Enclosure 1

Responses to RAI No. 101,
Questions 11.02-2 through 11.02-5, 11.03-1, 11.03-2
and
RAI No. 106,
Questions 11.02-6, 11.02-7, and 11.04-2

RAI No. 101
Question 11.02-2

Section II.D of Appendix I to 10 CFR 50 requires that Liquid radwaste systems for light water cooled nuclear power reactors include all items of reasonably demonstrated technology that when added to the system sequentially and in order of diminishing cost-benefit return can for a favorable cost benefit ratio effect reductions in dose to populations reasonably expected to be within a 50 mile radius of the reactor. SRP Section 11.2 of NUREG-0800 and RG 1.206 require each applicant for a permit to construct and operate a power reactor to provide reasonable assurance that the design objectives for as low as reasonably achievable effluent releases are satisfied by the liquid radwaste system. The applicant should demonstrate by means of a cost benefit analysis (CBA) that further reductions to the cumulative dose to the population in the 50-mile (80 km) radius cannot be effected at an annual cost of $1,000 per person-rem (or person-thyroid-rem) for a particular case and additional treatment technology.

SRP Section 11.2 and RG 1.206 refer to Regulatory Guide 1.110 as providing acceptable methods for performing a CBA. The cost-benefit analysis presented by the applicant in BBNPP FSAR Tier, Section 11.2.4 needs to be reviewed based on separate analysis performed by the NRC staff. As such, the applicant needs to provide a complete evaluation, including methodology used, components considered, and all assumptions and parameters used.

BBNPP has referenced the Environmental Report (ER) Section 5.4 as providing the detailed assumptions used in determining the base case and augmented radwaste system analysis, rather than providing the information as part of the BBNPP FSAR Section 11.2, as noted in SRP Section 11.2 and RG 1.206. Section 5.4.3 in turn provides reference back to BBNPP ER Section 3.5 for detailed data input to PWR-GALE and LADTAP II code calculations. However, there is some information and parameters that are in question or that were not provided or adequately described in the applicant's analysis. The applicant is requested to review the staff's observations and revise FSAR Tier 2, Section 11.2.4 accordingly. The applicant is requested to:

1. Explain how or confirm that the "Base Case" population doses as they appear in BBNPP Table 11.2-8 (and in Table ER 3.5-17) do not already include the use of demineralizer decontamination factors as the basis of the liquid effluent source term, and whether the analysis and results of population doses in ER Table 5.4-19 already include the use of a demineralizer system in the corresponding source term calculation (normal operation and anticipated operational occurrences). These assumptions and use of parameters appear to be inconsistent with the standard U.S. EPR design application, which includes a demineralizer system and application of associated decontamination factors.

2. Explain differences for or provide the variables assigned to the base case and augmented case used for the PWR-GALE and LADTAP II code inputs. For example, identify all differences in LWMS system configurations and assumptions between the base case versus the augmented case, such as differences in flow rates, decontamination factors, and resulting radioactive source terms.

3. Explain the basis of the 400-gpm demineralizer clean waste flow rate in BBNPP FSAR Table 11.2-9 considering that it is inconsistent with the normal flow rate shown as item 27 in BBNPP FSAR Table 11.2-1 and U.S. EPR FSAR Tier 2, Table 11.2-2. Also, confirm and compare the cost data shown in BBNPP FSAR Table 11.2-9, derived from the above flow rate, with the cost information presented in BBNPP ER Section 3.5.2.

4. Determine whether the system augmentation complies with Section II.D of Appendix I to 10 CFR Part 50, given that the methodology summarized in BBNPP FSAR Section 11.2.4 and FSAR Tables 11.2-8 to 11.2-10 describes a process different than noted in RG 1.110, Regulatory Position C.5 and Appendix A, while stating in FSAR Section 11.2.4 that the method applies RG 1.110. The applicant is requested to describe the equivalency and conservatism of the method applied in the BBNPP FSAR, or revise the methodology accordingly using the guidance of RG 1.110.

5. Provide, as per NUREG-0800, SRP 11.2 and RG 1-206, the information that supports the CBA of FSAR Section 11.2 and appropriate references to ensure that all assumptions and values applied in the CBA are fully contained in BBNPP FSAR Tier 2, Section 11.2.4, as opposed to referencing the BBNPP Environmental Report for essential supporting data. This approach would facilitate the staff's evaluation and preparation of the BBNPP safety evaluation report.

For all above items, the applicant is requested to describe in its response and revisions of BBNPP FSAR Section 11.2.4 the methodology, assumptions, and provide the supporting information and applied data to enable the staff to conduct an independent evaluation of the CBA and confirm the results and conclusions presented by the applicant in BBNPP FSAR Tier 2, Section 11.2.4 using SRP Section 11.2, RG 1.109 and RG 1.110, and the PWR-GALE and LADTAP II computer codes.

Response

The cost benefit evaluation will be revised to follow the approach described in Regulatory Guide 1.110 and to assess all possible liquid radwaste system augments and BBNPP FSAR Section 11.2 will be updated accordingly. The total annual cost of potential liquid radwaste system augments listed in Regulatory Guide 1.110 were determined and compared against the site-specific population doses in determining if any liquid radwaste system augments should be selected based on a favorable cost benefit ratio. The guidance used to make this decision is that the cumulative dose to a population within a 50-mile radius of the reactor site cannot be reduced at an annual cost of no more than $1000 per person-rem or $1000 per person-thyroid rem. Regulatory Guide 1.110 provides values in 1975 dollars and instructs that these values not be adjusted for inflation.

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

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

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

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

The annual costs associated with the liquid radwaste system augments provided in Table 11.02-2-1 show that the lowest-cost option for liquid radwaste treatment system augments is a 20-gpm cartridge filter at $11,390 per year. Dividing this value by the dollar value for estimated impact of $1000 per person-rem, results in a threshold value of 11.39 person-rem total body or thyroid dose from liquid effluents. Therefore, for U.S. EPR sites with population dose estimates less than 11.39 person-rem total body or thyroid dose from liquid effluents, no further cost-benefit analysis is needed to demonstrate compliance with 10 CFR Part 50, Appendix I, Section II.D. Because the total body and thyroid population doses for liquid effluents for BBNPP of 0.289 and 0.343 person-rem, respectively, are a small fraction of the threshold dose of 11.39 person-rem, no further cost-benefit analysis is needed.

Based on the above, the answers to the specific RAI questions are as follows:

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

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

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

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

5. The information supporting the cost-benefit analysis and supporting references has been provided above and will be included in BBNPP FSAR Section 11.2.4 and ER Sections 3.5.2.3 and 5.4.3.1.

COLA Impact

BBNPP COLA FSAR Section 11.2.4 and COLA ER Sections 3.5.2.3 and 5.4.3.1 will be revised as shown on the markups included in Enclosure 2 in a future revision of the COLA.

Table 11.02-2-1: Annual Costs (1975 $1000) Associated with Liquid Radwaste System Augments

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

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

RAI No. 101
Question 11.02-3

BBNPP has proposed alternate input variables for the GALE code from those that were used in the U.S. EPR FSAR. The new input variables are listed in BPNPP FSAR Table 11.2-1. The original U.S. EPR FSAR GALE code input variables appear in their Table 11.2-3, "Liquid and Gaseous Effluent Input Parameters for the PWR-GALE Computer Code." The COL applicant states that they are not deviating from the use of the PWR-GALE code for calculating annual effluent releases as recommended by NUREG-0800, "Standard Review Plan," and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants." Instead, BBNPP has chosen to use different input parameters from those used in the U.S. EPR FSAR, and as such this is a departure from the referenced design certification.

Specifically, BBNPP has departed from NUREG-0017 by modifying the C^{14} source term released as gaseous effluents. NUREG-0017, Section 2.2.25, states that the 7.3 Ci/yr value assumes most of the carbon-14 will form volatile compounds. This C14 source term is based on actual plant measurements. With respect to dose calculations, NRC guidance and dose calculation methods assume that C^{14} is present as oxides (CO and CO_2). In FSAR Tier 2, Section 11.2.3.2, the applicant first assumes a C^{14} source term of 15.8 Ci/yr by applying an adjustment factor in accounting for the difference in the rated thermal power level of the U.S. EPR design. The adjustment is based on a comparison of the U.S. EPR design thermal power with that of thermal power levels given in NUREG-0017 for the plants forming the basis of the 7.3 Ci/yr. In addition to this adjustment, the applicant applies another correction factor for the assumed distribution of organic and inorganic forms of C^{14} compounds. The applicant applies a correction factor 20% to the C^{14} source term of 15.8 Ci/yr, resulting in final C^{14} source term of 18.9 Ci/yr. The applicant states that this estimated C^{14} source term is expected to be released in an organic form (80% methane) and as an oxide (20% CO_2). However, the justification for the 20% adjustment is not explained in the BBNPP FSAR and how this distribution would be applied in calculating associated doses to offsite receptors.

Based on a review of the U.S. EPR design (FSAR Tier 2, Section 11.3.2), NUREG-0017, and the EPRI 2010 Technical Report on estimation of C^{14} in nuclear power plant gaseous effluent releases, the staff does not concur with these adjustments and assumed distribution of organic and oxide forms of C^{14} compounds. Specifically, the applicant is requested to evaluate the following staff observations and revise BBNPP FSAR Tier 2, Section 11.2.3.2 accordingly. The applicant is requested to:

1. provide the justification for the applied 20% adjustment in correcting the C^{14} distribution (80% methane and 20% CO2).

2. describe how associated C^{14} offsite doses would be calculated for this assumed distribution of C^{14} (80% organic form and 20% oxide) using the methodology of RG 1.109 and GASPAR II computer code.

3. consider the effects of the H_2/O_2 recombiner (high temperatures and oxidizing conditions) of the U.S. EPR gaseous waste processing system on the distribution of C^{14} compounds present in gaseous effluents.

4. address and revise, given the resolution of staff observations, the C^{14} source term in confirming compliance with the effluent concentration limits of Part 20 (Appendix B, Table 2, Column 1); 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; and design objectives of Section II.A of Appendix I to Part 50.

5. revise the designation of Turkey Point Units 1 and 2 in FSAR Tier 2, Table 11.2-4 since Turkey Point Units 1 and 2 are fossil-fired power plants.

For all of the above, the applicant is requested to describe in its response and revisions of BBNPP FSAR Tier 2, Section 11.2.3, the methodology, assumptions and default parameters used in finalizing the C^{14} source term, and updating offsite effluent concentrations and dose results. The applicant should provide sufficient information to enable the staff to conduct an independent evaluation of the C^{14} source term and offsite effluent concentrations, doses to members of the public and populations, and confirm the results and conclusions of regulatory compliance presented by the applicant in BBNPP FSAR Tier 2, Section 11.2.3 using SRP Section 11.2; RG 1.206, 1.109 and 1.111; and the GASPAR II computer code (NUREG/CR-4653).

Response

1. Due to the affects of the H_2/O_2 recombiner, the gaseous effluent dose analyses supporting BBNPP FSAR Section 11 and ER Section 5.4 have been revised to assume that 100% of the C^{14} is released as CO_2. Section 11.2.3.2 of the BBNPP FSAR and Sections 3.5 and 5.4 of the BBNPP ER will be updated to reflect this revision.

2. Based on the response to the question above, the offsite doses have been recalculated assuming a.100% release of C^{14} as CO_2 (i.e., 18.9 Ci/year release). In addition to this change in the C^{14} gaseous effluent release rate, it was necessary to remove some conservatism used in developing the dispersion/deposition factors that were used in the gaseous effluent dose analysis in order to meet the offsite dose limit criteria of 10 CFR Part 50, Appendix I and 40 CFR 190. Specifically, the methodology used in determining the terrain height for the receptor locations was refined. This update resulted in lower dispersion/deposition factors, thereby, offsetting the increase in the MEI dose from gaseous effluents due to the increase in the release rate of C^{14} as CO_2, and resulting in offsite doses that are within the dose limits of 10 CFR Part 50, Appendix I and 40 CFR Part 190.

3. The effects of the H_2/O_2 recombiner on the distribution of C^{14} compounds in gaseous effluents have been considered and the gaseous effluent dose analyses have been revised to assume that 100% of the C^{14} is released as CO_2.

4. Given the change in methodology described above, the analyses used to demonstrate compliance with the effluent concentrations of 10 CFR Part 20, Appendix B, Table 2, Column 1, dose limits to members of the public under 10 CFR Parts 20.1301 and 20.1302 and 40 CFR Part 190 and the design objectives of Section II.A of Appendix I to 10 CFR Part 50, have been updated accordingly.

5. BBNPP FSAR Table 11.2-4 will be corrected to refer to Turkey Point Units 3 and 4.

COLA Impact

BBNPP COLA FSAR Sections 2.3.5 and 11.2.and COLA ER Sections 2.7, 3.5 and 5.4 will be revised as shown on the markups in Enclosure 2 in a future revision of the COLA.

RAI No. 101
Question 11.02-4

BBNPP has chosen an operational practice that relies on 100% recycling of shim bleed as compared to the approach used in the U.S. EPR design basis and supporting calculations in developing effluent releases and offsite doses. The radiological consequences of this departure on liquid and gaseous effluent source terms, differences in radionuclide concentrations in releases to unrestricted areas, and offsite doses are addressed in separate RAIs. Rather, the focus of this RAI is on whether BBNPP needs to identify operational procedures to ensure that 100% shim bleed recycling is the preferred mode of operation and set restrictions on effluent releases when it is not possible due to equipment down time and failures. Accordingly, the applicant is requested to evaluate the following concerns and revise BBNPP FSAR Tier 2, Sections 11.2, and 13.5.1 and 13.5.2 accordingly. The applicant is requested to:

1. Describe how plant procedures will address an operating mode that relies on 100% shim bleed recycling,

2. Identify conditions and expected duration, as anticipated operational occurrences, when 100% shim bleed recycling will not be feasible,

3. Describe how operating procedures will address situations when 100% shim bleed is not feasible, and

4. Describe actions to be taken by plant operators when 100% shim bleed is not feasible in recognizing that (i) liquid and gaseous effluent source terms may be markedly different, (ii) there may be a need to evaluate resulting releases and offsite doses, and (iii) make appropriate changes to instrumentation set-points in controlling and monitoring offsite doses using the plant's standard radiological effluent controls and offsite dose calculation manual in demonstrating compliance with Part 20.1301 and 20.1302, Part 20, Appendix B effluent concentration limits, and Part 50, Appendix I design objectives.

Response

It is acknowledged that discharge of the shim bleed distillate via liquid effluents will be necessary in order to limit in-plant tritium levels. Therefore, the assumptions used in the GALE analysis for BBNPP have been revised from the original assumption of 0% discharge of shim bleed to a revised assumption of 90% discharge of shim bleed in order to provide for operational flexibility and to reduce the potential for buildup of tritium in the RCS.

The purpose of this revision is to provide necessary operational flexibility in order to ensure compliance with 10 CFR 20 Derived Airborne Concentration limits within the plant during normal operation and refueling outages while also ensuring compliance with 10 CFR 20 Appendix B effluent concentration limits and 10 CFR 50 Appendix I and 40 CFR 190 dose limits.

Based on these changes parts 1 through 4 of this RAI question pertaining to 100% recycling are no longer applicable.

COLA Impact

The BBNPP COLA will not be revised as a result of this response.

RAI No. 101
Question 11.02-5

BBNPP has proposed alternate input variables for the PWR-GALE code from those that were used in the corresponding sections of the U.S. EPR FSAR. The new input variables are listed in BPNPP FSAR Table 11.2-1, with the resulting changes in source terms presented in BBNPP FSAR Tables 11.2-2 (liquid effluent releases) and 11.2-3 (gaseous effluent releases). The original U.S. EPR FSAR PWR-GALE code input variables appear in Table 11.2-3, "Liquid and Gaseous Effluent Input Parameters for the GALE Computer Code." The applicant states that the approach is not a deviation from the use of the PWR-GALE code for calculating annual effluent releases as recommended by NUREG-0800, "Standard Review Plan," Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants," and NUREG-0017 (PWR-GALE Code). Instead, BBNPP has chosen to use different input parameters from those used in the U.S. EPR FSAR, and as such this is stated to be a departure from the referenced design certification.

Specifically, BBNPP has departed from NUREG-0017 by modifying the assumptions on the amount of shim bleed that is processed and discharged as liquid waste. The shim bleed is typically processed through an evaporator and reused or disposed of as solid waste. The distillate is recycled back to the reactor coolant as makeup or discharged to the environment as liquid radioactive waste. Under NUREG-0017, the fraction of shim bleed that is discharged after processing may vary between 10% and 100%, based on the capability of the system to process liquid waste during equipment downtime, waste volume surges, tritium control requirements, and tank surge capacity. A minimum value of 10% discharge for liquid radioactive waste treatment system is used when the system is designed for maximum waste recycle, when the system capacity is sufficient to process wastes for reuse during equipment downtime and anticipated operational occurrences, and when a discharge option and path are identified. In its departure, BBNPP has assumed no recycling and has recalculated gaseous and liquid effluent yearly releases using that assumption. While the staff agrees that the assumption of 100% recycling will have an effect on the amounts of radioactivity present in gaseous and liquid effluent releases, the staff does not concur with the stated assumptions and results of the revised source terms.

Specifically, the applicant is requested to evaluate the following staff observations and revise BBNPP FSAR Tier 2, Section 11.2.3.2 accordingly.

1. With respect to tritium, 100% shim bleed recycling has the potential of impacting tritium levels and build up in primary system coolant. Plants typically control the normal tritium buildup in the primary system during the fuel cycle by diluting the system with fresh makeup water. When all of the shim bleed distillate is returned to the primary coolant, tritium concentrations could increase above normally expected levels. This has the potential to affect conditions inside containment during shutdown operations, and when the reactor cavity is flooded. The applicant did not describe any impact to these operational conditions and did not address the potential need to dilute the primary coolant prior to refueling outages. The applicant is requested to:

    a. Explain what impact this approach will have on tritium levels in primary coolant, and address why shim bleed processing through liquid effluent discharges would not be a necessary step in controlling tritium levels. If releases were shown to be necessary in controlling tritium levels in system coolant, confirm whether the

assumed PWR-GALE Code departure is reasonably conservative in characterizing effluent source terms.

b. Assess, depending on the evaluation of the above, radiation protection issues and impacts associated with increased tritium levels during various plant evolutions, such as refueling, system downtime, waste volume surges (e.g., late-cycle outages), and on effluent releases during normal operations and anticipated operational occurrences.

2. With respect to noble gases, a review of BBNPP FSAR Table 11.2-3 on gaseous effluents indicates decreases in activity levels for Kr-85 (91.76%), Xe-131m (22.86%), Xe-133m (5.56%), and Xe-133 (16.28%). A change in shim bleed recycling is expected to account for some of the decreases in most noble gas activity levels. However, the calculated data do not explain why Kr-85 would decrease. The long half-life of Kr-85 (10. 7 yr) and its limited holdup time (1.7 days) in the gas delay beds should result in little to no change of activity levels. The applicant did not explain the direction and magnitude of changes in activity levels. The applicant is requested to:

   a. Describe the process leading to changes in activity levels for the radionuclides listed in BBNPP FSAR Table 11.2-3.

   b. Confirm whether the containment low volume purge rate of 2970 CFM is correct in BBNPP FSAR Table 11.2-1, given that U.S. EPR FSAR Table 11.2-3 applies a value of 3210 CFM.

   c. Confirm that BBNPP's analysis applied the same assumption on the number of yearly containment high volume purges as that stated in U.S. EPR FSAR Table 11.2-3.

3. With respect to liquid effluents, a review of BBNPP FSAR Table 11.2-2 indicates increases in activity levels for Co-58 (6.7%), Na-24 (1.6%), W-187 (2.2%), Te-131m (3.2%), La-140 (1.3%), and Ce-143 (1.6%), and a decrease for I-133 (2.9%). A change in shim bleed recycling is expected to account for some decreases in releases. However, the calculated data does not explain why the activity of relatively shorter-lived radionuclides would increase, ranging from 15 to 40 hrs for all with the exception of Co-58 (71 days). The applicant did not explain the direction and magnitude of such changes in activity levels. The applicant is requested to:

   a. Describe the process leading to changes in activity levels for the radionuclides listed in BBNPP FSAR Table 11.2-2.

   b. Confirm whether the "Ru-103m" entry in BBNPP FSAR Table 11.2-2 should be changed to "Rh-103m" instead.

For all of the above, the applicant is requested to describe in its response and revisions of BBNPP FSAR Tier 2, Section 11.2.3, the methodology, assumptions and default parameters used in revising the source terms, and updating offsite effluent concentrations and dose results accordingly. The applicant should provide sufficient information to enable the staff to conduct an independent evaluation of the revised source terms and offsite effluent concentrations, doses to members of the public and populations, and confirm the results and conclusions of regulatory compliance presented by the applicant in BBNPP FSAR Tier 2, Section 11.2.3 using SRP

Section 11.2; RG 1.206, 1.109, 1.111, and 1.113; and the PWR-GALE computer code (NUREG-0017).

Response

1. The shim-bleed discharge fraction used in the BBNPP GALE analysis has been revised from 0.0 to 0.90 in order to provide for operational flexibility during normal and refueling operations to control tritium levels in the RCS. This operational flexibility is needed not only to control boron concentrations in RCS via boron injection or boron dilution during the cycle but also to control tritium concentrations in the RCS to ensure occupational exposure in maintained ALARA and that airborne concentrations in the plant meet 10 CFR 20 Derived Airborne Concentrations criteria. Moreover, modeling 0.90 discharge of the shim bleed in PWR-GALE conservatively bounds liquid and gaseous effluents source terms for BBNPP.

   Therefore, questions pertaining to 100% recycling are no longer applicable. Likewise, the subsequent primary coolant tritium concentration question is not applicable.

   BBNPP COLA FSAR Sections 11.2 and ER Sections 3.5 and 5.4 will be updated to reflect this response.

2. The differences in the GALE input files between the U.S. EPR FSAR and updated BBNPP scenarios for computation of the annual gaseous effluent releases involve the following three parameters:

   - Shim-bleed flow rate,
   - Shim-bleed recycling fraction, and
   - Shim-bleed and equipment drain collection times prior to processing (applicable to liquid releases, with no impact on the gaseous effluents).

   Details on the differences are summarized in Table 11.02-5-1. In addition, the C^{14} release was increased to 18.9 Ci/yr, as identified in the response to RAI 101, Question 11.02-3.

   It is confirmed that the containment low-volume purge flow rate is 3210 cfm in both the U.S. EPR and BBNPP GALE analyses, and that the GALE default value of 2 was used in both cases for the number of yearly containment high-volume purges.

   An updated comparison of the radionuclide-specific total gaseous effluent releases between the U.S. EPR and BBNPP plants is presented in Table 11.02-5-2. The following are noted with respect to (a) the impact of the shim-bleed recycling factor on the gaseous effluent for a fixed shim-bleed flow and (b) the impact of the shim-bleed flow on gaseous effluent:

   - With respect to the BBNPP annual releases in Table 11.02-5-2, the only change resulting from the current update is in C^{14}, as identified in the response to RAI 101, Question 11.02-3. All other entries remain unchanged, implying that the change in the BBNPP shim-bleed recycling fraction (previously 0 and currently 90%) has no impact on the gaseous effluent. Specifically, the noble-gas releases are not impacted because they are based on the sum of the equipment drain flow and the total shim-bleed flow, which remains unchanged (i.e., they are independent of the fraction of the shim-bleed flow that gets discharged). As for

the other particulates, their annual releases are dictated by the physical properties of the gaseous system and the building ventilation systems, and are not impacted by changes in the shim-bleed.

- With respect to the comparative analysis in Table 11.02-5-2 (BBNPP vs. U.S. EPR FSAR), differences are identified between the annual releases for Kr-85m, Kr-85, Xe-131m, Xe-133m and Xe-133, with the BBNPP releases being lower in all cases by a factor ranging from 1.07 (for Kr-85m) to 12.1 for (Kr-85). [Note: Corresponding percent differences are -6.25% and -91.76%, respectively.] This is an unexpected result considering there is a higher shim-bleed distillate discharge at BBNPP (1944 gpd, in comparison to the 110 gpd for the U.S. EPR plant). This apparent discrepancy was traced to the GALE model for the noble-gas concentration in the primary coolant. GALE computes the RCS noble gas activity using only the shim-bleed plus decay as the only removal mechanisms; i.e., it does not account for losses resulting from equipment leakage. It then uses that activity times the "shim-bleed plus equipment drain flow" to determine the noble gas release, and that is why the latter could be overestimated, particularly for the long-lived radionuclides.

  [Note: With the current GALE modeling, the RCS Kr-85 concentration ratio between the U.S. EPR plant and BBNPP is [(6.836 μCi/gm) / (0.3854 μCi/gm)] = 17.74. This translates into a BBNPP Kr-85 annual release rate from all pathways which is 12.1 times lower than the corresponding release from the U.S. EPR plant, as given above.]

  BBNPP COLA FSAR will not be updated as a result of this response.

11.02-5-1: Gaseous-Effluent Scenario Differences - BBNPP vs. U.S. EPR FSAR

Description	Scenario Case	
	U.S. EPR FSAR Base Case[(a)]	**BBNPP Updated Base Case**
Shim-bleed flow rate	110 gpd (dischargeable fraction of the 2160 gpd flow)	2160 gpd
Shim-bleed distillate average fraction to be discharged (and flow rate)	100% (110 gpd)	90% (1944 gpd)
Shim-bleed discharged distillate plus Equipment Drain discharge rate	110 + 1728 = 1838 gpd	1944 + 1728 = 3672 gpd
Shim-bleed and equipment drain collection time prior to processing	(18500 gal / 1838 gpd) = 8.10 days	(18500 gal / 3672 gpd) = 4.03 days

(a) U.S. EPR Tier 2 FSAR Table 11.2-3

Table 11.02-5-2: Comparison of Total Gaseous Effluent Releases - BBNPP vs. U.S. EPR FSAR

Nuclide	U.S. EPR FSAR[(a)] (Ci/yr)	BBNPP (Ci/yr)	Activity Change BBNPP - U.S. EPR FSAR (Ci/yr)	Percent Change from U.S. EPR FSAR[(b)]
H 3	180	180	0	0.00%
C 14	7.3	18.9	11.6	158.90%
Ar 41	34	34	0	0.00%
Iodines				
I 131	8.8E-03	8.8E-03	0	0.00%
I 133	3.2E-02	3.2E-02	0	0.00%
Noble Gases				
Kr 85m	1.6E+02	1.5E+02	-10	-6.25%
Kr 85	3.4E+04	2.8E+03	-31200	-91.76%
Kr 87	5.6E+01	5.6E+01	0	0.00%
Kr 88	1.9E+02	1.9E+02	0	0.00%
Xe 131m	3.5E+03	2.7E+03	-800	-22.86%
Xe 133m	1.9E+02	1.7E+02	-20	-10.53%
Xe 133	8.6E+03	7.3E+03	-1300	-15.12%
Xe 135m	1.5E+01	1.5E+01	0	0.00%
Xe 135	1.2E+03	1.2E+03	0	0.00%
Xe 138	1.2E+01	1.2E+01	0	0.00%
Airborne Particulates				
Cr 51	9.7E-05	9.7E-05	0	0.00%
Mn 54	5.7E-05	5.7E-05	0	0.00%
Co 57	8.2E-06	8.2E-06	0	0.00%
Co 58	4.8E-04	4.8E-04	0	0.00%
Co 60	1.1E-04	1.1E-04	0	0.00%
Fe 59	2.8E-05	2.8E-05	0	0.00%
Sr 89	1.6E-04	1.6E-04	0	0.00%
Sr 90	6.3E-05	6.3E-05	0	0.00%
Zr 95	1.0E-05	1.0E-05	0	0.00%
Nb 95	4.2E-05	4.2E-05	0	0.00%
Ru 103	1.7E-05	1.7E-05	0	0.00%
Ru 106	7.8E-07	7.8E-07	0	0.00%
Sb 125	6.1E-07	6.1E-07	0	0.00%
Cs 134	4.8E-05	4.8E-05	0	0.00%
Cs 136	3.3E-05	3.3E-05	0	0.00%
Cs 137	9.0E-05	9.0E-05	0	0.00%
Ba 140	4.2E-06	4.2E-06	0	0.00%
Ce 141	1.3E-05	1.3E-05	0	0.00%

(a) U.S. EPR Tier 2 FSAR, Table 11.2-4
(b) 100 x (BBNPP – U.S. EPR FSAR) / U.S. EPR FSAR

3. The differences in the GALE input files between the U.S. EPR FSAR and updated BBNPP scenarios for computation of the annual liquid effluent releases involve the following three parameters:

    - Shim-bleed flow rate,
    - Shim-bleed recycling fraction, and
    - Shim-bleed and equipment drain collection times prior to processing.

    The differences are identical to those summarized in Table 11.02-5-1 for the gaseous effluents.

    It is confirmed that the "Ru-103m" entry in BBNPP FSAR Table 11.2-2 is a typographical error and it will be corrected to "Rh-103m," as shown in the markups.

    A comparison of the radionuclide-specific total liquid effluent releases between the U.S. EPR and BBNPP plants is presented in Table 11.02-5-3. This is an updated comparison reflecting the changes to the GALE input described above, and the overall trend is now reversed (i.e., the iodine releases increase whereas the activation product and particulate releases decrease). It is seen that the only increases in the BBNPP annual liquid releases in comparison to those for the U.S. EPR plant are for I- 131, I-133 and I-135 (an obvious result of the increased shim-bleed distillate discharge rate at BBNPP, but with little impact on I-132 because the release is dominated by the Miscellaneous Waste). The remaining radionuclides, on the other hand, show a reduction in the release rates, a questionable result at first sight. To further understand the table entries, a more detailed comparison was carried out on selected radionuclides and is presented in Table 11.02-5-4. The following are noted:

    - Table 11.02-5-4 presents the individual releases via the various pathways. It is seen that there is no difference between the U.S. EPR and BBNPP values for the selected activation products and particulates (Na-24, Sr-89 and Cs-137) for each of the applicable release pathways (boron shim-bleed and equipment drains, miscellaneous waste, secondary wastes, and turbine building releases), and between the LWS sum totals. The activation product and particulate releases via the shim-bleed and equipment drain pathways are nil (i.e., significantly lower than the GALE built-in printout limit), regardless of the flow rate, due to the high decontamination factor of 1.0E+07 for these radionuclides.

    - The only differences in the annual release of activation products and particulates appear in the last column of Table 11.02-5-4, showing the adjusted totals. The GALE code artificially adds 0.16 Ci/yr to the total annual release as a conservative measure, distributed amongst all the radionuclides in proportion to their numerical significance, as shown in the last column of the table. This is accomplished through the use of an adjustment factor. From the "Total" section of the table (last three rows), the adjustment factor for the U.S. EPR FSAR releases is [(0.16 + 0.03300) / 0.03300] = 5.85, whilst for the BBNPP the ratio is (0.19600 / 0.03597) = 5.45. In short, the adjustment factor for BBNPP is about 7% lower, and this is reflected in the difference between the BBNPP and U.S. EPR FSAR activation product and particulate "adjusted" releases. The actual

entries in the last column of Table 11.02-5-4 would have been the same had there not been round-off errors compounding the differences.

- For the iodines, Table 11.02-5-4 shows increases in the annual release rates due to the increased shim-bleed flow rate which, unlike the particulates, is more evident due to the lower decontamination factor associated with this release pathway (a decontamination factor (DF) of 1.0E+04 for the iodines vs. 1.0E+07 for the activation products and particulates). The actual increases in the BBNPP shim-bleed plus equipment drain release rates for I-133 and I-135 are by about a factor of 2, consistent with the increase in the corresponding flow rates [namely, (3672 gpd / 1838 gpd) = 2.0, from Table 11.02-5-1]. The reduction in the BBNPP shim-bleed and equipment drain collection time prior to processing has no impact on these radionuclides because they reach equilibrium concentration values within the collection tanks, in view of their short decay times in comparison to the collection time. For I-131 on the other hand, equilibrium concentration prior to discharge is not achieved and, as a result, the overall increase in the BBNPP annual release for this radionuclide is less than the factor of 2 increase in the shim-bleed plus equipment drain flow rate.

In summary, the reduction in the activation product and particulate annual releases at BBNPP, as compared to the U.S. EPR values, is not a result of any physical processes, but is simply due to the arbitrary addition of 0.16 Ci/yr to the total calculated releases as a conservative measure. The increase in the iodine releases is a result of physical processes, as expected.

BNPP COLA FSAR Section 11.2 will be updated to reflect this response.

<u>COLA Impact</u>

BBNPP COLA FSAR Section 11.2 and COLA ER Sections 3.5 and 5.4 will be revised as shown on the markups in Enclosure 2 in a future revision of the COLA.

Table 11.02-5-3: Comparison of Total Liquid Effluent Releases – BBNPP vs. U.S. EPR FSAR

Nuclide	U.S. EPR FSAR[(a)] (Ci/yr)	BBNPP (Ci/yr)	Activity Change BBNPP - U.S. EPR FSAR (Ci/yr)	Percent Change from U.S. EPR FSAR[(b)]
Na 24	6.10E-03	5.72E-03	-3.80E-04	-6.23%
Cr 51	1.00E-03	9.60E-04	-4.00E-05	-4.00%
Mn 54	5.40E-04	5.10E-04	-3.00E-05	-5.56%
Fe 55	4.10E-04	3.80E-04	-3.00E-05	-7.32%
Fe 59	1.00E-04	9.00E-05	-1.00E-05	-10.00%
Co 58	1.50E-03	1.44E-03	-6.00E-05	-4.00%
Co 60	1.80E-04	1.70E-04	-1.00E-05	-5.56%
Zn 65	1.70E-04	1.60E-04	-1.00E-05	-5.88%
W 187	4.60E-04	4.30E-04	-3.00E-05	-6.52%
Np 239	5.80E-04	5.40E-04	-4.00E-05	-6.90%
Sr 89	5.00E-05	4.00E-05	-1.00E-05	-20.00%
Sr 91	8.00E-05	7.00E-05	-1.00E-05	-12.50%
Y 91m	5.00E-05	5.00E-05	0.00E+00	0.00%
Y 93	3.60E-04	3.30E-04	-3.00E-05	-8.33%
Zr 95	1.30E-04	1.20E-04	-1.00E-05	-7.69%
Nb 95	1.00E-04	9.00E-05	-1.00E-05	-10.00%
Mo 99	1.80E-03	1.63E-03	-1.70E-04	-9.44%
Tc 99m	1.70E-03	1.59E-03	-1.10E-04	-6.47%
Ru 103	2.50E-03	2.34E-03	-1.60E-04	-6.40%
Rh 103m	2.50E-03	2.34E-03	-1.60E-04	-6.40%
Ru 106	3.10E-02	2.84E-02	-2.60E-03	-8.39%
Rh 106	3.10E-02	2.84E-02	-2.60E-03	-8.39%
Ag 110m	4.40E-04	4.10E-04	-3.00E-05	-6.82%
Ag 110	6.00E-05	5.00E-05	-1.00E-05	-16.67%
Te 129m	6.00E-05	6.00E-05	0.00E+00	0.00%
Te 129	4.00E-05	4.00E-05	0.00E+00	0.00%
Te 131m	3.10E-04	2.90E-04	-2.00E-05	-6.45%
Te 131	6.00E-05	5.00E-05	-1.00E-05	-16.67%
Te 132	4.80E-04	4.50E-04	-3.00E-05	-6.25%
I 131	3.40E-02	3.54E-02	1.40E-03	4.12%
I 132	1.20E-03	1.14E-03	-6.00E-05	-5.00%
I 133	3.50E-02	4.21E-02	7.10E-03	20.29%
I 135	1.50E-02	1.69E-02	1.90E-03	12.67%
Cs 134	2.60E-03	2.45E-03	-1.50E-04	-5.77%
Cs 136	3.10E-04	2.90E-04	-2.00E-05	-6.45%
Cs 137	3.50E-03	3.25E-03	-2.50E-04	-7.14%

Table 11.02-5-3 (Continued)
Comparison of Total Liquid Effluent Releases – BBNPP vs. U.S. EPR FSAR

Nuclide	U.S. EPR FSAR[(a)] (Ci/yr)	BBNPP (Ci/yr)	Activity Change BB - FSAR (Ci/yr)	Percent Change from U.S. EPR FSAR[(b)]
Ba 137m	3.30E-03	3.04E-03	-2.60E-04	-7.88%
Ba 140	4.20E-03	3.93E-03	-2.70E-04	-6.43%
La 140	7.60E-03	7.12E-03	-4.80E-04	-6.32%
Ce 141	5.00E-05	5.00E-05	0.00E+00	0.00%
*Ce 143	6.10E-04	5.70E-04	-4.00E-05	-6.56%
Ce 144	1.30E-03	1.23E-03	-7.00E-05	-5.38%
Pr 143	5.00E-05	5.00E-05	0.00E+00	0.00%
Pr 144	1.30E-03	1.23E-03	-7.00E-05	-5.38%
other	2.00E-05	2.00E-05	0.00E+00	0.00%
Total (except H-3)	1.90E-01	1.96E-01	6.00E-03	3.16%
H 3	1.66E+03	1.66E+03	0.00E+00	0.00%

(a) U.S. EPR Tier 2 FSAR, Table 11.2-4
(b) 100 x (BBNPP – U.S. EPR FSAR) / U.S. EPR FSAR

Table 11.02-5-4: Detailed Comparison of Liquid Effluent Releases for Selected Radionuclides - BBNPP vs. U.S. EPR FSAR

Power Plant	RCS Concent. (µCi/ml)	Boron Shim-Bleed and Eq. Drains (Ci/yr)	Misc. Wastes (Ci/yr)	Secondary Wastes (Ci/yr)	Turbine Building Releases (Ci/yr)	Total LWS (Ci/yr)	Adjusted Total (Ci/yr)
Na-24 (0.625-day half-life)							
U.S. EPR[a]	2.84E-02	0.00000	0.00104	0.00000	0.00001	0.00105	0.00610
BBNPP	2.84E-02	0.00000	0.00104	0.00000	0.00001	0.00105	0.00572
% diff	0	N/A	0	N/A	0	0	-6.2
Sr-89 (52-day half-life)							
U.S. EPR	6.23E-05	0.00000	0.00001	0.00000	0.00000	0.00001	0.00005
BBNPP	6.23E-05	0.00000	0.00001	0.00000	0.00000	0.00001	0.00004
% diff	0.0	N/A	0	N/A	N/A	0	-20.0
Cs-137 (1.10E+04 days half-life)							
U.S. EPR	4.57E-03	0.00000	0.00060	0.00000	0.00000	0.00060	0.00350
BBNPP	4.54E-03	0.00000	0.00059	0.00000	0.00000	0.00060	0.00325
% diff	-0.7	N/A	-1.7	N/A	N/A	0	-7.1
I-131 (8.05-day half-life)							
U.S. EPR	2.07E-02	0.00341	0.00243	0.00000	0.00002	0.00586	0.03400
BBNPP	2.07E-02	0.00403	0.00243	0.00000	0.00002	0.00649	0.03536
% diff	0.0	18.2	0.0	N/A	0.0	10.8	4.1
I-133 (0.875-day half-life)							
U.S. EPR	7.92E-02	0.00185	0.00405	0.00000	0.00007	0.00597	0.03500
BBNPP	7.92E-02	0.00360	0.00405	0.00000	0.00007	0.00773	0.04209
% diff	0	94.6	0	N/A	0	29.5	20.3
I-135 (0.279-day half-life)							
U.S. EPR	1.90E-01	0.00052	0.00194	0.00000	0.00010	0.00256	0.01500
BBNPP	1.90E-01	0.00106	0.00194	0.00000	0.00010	0.00310	0.01689
% diff	0	103.8	0	N/A	0	21.1	12.7
Total							
U.S. EPR	1.27E+00	0.00582	0.02690	0.00000	0.00033	0.03300	0.19000
BBNPP	1.27E+00	0.00876	0.02689	0.00000	0.00033	0.03597	0.19597
% diff	0.0	50.5	0.0	N/A	0.0	8.9	3.2

(a) The U.S. EPR entries are from the Tier 2 FSAR Table 11.2-4.

RAI No. 101
Question 11.03-1

Section II.D of Appendix I to 10 CFR 50 requires that gaseous radwaste systems for light water cooled nuclear power reactors include all items of reasonably demonstrated technology that when added to the system sequentially and in order of diminishing cost-benefit return can for a favorable cost benefit ratio effect reductions in dose to populations reasonably expected to be within a 50 mile radius of the reactor. NUREG-0800, SRP 11.3 and RG 1.206 require each applicant for a permit to construct and operate a power reactor to provide reasonable assurance that the design objectives for as low as reasonably achievable effluent releases are satisfied by the gaseous radwaste system. The applicant should demonstrate by means of a cost benefit analysis (CBA) that further reductions to cumulative population doses within a 50 mile (80 km) radius cannot be effected at an annual cost of $1,000 per person-rem (or person-thyroid-rem) for a particular case/additional technology.

SRP 11.3 and RG 1.206 refer to Regulatory Guide 1.110 as providing acceptable methods for performing a CBA. The cost-benefit analysis presented by the applicant in BBNPP FSAR Tier 2, Section 11.3.4 needs to be reviewed based on independent analysis performed by the NRC staff. As such, the applicant needs to provide a complete evaluation including methodology used, components considered, and all assumptions and parameters used.

BBNPP has referenced the Environmental Report Section 5.4 as providing the detailed assumptions used in determining the base case and augmented radwaste system analysis, rather than providing the information as part of BBNPP FSAR Section 11.3, as noted in SRP Section 11.3 and RG 1.206. BNPP ER Section 5.4.3 provides reference back to ER Section 3.5 for data input to GALE code and GASPAR code calculations. However, there is some information and parameters missing or in question that was not provided as part of the applicant's analysis, the applicant is requested to review the staff's observations and revise FSAR Tier 2, Section 11.3.4 accordingly. The applicant is requested to:

1. Verify the cost data presented in FSAR Table 11.3-2 so that it matches the description in FSAR Section 11.3.4. Provide the assumed values for "Total O&M" as it applies values other than given in RG 1.110, Tables A-2 and A-3.

2. Consider another CBA case that includes a system augmentation applying a HEPA/charcoal filtration system for particulates and radioiodines. In FSAR Section 11.3.4, the last paragraph acknowledges that sources of airborne radioactivity from building ventilation systems do not benefit from the holdup afforded by the additional charcoal delay tank as a system augmentation. The sources of radioactivity from plant buildings is characterized as being significantly higher than the source term processed and treated via the gaseous waste processing system. For the gaseous effluent source term shown in U.S. EPR FSAR Table 11.3-3, the radioiodine source term is two to three orders of magnitude higher than any of the particulate radionuclides, and the particulate source term, in the aggregate, is comparable to that of I-131 or I-132. The applicant is requested to evaluate the source term presented in U.S. EPR FSAR Table 11.3-3 and update the assumptions for the base and alternate cases and CBA results presented in FSAR Tables 11.3-1 and 11.3-2.

3. Clearly indicate in the description of the CBA presented in FSAR 11.3.4 which sections of the FSAR are referred to for input data for the CBA, including the full set χ/Q and D/Q

values used in the analysis to calculate population doses in each wind sector out to 50 miles (80 km) using RG 1.109 and the GASPAR II computer code.

4. Provide references supporting the listed population distributions and production rates for milk, beef, poultry, grain, and vegetables within the 50-mile (80 km) radius for the food production data presented in BBNPP ER Tables 5.4-6 to 5.4-12.

5. Provide the detailed information as required by the NUREG-0800, SRP 11.3 and RG 1-206 that supports the CBA as part of FSAR Section 11.3, supported with appropriate references, to ensure that all assumptions and values applied in the CBA are fully contained in BBNPP FSAR Tier 2, Section 11.3.4.

6. In determining whether the system augmentation complies with Section II.D of Appendix I to 10 CFR Part 50, the methodology summarized in FSAR Section 11.3.4 and FSAR Table 11.3-2 describes a process other than noted in RG 1.110, Regulatory Position C.5 and Appendix A, while stating in FSAR Section 11.3.4 that the method applies RG 1.110. The applicant is requested to describe the equivalency the method applied in the BBNPP FSAR or revise it accordingly.

7. The applicant is requested to describe in its response and revisions of FSAR Section 11.3.4 the methodology, assumptions, and provide the supporting information and applied data to enable the staff to conduct an independent evaluation of the CBA and confirm the results and conclusions presented by the applicant in BBNPP FSAR Tier 2, Section 11.3.4 using RG 1.109 and RG 1.110, and the GASPAR II computer code.

Response

The cost-benefit evaluation has been revised to follow the approach described in Regulatory Guide 1.110 and to assess all possible gaseous radwaste system augments and BBNPP FSAR Section 11.3 will be updated accordingly. The revised evaluation considers all possible gaseous radwaste system augments and determines the lowest annual cost associated with the possible augments. This lowest cost is considered a threshold value and is compared against the gaseous effluent population dose in determining whether a system augment is warranted based on the cost-benefit ratio. The guidance used to make this decision is that the cumulative dose to a population within a 50-mile radius of the reactor site cannot be reduced at an annual cost of no more than $1000 per person-rem or $1000 per person-thyroid rem. Regulatory Guide 1.110 provides values in 1975 dollars and instructs that these values not be adjusted for inflation.

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

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

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

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

The annual costs associated with the gaseous radwaste system augments are provided in Table 11.03-1-1. Table 11.03-1-1 shows that the lowest-cost option for gaseous radwaste treatment system augments is the steam generator flash tank vent to main condenser augment at $6,650 per year. Dividing this value by the dollar value for estimated impact of $1000 per person-rem, results in a threshold value of 6.65 person-rem total body or thyroid dose from gaseous effluents. Therefore, for U.S. EPR sites with population dose estimates less than 6.65 person-rem total body or thyroid dose from gaseous effluents, no further cost-benefit analysis is needed to demonstrate compliance with 10 CFR Part 50, Appendix I, Section II.D.

The total body and thyroid population doses from gaseous effluents for BBNPP are 8.25 person-rem and 8.57 person-rem, respectively. Since these doses exceed the 6.65 person-rem threshold value, the system augments with a total annual cost less than $8,250 are further evaluated below. For use in the evaluation, the dose breakdown from noble gases, iodines, particulates, C^{14} and H-3 as taken from the GASPAR-2 output is provided below:

Gaseous Effluent Population Dose Breakdown

	Gaseouse Effluent Release Rate (Ci/Yr)	**Total Body Dose (person-rem)**	**% of Dose**	**Thyroid Dose (person-rem)**	**% of Dose**
Noble	1.46E+04	3.74E+00	45%	3.74E+00	44%
Iodines	4.08E-02	7.33E-04	0%	3.24E-01	4%
Particulates	1.26E-03	7.46E-03	0%	5.62E-03	0%
C-14	1.89E+01	4.18E+00	51%	4.18E+00	49%
H-3	1.80E+02	3.15E-01	4%	3.15E-01	4%
Total	1.48E+04	8.25	100%	8.57	100%

Main Condenser Vacuum Pump Charcoal/HEPA Filtration System

The total annual cost for this system augment is $8,170. Therefore, in order to be beneficial at $1000 per person-rem, this augment must remove sufficient activity to decrease the population dose by at least 8.17 person-rem, thereby decreasing the total body dose from 8.25 person-rem to 0.08 person-rem and the thyroid dose from 8.57 person-rem to 0.40 person-rem. However, as shown in BBNPP FSAR Table 11.2-7, for the noble gases, which make up nearly half of the dose, only a small fraction (<1%) are released through the condenser air removal system. Therefore, it would be impossible to achieve the necessary dose reduction, and this augment is not cost-beneficial.

1,000-cfm Charcoal/HEPA Filtration System

The total annual cost for this system augment is $7,960. Therefore, in order to be beneficial at $1000 per person-rem, this augment must remove sufficient activity to decrease the population dose by at least 7.96 person-rem, thereby decreasing the total body dose from 8.25 person-rem to 0.29 person-rem and the thyroid dose from 8.57 person-rem to 0.61 person-rem. However, this augment would not be effective in reducing the noble gases or C^{14} release, which make up over 90% of the population dose. Therefore, it would be impossible to achieve the necessary dose reduction, and this augment is not cost-beneficial.

600-ft^3 Gas Decay Tank

The total annual cost for this system augment is $8,040. Therefore, in order to be beneficial at $1000 per person-rem, this augment must remove sufficient activity to decrease the population dose by at least 8.04 person-rem, thereby decreasing the total body dose from 8.25 person-rem to 0.21 person-rem and the thyroid dose from 8.57 person-rem to 0.53 person-rem. However, this augment would not be effective in reducing the C^{14} release, which makes up 50% of the population dose. Therefore, it would be impossible to achieve the necessary dose reduction, and this augment is not cost-beneficial.

Steam Generator Flash Tank Vent to Main Condenser

The total annual cost for this system augment is $6,650. Therefore, in order to be beneficial at $1000 per person-rem, this augment must remove sufficient activity to decrease the population dose by at least 6.65 person-rem, thereby decreasing the total body dose from 8.25 person-rem to 1.6 person-rem and the thyroid dose from 8.57 person-rem to 1.92 person-rem. However, the current design for the U.S. EPR already includes a steam generator flash tank/condenser. Also, as shown in BBNPP FSAR Table 11.2-7, none of the noble gases (which make up almost 50% of the dose) are released via the blowdown vent offgas. Therefore, it would be impossible to achieve the necessary dose reduction, and this augment is not cost-beneficial.

Based on the above evaluation, none of the radwaste augments are cost-beneficial in reducing the total body or thyroid dose from gaseous effluents.

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

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

3. The values used in the population dose calculation in support of the cost-benefit analysis are provided in Tables 11.03-1-2 – 11.03-1-9. The 50-mile dispersion/deposition factors were also updated to remove excess conservatism used in the determination of the terrain height. The updated dispersion/deposition factors are provided in Tables 11.03-1-4 – 11.03-1-6. BBNPP FSAR Sections 2.3.5 and 11.3 and ER Sections 2.7, 3.5 and 5.4 will be updated to include this information.

4. The 50-mile population projections were estimated using the SECPOP 2000 code in conjunction with U.S. census data and county census projection data for Pennsylvania and are presented in Table 11.03-1-3. The data for the 50-mile food and crop production rates was obtained from the U.S. Department of Agriculture statistics for Pennsylvania. (USDA, 2002). The production rates for milk, meat and vegetables are provided in Tables 11.03-1-7 – 11.03-1-9. BBNPP FSAR Section 11.3 will be updated to include this information.

5. The inputs used in the cost benefit analysis are provided above and in Tables 11.03-1-1 – 11.03-1-9.

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

7. BBNPP FSAR Section 11.3.4 will be updated to reflect this revised cost-benefit analysis and supporting inputs.

The description of the cost-benefit analysis provided in BBNPP FSAR Section 11.3.4 and ER Sections 3.5.3.3 and associated tables will be updated to reflect the above response.

COLA Impact

BBNPP COLA FSAR Section 11.3.4 and COLA ER Section 3.5 will be revised as shown on the markups included in Enclosure 2 in a future revision of the COLA.

Table 11.03-1-1: Annual Costs (1975 $1000) Associated with Gaseous Radwaste System Augments

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

Table 11.03-1-1: Annual Costs (1975 $1000) Associated with Gaseous Radwaste System Augments Continued

Equipment	Direct Costs[1]			Corrected Labor Cost[2]	Total Direct Cost[3]	Total Capital Cost[4]	Annual Fixed Cost[5]	Annual Operating Cost[6]	Annual Maint. Cost[7]	Total Annual Cost[8]
	Equip. /Material	Labor	Total							
PWR Air Ejector Charcoal/HEPA Filtration Unit	14	10	24	10.00	24.00	42.00	3.39	4.00	2.00	9.39
Steam Generator Flash Tank Vent to Main Condenser	19	14	33	14.00	33.00	57.75	4.65	1.00	1.00	6.65

*In cases where the equipment may be located in either the auxiliary building or the turbine building and common usage does not indicate a definite preference of one location or the other, cost for both locations are listed with the turbine building location cost in parenthesis.

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

Table 11.03-1-2 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	6.6
Average temperature in the growing season	63.2°F
50-mile Population Distribution	Table 11.03-1-3
50-mile distribution of normal effluent undecayed/undepleted X/Q values[2]	Table 11.03-1-4
50-mile distribution of normal effluent decayed (I-131)/depleted X/Q values	Table 11.03-1-5
50-mile distribution of normal effluent D/Q values	Table 11.03-1-6
Milk Production within 50 mi (kg/yr)[3]	Table 11.03-1-7
Meat Production within 50 mi (kg/yr)[3]	Table 11.03-1-8
Vegetable Production within 50 mi (kg/yr)[3]	Table 11.03-1-9

Notes:

1. The growing season is the span of months when the temperature is above freezing for all days during the month. Based on local climatological data, this occurs from April through October. (NOAA, 2006a, NOAA, 2006b, NOAA, 2006c)
2. The undecayed/undepleted χ/Q for each distance and sector is used as a bounding input to the GASPAR II population dose input file for the decayed/undepleted atmospheric dispersion factors This approach is conservative since no credit is taken for radiological decay.
3. Data for 50-mile food and crop production obtained from the U.S. Department of Agriculture statistics for Pennsylvania. (USDA, 2002)'

Table 11.03-1-3: Population Distribution by Sector for the Year 2080 (Projected)[1]

Sector	Distance										
	0-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50	Total
N	54	148	0	2	1,329	2,994	6,263	567	9,666	10,998	32,021
NNE	0	0	8	942	528	3,181	19,826	20,811	25,793	15,193	86,282
NE	0	160	2	78	264	4,934	154,276	136,468	229,401	74,855	600,438
ENE	0	247	0	530	108	2,460	38,921	10,117	20,278	30,195	102,856
E	560	86	175	25	223	2,199	9,347	6,392	28,325	73,141	120,473
ESE	0	138	137	444	466	3,007	21,436	14,493	42,456	79,364	161,941
SE	0	55	6	160	199	7,117	61,858	40,759	54,967	329,084	494,205
SSE	0	234	99	158	95	2,189	8,374	23,523	25,435	100,278	160,385
S	183	127	166	218	83	1,394	26,141	74,028	42,832	49,517	194,689
SSW	2	157	0	265	231	832	3,867	35,472	25,136	26,652	92,614
SW	77	64	311	3,061	1,191	1,553	4,502	44,553	15,145	23,886	94,343
WSW	0	372	205	5,689	8,527	11,757	41,741	27,022	70,234	51,224	216,771
W	0	0	284	473	689	2,587	9,647	8,754	48,785	20,178	91,397
WNW	0	81	112	4	2	1,929	5,831	8,131	28,521	105,179	149,790
NW	0	56	0	134	199	1,554	4,528	2,595	2,298	2,317	13,681
NNW	0	87	284	172	50	2,051	2,484	1,888	6,416	15,050	28,482
Totals	876	2,012	1,789	12,355	14,184	51,738	419,042	455,573	675,688	1,007,111	2,640,368

[1] 50-mile population projections estimated using the SECPOP 2000 code in conjunction with U.S. census data (USCB, 2000) and county census projection data for Pennsylvania (PA Census, 2008).

Table 11.03-1-4: Annual Average (2001-2007), Undecayed/Undepleted χ/Q (sec/m^3)

Sector	Downwind Distance (miles)									
	0.5	1.5	2.5	3.5	4.5	7.5	15	25	35	45
N	9.790E-07	4.803E-07	2.616E-07	1.438E-07	8.936E-08	3.949E-08	1.483E-08	7.308E-09	4.609E-09	3.275E-09
NNE	1.419E-06	5.188E-07	2.195E-07	1.388E-07	8.878E-08	3.852E-08	1.327E-08	6.493E-09	4.076E-09	2.886E-09
NE	9.185E-07	4.596E-07	1.858E-07	1.008E-07	7.378E-08	3.065E-08	1.128E-08	5.494E-09	3.442E-09	2.435E-09
ENE	4.617E-07	1.496E-07	7.889E-08	4.576E-08	3.185E-08	1.406E-08	5.065E-09	2.424E-09	1.500E-09	1.051E-09
E	2.480E-07	5.514E-08	4.693E-08	2.708E-08	1.946E-08	8.150E-09	2.874E-09	1.359E-09	8.338E-10	5.802E-10
ESE	1.769E-07	4.983E-08	3.945E-08	2.218E-08	1.804E-08	7.342E-09	2.241E-09	1.031E-09	6.290E-10	4.357E-10
SE	2.317E-07	6.034E-08	5.233E-08	3.149E-08	2.157E-08	9.898E-09	3.499E-09	1.643E-09	1.003E-09	6.952E-10
SSE	3.050E-07	8.764E-08	6.651E-08	4.252E-08	2.496E-08	1.197E-08	4.034E-09	1.912E-09	1.174E-09	8.180E-10
S	2.607E-07	1.050E-07	1.000E-07	6.092E-08	4.212E-08	1.970E-08	7.189E-09	3.467E-09	2.156E-09	1.515E-09
SSW	5.086E-07	1.946E-07	2.082E-07	1.259E-07	8.903E-08	4.099E-08	1.527E-08	7.478E-09	4.698E-09	3.329E-09
SW	4.838E-07	1.653E-07	1.173E-07	2.575E-07	1.828E-07	9.552E-08	3.745E-08	1.908E-08	1.232E-08	8.907E-09
WSW	8.691E-07	2.881E-07	2.188E-07	1.749E-07	1.445E-07	2.326E-07	9.377E-08	4.878E-08	3.191E-08	2.330E-08
W	1.800E-07	1.026E-06	4.531E-07	2.783E-07	1.948E-07	9.585E-08	3.759E-08	1.916E-08	1.237E-08	8.946E-09
WNW	1.433E-07	6.329E-07	2.358E-07	1.446E-07	1.004E-07	4.860E-08	1.865E-08	9.354E-09	5.973E-09	4.286E-09
NW	4.518E-07	4.378E-07	2.024E-07	1.237E-07	8.467E-08	4.055E-08	1.533E-08	7.595E-09	4.809E-09	3.428E-09
NNW	6.274E-07	3.367E-07	1.631E-07	9.873E-08	6.826E-08	3.267E-08	1.233E-08	6.096E-09	3.855E-09	2.745E-09

Table 11.03-1-5: Annual Average (2001-2007), Decayed (I-131)/Depleted χ/Q (sec/m^3)

Sector	Downwind Distance (miles)									
	0.5	1.5	2.5	3.5	4.5	7.5	15	25	35	45
N	9.522E-07	4.592E-07	2.142E-07	1.135E-07	6.806E-08	2.809E-08	9.226E-09	4.045E-09	2.328E-09	1.530E-09
NNE	1.377E-06	4.955E-07	1.798E-07	1.096E-07	6.800E-08	2.746E-08	8.253E-09	3.594E-09	2.059E-09	1.348E-09
NE	8.578E-07	4.282E-07	1.685E-07	8.958E-08	6.359E-08	2.176E-08	7.015E-09	3.041E-09	1.738E-09	1.138E-09
ENE	4.241E-07	1.381E-07	7.041E-08	3.977E-08	2.683E-08	9.990E-09	3.150E-09	1.342E-09	7.576E-10	4.911E-10
E	2.274E-07	4.938E-08	4.039E-08	2.243E-08	1.505E-08	5.748E-09	1.787E-09	7.521E-10	4.210E-10	2.710E-10
ESE	1.621E-07	4.474E-08	3.351E-08	1.827E-08	1.447E-08	5.179E-09	1.394E-09	5.707E-10	3.177E-10	2.035E-10
SE	2.122E-07	5.395E-08	4.675E-08	2.731E-08	1.633E-08	6.983E-09	2.178E-09	9.105E-10	5.072E-10	3.252E-10
SSE	2.795E-07	7.847E-08	5.968E-08	3.708E-08	1.889E-08	8.442E-09	2.509E-09	1.058E-09	5.931E-10	3.821E-10
S	2.392E-07	9.667E-08	9.266E-08	5.533E-08	3.192E-08	1.389E-08	4.471E-09	1.919E-09	1.089E-09	7.079E-10
SSW	4.665E-07	1.798E-07	1.971E-07	1.178E-07	8.242E-08	2.890E-08	9.497E-09	4.139E-09	2.373E-09	1.555E-09
SW	4.430E-07	1.508E-07	1.076E-07	2.488E-07	1.755E-07	6.735E-08	2.329E-08	1.056E-08	6.220E-09	4.161E-09
WSW	7.945E-07	2.644E-07	2.029E-07	1.626E-07	1.343E-07	1.644E-07	5.845E-08	2.706E-08	1.616E-08	1.089E-08
W	1.657E-07	1.015E-06	4.081E-07	2.457E-07	1.685E-07	6.781E-08	2.347E-08	1.065E-08	6.261E-09	4.180E-09
WNW	1.327E-07	6.094E-07	2.238E-07	1.144E-07	7.680E-08	3.446E-08	1.167E-08	5.182E-09	3.020E-09	2.003E-09
NW	4.391E-07	4.187E-07	1.659E-07	9.764E-08	6.444E-08	2.882E-08	9.536E-09	4.205E-09	2.430E-09	1.602E-09
NNW	6.124E-07	3.289E-07	1.343E-07	7.837E-08	5.216E-08	2.319E-08	7.670E-09	3.375E-09	1.948E-09	1.283E-09

Table 11.03-1-6: Annual Average (2001-2007), D/Q ($1/m^2$)

Sector	Downwind Distance (miles)									
	0.5	1.5	2.5	3.5	4.5	7.5	15	25	35	45
N	3.044E-09	1.059E-09	1.036E-09	5.191E-10	3.004E-10	1.125E-10	3.599E-11	1.460E-11	7.858E-12	4.880E-12
NNE	5.536E-09	1.504E-09	1.100E-09	6.371E-10	3.773E-10	1.404E-10	4.171E-11	1.692E-11	9.106E-12	5.656E-12
NE	1.246E-08	2.995E-09	1.144E-09	5.929E-10	5.091E-10	1.881E-10	5.995E-11	2.433E-11	1.309E-11	8.130E-12
ENE	7.394E-09	1.313E-09	5.935E-10	3.267E-10	2.430E-10	9.840E-11	3.135E-11	1.272E-11	6.846E-12	4.252E-12
E	3.494E-09	6.433E-10	4.389E-10	2.646E-10	1.406E-10	5.162E-11	1.621E-11	6.579E-12	3.540E-12	2.199E-12
ESE	2.353E-09	5.661E-10	3.709E-10	2.047E-10	1.611E-10	4.714E-11	1.293E-11	5.144E-12	2.768E-12	1.719E-12
SE	3.141E-09	7.040E-10	3.795E-10	2.126E-10	1.621E-10	6.573E-11	2.085E-11	8.460E-12	4.552E-12	2.827E-12
SSE	3.979E-09	9.828E-10	4.524E-10	2.703E-10	1.824E-10	7.688E-11	2.300E-11	9.335E-12	5.023E-12	3.120E-12
S	2.791E-09	8.052E-10	4.319E-10	2.458E-10	2.300E-10	9.335E-11	2.961E-11	1.202E-11	6.465E-12	4.016E-12
SSW	4.034E-09	1.067E-09	5.360E-10	3.031E-10	2.009E-10	1.368E-10	4.338E-11	1.760E-11	9.472E-12	5.883E-12
SW	2.355E-09	6.785E-10	3.442E-10	2.241E-10	1.476E-10	1.705E-10	5.409E-11	2.195E-11	1.181E-11	7.336E-12
WSW	1.991E-09	4.865E-10	2.370E-10	1.421E-10	9.438E-11	2.615E-10	8.296E-11	3.367E-11	1.813E-11	1.130E-11
W	9.033E-10	4.398E-10	2.173E-09	1.574E-09	1.156E-09	1.235E-10	3.909E-11	1.587E-11	8.565E-12	5.341E-12
WNW	1.032E-09	7.614E-10	4.822E-10	3.057E-10	1.960E-10	8.016E-11	2.537E-11	1.038E-11	5.584E-12	3.472E-12
NW	1.647E-09	8.352E-10	6.106E-10	3.407E-10	2.166E-10	8.760E-11	2.802E-11	1.137E-11	6.118E-12	3.800E-12
NNW	1.699E-09	5.210E-10	5.434E-10	2.997E-10	1.930E-10	7.853E-11	2.507E-11	1.017E-11	5.474E-12	3.400E-12

Table 11.03-1-7 Cow Milk Production (kg/yr)[1] within 50 miles of BBNPP Site

Direction	Distance (miles)										
	0-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50	Total
N	2,338	7,013	11,690	16,360	21,040	175,300	701,300	8,095,000	25,090,000	32,260,000	66,380,041
NNE	2,338	7,013	11,690	16,360	21,040	175,300	701,300	8,095,000	14,980,000	19,260,000	43,270,041
NE	2,338	7,013	11,690	16,360	21,040	175,300	701,300	8,095,000	11,330,000	19,260,000	39,620,041
ENE	2,338	7,013	11,690	16,360	21,040	175,300	701,300	2,330,000	10,500,000	13,500,000	27,265,041
E	2,338	7,013	11,690	16,360	21,040	175,300	701,300	1,169,000	458,100	382,000	2,944,141
ESE	2,338	7,013	11,690	16,360	21,040	175,300	701,300	1,169,000	7,632,000	9,813,000	19,549,041
SE	2,338	7,013	11,690	16,360	21,040	175,300	1,639,000	2,732,000	4,109,000	42,840,000	51,553,741
SSE	2,338	7,013	11,690	16,360	21,040	175,300	1,639,000	2,732,000	33,320,000	42,840,000	80,764,741
S	2,338	7,013	11,690	16,360	21,040	175,300	1,639,000	2,732,000	33,320,000	107,900,000	145,824,741
SSW	2,338	7,013	11,690	16,360	21,040	979,500	3,918,000	8,298,000	3,825,000	107,900,000	124,978,941
SW	2,338	7,013	11,690	16,360	117,500	979,500	3,918,000	14,020,000	11,620,000	19,240,000	49,932,401
WSW	2,338	7,013	11,690	91,420	117,500	979,500	3,918,000	14,020,000	26,390,000	40,950,000	86,487,461
W	2,338	7,013	11,690	91,420	117,500	979,500	3,918,000	14,020,000	31,850,000	40,950,000	91,947,461
WNW	2,338	7,013	11,690	91,420	117,500	979,500	3,918,000	6,530,000	6,111,000	7,857,000	25,625,461
NW	2,338	7,013	11,690	16,360	117,500	979,500	3,918,000	4,365,000	6,111,000	32,260,000	47,788,401
NNW	2,338	7,013	11,690	16,360	21,040	175,300	3,918,000	8,095,000	25,090,000	32,260,000	69,596,741
Total	37,408	112,208	187,040	486,940	818,940	7,630,000	36,550,800	106,497,000	251,736,100	569,472,000	973,528,436

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 11.03-1-8 Meat Production (kg/yr)[1] within 50 miles of BBNPP Site

Direction	Distance (miles)										
	0-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50	Total
N	449.7	1,349	2,249	3,149	4,048	33,733	134,891	751,532	2,506,716	3,138,215	6,576,331
NNE	449.7	1,349	2,249	3,149	4,048	33,733	134,891	713,681	1,448,007	1,862,436	4,203,992
NE	449.7	1,349	2,249	3,149	4,048	33,733	134,891	713,681	999,191	1,877,563	3,770,303
ENE	449.7	1,349	2,249	3,149	4,048	33,733	134,891	370,056	976,660	1,255,244	2,781,828
E	449.7	1,349	2,249	3,149	4,048	33,733	134,891	263,245	216,389	169,340	828,842
ESE	449.7	1,349	2,249	3,149	4,048	33,733	154,223	257,149	836,484	988,999	2,281,832
SE	449.7	1,349	2,249	3,149	4,048	33,733	1,264,081	2,106,435	3,037,630	7,733,670	14,186,793
SSE	449.7	1,349	2,249	3,149	4,048	33,733	1,263,903	2,105,820	6,015,430	7,733,670	17,163,800
S	449.7	1,349	2,249	3,149	4,048	33,733	1,263,903	2,105,820	6,013,037	34,698,780	44,126,517
SSW	449.7	1,349	2,249	3,149	4,048	177,613	1,519,811	3,970,157	2,948,628	34,698,780	43,326,233
SW	449.7	1,349	2,249	3,149	21,317	177,613	710,511	3,974,790	5,374,760	7,232,850	17,499,037
WSW	449.7	1,349	2,249	16,578	21,317	177,613	710,511	3,974,790	21,052,940	27,058,960	53,016,757
W	449.7	1,349	2,249	16,578	21,317	177,613	710,511	1,191,490	9,608,840	11,682,756	23,413,153
WNW	449.7	1,349	2,249	16,578	21,317	177,613	710,511	1,184,118	1,248,755	1,605,556	4,968,496
NW	449.7	1,349	2,249	3,149	21,317	177,613	710,511	891,853	1,248,755	3,366,542	6,423,787
NNW	449.7	1,349	2,249	3,149	4,048	33,733	710,511	751,532	2,497,383	3,138,215	7,142,618
Total	7,196	21,583	35,987	90,665	151,112	1,403,005	10,403,444	25,326,149	66,029,605	148,241,576	251,710,321

Notes:

1. Meat production overall total consists of 49.6% poultry, 30% hog, 20.2% beef, and 0.2% sheep.

Table 11.03-1-9 Vegetable Production (kg/yr)[1] within 50 miles of BBNPP Site

Sector	Distance (miles)										Total
	0-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50	
N	5,902	17,708	29,511	41,319	53,128	442,721	1,770,780	3,373,330	3,616,190	4,161,300	13,511,889
NNE	5,902	17,708	29,511	41,319	53,128	442,721	1,770,780	3,373,330	3,814,190	4,905,000	14,453,589
NE	5,902	17,708	29,511	41,319	53,128	442,721	1,770,780	3,497,330	3,785,190	2,979,530	12,623,119
ENE	5,902	17,708	29,511	41,319	53,128	442,721	1,770,780	3,076,100	2,951,340	2,873,530	11,262,039
E	5,902	17,708	29,511	41,319	53,128	442,721	1,770,780	3,086,600	2,546,400	2,199,550	10,193,619
ESE	5,902	17,708	29,511	41,319	53,128	442,721	1,810,760	3,018,240	23,775,500	29,798,500	58,993,289
SE	5,902	17,708	29,511	41,319	53,128	442,721	4,511,600	7,170,400	32,042,800	39,716,900	84,031,989
SSE	5,902	17,708	29,511	41,319	53,128	442,721	4,494,900	6,814,100	32,297,200	39,001,910	83,198,399
S	5,902	17,708	29,511	41,319	53,128	442,721	4,494,900	6,814,100	18,330,200	37,317,600	67,547,089
SSW	5,902	17,708	29,511	41,319	53,128	1,759,350	7,618,000	20,906,100	9,539,800	40,776,700	80,747,518
SW	5,902	17,708	29,511	41;319	211,110	1,705,110	6,818,740	20,242,200	26,834,800	35,196,200	91,102,600
WSW	5,902	17,708	29,511	164,210	204,595	1,705,110	6,818,740	20,242,200	27,278,300	34,131,000	90,597,276
W	5,902	17,708	29,511	164,210	204,595	1,705,110	6,818,740	13,466,200	25,246,260	17,323,890	64,982,126
WNW	5,902	17,708	29,511	164,210	204,595	1,759,350	6,818,740	11,374,200	4,955,310	6,371,470	31,700,996
NW	5,902	17,708	29,511	41,319	211,110	1,759,350	7,035,880	3,621,120	5,070,180	6,577,930	24,370,010
NNW	5,902	17,708	29,511	41,319	53,128	442,721	7,035,880	3,373,330	3,277,540	4,118,600	18,395,639
Total	94435	283325	472176	1029781	1620413	14820590	73130780	133448880	225361200	307449610	757711190

Notes:
1. Vegetable production overall total includes 79% grains, 14% above ground vegetables, 6% below ground vegetables, 1% leafy vegetables.

RAI No. 101
Question 11.03-2

BBNPP FSAR Tier 2, Rev. 2, 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 BBNPP FSAR Tier 2, Rev. 2, 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 Bell Bend site used in confirming compliance with NRC regulations and guidance. Specifically, the following observations were noted:

a. BBNPP 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 (Appendix B, Table 2, Column 1) gaseous effluent concentration limits. The BBNPP 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 Bell Bend site and, for those that are not, provide site specific parameters with appropriate justifications. A review of U.S. EPR, Rev. 2, 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 atmospheric dispersion and deposition parameters (EAB and dose receptors); different annual vegetable and grain production rates within 50 miles of the site; sectors with no residents; different 50-mile population projections; and the U.S. EPR FSAR Tier 2, Section 11.3.3 provides a set atmospheric dispersion and deposition parameters based on a different set of conditions.

b. In BBNPP 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. 2, FSAR, Tier 2, Section 11.3.3 apply to the specific conditions of the Bell Bend 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 BBNPP 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 BBNPP than that described in the U.S. EPR FSAR. 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 BBNPP FSAR Tier 2, Section 11.3.3 as a substitute assessment of radiological impacts associated with gaseous effluent releases and compliance with NRC regulations and guidance.

c. BBNPP communications to the NRC (BNP-2010-117) describes the change in the location of the nuclear power block on the site; however, FSAR Section 11.3 on gaseous effluent releases has not been revised to reflect such changes and address the associated impacts on offsite effluent concentrations and doses. In addition, BBNPP communications BNP-2010-176 and BNP-2010-276 identified changes to nearby population distributions. Any changes to the location of the nuclear power block on the site or changes in distances from discharge points to the locations of offsite dose receptors need to be identified and their impacts on the dispersion of effluent discharges and doses to members of the public need to be assessed in demonstrating compliance

with Part 20.1301 and 20.1302, Part 20, Appendix B, Table 2 effluent concentration limits, and 40 CFR Part 190 as implemented under 10 CFR 20.1301(e).

In light of the above, the applicant is requested to evaluate the following and revise the BBNPP FSAR Tier 2, Section 11.3 accordingly. The applicant is requested to:

1. Present in FSAR Tier 2, Section 11.3 the descriptions of Bell Bend site-specific features with cited references used to estimate doses to members of the public and populations, including descriptions of offsite dose receptors and exposure pathways based on the results of the current land-use census; locations and distances of dose receptors and exposure pathways from BBNPP if different than specifically referred to in BBNPP FSAR Tier 2,Section 2.3.5; sources and estimates of direct radiation exposures from BBNPP building and facilities and materials to members of the public; annual average atmospheric dispersion and deposition parameters for all identified offsite dose receptors and populations within a 50-mile (80 km) radius of BBNPP; 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. Apply Bell Bend site-specific information, revise BBNPP FSAR Tier 2, Section 11.3.3 and describe the evaluation and present results specific to BBNPP that demonstrates compliance with the effluent concentration limits of Part 20 (Appendix B, Table 2, Column 1); unity rule using the sum-of-the-ratios for all identified radionuclides; 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; and each design objective of Sections II.B and II.C of Appendix I to Part 50 for dose receptors based on the current land-use census, default parameters, and other assumptions.

3. Providing description of any changes to BBNPP Section 11.3 as a result of the relocation of the nuclear power block on the site. This description should include any changes to effluent release heights for the plant vent and vents from other buildings, changes in atmospheric dispersion and deposition parameters, changes in distances from discharge points to the locations of offsite dose receptors and populations, and resulting changes in dose consequences to members of the public.

For all of the above, the applicant is requested to describe in its response and revisions of FSAR Section 11.3, the methodology, assumptions and default parameters, revised atmospheric dispersion and deposition parameters, site-specific information on dose receptor locations, exposure pathways, and updated offsite effluent concentrations and dose results. The applicant should provide sufficient information to enable the staff to conduct an independent evaluation of offsite effluent concentrations, doses to members of the public and populations, and confirm the results and conclusions of regulatory compliance presented by the applicant in BBNPP FSAR Tier 2, Section 11.3 using RG 1.109 and RG 1.111, and the GASPAR II computer code (NUREG/CR-4653).

Response

1. BBNPP FSAR Sections 2.3.5 and 11.3, and ER Sections 2.7 and 5.4, will be revised to include the site-specific features and calculated doses to members of the public and populations related to the gaseous effluent discharges. The changes include the following

Bell Bend site-specific features used to estimate doses to members of the public and populations:

- Descriptions (including sector and distance relative to BBNPP) of offsite dose receptors and exposure pathways used in the gaseous effluent dose analysis based on current land-use census information,
- Clarification of OCA boundary (versus site boundary) used for gaseous effluent concentration and noble gas dose analyses in support of FSAR Section 11.3 and ER Sections 3.5 and 5.4,
- Sources and estimates of direct radiation exposures from BBNPP 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 BBNPP,
- Use of estimated 50-mile population distribution for the year 2080 in calculation population doses,
- 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. BBNPP FSAR Section 11.3.3 will be revised using BBNPP balance-of-plant design features and site-specific information. Section 11.3.3 describes the evaluations and presents results demonstrating compliance with the effluent concentration limits of 10 CFR Part 20, Appendix B, Table 2, Column 1, and 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 complying with 40 CFR Part 190 for all exposure pathways. The results demonstrate that BBNPP meets the ALARA design objectives of 10 CFR Part 50, Appendix I. BBNPP site maximum exposed individual and population doses have been performed together with a site-specific cost-benefit analysis.

3. There were no changes to the effluent release heights as part of the BBNPP Powerblock change. There were changes to the dose receptor locations and distances, site boundary locations and direct dose from on-site radioactive sources, atmospheric dispersion and deposition factors and resulting dose consequences to members of the public as a result of the BBNPP Powerblock change. These changes were incorporated into BBNPP ER Section 5.4 as part of Revision 3 to the COLA and will be incorporated into BBNPP FSAR Section 11.3.

COLA Impact

BBNPP COLA FSAR Sections 2.3.5 and 11.3 and ER Sections 2.7 and 5.4 will be revised as shown on the markups included in Enclosure 2 in a future revision of the COLA.

RAI No. 106
Question 11.02-6

A review of BBNPP FSAR Tier 2, Rev. 2, Section 11.2 and Chapter 17 indicates that the design basis and system descriptions incorporate by reference the information presented in FSAR Section 11.2 of the U.S. EPR design certification. In turn, this endorsement references several other supporting QA documents. These documents address certain aspects of the quality assurance program for the design, fabrication, procurement, and installation of the LWMS that would meet the guidance of RG 1.143. BBNPP FSAR Tier 2, Section 17 refers to the Unistar Nuclear Topical Report No. UN-TR-06-001-A, "Quality Assurance Program Description," Rev. 0, April 9, 2007; and incorporates by reference FSAR Section 17 of the U.S. EPR design certification. A review of U.S. EPR FSAR Section 17.2 indicates that the construction phase and operations of the U.S. EPR are not applicable in the context of its design certification. U.S. EPR FSAR Section 17.3 refers to U.S. EPR FSAR Section 17.5 for details on the description of the QA program. U.S. EPR FSAR Section 17.4 is devoted to the reliability program. U.S. EPR FSAR Section 17.5 relies on the AREVA NP Topical Report ANP-10266A (Rev. 1) in describing its quality assurance program. U.S. EPR FSAR Section 17.2 commits the COLA applicant to provide the applicable quality assurance program for the construction and operational phases.

BBNPP FSAR Section 17.3 states that the corresponding section of the U.S. EPR FSAR Section 17.3 is incorporated by reference. BBNPP FSAR Section 17.4 is devoted to the reliability program. BBNPP FSAR Section 17.5 incorporates by reference the U. S. EPR FSAR Section 17.5; and, with some exceptions, also adopts Revision 0 of the Unistar topical report (Unistar Nuclear Topical Report, UN-TR-06- 001-A) in describing its QA program in Part 11a (Bell Bend Quality Assurance Program Description (QAPD, Rev.1).

A review of the Bell Bend Quality Assurance Program Description, Revision 1, Section U (Quality Assurance Program Commitments) and Section V (Nonsafety-Related SSC Quality Controls) indicates that RG 1.143 is not listed among the cited documents for the LWMS, GWMS or the SWMS in complying with NRC regulations. Note that although Section U refers to RGs 1.26 and 1.29, these two RGs do not apply to radioactive waste management systems, as stated in both RGs. Similar observations were made during the review of the AREVA NP Topical Report ANP-10266A (Rev. 1). As a result, BBNPP FSAR Tier 2, Section 11.2 makes a design commitment for the LWMS that is not supported by (i) BBNPP FSAR Tier 2, Sections 11.2 and 17, (ii) Bell Bend Quality Assurance Program Description, Revision 1, and (iii) Unistar Nuclear Topical Report UN-TR-06-001-A.

Accordingly, the applicant is requested to consider the following and make appropriate revisions to BNPP FSAR Tier 2, Sections 11.2 and 17.5. Specifically:

1. Revise Section U or V of the Bell Bend Quality Assurance Program Description (QAPD) to include RG 1.143 in its QA program commitments, and as part of that commitment the applicant is requested to endorse the following industry guidance: ANSI/ANS-55-6-1993 (Reaffirmed May 14, 2007) for the LWMS; ANSI/ANS-55-4-1993 (Reaffirmed May 14, 2007) for the GWMS; and ANSI/ANS-40-37-2009 for the SWMS in the appropriate sections of the BBNPP FSAR.

2. Describe in BBNPP FSAR Tier 2, Section 11.2 the elements of QA program that address the design, fabrication, procurement, and installation of the LWMS based on the guidance of RG 1.143 in response to U.S. EPR COL Information Item 17.2-1, and provide the details on

how the QA elements of the regulatory guide would be implemented at BBNPP for fabrication, procurement, and installation of permanently installed and skid-mounted systems and components.

3. Identify corresponding changes to BBNPP FSAR Tier 2, Section 11.3 for the GWMS, BNPP FSAR Section 11.4 for the SWMS, and BBNPP FSAR Section 11.5 for the PERMSS in ensure a consistent application of QA requirements and guidance for the purpose of demonstrating compliance with effluent concentration and dose limits of 10 CFR 20.1301 and 20.1302 and design objectives of Part 50, Appendix I.

4. Make a clear distinction among those elements of the QA program that are mandated under the requirements of Part 50, Appendix B, as identified in U.S. EPR FSAR Rev. 1, Table 3.2.2-1, versus those that would be implemented under RG 1.143 which should be described in BBNPP FSAR Section 11.2 for the LWMS, BBNPP FSAR Section 11.3 for the GWMS, and BBNPP FSAR Section 11.4 for the SWMS.

5. For the permanently installed LWMS, as described in the BBNPP FSAR Section 11.2, the applicant is requested to clarify those aspects of the RG 1.143 QA program that are the responsibility of BBNPP in developing procurement specifications in confirming the proper fabrication and installation of LWMS components.

6. For skid mounted-LWMS and SWMS, described as COLA options in U.S. EPR FSAR, Rev. 1, Sections 11.2.2 and 11.4.1, the applicant is requested to clarify those aspects of the RG 1.143 QA program that are the responsibility of BBNPP for the design and development of procurement specifications, proper fabrication in confirming correct operational interfaces of supplemental skid-mounted processing subsystems connected to the permanently installed LWMS and SWMS.

7. For the permanently installed GWMS, as described in the BBNPP FSAR Section 11.3, the applicant is requested to clarify those aspects of the RG 1.143 QA program that are the responsibility of BBNPP for the development of procurement specifications in confirming the proper fabrication and installation of GWMS components against those portions of the GWMS system that fall under the requirements of Part 50, Appendix B QA program as identified in U.S EPR Rev. 1, FSAR Table 3.2.2-1.

Response

Items 1 through 3 are addressed as follows:

The BBNPP FSAR Sections will be revised as follows:

11.2.3.8, Quality Assurance

{The impact of radwaste systems on safety is limited, the extent of control required by Appendix B to 10 CFR Part 50 is similarly limited. Thus, a supplemental quality assurance program applicable to design, construction, installation and testing provisions of the liquid radwaste system is established by procedures that complies with the guidance presented in SRP Section 11.2, RG 4.21 and 1.143, IE Bulletin 80-10, NEI 08-08A (NEI, 2009), and ANSI/ANS 55.6-1993 (ANS, 2007).}

11.3.3.7, Quality Assurance

{The impact of radwaste systems on safety is limited, the extent of control required by Appendix B to 10 CFR Part 50 is similarly limited. Thus, a supplemental quality assurance program applicable to design, construction, installation and testing provisions of the gaseous radwaste system is established by procedures that complies with the guidance presented in SRP Section 11.3, RG 4.21 and 1.143, IE Bulletin 80-10, NEI 08-08A (NEI, 2009), and ANSI/ANS 55.4-1993 (ANS, 2007).}

11.4.6, Quality Assurance

{The impact of radwaste systems on safety is limited, the extent of control required by Appendix B to 10 CFR Part 50 is similarly limited. Thus, a supplemental quality assurance program applicable to design, construction, installation and testing provisions of the solid radwaste system is established by procedures that complies with the guidance presented in SRP Section 11.4, RG 4.21 and 1.143, IE Bulletin 80-10, NEI 08-08A (NEI, 2009b), and ANSI/ANS 40.37-2009 (ANS, 2009).}

This appropriately captures the elements of the QA program that address the design, construction, installation and testing provisions of the radwaste systems, based on the guidance of RG 1.143 and endorses the requested industry guidance.

The BBNPP FSAR Sections 11.2.3.8, 11.3.3.7, and 11.4.6 will be revised to address the elements of the QA program that addresses the design, construction, installation and testing provisions of the radwaste systems, based on the guidance of RG 1.143 and the requested industry guidance. The Bell Bend QAPD will not be revised.

Item 4 is addressed as follows:

As stated in AREVA's response to U.S. EPR RAI 436, Question 11.02-26[1], "U.S. EPR FSAR Tier 2, Table 3.2.2-1 shows the components designated as Supplemented Grade (NS-AQ) safety class and reference Regulatory Guide (RG) 1.143 in the comment column. As shown in U.S. EPR FSAR Tier 2, Table 3.2.2-1, 10 CFR 50, Appendix B requirements are not applicable to these components (they are designated as 'no' under the 10 CFR 50 Appendix B column). Quality Assurance (QA) for these components is implemented following the guidance of RG 1.143."

In accordance with RG 1.143, Section 7, BBNPP has established and documented quality assurance program (QAP) requirements for non-safety-related systems that meet the requirements of ANSI/ANS 55.6-1993 (LWMS), ANSI/ANS 55.4-1993 (GWMS), and ANSI/ANS 40.37-2009 (SWMS). The applicable QAP requirements are implemented in accordance with the Quality Assurance Program Description (QAPD) Revision 2. Specifically, applicable elements of the quality assurance program, specified in QAPD, Section V, "Nonsafety-related SSC Quality Controls" meet the requirements of RG 1.143 and ANSI/ANS 55.6-1993, ANSI/ANS 55.4-1993, and ANSI/ANS 40.37-2009.

[1] M. Bryan (AREVA) to G. Tesfaye (NRC), "Response to U.S. EPR Design Certification Application RAI No. 436, FSAR Ch.11, OPEN ITEM, Supplement 2," email dated November 8, 2010.

As shown in the response to Question 11.02-6(1)-(3) above, BBNPP COLA FSAR Sections 11.2.3.8, 11.3.3.7, and 11.4.6 will be revised to reflect the basis for the systems' quality assurance program.

Item 5 will be addressed as follows:

BBNPP COLA FSAR Section 11.2.3.8 will be revised to provide the basis for an acceptable quality assurance program for a liquid waste management system.

Item 6 will be addressed as follows:

BBNPP COLA FSAR Sections 11.2.3.8 and 11.4.6 will be revised to provide the basis for an acceptable quality assurance program for skid-mounted liquid and solid waste management system.

Item 7 will be addressed as follows:

BBNPP COLA FSAR Section 11.3.3.7 will be revised to provide the basis for an acceptable quality assurance program for a gaseous waste management system.

COLA Impact

BBNPP COLA FSAR Sections 11.2, 11.3 and 11.4 will be revised as shown on the markups included in Enclosure 2 in a future revision of the COLA.

RAI No. 106
Question 11.02-7

BBNPP FSAR Tier 2, Rev. 2, Section 11.2.3 presents information on liquid effluent discharges and doses to members of the public by incorporating by reference, with additional supplemental information, the corresponding FSAR sections of the U.S. EPR design certification. A comparison of the information presented in BBNPP FSAR Tier 2, Rev. 2, Sections 11.2.2, 11.2.3, 10.4.5 and 2.1.1.3, and FSAR Figure 10.4-8 indicates that the information presented in the corresponding sections of the U.S. EPR is different and inconsistent with the characteristics of the Bell Bend site used in confirming compliance with NRC regulations. Specifically, the following items were noted:

a. BBNPP 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 (Appendix B, Table 2, Column 2) effluents concentration limits. The BBNPP 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 Bell Bend 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 dilution flow rates of 100 ft^3/s, 20 ft^3/s, and 39.3 ft^3/s under different conditions and calculation applications; 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 BBNPP 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 Bell Bend site, including confirmation of offsite dose receptors based on the results of the most current the land-use census. In addition, the referenced BBNPP Environmental Report (ER) Sections 5.4.1 and 5.4.2 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 BBNPP 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. BBNPP FSAR Tier 2, Rev. 2, Section 10.4.5 and FSAR Figure 10.4-8 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. BBNPP 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 Susquehanna River 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. BBNPP FSAR Tier 2, Section 11.2.2 should be revised to include descriptions of all design features and assumptions that are applicable to the Bell Bend site and provide a complete description of the liquid effluent discharge path to the Susquehanna River.

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 BBNPP FSAR Sections 9.2.5, 10.4.5, and 11.2 and Figures 9.2-3, and 10.4-8 indicates that dilution streams from other plant systems are not fully accounted in the descriptions of the discharge path. BBNPP FSAR Sections 9.2.5 and 10.4.5 and Figure 10.4-8 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, does not describe the "alternate blowdown path" and its expected flow rates, and does not list the flow rate from the water treatment plant with which liquid radioactive effluent are mixed prior to discharge to the Susquehanna River via the CWS outfall. As a result, the description of the liquid effluent discharge path and site-specific conditions are different for BBNPP 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 the BBNPP 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. Based on the applicant's communication to the NRC (BNP-2010-117) describing the impact of the relocation of the nuclear power block on the site, BBNPP Section 11.2 has not identified nor addressed the implications and impacts associated with the relocation of the nuclear power block on the discharge path from the RWB to the point of release in unrestricted areas. Any changes to the discharge path, changes in connections from other process or dilution streams, and structure or discharge location need to be identified, and their impacts on effluent discharge dilution flows and rates, and doses to members of the public in complying with Part 20.1301, 20.1302, and Appendix B Table 2 requirements need to be assessed.

e. Under BBNPP 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 Susquehanna River 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 (Appendix B, Table 2, Column 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 BBNPP FSAR Tier 2, Section 11.2 accordingly. The applicant is requested to:

1. Present in FSAR Tier 2, Section 11.2.2 the descriptions of design features that are applicable to the Bell Bend 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 Susquehanna River, 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, changes of in-plant dilution rates whenever the plant operates

in the "alternate blowdown path," and provide information and cite references supporting the applied Susquehanna River dilution factor/mixing ratio, if used in liquid effluent dose calculations. The discharge dilution blowdown rate described in BBNPP FSAR Tier 2, Table 10.4-1 is different than that applied in Gale Code input values identified in BBNPP FSAR Table 11.2-1.

2. Use Bell Bend balance-of-plant design features and site-specific information, revise BBNPP FSAR Tier 2, Section 11.2.3 and describe the evaluation and present results demonstrating compliance with the effluent concentration limits of Part 20 (Appendix B, Table 2, Column 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; and design objectives of Sections II.A and II.D of Appendix I to Part 50 for dose receptors based on the current land-use census. The applicant is requested to provide as part of the BBNPP Section 11.2 submittal sufficient information including cited references 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 BBNPP ER.

3. Update the regulatory description of the plant boundary for radioactive liquid effluents in BBNPP FSAR Tier 2, Section 2.1.1.3 by including the requirements of Part 20 (Appendix B, Table 2, Column 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.).

4. Provide description of any changes to BBNPP Section 11.2 as a result of the relocation of the nuclear power block on the current site layout. This description would include any changes to the discharge path from the boundary of the RWB, implications on discharge flow rates, basis and application of onsite dilution factors, effluent release rates, effluent concentrations at the point of discharge in unrestricted areas, and supporting assumptions in calculations used to estimate releases and dose consequences to members of the public.

For all of the above, the applicant is requested to describe in its response and revisions of FSAR Section 11.2, the methodology, assumptions and default parameters, revised discharge flow paths and dilution rates, site-specific information on dose receptor locations, exposure pathways, and updated offsite effluent concentrations and dose results. The applicant should provide sufficient information to enable the staff to conduct an independent evaluation of offsite effluent concentrations, doses to members of the public and populations, and confirm the results and conclusions of regulatory compliance presented by the applicant in BBNPP FSAR Tier 2, Section 11.2 using SRP Section 11.2, RG 1.206, 1.109 and 1.113, and the LADTAP II computer code (NUREG/CR-4013).

Response

1. The discharge flow rate value used in assessing offsite doses due to liquid effluents is 8,665 gpm, or 19.3 ft^3/sec. The values reported in FSAR Table 10.4-1 represent only the cooling tower blowdown rather than the total effluent discharge to the Susquehanna River, which

includes additional components such as the discharge from the combined waste water retention pond.

The liquid effluent environmental dilution factors were calculated using the Cornell Mixing Expert System (CORMIX) and the Generalized Environmental Modeling System for Surface Waters (GEMSS®) models along with average flow conditions in the Susquehanna River and information on the configuration, placement and operation of the multi-port diffuser. The CORMIX model was used to determine the size of the plume and to calculate near-field dilution factors. GEMSS® was used for the determination of far-field dilution factors. More information regarding the inputs used in the modeling can be found in ER Section 5.3.2.

BBNPP FSAR Section 11.2.3.3 will be revised to include a description of the discharge path from the boundary of the Radioactive Waste Processing Building (RWB) to the Susquehanna River along with the above explanation regarding the calculation of the dilution factors. The CORMIX report documenting the calculation of the dilution factors can be made available for staff audit, if required.

2. BBNPP FSAR Section 11.2.3 will be updated to describe the evaluation and present results demonstrating compliance with the effluent concentration limits of 10 CFR Part 20 (Appendix B, Table 2, Column 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; and design objectives of Sections II.A and II.D of Appendix I to Part 50 for dose receptors based on the current land-use census.

3. The BBNPP FSAR Section 2.1.1.3 will be updated to include the requirements for liquid and gaseous radionuclide effluent concentrations at the plant interface with the environment to meet the concentrations limits of 10 CFR Part 20, Appendix B, Table 2. The section will also be updated to include the dose limits for individual members of the public of 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 will also be included in the update.

4. There are no changes to BBNPP FSAR Section 11.2 as a result of the relocation of the nuclear power block.

COLA Impact

BBNPP COLA FSAR Sections 2.1 and 11.2 will be revised as shown on the markups included in Enclosure 2 in a future revision of the COLA.

RAI No. 106
Question 11.04-2

In U.S. EPR FSAR, Tier 2, Table 1.8-2 and Section 11.4.2.4, COL Information Item 11.4-3 states that if a need for onsite storage of low-level radioactive waste has been identified beyond that provided in U.S. EPR Standard Design because of unavailability of offsite storage or disposal, the applicant should submit the details of any proposed onsite storage facility to the NRC. Please provide any arrangements for offsite storage for low-level radioactive waste or submit plans for onsite storage.

Response

Bell Bend Nuclear Power Plant (BBNPP) has capacity for storing packaged low-level radioactive waste (LLRW) onsite until it is shipped offsite to a licensed radioactive waste processing facility or a burial site. Onsite processing of the waste will be performed in accordance with the Process Control Program (PCP) identified in FSAR Section 11.4.3 of the BBNPP COLA. The development of this PCP is a License Condition identified in COLA Part 10, Appendix A, Item 3, Operational Program Implementation and is listed in FSAR Table 13.4-1. The PCP assures that the final solid waste disposal product from BBNPP meets applicable Federal, State, and Disposal Site requirements for low-level radioactive waste classification and characterization, waste transfers and shipping manifests, shipping regulations, and waste acceptance criteria of authorized disposal facilities.

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

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

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

If additional onsite storage capacity for Class B and C were necessary, BBNPP could elect to construct a new temporary storage facility. The facility would meet applicable NRC guidance, including Appendix 11.4-A of the Standard Review Plan, "Design Guidance for Temporary Storage of Low-Level Waste." Such a facility would be located in an appropriate onsite location.

The environmental impacts of constructing such a facility would be minimal and would be addressed at the time the facility was announced. The operation of a storage facility meeting the standards in Appendix 11.4-A would provide appropriate protection against releases, maintain exposures to workers and the public below applicable limits, and result in no significant environmental impact.

As an alternative to onsite storage, BBNPP could enter into a commercial agreement with a third-party contractor to process, store, own, and ultimately dispose of low-level waste generated as a result of BBNPP operations. Activities associated with the transportation, processing, and ultimate disposal of low level waste by the third-party contractor would necessarily comply with applicable laws and regulations in order to assure public health and safety and protection of the environment. In particular, the third-party contractor would conduct its operations consistent with applicable Agreement State or NRC regulations (e.g., 10 CFR Part 20), which assure that the radiological impacts from these activities would be acceptable. Environmental impacts resulting from management of low-level wastes are expected to be bounded by the NRC findings in 10 CFR 51.51(b) (Table S-3). Table S-3 assumes that solid, low-level waste from reactors will be disposed of through shallow land burial, and concludes that this kind of disposal will not result in the release of any significant effluent to the environment.

COLA Impact

The BBNPP COLA will not be revised as a result of this response.