Nuclear Operating Company
South Texas Project Electric Generating Station P.O. Box 289 Wadsworth, Texas 77483

March 24, 2010
U7-C-STP-NRC-100058

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

South Texas Project
Units 3 and 4
Docket Nos. 52-012 and 52-013
Response to Requests for Additional Information

Attached are responses to NRC staff questions included in Request for Additional Information (RAI) letter number 308 related to Combined License Application (COLA) Part 2, Tier 2, Section 12.2. This submittal completes the response to letter 308.

Attachments 1 and 2 provide responses to the following:

12.02-15
12.02-16

The Enclosure in Attachment 1 provides the input parameter values required to support the requested information.

There are no commitments in this letter.

If you have any questions regarding this response, please contact me at (361) 972-7136 or Bill Mookhoek at (361) 972-7274.

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

Executed on 3/24/10

Scott Head
Manager, Regulatory Affairs
South Texas Project Units 3 & 4

scs
Attachments:
Question 12.02-15
Question 12.02-16

D091

STI 32629638 NRO

cc: w/o attachment except*
(paper copy)

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RAI 12.02-15

QUESTION:

This RAI is related to the applicant's response to RAI 11.02-3. COL Tier 2 (Rev 3), Section 12.2, Table 12.2-22 presents calculated Average Annual Liquid Releases (MBq/yr) from some input design parameters and values in Tables 11.2-2 through Table 11.2-6 used in the BWR-GALE computer code. The resulting calculated annual liquid radionuclide releases are compared to 10 CFR 20 Appendix B liquid effluent concentration limits in Tables 12.2-22. Staff review indicates that a total departure was taken for the LWMS in STD DEP 11.2-1. The new design did not provide information to independently confirm the calculated annual liquid radionuclide releases for compliance with 10 CFR 20.1302; 10 CFR 20, Appendix B, Table 2, Column 2; 10 CFR 50, Appendix I; 10 CFR 50.34a; and 10 CFR 50, Appendix A, GDC 60.

The staff requests that the applicant address the following items and revise the COL to include this information:

1. Provide the basis for all values and assumptions used in the revised BWR-GALE code calculation of average annual liquid releases in Table 12.2-22. Include value derivations and references (e.g., pointer to applicable FSAR section, NUREG-0016, etc.).

2. Provide the BWR-GALE code input/output files used to calculate the average annual liquid radionuclide releases.

RESPONSE:

1. The guidance of NUREG-0016 provides information and acceptable methods for calculating average annual expected releases of radioactive materials in liquid effluents from BWRs using the BWR-GALE Code. The GALE methodology was previously used to calculate average annual liquid releases. The code input has been reviewed by STPNOC and deemed appropriate for the calculation to develop the average annual liquid releases in FSAR Table 12.2-22. However, this review also indicated that the complete input/output files for the calculation are non-retrievable.

   Accordingly, STPNOC has used the information in the COLA and DCD to develop input parameters and to calculate the values provided in FSAR Table 12.2-22, using the BWR-GALE86 Code (The GALE86 Code abstract reference indicates that this newer code is associated with more recent information in NUREG-0016, Revision 1, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors (BWR-GALE Code)". The NRC Staff found the use of the GALE86 Code to be acceptable for calculating expected releases of radioactive materials in Gaseous and Liquid Effluents (GALE) from light-water reactors during normal operations and anticipated operational occurrences (AOO) in ISG-5 "Interim Staff Guidance on the use of the GALE86 Code for Calculation of Routine Radioactive Releases in Gaseous and Liquid Effluents from Boiling-Water Reactors and Pressurized-Water Reactors to Support Design Certification and Combined License Applications.").

The input parameter values and basis/reference are provided in Enclosure 1. The liquid annual release activity concentration for STP 3 & 4 was calculated from the GALE86 Code output as follows:

The assumed capacity factor for each STP ABWR power plant unit is 0.93, and the default capacity factor used by GALE86 Code is 0.80.

The circulating water flow rate is 272,550 m^3/hr.

Because the GALE86 Code uses a capacity factor of 0.80 to calculate the liquid release activities, it was necessary to increase the output results by a factor of 0.93/0.80 to account for the capacity factor specific to each STP ABWR unit. Also, the output of the GALE86 Code is in units of Ci/yr. It is necessary to convert the annual liquid release activity results to units of MBq/yr and liquid release concentrations to units of MBq/ml to be consistent with the existing units in Table 12.2-22 of the STP 3 & 4 FSAR.

Therefore, to obtain the annual liquid release activities in units of MBq/yr, the GALE86 Code annual liquid release activity results were multiplied by the following factor:

$$(3.7 \text{ x } 10^{10} \text{ Bq/Ci x 1 MBq / } 10^6 \text{ Bq x } 0.93/0.80) = 4.30 \text{ x } 10^4 \text{ MBq/Ci.}$$

The annual average concentrations are the annual releases divided by the annual flow in the circulating water system. To obtain the liquid release activity concentrations in units of MBq/ml, the GALE86 Code liquid release activity results were multiplied by the following factor:

$$(3.7 \text{ x } 10^{10} \text{ Bq/Ci x 1 MBq / } 10^6 \text{ Bq x } 0.93/0.80) \, / \, (272{,}550 \text{ m}^3\text{/hr x 8760 hr/yr x } 10^6 \text{ ml/m}^3 \text{ x } 0.93) = 1.937 \text{ x } 10^{-11} \text{ MBq-yr/ml-Ci.}$$

The Iodine adjustment factor was calculated as follows:

The I-131 concentration in reactor water is 0.085 MBq/kg (ABWR DCD Subsection 12.2.2.1). This parameter is not a direct input to the GALE86 Code, but is internally calculated and reflected in the output. As a result, the I-131 concentration is adjusted as noted below to ensure the I-131 release rate corresponds to an I-131 concentration of 0.085 MBq/kg.

The I-131 concentration calculated by GALE86 Code is 1.92 x 10^{-3} μCi/g.

To adjust the GALE86 Code iodine results to the I-131 concentration in reactor water of 0.085 MBq/kg, the liquid release results for the iodines are multiplied by the following factor in addition to the adjustment factors calculated above.

$$0.085 \text{ MBq/kg / } (1.92 \text{ x } 10^{-3} \, \mu\text{Ci/g x 1 Ci/}10^6 \, \mu\text{Ci x 1000 g/kg x } 3.7 \text{ x } 10^{10} \text{ Bq/Ci x 1 MBq / } 10^6 \text{ Bq}) = 0.085 \text{ MBq/kg / } 0.07104 \text{ MBq/kg} = 1.196.$$

The use of the GALE86 Code, which is the latest NRC implementation of the GALE methodology, results in slightly different releases compared to the values shown in the COLA Rev. 3 FSAR. Specifically, use of the GALE86 Code for FSAR Table 12.2-22 reflects the deletion of 12 low-concentration nuclides and the addition of 8 low-concentration nuclides. The 12 deletions are C-14, Co-56, Co-57, Rb-89, Y-90, Rh-103m, Rh-106, Sb-124, Te-132, La-140, Ce-144, and Nd-147. The 8 additions are Ni-65, Zn-69m, Br-83, Ru-105, Ba-139, La-142, Ce-143, and Ce-144. This confirmatory calculation shows the total fraction of allowable concentration as 3.32E-05, supporting the original determination that STP Units 3 & 4 liquid effluent values remain well below the 10 CFR 20, Appendix B Unity Rule of one. The liquid effluent values are provided in the table below. The first column provides the GALE86 output that is modified by the above factors to obtain the STP 3 & 4 releases.

GALE86 Code Liquid Release Source Term

Nuclide	GALE86 Annual Release (Ci/yr/unit)	STP 3 & 4 Annual Release (MBq/yr/unit)	STP 3 & 4 Concentration (MBq/ml)	Allowable Concentration (MBq/ml)	Fraction of Allowable Concentration
I-131	6.5E+03	3.35E+02	1.51E-13	3.70E-08	4.07E-06
I-132	2.1E-03	1.08E+02	4.87E-14	3.70E-06	1.32E-08
I-133	3.0E-02	1.54E+03	6.95E-13	2.59E-07	2.68E-06
I-134	2.8E-04	1.44E+01	6.49E-15	1.48E-05	4.39E-10
I-135	9.5E-03	4.89E+02	2.20E-13	1.11E-06	1.98E-07
H-3	7.0E+00	3.01E+05	1.36E-10	3.70E-05	3.66E-06
Na-24	4.1E-03	1.76E+02	7.94E-14	1.85E-06	4.29E-08
P-32	4.2E-04	1.81E+01	8.14E-15	3.33E-07	2.44E-08
Cr-51	1.2E-02	5.16E+02	2.32E-13	1.85E-05	1.26E-08
Mn-54	3.9E-03	1.68E+02	7.55E-14	1.11E-06	6.81E-08
Mn-56	2.1E-03	9.03E+01	4.07E-14	2.59E-06	1.57E-08
Co-58	8.2E-03	3.53E+02	1.59E-13	7.40E-07	2.15E-07
Co-60	1.5E-02	6.45E+02	2.91E-13	1.11E-07	2.62E-06
Fe-55	8.5E-03	3.66E+02	1.65E-13	3.70E-06	4.45E-08
Fe-59	2.2E-03	9.46E+01	4.26E-14	3.70E-07	1.15E-07
Ni-63	1.7E-03	7.31E+01	3.29E-14	3.70E-06	8.90E-09
Ni-65	1.0E-05	4.30E-01	1.94E-16	3.70E-06	5.24E-11
Cu-64	1.1E-02	4.73E+02	2.13E-13	7.40E-06	2.88E-08
Zn-65	2.6E-04	1.12E+01	5.04E-15	1.85E-07	2.72E-08
Zn-69m	7.6E-04	3.27E+01	1.47E-14	2.22E-06	6.63E-09
Br-83	2.3E-04	9.89E+00	4.46E-15	3.33E-05	1.34E-10
Sr-89	2.2E-04	9.46E+00	4.26E-15	2.96E-07	1.44E-08
Sr-90	2.0E-05	8.60E-01	3.87E-16	1.85E-08	2.09E-08
Sr-91	1.1E-03	4.73E+01	2.13E-14	7.40E-07	2.88E-08
Y-91	1.7E-04	7.31E+00	3.29E-15	2.96E-07	1.11E-08
Sr-92	4.5E-04	1.94E+01	8.72E-15	1.48E-06	5.89E-09
Y-92	1.3E-03	5.59E+01	2.52E-14	1.48E-06	1.70E-08
Y-93	1.1E-03	4.73E+01	2.13E-14	7.40E-07	2.88E-08
Zr-95	1.1E-03	4.73E+01	2.13E-14	7.40E-07	2.88E-08
Nb-95	1.9E-03	8.17E+01	3.68E-14	1.11E-06	3.32E-08
Mo-99	1.9E-03	8.17E+01	3.68E-14	7.40E-07	4.97E-08
Tc-99m	4.5E-03	1.94E+02	8.72E-14	3.70E-05	2.36E-09
Ru-103	3.2E-04	1.38E+01	6.20E-15	1.11E-06	5.58E-09
Ru-105	2.0E-04	8.60E+00	3.87E-15	2.59E-06	1.50E-09
Ru-106	8.9E-03	3.83E+02	1.72E-13	1.11E-07	1.55E-06
Ag-110m	1.2E-03	5.16E+01	2.32E-14	2.22E-07	1.05E-07
Te-129m	5.0E-05	2.15E+00	9.69E-16	2.59E-07	3.74E-09
Te-131m	7.0E-05	3.01E+00	1.36E-15	2.96E-07	4.58E-09

GALE86 Code Liquid Release Source Term

Nuclide	GALE86 Annual Release (Ci/yr/unit)	STP 3 & 4 Annual Release (MBq/yr/unit)	STP 3 & 4 Concentration (MBq/ml)	Allowable Concentration (MBq/ml)	Fraction of Allowable Concentration
Cs-134	1.2E-02	5.16E+02	2.32E-13	3.33E-08	6.98E-06
Cs-136	7.4E-04	3.18E+01	1.43E-14	2.22E-07	6.46E-08
Cs-137	1.8E-02	7.74E+02	3.49E-13	3.70E-08	9.42E-06
Cs-138	4.0E-05	1.72E+00	7.75E-16	1.48E-05	5.24E-11
Ba-139	1.1E-04	4.73E+00	2.13E-15	7.40E-06	2.88E-10
Ba-140	1.4E-03	6.02E+01	2.71E-14	2.96E-07	9.16E-08
Ce-141	2.7E-04	1.16E+01	5.23E-15	1.11E-06	4.71E-09
La-142	8.0E-05	3.44E+00	1.55E-15	3.70E-06	4.19E-10
Ce-143	2.0E-05	8.60E-01	3.87E-16	7.40E-07	5.24E-10
Ce-144	3.9E-03	1.68E+02	7.55E-14	1.11E-07	6.81E-07
Pr-143	5.0E-05	2.15E+00	9.69E-16	7.40E-07	1.31E-09
W-187	1.7E-04	7.31E+00	3.29E-15	1.11E-06	2.97E-09
Np-239	7.0E-03	3.01E+02	1.36E-13	7.40E-07	1.83E-07
				Total[1]:	3.32E-05

1. The total annual release for "All Others" nuclides identified by GALE86 is 3.8E-03 Ci/yr. The nuclides in this group are primarily daughter products of the reactor coolant nuclides evaluated by GALE86. They are not radiologically significant because of short half-lives or because their effect is included with the parent nuclide. Consideration of "All Others" will have no effect on the fraction of allowable concentration.

This calculation using GALE86 resulted in no significant effect on the liquid effluent values presently given in FSAR Table 12.2-22 and does not change the conclusion that the STP 3 & 4 design is in compliance with 10 CFR 20.1302; 10 CFR 20, Appendix B, Table 2, Column 2; 10 CFR 50, Appendix I; 10 CFR 50.34a; and 10 CFR 50, Appendix A, GDC 60. Therefore, there is no change needed to the STP 3&4 COLA as a result of this RAI response.

2. The parameters in the BWR-GALE86 Code input files used to confirm the STP 3 & 4 average annual liquid radioactive releases are provided in the Enclosure for NRC use.

BWR – GALE86 Code Input Parameter Values and Basis/Reference

INPUT CARD NO.	INPUT REQUIRED	INPUT FILE VALUE	REFERENCE VALUE	REFERENCE
CARD 1	Model title.	STP BWR CASE 1	-	-
CARD 2	Power (MWt): maximum thermal power level.	3926	3926 MWt	FSAR Rev. 3, Table 11.1-6
CARD 3	Steam flow (10^6 lbs/hr): total steam flow rate from reactor.	16.87	7.65E6 kg/h, (2.205 lb/kg)	FSAR Rev. 3, Table 11.1-6
CARD 4	Mass of coolant in reactor vessel (10^6 lbs/hr): total mass of water in the reactor vessel and recirculation lines.	0.675	.306E6 kg/h, (2.205 lb/kg)	FSAR Rev. 3, Table 11.1-6
CARD 5	Cleanup demineralizer flow: reactor coolant flow rate through the reactor coolant cleanup system demineralizers (10^6 lbs/hr).	0.335	0.152E6 kg/h, (2.205 lb/kg)	FSAR Rev. 3, Table 11.1-6
CARD 6	Condensate demineralizer regeneration time (days).	0	Regeneration of the condensate demineralizers is not performed.	FSAR Rev. 3, Subsection 11.2.1.2.4.2
CARD 7	Is copper tubing used for the condenser or not?	0	Copper tubing is not used.	FSAR Rev. 3, Subsection 12.4.1
CARD 8	Fraction of feedwater through condensate demineralizer.	0.90	Per Table 10.4-4, condensate polisher design flow rate per vessel is 1380 m^3/h. In normal operation, five vessels are in service (5*1380 m^3/h=6.90E3 m^3/h, 6.90E3 m^3/h = 6.90E6 kg/h, assuming density of 1g/cm^3). Per Table 11.1-6, steam flow rate is 7.65E6 kg/h. 6.90/7.65≈0.90	FSAR Rev. 3, Tables 10.4-4 and 11.1-6

INPUT CARD No.	INPUT REQUIRED	INPUT FILE VALUE	REFERENCE VALUE	REFERENCE
CARD 9	Liquid radwaste treatment system (high-purity waste, LCW): Data needed to determine input: **1**. flow rate (gal/day). **2**. activity of the inlet stream expressed as a fraction of the primary coolant activity (PCA).	14529 0.145	**1.** Per Table 11.2-6, the flow rate is 55 m^3/day, (1 m^3/264.172 gal) **2.** 0.145PCA	FSAR Rev. 3, Table 11.2-6
CARD 10	Liquid radwaste treatment system (high-purity waste, LCW): Data needed to determine input: **1.** Decontamination factor for anions. **2.** Decontamination factor for cesium and rubidium. **3.** Decontamination factor for other nuclides.	10000 1000 10000	**1.** 10000 **2.** 1000 **3.** 10000	FSAR Rev. 3, Table 11.2-5

INPUT CARD NO.	INPUT REQUIRED	INPUT FILE VALUE	REFERENCE VALUE	REFERENCE
CARD 11	Liquid radwaste treatment system (high-purity waste, LCW): Data needed to determine input: **1.** Waste collection time prior to processing (days). **2.** Sum of the waste processing and discharge time (days). **3.** Average fraction of wastes to be discharged after processing.	2.04 0.14 0.01	Analysis based on method presented in NUREG 0016/GALE86 Manual: **1.** Per Table 11.2-4: Single LCW tank capacity: 140 m^3. Per Table 11.2-2: LCW inflow is 55 m^3/day. Collection time (80% capacity of 1 tank) is then 2.04 days (0.8 * 140 m^3/55 m^3/day) **2.** Per Table 11.2-2: LCW process rate is 34 m^3/hr (816 m^3/day). To process 80% of single LCW tank capacity it takes 0.14 days (0.8 * 140 m^3 /816 m^3/day). Discharge is conservatively assumed to be instantaneous (no decay). **3.** Per NUREG 0016/GALE86 Manual, a minimum 1% discharge is recommended for high-purity waste.	FSAR Rev. 3, Tables 11.2-2, 11.2-4, 11.2-6. NUREG 0016/GALE86 Manual

INPUT CARD NO.	INPUT REQUIRED	INPUT FILE VALUE	REFERENCE VALUE	REFERENCE
CARD 12	Liquid radwaste treatment system (low-purity waste, HCW): Data needed to determine input: **1.** flow rate (gal/day). **2.** activity of the inlet stream expressed as a fraction of the primary coolant activity.	3963 0.01	**1.** Per Table 11.2-6, the flow rate is 15 m^3/day, (1 m^3/264.172 gal) **2.** 0.01	FSAR Rev. 3, Table 11.2-6
CARD 13	Liquid radwaste treatment system (low-purity waste, HCW): Data needed to determine input: **1.** Decontamination factor for anions. **2.** Decontamination factor for cesium and rubidium. **3.** Decontamination factor for other nuclides.	10000 200 10000	**1.** 10000 **2.** 200 **3.** 10000	FSAR Rev. 3, Table 11.2-5

INPUT CARD NO.	INPUT REQUIRED	INPUT FILE VALUE	REFERENCE VALUE	REFERENCE
CARD 14	Liquid radwaste treatment system (low-purity waste, HCW): Data needed to determine input: 1. Waste collection time prior to processing (days). 2. Sum of the waste processing and discharge time (days). 3. Average fraction of wastes to be discharged after processing.	7.47 0.14 0.10	Analysis based on method presented in NUREG 0016/GALE86 Manual: **1.** Per Table 11.2-4: Single HCW tank capacity: 140 m^3. Per Table 11.2-2: HCW inflow is 15 m^3/day. Collection time (80% capacity of 1 tank) is then 7.47 days (0.8 * 140 m^3/15 m^3/day) **2.** Per Table 11.2-2: HCW process rate is 34 m^3/hr (816 m^3/day). To process 80% of single HCW tank capacity it takes 0.14 days (0.8 * 140 m^3 /816 m^3/day). Discharge is conservatively assumed to be instantaneous (no decay). **3.** Per NUREG 0016/GALE86 Manual, a minimum 10% discharge is recommended for low-purity waste.	FSAR Rev. 3, Tables 11.2-2, 11.2-4, 11.2-6. NUREG 0016/GALE86 Manual
CARD 15	Liquid radwaste treatment system (chemical waste): Data needed to determine input: 1. flow rate (gal/day). 2. activity of the inlet stream expressed as a fraction of the primary coolant activity.	0 0	Chemical waste is combined with HCW.	FSAR Rev. 3, Chapter 11

INPUT CARD NO.	INPUT REQUIRED	INPUT FILE VALUE	REFERENCE VALUE	REFERENCE
CARD 16	Liquid radwaste treatment system (chemical waste): Data needed to determine input: 1. Decontamination factor for anions. 2. Decontamination factor for cesium and rubidium. 3. Decontamination factor for other nuclides.	10 10 10	Chemical waste is combined with HCW. Dummy values (10) are assigned to variables to avoid crashing of the program.	FSAR Rev. 3, Chapter 11
CARD 17	Liquid radwaste treatment system (chemical waste): Data needed to determine input: 1. Waste collection time prior to processing (days). 2. Sum of the waste processing and discharge time (days). 3. Average fraction of wastes to be discharged after processing.	10 10 10	Chemical waste is combined with HCW. Dummy values (10) are assigned to variables to avoid crashing of the program.	FSAR Rev. 3, Chapter 11
CARD 18	Liquid radwaste treatment system (regenerant solutions waste): the flow rate of the regenerant solutions waste inlet stream (gal/day).	0	There is no regenerant radwaste system.	FSAR Rev. 3, Chapter 11
CARD 19	Liquid radwaste treatment system (regenerant solutions waste): Data needed to determine input: 1. Decontamination factor for anions. 2. Decontamination factor for cesium and rubidium. 3. Decontamination factor for other nuclides.	10 10 10	There is no regenerant radwaste system. Dummy values (10) are assigned to variables to avoid crashing of the program.	FSAR Rev. 3, Chapter 11
CARD 20	Liquid radwaste treatment system (regenerant solutions waste): Data needed to determine input: 1. Waste collection time prior to processing (days). 2. Sum of the waste processing and discharge time (days). 3. Average fraction of wastes to be discharged after processing.	10 10 10	There is no regenerant radwaste system. Dummy values (10) are assigned to variables to avoid crashing of the program.	FSAR Rev. 3, Chapter 11

INPUT CARD NO.	INPUT REQUIRED	INPUT FILE VALUE	REFERENCE VALUE	REFERENCE
CARD 21	Gland seal steam flow (10^3 lbs/hr): Data needed to determine input: 1. Is main steam used for the sealing steam? 2. Is clean (nonradioactive) steam from an auxiliary boiler used for sealing steam?	0	During normal power operation, clean steam from the gland seal evaporator is used.	FSAR Rev. 3, Subsection 10.4.3.3
CARD 22	Gland seal holdup time (hours): design holdup time for gases vented from the gland seal condenser.	0	During normal power operation, clean steam from the gland seal evaporator is used.	FSAR Rev. 3, Subsection 10.4.3.3
CARD 23	Holdup time for condenser air ejector offgas (hours): the design holdup time for offgases from the main condenser air ejector prior to being processed through the offgas treatment system.	0	There is no definitive value available. Conservative assumption is made that there is no holdup time.	
CARD 24	Containment building releases: Data needed to determine input: 1. Is ventilation exhaust air treated through charcoal adsorbers which satisfy the guidelines of Regulatory Guide 1.140? If yes, (1) what is the carbon bed depth, (2) is the air filtration system designed to operate inside containment, (3) is the air filtration system designed to operate outside the reactor containment where relative humidity is controlled at 70%. 2. Is ventilation exhaust air treated through HEPA filters which satisfy the guidelines of Regulatory Guide 1.140?	0 0	No charcoal or HEPA filters used. Removal efficiency for each is 0%.	DCD Chapter 9

INPUT CARD NO.	INPUT REQUIRED	INPUT FILE VALUE	REFERENCE VALUE	REFERENCE
CARD 25	Turbine building releases: Data needed to determine input: 1. Is ventilation exhaust air treated through charcoal adsorbers which satisfy the guidelines of Regulatory Guide 1.140? If yes, (1) what is the carbon bed depth, (2) is the air filtration system designed to operate inside containment, (3) is the air filtration system designed to operate outside the reactor containment where relative humidity is controlled at 70%. 2. Is ventilation exhaust air treated through HEPA filters which satisfy the guidelines of Regulatory Guide 1.140?	0 0	No charcoal or HEPA filters used. Removal efficiency for each is 0%.	DCD Chapter 9
CARD 26	Fraction of radioiodine released from turbine gland seal condenser vent: Data needed to determine input: 1. Are, prior to release, the offgases from the turbine gland seal condenser vent processed through charcoal adsorbers which satisfy the guidelines of Regulatory Guide 1.140? 2. Are offgases released from the turbine gland seal condenser without treatment or is the clean steam used?	0	During normal power operation, clean steam is used.	FSAR Rev. 3, Subsection 10.4.3.3

Input Card No.	Input Required	Input File Value	Reference Value	Reference
CARD 27	Fraction of radioiodine released from the condenser air ejector offgas treatment system. Data needed to determine input: 1. Are, prior to release. the offgases processed through charcoal adsorbers which satisfy the guidelines of Regulatory Guide 1.140? 2. Are the offgases released without treatment? 3. Are the offgases treated through a charcoal delay system? 4. Are the offgases processed by a cryogenic distillation system?	1	Charcoal delay system is used.	DCD Chapter 11
CARD 28	Auxiliary building releases: Data needed to determine input: 1. Is ventilation exhaust air treated through charcoal adsorbers which satisfy the guidelines of Regulatory Guide 1.140? 2. Is ventilation exhaust air treated through HEPA filters which satisfy the guidelines of Regulatory Guide 1.140?	0 0	No charcoal or HEPA filters used. Removal efficiency for each is 0%.	DCD Chapter 9
CARD 29	Radwaste building releases: Data needed to determine input: 1. Is ventilation exhaust air treated through charcoal adsorbers which satisfy the guidelines of Regulatory Guide 1.140? 2. Is ventilation exhaust air treated through HEPA filters which satisfy the guidelines of Regulatory Guide 1.140?	0 0	No charcoal or HEPA filters used. Removal efficiency for each is 0%.	DCD Chapter 9

INPUT CARD NO.	INPUT REQUIRED	INPUT FILE VALUE	REFERENCE VALUE	REFERENCE
CARD 30	Condenser air ejector offgas treatment system: Data needed to determine input: 1. Is charcoal delay system used to treat the offgas from the condenser air ejector? 2. Are the offgases from the condenser air ejector processed by a cryogenic distillation system?	1	Charcoal delay system is used.	DCD Chapter 11
CARD 31	Dynamic adsorption coefficient for krypton (cm^3/gm): Data needed to determine input: 1. What is the operating temperature? (Condenser air ejector offgas treatment system) 2. What is the dew point? (Condenser air ejector offgas treatment system)	16.74	Krypton holdup time is 46 hours. Per Subsection 1.5.1.6 of NUREG 0016/GALE86 Manual, adsorption coefficient is 16.74 cm^3/gm.	DCD Subsection 11.3.2 NUREG 0016/GALE86 Manual
CARD 32	Dynamic adsorption coefficient for xenon (cm^3/gm): Data needed to determine input: 1. What is the operating temperature? (Condenser air ejector offgas treatment system) 2. What is the dew point? (Condenser air ejector offgas treatment system)	366.82	Xenon holdup time is 42 days. Per Subsection 1.5.1.6 of NUREG 0016/GALE86 Manual, adsorption coefficient is 366.82 cm^3/gm. m.	DCD Subsection 11.3.2 NUREG 0016/GALE86 Manual
CARD 33	Mass of charcoal in charcoal delay system (10^3 lbs)	250.3	Guard bed unit mass is 4721 kg. Charcoal adsorber unit mass is 27200 kg (quantity = 4). Total mass is 113521 kg (2.503E5 lb, using the conversion factor of 2.205 lb/kg)	FSAR Rev. 3, Table 11.3-2

INPUT CARD NO.	INPUT REQUIRED	INPUT FILE VALUE	REFERENCE VALUE	REFERENCE
CARD 34	Detergent waste: Data needed to determine input: 1. Does the plant have an onsite laundry? 2. If the plant has an onsite laundry – are detergent wastes released without treatment? 3. If the detergent wastes are treated prior to discharge – what is the decontamination factor?	1	Decontamination factor for detergent drain subsystem is 1.	FSAR Rev. 3, Table 11.2-5
-	Capacity factor.	0.80	Per NUREG 0016, Subsection 1.5.1.1 the default plant capacity factor is 0.80. This value is a parameter built into the GALE86 Code and can not be altered. To incorporate the capacity factor specific to ABWR (93%, per Subsection 3.4.1.3.1 of ER), the values from the output files (liquid and gaseous) are multiplied by a factor of 1.1625 (93/80=1.1625).	NUREG 0016/GALE86 Manual ER Rev. 3, Subsection 3.4.1.3.1

INPUT CARD NO.	INPUT REQUIRED	INPUT FILE VALUE	REFERENCE VALUE	REFERENCE
-	Dilution factor	-	The annual liquid release concentrations are diluted prior to release by mixing the liquid radwaste with the circulating water (normal water flow of 272550 m^3/h, FSAR Subsection 12.2.2.5.1). Therefore, the resulting annual release concentrations (MBq/yr) are multiplied by a factor of 1/(272550 m^3/h * 8760 hours/year * 10^6 ml/1 m^3*0.93)≈ 1/(2.220E+15 ml/year)≈ 4.504E-16 year/ml. (0.93 above is ABWR capacity factor)	FSAR Rev. 3, Subsection 12.2.2.5.1 ER Rev. 3, Subsection 3.4.1.3.1
-	X/Q value for the nearest EAB		The annual gaseous release concentrations are diluted prior to comparison with the associated 10CFR20 limits using the appropriate X/Q factor. Per Subsection 2.3S.5.2, 8.1E-6 sec/m^3 is the value for the nearest EAB. Therefore, the resulting annual gaseous release concentrations (MBq/yr) are multiplied by a factor of 8.1E-6 sec/m^3/(3600 sec/hour * 8760 hours/year * 10^6 cm/1 m^3*)≈ 2.568E-19 year/cm^3.	FSAR Rev. 3, Subsection 2.3S.5.2

RAI 12.02-16

QUESTION:

This RAI is related to the applicant's response to RAI 11.02-3. COL Tier 2 (Rev 3), Section 12.2, Table 12.2-20 presents calculated Average Annual Gaseous Releases (MBq/yr) from some input design parameters and values in Sections 11.2 and 11.3, Table 11.3-2 through Table 11.3-4 used in the BWRGALE computer code. The resulting calculated annual gaseous radionuclide releases are compared to 10 CFR 20 Appendix B gaseous effluent concentration limits in Table 12.2-20. Staff review indicates that a partial departure was taken for the GWMS in STD DEP 11.3-1. The new design did not provide information to independently confirm the calculated annual airborne radionuclide releases for compliance with 10 CFR 20.1302; 10 CFR 20, Appendix B, Table 2, Column 1; 10 CFR 50, Appendix I; 10 CFR 50.34a; and 10 CFR 50, Appendix A, GDC 60.

The staff requests that the applicant address the following items and revise the COL to include this information:

1. Provide the basis for all values and assumptions used in the revised BWR-GALE code calculation of annual gaseous radioactive effluent releases. Include value derivations and references (e.g., pointer to applicable FSAR section, RG 1.109 table, etc.).

2. Provide the BWR-GALE code input/output files used to calculate the annual airborne radionuclide releases in Table 12.2-20.

RESPONSE:

1. The guidance of NUREG-0016 provides information and acceptable methods for calculating average annual expected releases of radioactive materials in airborne effluents from BWRs using the BWR-GALE Code. The GALE methodology was previously used to calculate average annual airborne releases. The code input has been reviewed by STPNOC and deemed appropriate for the calculation to develop the average annual airborne releases in FSAR Table 12.2-20. However, this review also indicated that the complete input/output files for the calculation are non-retrievable.

   Accordingly, STPNOC has used the information in the COLA and DCD to develop input parameters and to recalculate the values provided in DCD Table 12.2-19 and FSAR Table 12.2-20, using the BWR-GALE86 Code (The GALE86 Code abstract reference indicates that this newer code is associated with more recent information in NUREG-0016, Revision 1, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors (BWR-GALE Code)." The NRC Staff found the use of the "GALE86 Code" to be acceptable for calculating expected releases of radioactive materials in Gaseous and Liquid Effluents (GALE) from light-water reactors during normal operations and anticipated operational occurrences (AOO) in ISG-5 "Interim Staff Guidance on the use of the GALE86 Code for Calculation of Routine Radioactive Releases in Gaseous and Liquid Effluents from Boiling-Water Reactors and Pressurized-Water Reactors to Support Design Certification and Combined License Applications.").

The STP 3 & 4 annual gaseous release source term rates were calculated assuming that the Reactor Building, Turbine Building, Service and Control Buildings, and Radwaste Building gaseous releases are not processed by a HEPA or charcoal filter. This is conservative because the Reactor Building, Service and Control Buildings, and Radwaste Buildings all have emergency filter trains that will filter effluent gases upon detection of high radiation levels.

The input parameter values and basis/references are the same for the gaseous releases as for liquid releases, and are provided in the Enclosure in the response to RAI 12.02-15. The gaseous annual release activity concentration and gaseous release source term rates were calculated from the GALE86 Code output as shown below.

The assumed capacity factor for each STP ABWR unit is 0.93, and the default capacity factor used by the GALE86 Code is 0.80.

The χ/Q value for the nearest site boundary is 8.1×10^{-6} sec/m^3.

Because the GALE86 Code uses a capacity factor of 0.80 to calculate the gaseous release activities, it was necessary to increase the output results by a factor of 0.93/0.80 to account for the capacity factor specific to each STP ABWR unit. Also, the output of the GALE86 Code is in units of Ci/yr. It is necessary to convert these units because the annual gaseous release activity results are in units of MBq/yr and gaseous release concentrations are in units of MBq/cm^3 for the existing units in Table 12.2-20 of the STP 3 & 4 FSAR.

Therefore, to obtain the annual gaseous release activities in units of MBq/yr, the GALE86 Code annual gaseous release activity results were multiplied by the following factor:

$$(3.7 \times 10^{10}\ \text{Bq/Ci} \times 1\ \text{MBq} / 10^{6}\ \text{Bq} \times 0.93/0.80) = 4.30 \times 10^{4}\ \text{MBq/Ci}.$$

To obtain the gaseous release activity concentrations in units of MBq/cm^3, the GALE86 Code gaseous release activity results were multiplied by the following factor:

$$(3.7 \times 10^{10}\ \text{Bq/Ci} \times 1\ \text{MBq} / 10^{6}\ \text{Bq} \times 0.93/0.80 \times 8.1 \times 10^{-6}\ \text{sec/m}^3) / (3600\ \text{sec/hr} \times 8760\ \text{hr/yr} \times 10^{6}\ \text{cm}^3 / 1\ \text{m}^3) = 1.105 \times 10^{-14}\ \text{MBq-yr/Ci-cm}^3.$$

Note that the gaseous release through the mechanical vacuum pump is not a continuous release, and the GALE86 Code results for this pathway were therefore not modified by the capacity factor adjustment of 0.93/0.80.

The Iodine adjustment factor was calculated as follows:

The I-131 concentration in reactor water is 0.085 MBq/kg (ABWR DCD Subsection 12.2.2.1). This parameter is not a direct input to the GALE86 Code, but is internally calculated and reflected in the output. As a result, the I-131 concentration is adjusted as noted below to ensure the I-131 release rate corresponds to an I-131 concentration of 0.085 MBq/kg.

The I-131 concentration calculated by the GALE86 Code is 1.92×10^{-3} μCi/g.

To adjust the GALE86 Code iodine results to the I-131 concentration in reactor water of 0.085 MBq/kg, the gaseous release results for the iodines were multiplied by the following factor in addition to the adjustment factors calculated above.

0.085 MBq/kg /

(1.92×10^{-3} µCi/g x 1 Ci/10^{6} µCi x 1000 g/kg x 3.7×10^{10} Bq/Ci x 1 MBq / 10^{6} Bq)

= 0.085 MBq/kg / 0.07104 MBq/kg = 1.196.

The noble gases adjustment factor was calculated as follows:

The ABWR DCD, Subsection 12.2.2.1, states a noble gas release rate of 555 MBq/s whereas the GALE86 Code utilizes a noble gas release rate of 1850 MBq/s. To adjust the GALE86 Code results to the noble gas release rate of 555 MBq/s, the noble gas release results were multiplied by the following factor in addition to the adjustment factors calculated above.

555 MBq/s / 1850 MBq/s = 0.3.

The use of the GALE86 Code, which is the latest NRC implementation of the GALE methodology, results in different gaseous releases compared to the DCD and the STP 3 & 4 FSAR. Specifically, the use of the GALE86 Code for Tables 12.2-19 and 12.2-20 reflects the deletion of 31 low-concentration nuclides. These 31 deletions are Kr-90, Xe-139, I-132, I-134, I-135, Na-24, P-32, Mn-56, Fe-55, Ni-63, Cu-64, Rb-89, Y-90, Sr-91, Sr-92, Y-91, Y-92, Y-93, Tc-99m, Rh-103m, Ru-106, Rh-106m, Te-129m, Te-131m, Te-132, Cs-138, La-140, Ce-144, Pr-144, W-187, and Np-239. This confirmatory calculation shows the total fraction of allowable concentration as 1.84E-01, supporting the original determination that STP Units 3 & 4 gaseous effluent values remain below the 10 CFR 20 Appendix B Unity Rule of one. The gaseous effluent values and gaseous release source term rates are provided in the tables below. The first column provides the GALE86 output that is modified by the above factors to obtain the STP 3 & 4 releases.

GALE86 Code Gaseous Release Source Term

Nuclide	GALE86 Annual Release (Ci/yr/unit)	STP 3 & 4 Annual Release (MBq/yr/unit)	STP 3 & 4 Concentration (MBq/cm^3)	Site Wide 10CFR20 Limits (MBq/cm^3)	Fraction of Allowable Concentration
Kr-83m	0.00E+00	0.00E+00	0.00E+00	1.85E-06	0.00E+00
Kr-85m	8.91E+01	1.15E+06	2.95E-13	3.70E-09	7.97E-05
Kr-85	2.7E+02	3.48E+06	8.95E-13	2.59E-08	3.46E-05
Kr-87	6.3E+01	8.13E+05	2.09E-13	7.40E-10	2.82E-04
Kr-88	9.8E+01	1.26E+06	3.25E-13	3.33E-10	9.75E-04
Kr-89	6.1E+02	7.87E+06	2.02E-12	3.70E-11	5.46E-02
Xe-131m	1.8E+01	2.32E+05	5.97E-14	7.40E-08	8.06E-07
Xe-133m	0.00E+00	0.00E+00	0.00E+00	2.22E-08	0.00E+00
Xe-133	2.2E+03	2.06E+07	5.28E-12	1.85E-08	2.86E-04
Xe-135m	9.9E+02	1.28E+07	3.28E-12	1.48E-09	2.22E-03
Xe-135	1.2E+03	1.25E+07	3.21E-12	2.59E-09	1.24E-03
Xe-137	1.3E+03	1.68E+07	4.31E-12	3.70E-11	1.16E-01
Xe-138	1.0E+03	1.29E+07	3.31E-12	7.40E-10	4.48E-03
I-131	2.5E-01	1.23E+04	3.17E-15	7.40E-12	4.28E-04
I-133	3.2E+00	1.59E+05	4.08E-14	3.70E-11	1.10E-03
H-3	1.2E+02	5.16E+06	1.33E-12	3.70E-09	3.58E-04
C-14	9.5E+00	4.09E+05	1.05E-13	1.11E-10	9.46E-04
Ar-41	1.6E+01	2.06E+05	5.30E-14	3.70E-10	1.43E-04
Cr-51	2.7E-03	1.16E+02	2.98E-17	1.11E-09	2.69E-08
Mn-54	6.0E-03	2.58E+02	6.63E-17	3.70E-11	1.79E-06
Fe-59	7.9E-04	3.40E+01	8.73E-18	1.85E-11	4.72E-07
Co-58	1.5E-03	6.45E+01	1.66E-17	3.70E-11	4.48E-07
Co-60	1.3E-02	5.59E+02	1.44E-16	1.85E-12	7.76E-05
Zn-65	1.1E-02	4.73E+02	1.22E-16	1.48E-11	8.21E-06
Sr-89	6.1E-03	2.62E+02	6.74E-17	3.70E-11	1.82E-06
Sr-90	3.0E-05	1.29E+00	3.31E-19	2.22E-13	1.49E-06
Zr-95	1.8E-03	0.00E+00	0.00E+00	1.48E-11	0.00E+00
Nb-95	1.0E-02	4.30E+02	1.10E-16	7.40E-11	1.49E-06
Mo-99	6.8E-02	2.92E+03	7.51E-16	1.48E-10	5.08E-06
Ru-103	4.3E-03	1.85E+02	4.75E-17	3.33E-11	1.43E-06
Ag-110m	2.4E-06	1.03E-01	2.65E-20	3.70E-12	7.17E-09
Sb-124	2.2E-04	9.46E+00	2.43E-18	1.11E-11	2.19E-07
Cs-134	7.3E-03	3.14E+02	8.06E-17	7.40E-12	1.09E-05
Cs-136	6.0E-04	2.58E+01	6.63E-18	3.33E-11	1.99E-07
Cs-137	1.1E-02	4.73E+02	1.22E-16	7.40E-12	1.64E-05
Ba-140	3.2E-02	1.38E+03	3.54E-16	7.40E-11	4.78E-06
Ce-141	1.1E-02	4.73E+02	1.22E-16	3.70E-11	3.28E-06
				Total:	1.84E-01

STP 3 & 4 Detailed Gaseous Release Source Term Rates (MBq/yr/unit)*

Gaseous Release Rate (MBq/yr/unit)							
Nuclide	Containment (Reactor) Building	Turbine Building	Auxiliary (Service and Control Buildings)	Radwaste Building	Gland Seal	Air Ejector	Mech. Vac. Pump
Kr-83m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-85m	1.29E+04	3.23E+05	3.87E+04	0.00E+00	0.00E+00	7.74E+05	0.00E+00
Kr-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.48E+06	0.00E+00
Kr-87	0.00E+00	7.87E+05	2.58E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kr-88	1.29E+04	1.17E+06	3.87E+04	0.00E+00	0.00E+00	3.87E+04	0.00E+00
Kr-89	0.00E+00	7.48E+06	2.58E+04	3.74E+05	0.00E+00	0.00E+00	0.00E+00
Xe-131m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.32E+05	0.00E+00
Xe-133m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-133	3.48E+05	1.94E+06	1.07E+06	2.84E+06	0.00E+00	5.81E+06	1.44E+07
Xe-135m	1.94E+05	5.16E+06	5.81E+05	6.84E+06	0.00E+00	0.00E+00	0.00E+00
Xe-135	4.26E+05	4.26E+06	1.21E+06	3.61E+06	0.00E+00	0.00E+00	5.55E+06
Xe-137	5.81E+05	1.29E+07	1.81E+06	1.07E+06	0.00E+00	0.00E+00	0.00E+00
Xe-138	2.58E+04	1.29E+07	7.74E+04	2.58E+04	0.00E+00	0.00E+00	0.00E+00
I-131	5.66E+02	6.18E+03	1.13E+03	6.18E+02	0.00E+00	0.00E+00	4.53E+03
I-133	8.23E+03	8.75E+04	1.54E+04	8.23E+03	0.00E+00	0.00E+00	4.99E+04
H-3	2.37E+06	2.37E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C-14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.09E+05	0.00E+00
Ar-41	1.94E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.29E+04	0.00E+00
Cr-51	8.60E+00	3.87E+01	3.87E+01	3.01E+01	0.00E+00	0.00E+00	4.30E-02
Mn-54	1.72E+01	2.58E+01	4.30E+01	1.72E+02	0.00E+00	0.00E+00	0.00E+00
Co-58	4.30E+00	4.30E+01	8.60E+00	8.60E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	3.87E+00	4.30E+00	1.29E+01	1.29E+01	0.00E+00	0.00E+00	0.00E+00
Co-60	4.30E+01	4.30E+01	1.72E+02	3.01E+02	0.00E+00	0.00E+00	2.41E-02
Zn-65	4.30E+01	2.58E+02	1.72E+02	1.29E+01	0.00E+00	0.00E+00	1.46E-02
Sr-89	1.29E+00	2.58E+02	8.60E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr-90	1.29E-01	8.60E-01	3.01E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	4.30E+01	2.58E-01	3.87E+02	1.72E-01	0.00E+00	0.00E+00	0.00E+00
Zr-95	1.29E+01	1.72E+00	3.01E+01	3.44E+01	0.00E+00	0.00E+00	0.00E+00
Mo-99	2.58E+02	8.60E+01	2.58E+03	1.29E-01	0.00E+00	0.00E+00	0.00E+00
Ru-103	8.60E+00	2.15E+00	1.72E+02	4.30E-02	0.00E+00	0.00E+00	0.00E+00
Ag-110m	1.72E-02	0.00E+00	8.60E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb-124	8.60E-01	4.30E+00	1.29E+00	3.01E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	3.01E+01	8.60E+00	1.72E+02	1.03E+02	0.00E+00	0.00E+00	1.38E-01
Cs-136	4.30E+00	4.30E+00	1.72E+01	0.00E+00	0.00E+00	0.00E+00	8.17E-02
Cs-137	4.30E+01	4.30E+01	2.15E+02	1.72E+02	0.00E+00	0.00E+00	3.83E-01
Ba-140	8.60E+01	4.30E+02	8.60E+02	1.72E-01	0.00E+00	0.00E+00	4.73E-01
Ce-141	8.60E+00	4.30E+02	3.01E+01	3.01E-01	0.00E+00	0.00E+00	0.00E+00

* Containment Building and Auxiliary Building terminology is used by the GALE86 Code and corresponds to the Reactor Building and Service and Control Buildings of the STP 3&4 power plants, respectively.

This calculation using GALE86 resulted in no significant effect on the airborne effluent values presently given in FSAR Table 12.2-20 or airborne release source term rates given in DCD Table 12.2-19 and does not change the conclusion that the STP 3 & 4 design is in compliance with 10 CFR 20.1302; 10 CFR 20, Appendix B, Table 2, Column 1; 10 CFR 50, Appendix I; 10 CFR 50.34a; and 10 CFR 50, Appendix A, GDC 60. Therefore, there is no change needed to the STP COLA as a result of this RAI response.

2. The parameters in the BWR-GALE86 Code input files used to confirm the STP 3 & 4 average annual airborne radioactive releases and release source term rates are provided in the Enclosure in STPNOC's response to RAI 12.02-15 for NRC use.