Table 11.2-8 {Obtainable Dose Benefits for Liquid Waste System Augment[1]}

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.}

11.3.2 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.

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.

11.3.3.4 Estimated Doses

This section of the U.S. EPR FSAR is incorporated by reference with the following departures: 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 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 U.S. 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. 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 11.3-2 and Table 11.3-3, and the receptor locations are shown in Table 11.3-4.

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. Projected dose impacts are well within the design objectives of Appendix I. If a hypothetical individual is postulated to be exposed to 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 seven 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

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

This section of the U.S. EPR FSAR is incorporated by reference with the following supplement.
The evaluation performed in support of the U.S. EPR FSAR section 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 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 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 methodology of Regulatory Guide 1.110 was used to perform a site-specific cost benefit analysis to satisfy these requirements.

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.

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

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

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, 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.}

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

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. No milk animals were identified within 5 miles of CCNPP.

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	Table 2.3-119
50-mile distribution of normal effluent gamma χ/Q values	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))	Table 11.3-11
Meat Production within 50 mi (kg/yr)	Table 11.3-14
Vegetable/Grain Production within 50 mi (kg/yr)	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. This occurs from April through October.
2. The more limiting (i.e., higher) value of the normal effluent annual average undecayed/ undepleted χ/Q and the gamma χ/Q was used in the analysis for each sector and distance.

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

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

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.
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. 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)	2.24E-01							2.11E+00
Ground (0.86 mi S)	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)								
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
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 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).

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

Location	Pathway	Total Body (mrem/yr)	Max Organ (Bone) (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	1.96E-03
0.88 mi SE	Inhalation			
	Adult	4.42E-03	7.55E-05	4.41E-03
	Teen	4.47E-03	9.21E-05	4.45E-03
	Child	3.95E-03	1.12E-04	3.93E-03
	Infant	2.27E-03	5.90E-05	2.26E-03
Nearest Garden	Vegetable			
0.98 mi SE	Adult	4.09E-02	1.85E-01	4.01E-02
	Teen	6.48E-02	3.04E-01	6.39E-02
	Child	1.51E-01	7.33E-01	1.49E-01
Nearest Beef	Meat			
0.88 mi SE	Adult	1.79E-02	8.39E-02	1.78E-02
	Teen	1.48E-02	7.09E-02	1.48E-02
	Child	2.74E-02	1.33E-01	2.74E-02

Note:

1. Results for milk ingestion are not presented as there are no milk producing animals for human consumption within 5 mi. Nearest meat animal assumed to be at limiting site boundary location since actual location of animals within 5 mi is not available.

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.

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

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**

Table 11.3-10 {Bounding 50-mile Dispersion Factors (sec/m^3) for CCNPP Site}

Sector	Distance (miles)																				
	0.5	0.75	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	7.5	10	15	20	25	30	35	40	45	50
N	1.923E-06	1.065E-06	5.811E-07	2.571E-07	1.538E-07	1.055E-07	8.046E-08	6.401E-08	5.261E-08	4.482E-08	3.881E-08	2.217E-08	1.608E-08	1.013E-08	7.265E-09	5.602E-09	4.526E-09	3.937E-09	3.363E-09	2.926E-09	2.584E-09
NNE	3.287E-06	1.754E-06	9.348E-07	3.980E-07	2.333E-07	1.584E-07	1.201E-07	9.528E-08	7.821E-08	6.663E-08	5.773E-08	3.321E-08	2.429E-08	1.555E-08	1.129E-08	8.797E-09	7.170E-09	6.090E-09	5.239E-09	4.773E-09	4.236E-09
NE	5.039E-06	2.711E-06	1.443E-06	6.059E-07	3.491E-07	2.334E-07	1.748E-07	1.372E-07	1.117E-07	9.446E-08	8.134E-08	4.586E-08	3.318E-08	2.099E-08	1.515E-08	1.236E-08	1.005E-08	8.434E-09	7.247E-09	6.340E-09	5.625E-09
ENE	2.038E-06	1.090E-06	5.855E-07	2.548E-07	1.519E-07	1.034E-07	7.835E-08	6.210E-08	5.093E-08	4.335E-08	3.752E-08	2.155E-08	1.580E-08	1.018E-08	7.445E-09	6.198E-09	5.078E-09	4.290E-09	3.706E-09	3.258E-09	2.903E-09
E	1.516E-06	8.448E-07	4.771E-07	2.182E-07	1.299E-07	8.848E-08	6.751E-08	5.374E-08	4.421E-08	3.773E-08	3.273E-08	1.892E-08	1.390E-08	8.963E-09	6.547E-09	5.263E-09	4.304E-09	3.629E-09	3.129E-09	2.746E-09	2.443E-09
ESE	1.987E-06	1.123E-06	6.238E-07	2.761E-07	1.627E-07	1.099E-07	8.269E-08	6.509E-08	5.305E-08	4.489E-08	3.866E-08	2.176E-08	1.570E-08	9.870E-09	7.089E-09	5.615E-09	4.546E-09	3.802E-09	3.257E-09	2.841E-09	2.514E-09
SE	2.416E-06	1.464E-06	8.347E-07	3.833E-07	2.214E-07	1.458E-07	1.072E-07	8.261E-08	6.606E-08	5.495E-08	4.660E-08	2.468E-08	1.706E-08	1.011E-08	6.975E-09	5.294E-09	4.183E-09	3.429E-09	2.888E-09	2.482E-09	2.169E-09
SSE	1.381E-06	8.911E-07	5.240E-07	2.393E-07	1.396E-07	9.489E-08	6.969E-08	5.363E-08	4.280E-08	3.554E-08	3.008E-08	1.578E-08	1.081E-08	6.328E-09	4.322E-09	3.249E-09	2.550E-09	2.079E-09	1.743E-09	1.492E-09	1.299E-09
S	1.815E-06	1.127E-06	6.501E-07	3.095E-07	1.771E-07	1.155E-07	8.420E-08	6.481E-08	5.148E-08	4.256E-08	3.589E-08	1.862E-08	1.270E-08	7.407E-09	5.053E-09	3.791E-09	2.977E-09	2.429E-09	2.037E-09	1.746E-09	1.522E-09
SSW	1.599E-06	1.050E-06	6.224E-07	2.824E-07	1.628E-07	1.066E-07	7.786E-08	5.963E-08	4.741E-08	3.922E-08	3.308E-08	1.716E-08	1.170E-08	6.808E-09	4.636E-09	3.470E-09	2.721E-09	2.217E-09	1.857E-09	1.590E-09	1.385E-09
SW	1.557E-06	1.013E-06	5.897E-07	2.619E-07	1.496E-07	9.750E-08	7.102E-08	5.432E-08	4.314E-08	3.568E-08	3.009E-08	1.562E-08	1.065E-08	6.206E-09	4.230E-09	3.169E-09	2.487E-09	2.078E-09	1.741E-09	1.519E-09	1.322E-09
WSW	1.053E-06	7.219E-07	4.396E-07	2.056E-07	1.204E-07	7.956E-08	5.843E-08	4.492E-08	3.580E-08	2.968E-08	2.508E-08	1.306E-08	8.908E-09	5.187E-09	3.526E-09	2.614E-09	2.048E-09	1.779E-09	1.486E-09	1.290E-09	1.120E-09
W	8.038E-07	5.327E-07	3.282E-07	1.627E-07	9.803E-08	6.584E-08	4.888E-08	3.787E-08	3.036E-08	2.528E-08	2.143E-08	1.128E-08	7.736E-09	4.767E-09	3.231E-09	2.399E-09	1.876E-09	1.525E-09	1.275E-09	1.089E-09	9.469E-10
WNW	5.959E-07	3.950E-07	2.331E-07	1.108E-07	6.956E-08	4.823E-08	3.671E-08	2.902E-08	2.365E-08	2.079E-08	1.781E-08	9.934E-09	6.957E-09	4.180E-09	2.903E-09	2.411E-09	1.901E-09	1.571E-09	1.321E-09	1.234E-09	1.074E-09
NW	7.179E-07	4.689E-07	2.742E-07	1.399E-07	8.563E-08	5.846E-08	4.403E-08	3.454E-08	2.799E-08	2.353E-08	2.012E-08	1.095E-08	7.658E-09	4.619E-09	3.201E-09	2.677E-09	2.106E-09	1.789E-09	1.499E-09	1.309E-09	1.139E-09
NNW	1.586E-06	9.808E-07	5.737E-07	2.658E-07	1.580E-07	1.062E-07	7.933E-08	6.190E-08	4.999E-08	4.193E-08	3.580E-08	2.036E-08	1.421E-08	9.444E-09	6.507E-09	5.273E-09	4.148E-09	3.389E-09	2.847E-09	2.442E-09	2.130E-09

Table 11.3-11 {Cow Milk Production (kg/yr)[1] within 50 miles of CCNPP Site}

Sector	Distance (miles)										
	1	2	3	4	5	10	20	30	40	50	**Total**
N	0	0	0	0	0	0	0	1,057,927	2,962,194	5,903,230	**9,923,351**
NNE	0	0	0	0	0	0	59,596	595,958	3,159,091	3,874,225	**7,688,870**
NE	0	0	0	0	0	79,344	1,174,298	844,274	7,208,509	9,268,082	**18,574,507**
ENE	0	0	0	0	0	396,722	3,110,304	4,231,706	7,208,509	9,268,082	**24,215,323**
E	0	0	0	0	0	396,722	3,173,780	5,289,633	7,405,486	9,521,339	**25,786,960**
ESE	0	0	0	0	0	79,344	2,856,402	2,644,816	5,183,840	9,045,272	**19,809,674**
SE	0	0	0	0	0	39,672	634,756	1,057,927	1,851,371	3,808,536	**7,392,262**
SSE	0	0	0	0	0	515,739	634,756	1,057,927	740,549	361,163	**3,310,134**
S	0	0	0	0	0	674,428	2,856,402	2,644,816	2,247,238	3,250,470	**11,673,354**
SSW	0	0	0	0	0	634,756	2,380,335	1,244,007	2,809,048	2,889,306	**9,957,452**
SW	0	0	0	0	0	674,428	2,697,713	802,585	2,809,048	3,611,633	**10,595,407**
WSW	0	0	0	0	0	555,411	3,173,780	2,644,816	2,387,691	3,611,633	**12,373,331**
W	0	0	0	0	0	634,756	2,856,402	4,760,669	5,924,389	7,617,071	**21,793,287**
WNW	0	0	0	0	0	793,445	2,697,713	5,289,633	6,664,937	8,093,138	**23,538,866**
NW	0	0	0	0	0	714,100	2,856,402	5,289,633	7,405,486	0	**16,265,621**
NNW	0	0	0	0	0	238,033	2,697,713	5,025,151	7,405,486	9,521,339	**24,887,722**
Total	**0**	**0**	**0**	**0**	**0**	**6,426,900**	**33,860,352**	**44,481,478**	**73,372,872**	**89,644,519**	**247,786,121**

Notes:

1. Values are converted to liters/yr by dividing by a density of 1.03 kg/L for input into the GASPAR code.

Table 11.3-12 {Beef Production (kg/yr) within 50 miles of CCNPP Site}

Sector	Distance (miles)										
	1	2	3	4	5	10	20	30	40	50	**Total**
N	0	0	0	0	0	0	0	6,557	18,360	36,589	**61,506**
NNE	0	0	0	0	0	0	721	7,205	30,815	37,791	**76,532**
NE	0	0	0	0	0	991	14,662	10,207	24,871	31,977	**82,708**
ENE	0	0	0	0	0	4,953	38,835	9,607	24,871	31,977	**110,243**
E	0	0	0	0	0	4,953	39,627	12,009	92,464	118,882	**267,935**
ESE	0	0	0	0	0	991	35,665	6,004	64,725	112,938	**220,323**
SE	0	198	198	231	297	495	7,925	2,402	23,116	30,490	**65,352**
SSE	0	396	660	925	1,189	6,439	6,631	11,052	1,824	2,345	**31,461**
S	0	396	660	925	1,189	8,421	29,841	6,513	14,588	322,421	**384,954**
SSW	0	396	660	925	951	6,631	24,867	123,396	278,635	286,596	**723,057**
SW	0	396	614	601	476	7,046	28,183	79,610	278,635	358,245	**753,806**
WSW	0	396	495	925	713	5,802	33,156	27,630	236,840	358,245	**664,202**
W	0	396	528	925	1,189	6,631	29,841	30,515	37,974	286,596	**394,595**
WNW	0	396	660	925	1,189	9,907	28,183	55,261	100,177	121,643	**318,341**
NW	0	258	429	647	892	8,916	29,841	33,906	42,813	0	**117,702**
NNW	0	0	0	0	0	2,972	33,683	31,147	45,901	59,015	**172,718**
Total	**0**	**3,228**	**4,904**	**7,029**	**8,085**	**75,148**	**381,661**	**453,021**	**1,316,609**	**2,195,750**	**4,445,435**

Table 11.3-13 {Poultry Production (kg/yr) within 50 miles of CCNPP Site}

Sector	Distance (miles)										
	1	2	3	4	5	10	20	30	40	50	**Total**
N	0	0	0	0	0	0	0	1,631	4,567	9,101	**15,299**
NNE	0	0	0	0	0	0	202,571	2,025,710	3,072,327	2,470,110	**777,0718**
NE	0	0	0	0	0	59,337	878,182	2,869,756	16,502,080	21,216,960	**41,526,315**
ENE	0	0	0	0	0	296,683	2,325,996	3,164,621	16,502,080	57,610,866	**79,900,246**
E	0	0	0	0	0	296,683	2,373,465	3,955,776	20,957,134	57,610,866	**85,193,924**
ESE	0	0	0	0	0	59,337	2,136,119	1,977,888	14,669,994	25,597,643	**44,440,981**
SE	0	47	47	55	71	118	474,693	791,155	4,569,955	9,401,049	**15,237,190**
SSE	0	95	158	221	284	1,538	110	183	185,492	238,489	**426,570**
S	0	95	158	221	284	2,012	493	662,471	1,483,934	2,146,405	**4,296,073**
SSW	0	95	158	221	227	110	411	821,464	1,854,918	1,907,916	**4,585,520**
SW	0	95	147	144	114	116	466	529,977	1,854,918	2,384,894	**4,770,871**
WSW	0	95	118	221	170	96	548	457	1,576,680	2,384,894	**3,963,279**
W	0	95	126	221	284	1,893	493	145	181	1,907,916	**1,911,354**
WNW	0	95	158	221	284	2,367	466	913	1,669,426	2,027,160	**3,701,090**
NW	0	62	103	155	213	2,130	493	260	364	0	**3,780**
NNW	0	0	0	0	0	710	8,047	7,747	364	468	**17,336**
Total	**0**	**774**	**1173**	**1680**	**1931**	**723,130**	**8,402,553**	**16,810,154**	**84,904,414**	**186,914,737**	**297,760,546**

Table 11.3-14 {Meat (Beef and Poultry) Production (kg/yr) within 50 miles of CCNPP Site}

Sector	Distance (miles)										
	1	2	3	4	5	10	20	30	40	50	**Total**
N	0	0	0	0	0	0	0	8188	22,927	45,690	**76,805**
NNE	0	0	0	0	0	0	20,3292	2,032,915	3,103,142	2,507,901	**7,847,250**
NE	0	0	0	0	0	60,328	892,844	2,879,963	16,526,951	2,1248,937	**41,609,023**
ENE	0	0	0	0	0	301,636	2,364,831	3,174,228	16,526,951	5,7642,843	**80,010,489**
E	0	0	0	0	0	301,636	2,413,092	3,967,785	21,049,598	5,7729,748	**85,461,859**
ESE	0	0	0	0	0	60,328	2,171,784	1,983,892	14,734,719	25,710,581	**44,661,304**
SE	0	245	245	286	368	613	482,618	793,557	4,593,071	9,431,539	**15,302,542**
SSE	0	491	818	1146	1,473	7,977	6,741	11,235	187,316	240,834	**458,031**
S	0	491	818	1146	1,473	10,433	30,334	668,984	1,498,522	2,468,826	**4,681,027**
SSW	0	491	818	1146	1,178	6,741	25,278	944,860	2,133,553	2,194,512	**5,308,577**
SW	0	491	761	745	590	7,162	28,649	609,587	2,133,553	2,743,139	**5,524,677**
WSW	0	491	613	1146	883	5,898	33,704	28,087	1,813,520	2,743,139	**4,627,481**
W	0	491	654	1146	1,473	8,524	30,334	30,660	38,155	2,194,512	**2,305,949**
WNW	0	491	818	1146	1,473	12,274	28,649	56,174	1,769,603	2,148,803	**4,019,431**
NW	0	320	532	802	1,105	11,046	30,334	34,166	43,177	0	**121,482**
NNW	0	0	0	0	0	3,682	41,730	38,894	46,265	59,483	**190,054**
Total	**0**	**4002**	**6077**	**8709**	**10,016**	**798,278**	**8,784,214**	**17,263,175**	**86,221,023**	**189,110,487**	**302,205,981**

Table 11.3-15 {Grain Production (kg/yr) within 50 miles of CCNPP Site}

Sector	Distance (miles)										
	1	2	3	4	5	10	20	30	40	50	**Total**
N	0	0	0	0	0	0	0	852,203	2,386,170	4,755,296	**7,993,669**
NNE	0	0	0	0	0	0	1,915,751	19,157,508	37,020,433	45,400,883	**103,494,575**
NE	0	0	0	0	0	230,809	3,415,980	27,139,803	56,954,513	73,227,230	**160,968,335**
ENE	0	0	0	0	0	1,154,047	9,047,731	25,543,344	44,700,852	55,589,006	**136,034,980**
E	0	0	0	0	0	1,154,047	9,232,378	31,929,180	21,542,216	55,589,006	**119,446,827**
ESE	0	0	0	0	0	230,809	8,309,140	15,964,590	15,079,551	21,193,035	**60,777,125**
SE	0	13,407	13,407	15,641	20,110	33,516	1,846,476	6,385,836	5,385,554	7,232,354	**20,946,301**
SSE	0	26,813	44,688	62,564	80,439	435,716	789,229	1,315,382	3,240,262	4,166,051	**10,161,144**
S	0	26,813	44,688	62,564	80,439	569,778	3,551,531	11,572,363	25,922,093	37,494,456	**79,324,725**
SSW	0	26,813	44,688	62,564	64,351	789,229	2,959,609	12,489,743	28,202,646	26,952,086	**71,591,729**
SW	0	26,813	41,560	40,667	32,176	838,556	3,354,224	8,057,899	28,202,646	33,690,108	**74,284,649**
WSW	0	26,813	33,516	62,564	48,264	690,575	3,946,146	3,288,455	23,972,249	8,427,616	**40,496,198**
W	0	26,813	35,751	62,465	80,439	789,229	3,551,531	2,093,125	2,604,778	3,349,000	**12,593,131**
WNW	0	26,813	44,688	62,564	80,439	670,327	3,354,224	6,576,909	2,930,375	3,558,312	**17,304,651**
NW	0	17,429	29,048	43,795	60,329	603,295	3,551,531	2,325,694	2,669,361	0	**9,300,482**
NNW	0	0	0	0	0	201,098	2,279,113	4,047,968	5,965,426	7,669,833	**20,163,438**
Total	**0**	**218,527**	**332,034**	**475,388**	**546,986**	**8,391,031**	**61,104,594**	**178,740,002**	**306,779,125**	**388,294,272**	**944,881,959**

Table 11.3-16 {Leafy Vegetable Production (kg/yr) within 50 miles of CCNPP Site}

Sector	Distance (miles)										
	1	2	3	4	5	10	20	30	40	50	**Total**
N	0	0	0	0	0	0	0	11,390	31,893	63,558	**106,841**
NNE	0	0	0	0	0	0	0	34,171	51,826	63,558	**149,555**
NE	0	0	0	0	0	854	12,643	48,409	79,732	102,512	**244,150**
ENE	0	0	0	0	0	4,271	33,487	45,561	79,732	512,771	**675,822**
E	0	0	0	0	0	4,271	34,171	56,951	79,732	512,771	**687,896**
ESE	0	0	0	0	0	854	30,754	28,476	55,812	97,387	**213,283**
SE	0	171	171	199	256	427	6,834	11,390	19,933	41,005	**80,386**
SSE	0	342	570	797	1,025	5,553	6,834	11,390	7,973	3,421	**37,905**
S	0	342	570	797	1,025	7,261	30,754	28,476	21,288	30,792	**121,305**
SSW	0	342	570	797	820	6,834	25,628	11,785	26,610	27,371	**100,757**
SW	0	342	530	518	410	7,261	29,045	7,603	26,610	34,213	**106,532**
WSW	0	342	427	797	615	5,980	34,171	28,476	22,619	34,213	**127,640**
W	0	342	456	797	1,025	6,834	30,754	51,256	63,785	82,010	**237,259**
WNW	0	342	570	797	1,025	8,543	29,045	56,951	71,759	87,135	**256,167**
NW	0	222	370	558	769	7,688	30,754	56,951	79,732	0	**177,044**
NNW	0	0	0	0	0	2,563	29,045	54,104	79,732	120,512	**285,956**
Total	**0**	**2,787**	**4,234**	**6,057**	**6,970**	**69,194**	**36,3919**	**543,340**	**798,768**	**1,813,229**	**3,608,498**

Table 11.3-17 {Vegetable (Grain and Leafy) Production (kg/yr) within 50 miles of CCNPP Site}

Sector	Distance (miles)										
	1	2	3	4	5	10	20	30	40	50	**Total**
N	0	0	0	0	0	0	0	863,593	2,418,063	4,818,854	**8,100,510**
NNE	0	0	0	0	0	0	1,915,751	19,191,679	37,072,259	45,464,441	**103,644,130**
NE	0	0	0	0	0	231,663	3,428,623	27,188,212	57,034,245	73,329,742	**161,212,485**
ENE	0	0	0	0	0	1,158,318	9,081,218	25,588,905	44,780,584	56,101,777	**136,710,802**
E	0	0	0	0	0	1,158,318	9,266,549	31,986,131	21,621,948	56,101,777	**120,134,723**
ESE	0	0	0	0	0	231,663	8,339,894	15,993,066	15,135,363	21,290,422	**60,990,408**
SE	0	13,578	13,578	15,840	20,366	33,943	1,853,310	6,397,226	5,405,487	7,273,359	**21,026,687**
SSE	0	27,155	45,258	63,361	81,464	441,269	796,063	1,326,772	3,248,235	4,169,472	**10,199,049**
S	0	27,155	45,258	63,361	81,464	577,039	3,582,285	11,600,839	25,943,381	37,525,248	**79,446,030**
SSW	0	27,155	45,258	63,361	65,171	796,063	2,985,237	12,501,528	28,229,256	26,979,457	**71,692,486**
SW	0	27,155	42,090	41,185	32,586	845,817	3,383,269	8,065,502	28,229,256	33,724,321	**74,391,181**
WSW	0	27,155	33,943	63,361	48,879	696,555	3,980,317	3,316,931	23,994,868	8,461,829	**40,623,838**
W	0	27,155	36,207	63,262	81,464	796,063	3,582,285	2,144,381	2,668,563	3,431,010	**12,830,390**
WNW	0	27,155	45,258	63,361	81,464	678,870	3,383,269	6,633,860	3,002,134	3,645,447	**17,560,818**
NW	0	17,651	29,418	44,353	61,098	610,983	3,582,285	2,382,645	2,749,093	0	**9,477,526**
NNW	0	0	0	0	0	203,661	2,308,158	4,102,072	6,045,158	7,790,345	**20,449,394**
Total	**0**	**221,314**	**336,268**	**481,445**	**553,956**	**8,460,225**	**61,468,513**	**179,283,342**	**307,577,893**	**390,107,501**	**948,490,457**

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 SYSTEMS

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.

11.4.2 SYSTEM DESCRIPTION

No departures or supplements.

11.4.3 RADIOACTIVE EFFLUENT RELEASES

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 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.

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, 2009a). 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 REFERENCES

No departures or supplements.

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.

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 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.

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.

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