TABLE OF CONTENTS

Page intentionally left blank.

LIST OF TABLES

Page intentionally left blank.

Chapter 11 Radioactive Waste Management

11.2.3 Liquid Radioactive Releases

This section describes the radiological impacts of liquid radwaste effluents from normal plant operation on members of the public. Section 11.2.3.1 describes the exposure pathways by which radiation and radioactive effluents can be transmitted from the new units to individuals living near the plant. Section 11.2.3.2 estimates the maximum doses to the public and evaluates the impacts of these doses by comparing them to regulatory limits.

11.2.3.1 Exposure Pathways

Small quantities of radioactive liquids would be discharged to the Savannah River during normal operation of the new units. VEGP Units 3 and 4 discharge structure and associated piping provide a pathway for liquid effluents, including radioactive liquids, discharged to the Savannah River. The impact of these releases on individuals and the population in the vicinity of the new units is evaluated by considering the most important pathways from the release to the receptors of interest. The major pathways are those that could yield the highest radiological doses for a given receptor. The relative importance of a pathway is based on the type and amount of radioactivity released, the environmental transport mechanism, and the consumption or usage factors at the receptor.

The exposure pathways considered and the analytical methods used to estimate doses to the maximally exposed individual (MEI) and to the population surrounding the new units are based on NRC Regulatory Guide 1.109, *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50, Appendix I*, Revision 1, October 1977 (RG 1.109). An MEI is a member of the public located to receive the maximum possible calculated dose. The MEI allows dose comparisons with established criteria for the public.

Liquid effluent releases would be to Savannah River. The discharge is assumed to be fully mixed with the river flow. The NRC-endorsed LADTAP II computer program **(NRC 1986)** is used to calculate liquid effluent doses, with parameters specific to the river and downstream locations. This program implements the radiological exposure models described in RG 1.109 for radioactivity releases in liquid effluent. The following exposure pathways are considered in LADTAP II in calculating MEI and population doses:

- Ingestion of aquatic foods
- Ingestion of drinking water
- External exposure to shoreline sediments
- External exposure to water through boating and swimming

The input parameters for the liquid pathway are presented in Tables 11.2-1, 11.2-2, and 11.2-3.

11.2.3.2 Liquid Pathway Doses

Based on the parameters shown in Tables 11.2-1, 11.2-2, and 11.2-3, the LADTAP II computer program is used to calculate doses to the MEI and the population via the following activities:

- Eating fish caught in Savannah River
- Drinking water from Savannah River
- Boating, swimming, and using the shoreline for recreational purposes

The liquid activity releases (source terms) for the two proposed AP1000 units are obtained from AP1000 DCD Table 11.2-7 **(Westinghouse 2005)** and are shown in Table 11.2-3. These are conservative, projected values that were calculated using the PWR-GALE computer code **(NRC 1985)**. Table 11.2-3 also shows the maximum measured activity releases for Units 1 and 2, based on information presented in the annual effluent reports **(SNC 2002**, **SNC 2003**, **SNC 2004)**. Projected activity concentrations in Savannah River are based on the calculated activity releases for Units 3 and 4 as well as the measured activity releases from Units 1 and 2. The concentrations are within the limits of 10 CFR 20, Appendix B, Table 2, Column 2. The calculated annual doses to the MEI are presented in Table 11.2-4. The maximum annual organ dose of 0.021 mrem per unit would be received by the liver of the maximally exposed child.

Table 11.2-5 shows that the doses to the MEI from the liquid effluents of a new unit meet the design objectives of 10 CFR 50, Appendix I. The total site doses due to liquid and gaseous effluents from the two existing units and the two new units would be well within the regulatory limits of 40 CFR 190, as shown in Table 11.2-6. Since 40 CFR 190 is more restrictive than 10 CFR 20.1301, compliance with the limits of 40 CFR 190 also demonstrates compliance with the 0.1 rem limit of 10 CFR 20.1301. Table 11.2-7 shows the doses from the new and existing units to the population within 50 miles of the ESP site. The doses from the proposed units are much higher than from the existing units because doses from the existing units are more realistic, based on measurements, whereas the doses from the proposed units are based on conservative calculations.

Table 11.2-1 Liquid Pathway Parameters

Parameter	Value
Release source terms	Table 11.2-3
Effluent discharge rate	9,229 ft^3/sec[a]
Dilution factor for discharge	1[a]
Transit time to receptor	0.1 hr for MEI, 16 hr average for population[b]
Impoundment reconcentration model	None[c]
Population within 50 miles	6.74E+05[d]
Population sport fishing harvest	3.5E+04 kg/yr[e]
Population shoreline usage	9.6E+05 hr/yr[e]
Population swimming	1.6E+05 hr/yr[e]
Population boating	1.1E+06 hr/yr[e]

[a] Liquid discharge assumed fully mixed with annual average flow rate of Savannah River at Vogtle.
[b] 16 hr is the average transit time to a point halfway along 50-mile stretch of Savannah River.
[c] Completely mixed model used for Savannah River.
[d] See Section 2.1.3.2
[e] Savannah River Site Environmental Report for 2005 **(WSRC 2006)**.

Table 11.2-2 Liquid Pathway Consumption Factors for Maximally Exposed Individual

	Annual Rate			
Consumption Factor	**Adult**	**Teen**	**Child**	**Infant**
Fish consumption (kg/yr)	21	16	6.9	0
Drinking water consumption (l/yr)	730	510	510	330
Shoreline usage (hr/yr)	12	67	14	0

Note: These are obtained from Regulatory Guide 1.109.

Table 11.2-3 Release of Activities in Liquid Effluent

	Release (Ci/yr)			Concentration (µCi/ml)		Fraction of
Isotope	Units 3 & 4	Units 1 & 2	Total	Site	ECL	ECL
H-3	2.0E+03	1.9E+03	4.0E+03	4.8E-07	1.0E-03	4.8E-04
Be-7	-	8.3E-06	8.3E-06	1.0E-15	6.0E-04	1.7E-12
Na-24	3.3E-03	2.7E-05	3.3E-03	4.0E-13	5.0E-05	8.0E-09
Cr-51	3.7E-03	2.2E-03	5.9E-03	7.1E-13	5.0E-04	1.4E-09
Mn-54	2.6E-03	3.7E-03	6.3E-03	7.6E-13	3.0E-05	2.5E-08
Fe-55	2.0E-03	7.7E-02	7.9E-02	9.6E-12	1.0E-04	9.6E-08
Fe-59	4.0E-04	1.9E-04	5.9E-04	7.1E-14	1.0E-05	7.1E-09
Co-57	-	1.1E-04	1.1E-04	1.3E-14	6.0E-05	2.2E-10
Co-58	6.7E-03	2.5E-02	3.2E-02	3.9E-12	2.0E-05	1.9E-07
Co-60	8.8E-04	5.7E-02	5.7E-02	7.0E-12	3.0E-06	2.3E-06
Zn-65	8.2E-04	5.5E-06	8.3E-04	1.0E-13	5.0E-06	2.0E-08
Br-84	4.0E-05	-	4.0E-05	4.9E-15	4.0E-04	1.2E-11
Rb-86	-	9.3E-06	9.3E-06	1.1E-15	7.0E-06	1.6E-10
Rb-88	5.4E-04	-	5.4E-04	6.6E-14	4.0E-04	1.6E-10
Sr-89	2.0E-04	2.7E-04	4.7E-04	5.7E-14	8.0E-06	7.2E-09
Sr-90	2.0E-05	1.5E-04	1.7E-04	2.0E-14	5.0E-07	4.0E-08
Sr-91	4.0E-05	-	4.0E-05	4.9E-15	2.0E-05	2.4E-10
Sr-92	-	2.4E-05	2.4E-05	2.9E-15	4.0E-05	7.2E-11
Y-91m	2.0E-05	-	2.0E-05	2.4E-15	2.0E-03	1.2E-12
Y-91	-	2.3E-04	2.3E-04	2.8E-14	8.0E-06	3.5E-09
Y-92	-	9.3E-06	9.3E-06	1.1E-15	4.0E-05	2.8E-11
Y-93	1.8E-04	4.0E-05	2.2E-04	2.7E-14	2.0E-05	1.3E-09
Zr-95	4.6E-04	6.3E-04	1.1E-03	1.3E-13	2.0E-05	6.6E-09
Nb-95	4.2E-04	1.3E-03	1.7E-03	2.0E-13	3.0E-05	6.8E-09
Nb-97	-	1.6E-04	1.6E-04	1.9E-14	3.0E-04	6.4E-11
Mo-99	1.1E-03	-	1.1E-03	1.4E-13	2.0E-05	6.9E-09
Tc-99m	1.1E-03	-	1.1E-03	1.3E-13	1.0E-03	1.3E-10
Ru-103	9.9E-03	-	9.9E-03	1.2E-12	3.0E-05	4.0E-08

Table 11.2-3 (Cont.) Release of Activities in Liquid Effluent

	Release (Ci/yr)			Concentration (µCi/ml)		Fraction of
Isotope	Units 3 & 4	Units 1 & 2	Total	Site	ECL	ECL
Ru-106	1.5E-01	-	1.5E-01	1.8E-11	3.0E-06	5.9E-06
Rh-103m	9.9E-03	-	9.9E-03	1.2E-12	6.0E-03	2.0E-10
Rh-106	1.5E-01	-	1.5E-01	1.8E-11	-	-
Ag-110m	2.1E-03	5.6E-05	2.2E-03	2.6E-13	6.0E-06	4.4E-08
Ag-110	2.8E-04	-	2.8E-04	3.4E-14	-	-
Sn-113	-	3.6E-06	3.6E-06	4.4E-16	3.0E-05	1.5E-11
Sb-122	-	4.7E-06	4.7E-06	5.6E-16	1.0E-05	5.6E-11
Sb-124	-	1.7E-04	1.7E-04	2.0E-14	7.0E-06	2.9E-09
Sb-125	-	1.9E-02	1.9E-02	2.4E-12	3.0E-05	7.9E-08
Te-125m	-	4.9E-02	4.9E-02	5.9E-12	2.0E-05	3.0E-07
Te-129m	2.4E-04	-	2.4E-04	2.9E-14	7.0E-06	4.2E-09
Te-129	3.0E-04	-	3.0E-04	3.6E-14	4.0E-04	9.1E-11
Te-131m	1.8E-04	-	1.8E-04	2.2E-14	8.0E-06	2.7E-09
Te-131	6.0E-05	-	6.0E-05	7.3E-15	8.0E-05	9.1E-11
Te-132	4.8E-04	5.1E-05	5.3E-04	6.4E-14	9.0E-06	7.2E-09
I-131	2.8E-02	5.5E-05	2.8E-02	3.4E-12	1.0E-06	3.4E-06
I-132	3.3E-03	4.7E-05	3.3E-03	4.0E-13	1.0E-04	4.0E-09
I-133	1.3E-02	3.6E-05	1.3E-02	1.6E-12	7.0E-06	2.3E-07
I-134	1.6E-03	-	1.6E-03	2.0E-13	4.0E-04	4.9E-10
I-135	9.9E-03	-	9.9E-03	1.2E-12	3.0E-05	4.0E-08
Cs-134	2.0E-02	1.5E-03	2.1E-02	2.6E-12	9.0E-07	2.9E-06
Cs-136	1.3E-03	-	1.3E-03	1.5E-13	6.0E-06	2.5E-08
Cs-137	2.7E-02	2.6E-03	2.9E-02	3.6E-12	1.0E-06	3.6E-06
Ba-137m	2.5E-02	-	2.5E-02	3.0E-12	-	-
Ba-140	1.1E-02	-	1.1E-02	1.3E-12	8.0E-06	1.7E-07
La-140	1.5E-02	3.5E-06	1.5E-02	1.8E-12	9.0E-06	2.0E-07
Ce-141	1.8E-04	1.7E-06	1.8E-04	2.2E-14	3.0E-05	7.4E-10
Ce-143	3.8E-04	-	3.8E-04	4.6E-14	2.0E-05	2.3E-09
Ce-144	6.3E-03	-	6.3E-03	7.7E-13	3.0E-06	2.6E-07

Table 11.2-3 (Cont.) Release of Activities in Liquid Effluent

	Release (Ci/yr)			Concentration (µCi/ml)		Fraction of
Isotope	**Units 3 & 4**	**Units 1 & 2**	**Total**	**Site**	**ECL**	**ECL**
Pr-143	2.6E-04	-	2.6E-04	3.2E-14	2.0E-05	1.6E-09
Pr-144	6.3E-03	-	6.3E-03	7.7E-13	6.0E-04	1.3E-09
Hf-181	-	3.9E-07	3.9E-07	4.7E-17	2.0E-05	2.4E-12
W-187	2.6E-04	-	2.6E-04	3.2E-14	3.0E-05	1.1E-09
Np-239	4.8E-04	-	4.8E-04	5.8E-14	2.0E-05	2.9E-09
Total	2.0E+03	1.9E+03	4.0E+03	4.8E-07	-	5.0E-04

Note: The releases for Units 3 and 4 are based on the AP1000 DCD **(Westinghouse 2005)** and are for two units. The releases for Units 1 and 2 are based on annual effluent release reports **(SNC 2002**, **SNC 2003**, **SNC 2004)** and are for two units. The effluent concentration limits (ECLs) are from 10 CFR 20, Appendix B, Table 2, Column 2.

Table 11.2-4 Liquid Pathway Doses for Maximally Exposed Individuals

	Dose per Unit (mrem/yr)							
	Skin	**Bone**	**Liver**	**Total Body**	**Thyroid**	**Kidney**	**Lung**	**GI-LLI**
Adult	1.3E-05	8.8E-03	2.1E-02	1.7E-02	9.0E-03	1.1E-02	7.2E-03	7.9E-03
Teen	7.2E-05	9.3E-03	2.0E-02	1.0E-02	7.0E-03	9.2E-03	5.9E-03	5.7E-03
Child	1.5E-05	1.2E-02	2.1E-02	9.9E-03	1.3E-02	1.2E-02	8.9E-03	8.6E-03
Infant	0.0E+00	5.8E-04	7.8E-03	7.2E-03	1.5E-02	7.4E-03	7.2E-03	7.7E-03
Maximum	7.2E-05	1.2E-02	2.1E-02	1.7E-02	1.5E-02	1.2E-02	8.9E-03	8.6E-03
	Teen	Child	Child	Adult	Infant	Child	Child	Child

Note: GI-LLI is gastrointestinal-lining of lower intestine.

Table 11.2-5 Comparison of Maximally Exposed Individual Doses with 10 CFR 50, Appendix I Criteria

		Dose per Unit (mrem/yr)	
	Location	**Estimated**	**Limit**
Total Body	Savannah River	0.017	3
Maximum Organ - Liver	Savannah River	0.021	10

Table 11.2-6 Comparison of Maximally Exposed Individual Doses with 40 CFR 190 Criteria

	Dose (mrem/yr)					
	Units 3 and 4			Units 1 and 2	Site Total	Regulatory Limit
	Liquid	Gaseous	Total			
Total Body	0.020	2.2	2.3	0.092	2.4	25
Thyroid	0.027	12	12	0.069	12	75
Other Organ - Bone	0.023	8.8	8.8	0.054	8.9	25

Note: Doses for Units 3 and 4 are for a child, the age group receiving the maximum total dose. Doses for Units 1 and 2 are the maximum reported in the annual effluent release reports for 2001, 2002, and 2003 **(SNC 2002**, **SNC 2003**, **SNC 2004)**.

Table 11.2-7 Collective Total Body Doses Within 50 Miles

	Dose (person-rem/yr)
Units 3 & 4	0.037
Units 1 & 2	0.0079
Total	0.045

Note: Doses for Units 1 and 2 are based on the maximum activity releases in the annual effluent release reports for 2001, 2002, and 2003 **(SNC 2002**, **SNC 2003**, **SNC 2004)**.

Section 11.2.3 References

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

(NRC 1986) NUREG/CR-4013, *LADTAP II Technical Reference and User Guide*, U. S. Nuclear Regulatory Commission, 1986.

(SNC 2002) *Annual Radioactive Effluent Release Report for January 1, 2001 to December 31, 2001*, Southern Nuclear Company, 2002.

(SNC 2003) *Annual Radioactive Effluent Release Report for January 1, 2002 to December 31, 2002*, Southern Nuclear Company, 2003.

(SNC 2004) *Annual Radioactive Effluent Release Report for January 1, 2003 to December 31, 2003,* Southern Nuclear Company, 2004.

(Westinghouse 2005) AP1000 Document APP-GW-GL-700, *AP1000 Design Control Document, Tier 2 Material*, Revision 15, Westinghouse Electric Company, 2005.

(WSRC 2006) WSRC-TR-2006-00007, *Savannah River Site Environmental Report for 2005,* Washington Savannah River Company, 2006. Accessed from http://www.srs.gov/general/pubs/ERsum/er06/liqdos_05.htm, April 18, 2007.

Page intentionally left blank.

11.3.3 Gaseous Radioactive Releases

This section describes the radiological impacts of gaseous radwaste effluents from normal plant operation on members of the public. Section 11.3.3.1 describes the exposure pathways by which radiation and radioactive effluents can be transmitted from the new units to individuals living near the plant. Section 11.3.3.2 estimates the maximum doses to the public and evaluates the impacts of these doses by comparing them to regulatory limits.

11.3.3.1 Exposure Pathways

Small quantities of radioactive gases would be discharged to the environment during normal operation of the new units. VEGP Units 3 and 4 airborne effluents are normally released through the plant vent or the turbine building vent. The plant vent is the release pathway for ventilation flows and discharges from the containment, the auxiliary building, the annex building, the radwaste building, and the gaseous radwaste system. The turbine building vents provide the release path for the condenser air removal system, gland seal condenser exhaust, and the turbine building ventilation releases **(Westinghouse, 2005)**. The impact of these releases on individuals and the population in the vicinity of the new units is evaluated by considering the most important pathways from the release to the receptors of interest. The major pathways are those that could yield the highest radiological doses for a given receptor. The relative importance of a pathway is based on the type and amount of radioactivity released, the environmental transport mechanism, and the consumption or usage factors at the receptor.

The exposure pathways considered and the analytical methods used to estimate doses to the maximally exposed individual (MEI) and to the population surrounding the new units are based on NRC Regulatory Guide 1.109, *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50, Appendix I*, Revision 1, October 1977 (RG 1.109) and NRC Regulatory Guide 1.111, *Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors*, Revision 1, July 1977. An MEI is a member of the public located to receive the maximum possible calculated dose. The MEI allows dose comparisons with established criteria for the public.

The NRC-endorsed GASPAR II computer program **(NRC 1987)** is used to calculate the doses to offsite receptors from the new units. This program implements the radiological exposure models described in RG 1.109 to estimate the doses resulting from radioactive releases in gaseous effluent. The atmospheric dispersion component of the analysis is calculated with the NRC-sponsored program XOQDOQ **(NRC 1982)**. Dispersion and deposition factors are calculated from onsite meteorological parameters (wind speed, wind direction, stability class) for 1998-2002. Section 2.3.5 shows dispersion data for the locations shown in Table 11.3-4 as well as deposition and undecayed/undepleted dispersion factors within 50 miles of the plant. Decayed/

undepleted and decayed/depleted dispersion factors within 50 miles are calculated using the same methodology as presented in Section 2.3.5.

The following exposure pathways are considered in GASPAR II:

- External exposure to airborne plume
- External exposure to contaminated ground
- Inhalation of airborne activity
- Ingestion of contaminated vegetables
- Ingestion of contaminated meat

The input parameters for the gaseous pathway are presented in Tables 11.3-1, 11.3-2, and 11.3-3 and the receptor locations are shown in Table 11.3-4.

11.3.3.2 Gaseous Pathway Doses

Based on the parameters in Tables 11.3-1 to 11.3-3, the GASPAR II computer program is used to calculate doses to the maximally exposed adult, teenager, child, and infant at the following locations:

- Nearest site boundary
- Nearest residence
- Nearest vegetable garden
- Nearest meat animal

The gaseous activity releases (source terms) for the two proposed AP1000 units are obtained from AP1000 DCD Table 11.3-3 and are shown in Table 11.3-3. These are conservative, projected values that were calculated using the PWR-GALE computer code **(NRC 1985)**. Table 11.3-3 also shows the maximum measured activity releases for Units 1 and 2, based on information presented in the annual effluent reports **(SNC 2002**, **SNC 2003**, **SNC 2004)**. Projected activity concentrations at the site boundary are based on the calculated activity releases for Units 3 and 4 as well as the measured activity releases from Units 1 and 2. The concentrations are within the limits of 10 CFR 20, Appendix B, Table 2, Column 1. The calculated annual doses to the MEI are presented in Table 11.3-5.

Table 11.3-6 shows that the doses to the MEI from the liquid effluents of a new unit meet the design objectives of 10 CFR 50, Appendix I. The total site doses due to liquid and gaseous effluents from the two existing units and the two new units would be well within the regulatory limits of 40 CFR 190, as shown in Table 11.3-7. Since 40 CFR 190 is more restrictive than 10 CFR 20.1301, compliance with the limits of 40 CFR 190 also demonstrates compliance with the 0.1 rem limit of 10 CFR 20.1301. Table 11.3-8 shows the doses from the new and existing units to the population within 50 miles of the ESP site. The doses from the proposed units are much higher than from the existing units because doses from the existing units are more realistic,

based on measurements, whereas the doses from the proposed units are based on conservative calculations.

Table 11.3-1 Gaseous Pathway Parameters

Parameter	Value
Release source terms	Table 11.3-3
Population distribution	Figures 2.1-3 & 2.1-10
Milk production rate within 50 miles	6.37E+07 l/yr[a]
Meat production rate within 50 miles	1.03E+07 kg/yr[a]
Vegetable production rate within 50 miles	6.57E+07 kg/yr[a]
Atmospheric dispersion factors	Table 2.3-17
Ground deposition factors	Table 2.3-17

[a] Animal and vegetable production from 2002 National Census of Agriculture. Production converted to food products using average conversion factors: 17,050 lb milk/cow; 377 lb beef/cow, calf; 81.2 lb meat/hog, pig; 95.8 lb meat/sheep, and 8,090 kg vegetables/acre.

Table 11.3-2 Gaseous Pathway Consumption Factors for Maximally Exposed Individual

	Annual Rate			
Consumption Factor	**Adult**	**Teen**	**Child**	**Infant**
Leafy vegetable consumption (kg/yr)	64	42	26	0
Meat consumption (kg/yr)	110	65	41	0
Vegetable/fruit consumption (kg/yr)	520	630	520	0

Note: These are obtained from Regulatory Guide 1.109. Leafy vegetables are assumed to be grown in the MEI's garden 58% of the year.

Table 11.3-3 Release of Activities in Gaseous Effluent

	Release (Ci/yr)			Concentration (µCi/ml)		Fraction of
Isotope	Units 3 & 4	Units 1 & 2	Total	Site	ECL	ECL
H-3	7.0E+02	2.0E+02	9.0E+02	1.6E-10	1.0E-07	1.6E-03
Be-7	-	7.0E-06	7.0E-06	1.2E-18	3.0E-08	4.1E-11
C-14	1.5E+01	-	1.5E+01	2.5E-12	3.0E-09	8.5E-04
Ar-41	6.8E+01	1.6E+00	7.0E+01	1.2E-11	1.0E-08	1.2E-03
Cr-51	1.2E-03	3.2E-06	1.2E-03	2.1E-16	3.0E-08	7.1E-09
Mn-54	8.6E-04	-	8.6E-04	1.5E-16	1.0E-09	1.5E-07
Fe-59	1.6E-04	-	1.6E-04	2.8E-17	5.0E-10	5.5E-08
Co-57	1.6E-05	-	1.6E-05	2.9E-18	9.0E-10	3.2E-09
Co-58	4.6E-02	5.9E-06	4.6E-02	8.0E-15	1.0E-09	8.0E-06
Co-60	1.7E-02	9.6E-06	1.7E-02	3.0E-15	5.0E-11	6.1E-05
Kr-85m	7.2E+01	3.8E-05	7.2E+01	1.3E-11	1.0E-07	1.3E-04
Kr-85	8.2E+03	3.4E+00	8.2E+03	1.4E-09	7.0E-07	2.0E-03
Kr-87	3.0E+01	-	3.0E+01	5.2E-12	2.0E-08	2.6E-04
Kr-88	9.2E+01	-	9.2E+01	1.6E-11	9.0E-09	1.8E-03
Sr-89	6.0E-03	1.1E-06	6.0E-03	1.0E-15	2.0E-10	5.2E-06
Sr-90	2.4E-03	4.5E-08	2.4E-03	4.2E-16	6.0E-12	7.0E-05
Zr-95	2.0E-03	-	2.0E-03	3.5E-16	4.0E-10	8.7E-07
Nb-95	5.0E-03	6.2E+00	6.2E+00	1.1E-12	2.0E-09	5.4E-04
I-131	2.4E-01	2.1E-02	2.6E-01	4.5E-14	2.0E-10	2.3E-04
I-132	-	3.6E-06	3.6E-06	6.2E-19	2.0E-08	3.1E-11
I-133	8.0E-01	4.9E-04	8.0E-01	1.4E-13	1.0E-09	1.4E-04
Xe-131m	3.6E+03	1.1E-01	3.6E+03	6.3E-10	2.0E-06	3.1E-04
Xe-133m	1.7E+02	3.3E-02	1.7E+02	3.0E-11	6.0E-07	5.1E-05
Xe-133	9.2E+03	2.2E+01	9.2E+03	1.6E-09	5.0E-07	3.2E-03
Xe-135m	1.4E+01	-	1.4E+01	2.4E-12	4.0E-08	6.1E-05
Xe-135	6.6E+02	4.0E-01	6.6E+02	1.2E-10	7.0E-08	1.6E-03
Xe-138	1.2E+01	-	1.2E+01	2.1E-12	2.0E-08	1.0E-04
Ru-103	1.6E-04	-	1.6E-04	2.8E-17	9.0E-10	3.1E-08

Table 11.3-3 (Cont.) Release of Activities in Gaseous Effluent

	Release (Ci/yr)			Concentration (µCi/ml)		Fraction of
Isotope	**Units 3 & 4**	**Units 1 & 2**	**Total**	**Site**	**ECL**	**ECL**
Ru-106	1.6E-04	-	1.6E-04	2.7E-17	2.0E-11	1.4E-06
Sb-125	1.2E-04	-	1.2E-04	2.1E-17	7.0E-10	3.0E-08
Cs-134	4.6E-03	-	4.6E-03	8.0E-16	2.0E-10	4.0E-06
Cs-136	1.7E-04	-	1.7E-04	3.0E-17	9.0E-10	3.3E-08
Cs-137	7.2E-03	2.2E-07	7.2E-03	1.3E-15	2.0E-10	6.3E-06
Ba-140	8.4E-04	-	8.4E-04	1.5E-16	2.0E-09	7.3E-08
Ce-141	8.4E-05	-	8.4E-05	1.5E-17	8.0E-10	1.8E-08
Total	2.3E+04	2.3E+02	2.3E+04	4.0E-09	-	1.4E-02

Note: The releases for Units 3 and 4 are based on the AP1000 DCD **(Westinghouse 2005)** and are for two units. The releases for Units 1 and 2 are based on annual effluent release reports **(SNC 2002**, **SNC 2003**, **SNC 2004)** and are for two units. The effluent concentration limits (ECLs) are from 10 CFR 20, Appendix B, Table 2, Column 1.

Table 11.3-4 Gaseous Pathway Receptor Locations

Receptor	Direction	Distance (miles)
Nearest site boundary	NE	0.50
Nearest residence	NE	0.67
Nearest vegetable garden	NE	0.67
Nearest meat animal	NE	0.67

Note: This data is taken from Table 2.3-17. There are no milk cows or goats within 5 miles of the plant.

Table 11.3-5 Gaseous Pathway Doses for Maximally Exposed Individuals

			Dose per Unit (mrem/yr)			
Location	**Pathway**		**Total Body**	**Thyroid**	**Bone**	**Skin**
Nearest Site Boundary (0.50 mi NE)	Plume		4.1E-01	4.1E-01	4.1E-01	2.1E+00
	Ground		1.5E-01	1.5E-01	1.5E-01	1.8E-01
	Inhalation	Adult	4.5E-02	4.3E-01	7.1E-03	4.4E-02
		Teen	4.6E-02	5.3E-01	8.6E-03	4.4E-02
		Child	4.1E-02	6.2E-01	1.1E-02	3.9E-02
		Infant	2.3E-02	5.6E-01	5.3E-03	2.3E-02
Nearest Residence (0.67 mi NE)	Plume		2.6E-01	2.6E-01	2.6E-01	1.3E+00
	Ground		8.7E-02	8.7E-02	8.7E-02	1.0E-01
	Inhalation	Adult	2.8E-02	2.6E-01	4.3E-03	2.7E-02
		Teen	2.8E-02	3.2E-01	5.2E-03	2.7E-02
		Child	2.5E-02	3.8E-01	6.3E-03	2.4E-02
		Infant	1.4E-02	3.4E-01	3.2E-03	1.4E-02
Nearest Garden (0.67 mi NE)	Vegetable	Adult	2.0E-01	2.0E+00	9.9E-01	1.8E-01
		Teen	3.0E-01	2.7E+00	1.6E+00	2.8E-01
		Child	6.7E-01	5.2E+00	3.6E+00	6.3E-01
Nearest Meat Animal (0.67 mi NE)	Meat	Adult	6.2E-02	1.5E-01	2.7E-01	6.0E-02
		Teen	5.0E-02	1.2E-01	2.3E-01	4.9E-02
		Child	9.1E-02	1.9E-01	4.3E-01	8.9E-02
Maximally Exposed Individual (0.67 mi NE)	Internal Only	Adult	2.9E-01	2.4E+00	1.3E+00	2.7E-01
		Teen	3.8E-01	3.1E+00	1.8E+00	3.5E-01
		Child	7.8E-01	5.8E+00	4.1E+00	7.4E-01
		Infant	1.4E-02	3.4E-01	3.2E-03	1.4E-02
	Total	Adult	6.4E-01	2.8E+00	1.6E+00	1.7E+00
		Teen	7.2E-01	3.5E+00	2.1E+00	1.7E+00
		Child	1.1E+00	6.1E+00	4.4E+00	2.1E+00
		Infant	3.6E-01	6.8E-01	3.5E-01	1.4E+00

Note: The internal doses for the maximally exposed individual are obtained by adding the doses from the inhalation, vegetable, and meat pathways. The total doses add the plume and ground doses to the internal doses.

Table 11.3-6 Comparison of Maximally Exposed Individual Doses with 10 CFR 50, Appendix I Criteria

		Dose per Unit	
Dose Type	**Location**	**Estimated**	**Limit**
Gamma Air (mrad)	Site Boundary	0.67	10
Beta Air (mrad)	Site Boundary	2.8	20
Total Body (mrem)	Site Boundary	0.56	5
Skin (mrem)	Site Boundary	2.2	15
Iodines and Particulates Maximum Organ - Thyroid (mrem)	Maximally Exposed Individual	5.9	15

Note: Total body and skin doses are the sums of plume and ground doses from Table 11.3-5. The dose due to iodines and particulates is for a child, the age group receiving the maximum total dose.

Table 11.3-7 Comparison of Maximally Exposed Individual Doses with 40 CFR 190 Criteria

	Dose (mrem/yr)					
	Units 3 and 4			Units 1	Site	Regulatory
	Liquid	**Gaseous**	**Total**	**and 2**	**Total**	**Limit**
Total Body	0.020	2.2	2.3	0.092	2.4	25
Thyroid	0.027	12	12	0.069	12	75
Other Organ - Bone	0.023	8.8	8.8	0.054	8.9	25

Note: Doses for Units 3 and 4 are for a child, the age group receiving the maximum total dose. Doses for Units 1 and 2 are the maximum reported in the annual effluent release reports for 2001, 2002, and 2003 (**SNC 2002**, **SNC 2003**, **SNC 2004**).

Table 11.3-8 Collective Total Body Doses Within 50 Miles

	Dose (person-rem/yr)		
	Units 3 and 4	**Units 1 and 2**	**Total**
Noble Gases	0.57	0.0011	0.57
Iodines & Particulates	0.14	0.16	0.30
H-3 & C-14	1.1	0.09	1.2
Total	1.8	0.26	2.1

Note: Doses for Units 1 and 2 are based on the maximum activity releases in the annual effluent release reports for 2001, 2002, and 2003 **(SNC 2002**, **SNC 2003**, **SNC 2004)**.

Section 11.3.3 References

(NRC 1982) NUREG/CR-2919, *XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations Final Report*, U. S. Nuclear Regulatory Commission, 1982.

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

(NRC 1987) NUREG/CR-4653, *GASPAR II Technical Reference and User Guide*, U. S. Nuclear Regulatory Commission, 1987.

(SNC 2002) *Annual Radioactive Effluent Release Report for January 1, 2001 to December 31, 2001*, Southern Nuclear Company, 2002.

(SNC 2003) *Annual Radioactive Effluent Release Report for January 1, 2002 to December 31, 2002*, Southern Nuclear Company, 2003.

(SNC 2004) *Annual Radioactive Effluent Release Report for January 1, 2003 to December 31, 2003,* Southern Nuclear Company, 2004.

(Westinghouse 2005) AP1000 Document APP-GW-GL-700, *AP1000 Design Control Document, Tier 2 Material*, Revision 15, Westinghouse Electric Company, 2005.

Page intentionally left blank.