CHAPTER 11

RADIOACTIVE WASTE MANAGEMENT

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CHAPTER 11

RADIOACTIVE WASTE MANAGEMENT

11.1 SOURCE TERMS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

TABLE 11.1-201
PARAMETERS USED TO CALCULATE SECONDARY COOLANT ACTIVITY

WLS DEP 6.4-1	Total secondary side water mass (lb/steam generator)	1.68×10^5
WLS DEP 6.4-1	Steam generator steam fraction	0.058
	Total steam flow rate (lb/hr)	1.5×10^7
	Moisture carryover (percent)	0.1
WLS DEP 6.4-1	Total makeup water feed rate (lb/hr)	700
	Total blowdown rate (gpm)	186
WLS DEP 6.4-1	Total primary-to-secondary leak rate (gpd)	300
	Iodine partition factor (mass basis)	100

TABLE 11.1-202

WLS DEP 6.4-1 DESIGN BASIS STEAM GENERATOR SECONDARY SIDE LIQUID ACTIVITY

Nuclide	Activity (μCi/g)	Nuclide	Activity (μCi/g)
Br-83	1.4×10^{-5}	Y-93	8.2×10^{-8}
Br-84	2.4×10^{-6}	Zr-95	1.5×10^{-7}
Br-85	3.1×10^{-8}	Nb-95	1.5×10^{-7}
I-129	1.3×10^{-11}	Mo-99	1.9×10^{-4}
I-130	7.9×10^{-6}	Tc-99m	1.7×10^{-4}
I-131	6.3×10^{-4}	Ru-103	1.2×10^{-7}
I-132	4.2×10^{-4}	Ru-106	4.1×10^{-8}
I-133	1.0×10^{-3}	Rh-103m	1.2×10^{-7}
I-134	4.9×10^{-5}	Rh-106	4.1×10^{-8}
I-135	5.0×10^{-4}	Ag-110m	3.0×10^{-6}
Rb-86	1.4×10^{-5}	Te-125m	1.5×10^{-7}
Rb-88	1.4×10^{-4}	Te-127m	7.0×10^{-7}
Rb-89	5.6×10^{-6}	Te-127	2.2×10^{-6}
Cs-134	1.1×10^{-3}	Te-129m	2.4×10^{-6}
Cs-136	1.7×10^{-3}	Te-129	2.1×10^{-6}
Cs-137	8.2×10^{-4}	Te-131m	5.6×10^{-6}
Cs-138	5.9×10^{-5}	Te-131	1.6×10^{-6}
H-3	3.8×10^{-1}	Te-132	7.0×10^{-5}
Cr-51	1.3×10^{-6}	Te-134	2.0×10^{-6}
Mn-54	6.6×10^{-7}	Ba-137m	7.7×10^{-4}
Mn-56	7.8×10^{-5}	Ba-140	9.4×10^{-7}
Fe-55	5.0×10^{-7}	La-140	3.3×10^{-7}
Fe-59	1.3×10^{-7}	Ce-141	1.4×10^{-7}
Co-58	1.9×10^{-6}	Ce-143	1.2×10^{-7}
Co-60	2.2×10^{-7}	Ce-144	1.1×10^{-7}
Sr-89	1.8×10^{-6}	Pr-143	1.4×10^{-7}
Sr-90	8.0×10^{-8}	Pr-144	1.1×10^{-7}
Sr-91	1.9×10^{-6}		
Sr-92	2.4×10^{-7}		
Y-90	1.4×10^{-8}		
Y-91m	1.0×10^{-6}		
Y-91	1.3×10^{-7}		
Y-92	2.8×10^{-7}		

TABLE 11.1-203

WLS DEP 6.4-1 DESIGN BASIS STEAM GENERATOR SECONDARY SIDE STEAM ACTIVITY

Nuclide	Activity (μCi/g)
Kr-83m	1.1×10^{-6}
Kr-85m	4.3×10^{-6}
Kr-85	1.5×10^{-5}
Kr-87	2.4×10^{-6}
Kr-88	7.7×10^{-6}
Kr-89	1.8×10^{-7}
Xe-131m	6.9×10^{-6}
Xe-133m	8.7×10^{-6}
Xe-133	6.4×10^{-4}
Xe-135m	5.5×10^{-6}
Xe-135	1.9×10^{-5}
Xe-137	3.4×10^{-7}
Xe-138	1.3×10^{-6}
I-129	1.5×10^{-13}
I-130	8.7×10^{-8}
I-131	6.9×10^{-6}
I-132	4.7×10^{-6}
I-133	1.1×10^{-5}
I-134	5.4×10^{-7}
I-135	5.5×10^{-6}
H-3	3.8×10^{-1}

11.2 LIQUID WASTE MANAGEMENT SYSTEMS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

11.2.1.2.4 Controlled Release of Radioactivity

Add the following to the end of DCD Subsection 11.2.1.2.4:

WLS SUP 11.2-3 The exterior liquid radwaste system discharge pipeline is routed from the Radwaste Building to the western bank of the Broad River where this effluent mixes with the blowdown sump discharge. This interface point between the waste water and liquid radwaste systems is upstream of the plant outfall to the Ninety-Nine Islands Reservoir via the outfall pipe/diffuser. The plant outfall is described in Subsection 9.2.9.2.2.

The exterior liquid radwaste system discharge pipe is stainless steel and is enclosed within a high-density polyethylene guard pipe. No valves or vacuum breakers are incorporated in exterior radwaste pipelines outside of monitored structures. The annular space between the liquid radwaste discharge pipe and the guard pipe is monitored for leakage at low points along the path. The guard pipe is continuous up to the underground pit where the liquid radwaste pipe ties into the outfall pipe. The underground pit is monitored for leakage. Monitoring points are provided to facilitate manual sampling for leakage consistent with NEI 08-08A and 10 CFR 20.1406 contamination minimization requirements. Leakage monitoring of the liquid radwaste system discharge pipeline and the underground pit where the liquid radwaste pipe ties into the outfall pipe will be implemented as part of the radiation protection program (See Appendix 12AA).

11.2.1.2.5.2 Use of Mobile and Temporary Equipment

Add the following information at the end of DCD Subsection 11.2.1.2.5.2.

WLS COL 11.2-1 When mobile or temporary equipment is selected to process liquid effluents, the equipment design and testing meets the applicable requirements of Regulatory Guide 1.143. When confirmed through sampling that the radioactive waste contents result in an inventory on a mobile system that is below the A_2 quantity limit for radionuclides specified in Appendix A to 10 CFR Part 71, the liquid effluent may be processed with the mobile liquid waste processing system in the Radwaste Building. When pre-process sampling and controls indicate that A_2 quantity limits may be exceeded by processing liquid effluent in the Radwaste

Building, liquid waste is processed in the seismic Category I Auxiliary Building. Procedural controls also ensure that the total cumulative source term of unpackaged wastes including liquid waste, wet waste, solid waste, gaseous waste, activated or contaminated metals and components, and contaminated waste present at any time in the Radwaste Building is limited consistent with RG 1.143, Revision 2, unmitigated radiological release criteria, so that an unmitigated release, occurring over a two hour time period, would not result in a dose of greater than 500 millirem at the protected area boundary, or an unmitigated exposure, occurring over a two hour time period, would not result in a dose of greater than 5 rem to site personnel located 10 feet from the total cumulative radioactive inventory. The unmitigated, unshielded worker dose is calculated at 10 feet from the source. Unlimited worker occupancy workstations and low dose rate waiting areas are located no closer than 10 feet from a mobile radwaste processing system or a Waste Monitor Tank.

STD COL 11.2-1 Mobile and temporary equipment are designed in accordance with the applicable mobile and temporary radwaste treatment systems guidance provided in Regulatory Guide 1.143, including the codes and standards listed in Table 1 of the Regulatory Guide.

Mobile and temporary equipment have the following features:

- Level indication and alarms (high-level) on tanks.
- Screwed connections are permitted only for instrument connections beyond the first isolation valve.
- Remote operated valves are used where operations personnel would be required to frequently manipulate a valve.
- Local control panels are located away from the equipment, in low dose areas.
- Instrumentation readings are accessible from the local control panels (i.e., temperature, flow, pressure, liquid level, etc.).
- Wetted parts are 300 series stainless steel, except flexible hose and gaskets.
- Flexible hose is used only for mobile equipment within the designated “black box” locations between mobile components and at the interface with the permanent plant piping.
- The contents of tanks are capable of being mixed, either through recirculation or with a mixer.
- Grab sample points are located in tanks and upstream and downstream of the process equipment.

Inspection and testing of mobile or temporary equipment is in accordance with the codes and standards listed in Table 1 of Regulatory Guide 1.143 with the following additions:

- After placement in the station, the mobile or temporary equipment is hydrostatically, or pneumatically, tested prior to tie-in to permanent plant piping.
- A functional test, using demineralized water, is performed. Remote operated valves are stroked (open-closed-open or closed-open-closed) under full flow conditions. The proper function of the instrumentation, including alarms, is verified. The operating procedures are verified correct during the functional test.
- Tank overflows are routed to floor drains.
- Floor drains are confirmed to be functional prior to placing mobile or temporary equipment into operation.

11.2.3 RADIOACTIVE RELEASES

Add the following new paragraph at the end of DCD Subsection 11.2.3:

WLS SUP 11.2-2 The only liquid effluent site interface parameter outside the Westinghouse scope is the release point to the Broad River at the Ninety-Nine Islands Dam.

11.2.3.3 Dilution Factor

Add the following information at the end of DCD Subsection 11.2.3.3.

WLS COL 11.2-2 A diffuser pipe upstream of the Ninety-Nine Islands Dam is the discharge point for the plant liquid radiological effluent. The diffuser pipe mixes the effluent with the Ninety-Nine Islands Reservoir, which acts as an impoundment, as described in Regulatory Guide 1.113. The annual average flowrates for the liquid radwaste effluent and the Broad River at the Ninety-Nine Islands Dam are used in the dose calculations. The dilution factors for points downstream of the dam are set at one. This conservatively assumes that no additional dilution occurs other than the dilution that takes place upstream of the dam.

The summary of parameters used in the impoundment model are presented in Table 11.2-201.

11.2.3.5 Estimated Doses

Replace the information in DCD Subsection 11.2.3.5 with the following paragraphs and subsections.

WLS COL 11.2-2 Dose and dose rate to man was calculated using the LADTAP II computer code. This code is based on the methodology presented in Regulatory Guide 1.109.
WLS COL 11.5-3 Factors common to both estimated individual dose rates and estimated population dose are addressed here. Unique data are discussed in the respective sections.

Activity pathways considered are drinking water, sport fishing, and recreational activities.

The nearest drinking water takeoff downstream of the Lee site is approximately 21 miles downstream at Union, South Carolina.

11.2.3.5.1 Estimated Individual Dose Rate

WLS COL 11.2-2 Dose rates to individuals are calculated for drinking water, fish consumption, and recreational activities.

Table 11.2-202 contains LADTAPII input data for dose rate calculations.

Table 11.2-203 gives the maximum individual dose rates.

The maximum doses to individuals resulting from routine liquid effluents per unit are presented and compared to the regulatory criteria set forth in 10 CFR Part 50, Appendix I, and 10 CFR 20.1301 in Table 11.2-207 and Table 11.2-208, respectively.

The maximum doses to individuals resulting from routine liquid effluents per unit are given in Table 11.2-203. These doses are multiplied by two (2) to account for both units at the site. The total maximum doses for both units are summarized in Table 11.2-205 for comparison to the regulatory limits set forth in 40 CFR Part 190.

The annual doses to a maximally exposed individual from gaseous effluents are given in Table 11.3-207. The total site dose compared with the 40 CFR Part 190 criteria is provided in Table 11.2-206. The liquid effluent doses per unit presented in Table 11.2-203 are added to the gaseous effluent doses per unit presented in Table 11.3-202. The resulting maximum doses to total body, thyroid, and to any organ are multiplied by two (2) to account for both units. These results are presented in Table 11.2-206. The radiation exposure at the site boundary was

considered in DCD Subsection 12.4.2. Direct radiation from containment and other plant buildings is negligible for the values in Table 11.2-206. Additionally, there is no contribution from refueling water because the refueling water is stored inside the containment instead of in an outside storage tank. In addition, there is no outside storage of solid radwaste. There are no radiation sources outside of the permanent plant structures. There are no other uranium fuel cycle facilities in the vicinity of the site that would contribute to the dose received by the maximally exposed individual. Thus, only the dose from effluent released from the site and direct radiation from the site need be considered.

11.2.3.5.2 Estimated Population Dose

WLS COL 11.2-2 The population dose is based on the fraction of the 50-mile population that will be exposed to the evaluated pathways. These pathways are drinking water, recreational activities, and sport fishing.

The sport fishing harvest given in Table 11.2-202 is estimated using observations of usage and South Carolina Department of Natural Resources harvest limits for the number and size applicable to the Broad River in the vicinity of the Lee Nuclear Station site.

Recreational activities considered are swimming, boating, and shoreline use. The annual usage for each of these activities, which is given in Table 11.2-202, is based on consideration of the recreational value of the Broad River, the population in the vicinity of the Broad River downstream of Lee Nuclear Station, and the average shoreline exposure time per person for each age group taken from Table E-4 of Regulatory Guide 1.109. The population doses are shown in Table 11.2-204.

11.2.3.5.3 Liquid Radwaste Cost Benefit Analysis Methodology

STD COL 11.2-2 The application of the methodology of Regulatory Guide 1.110 was used to satisfy the cost benefit analysis requirements of 10 CFR Part 50, Appendix I, Section II.D. The parameters used in calculating the Total Annual Cost (TAC) are fixed and are given for each radwaste treatment system augment listed in Regulatory Guide 1.110, including the Annual Operating Cost (AOC) (Table A-2), Annual Maintenance Cost (AMC) (Table A-3), Direct Cost of Equipment and Materials (DCEM) (Table A-1), and Direct Labor Cost (DLC) (Table A-1).

The following variable parameters were used:

- Capital Recovery Factor (CRF) – This factor is taken from Table A-6 of Regulatory Guide 1.110 and reflects the cost of money for capital expenditures. A cost-of-money value of 7% per year is assumed in this analysis, consistent with the “Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission” (NUREG/BR-0058). A CRF of 0.0806 was obtained from Table A-6.

- 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. It is assumed that the radwaste system for this analysis is a unitized system at a 2-unit site, which equals an ICF of 1.625.
- Labor Cost Correction Factor (LCCF) – This factor takes into account the differences in relative labor costs between geographical regions and is taken from Table A-4 of Regulatory Guide 1.110. A LCCF of 1.0 (the lowest value) is assumed in this analysis.

Appendix I to 10 CFR Part 50 prescribes a $1,000 per person-rem criterion for determining the cost benefit of actions to reduce radiation exposure.

The analysis used a conservative assumption that the respective radwaste treatment system augment is a “perfect” system that reduces the effluent and dose by 100%. The liquid radwaste treatment system augments annual costs were determined and the lowest annual cost considered a threshold value. The lowest-cost option for liquid radwaste treatment system augments is a 20 gpm Cartridge Filter at $11,140 per year, which yields a threshold value of 11.14 person-rem total body or thyroid dose from liquid effluents.

For AP1000 sites with population dose estimates less than 11.14 person-rem total body or thyroid dose from liquid effluents, no further cost-benefit analysis is needed to demonstrate compliance with 10 CFR 50, Appendix I Section II.D.

11.2.3.5.4 Liquid Radwaste Cost Benefit Analysis

WLS COL 11.2-2 The total body and thyroid population doses for liquid effluents given in Table 11.2-204 are a small fraction of the threshold dose of 11.14 person-rem. Thus, no further cost-benefit analysis is needed to demonstrate compliance with 10 CFR 50, Appendix I Section II.D.

11.2.3.6 Quality Assurance

Add the following to the end of DCD Subsection 11.2.3.6:

STD SUP 11.2-1 Since 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 Regulatory Guide 1.143.

11.2.5 COMBINED LICENSE INFORMATION

11.2.5.1 Liquid Radwaste Processing by Mobile Equipment

STD COL 11.2-1
WLS COL 11.2-1

This COL Item addressed in Subsection 11.2.1.2.5.2.

11.2.5.2 Cost Benefit Analysis of Population Doses

STD COL 11.2-2 This COL Item is addressed in Subsection 11.2.3.5.3.

WLS COL 11.2-2 This COL Item is addressed in Subsections 11.2.3.3, 11.2.3.5, 11.2.3.5.1, 11.2.3.5.2, and 11.2.3.5.4.

WLS COL 11.2-2

TABLE 11.2-201
IMPOUNDMENT MODEL PARAMETERS

Parameter	Average Annual Condition
Impoundment Model	Fully Mixed
Plant Discharge Rate (cfs)	18.3
Impoundment Volume (cubic feet)	1,746,300
Impoundment Blowdown Rate (cfs)	2,538

WLS COL 11.2-2
WLS COL 11.5-3

TABLE 11.2-202
LADTAP II INPUT PARAMETERS[a]

Input Parameter	Value
Freshwater Site	Selected
Discharge Flowrate (cfs)	18.3
50-mile Population	3,455,395 (Tables 2.1-203 and 2.1-204, Year 2036)[b]
Source Term	DCD Table 11.2-7
Impoundment Model	Table 11.2-201
Shore Width Factor	0.2
Dilution Factors	1.0
Transit Time – Drinking Water (hr)	14.2
Transit Time – Fish and Recreational Uses (hr)	0
Sport Fish Annual Harvest (lb/yr)	15,000
Commercial Fish Annual Harvest (lb/yr)	0
Shoreline Use (person-hrs/yr)	6,620,364[c]
Swimming Exposure (person-hrs/yr)	6,620,364[c]
Boating Exposure (person-hrs/yr)	6,620,364[c]
Drinking Water Intake	Union, SC
Distance	21 miles
Projected 2036 Population	24,725

a) Input parameters not specified use LADTAP II default values.

b) The population is conservatively projected to 2036; a date more than five years beyond the date of commercial operation of Unit 2.

c) Annual use is based on consideration of the recreational value of the Broad River, the population in the vicinity of the Broad River downstream of Lee Nuclear Station, and the average shoreline exposure time per person for each age group taken from Table E-4 of Regulatory Guide 1.109. Fifteen percent of the 50-mile 2036 population is assumed to access Broad River recreational area annually.

WLS COL 11.2-2

WLS COL 11.5-3

TABLE 11.2-203 (Sheet 1 of 2)
ANNUAL DOSE TO A MAXIMALLY EXPOSED INDIVIDUAL FROM LIQUID EFFLUENTS (PER UNIT)

Dose (mrem/yr)

Adult

Pathway	Skin	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
Fish		3.13E-02	5.50E-02	4.06E-02	4.17E-03	1.88E-02	6.48E-03	4.38E-03
Drinking		7.00E-04	2.04E-02	2.02E-02	2.79E-02	2.00E-02	1.96E-02	2.42E-02
Shoreline	4.72E-05	4.03E-05	4.03E-05	4.03E-05	4.03E-05	4.03E-05	4.03E-05	4.03E-05
Total	4.72E-05	3.20E-02	7.55E-02	6.09E-02	3.21E-02	3.88E-02	2.61E-02	2.86E-02

Teenager

Pathway	Skin	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
Fish		3.29E-02	5.64E-02	2.32E-02	3.82E-03	1.90E-02	7.46E-03	3.30E-03
Drinking		6.75E-04	1.46E-02	1.41E-02	2.09E-02	1.42E-02	1.38E-02	1.72E-02
Shoreline	2.64E-04	2.25E-04	2.25E-04	2.25E-04	2.25E-04	2.25E-04	2.25E-04	2.25E-04
Total	2.64E-04	3.38E-02	7.13E-02	3.75E-02	2.50E-02	3.34E-02	2.15E-02	2.07E-02

Child

Pathway	Skin	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
Fish		4.08E-02	4.92E-02	9.19E-03	3.90E-03	1.60E-02	5.89E-03	1.45E-03
Drinking		1.94E-03	2.82E-02	2.67E-02	4.37E-02	2.73E-02	2.65E-02	2.97E-02
Shoreline	5.51E-05	4.71E-05	4.71E-05	4.71E-05	4.71E-05	4.71E-05	4.71E-05	4.71E-05
Total	5.51E-05	4.28E-02	7.75E-02	3.60E-02	4.77E-02	4.34E-02	3.25E-02	3.12E-02

WLS COL 11.2-2

WLS COL 11.5-3

TABLE 11.2-203 (Sheet 2 of 2)
ANNUAL DOSE TO A MAXIMALLY EXPOSED INDIVIDUAL FROM LIQUID EFFLUENTS (PER UNIT)

Dose (mrem/yr)

Infant

Pathway	Skin	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
Fish		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drinking		2.11E-03	2.82E-02	2.61E-02	5.32E-02	2.69E-02	2.61E-02	2.80E-02
Shoreline	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	0.00E+00	2.11E-03	2.82E-02	2.61E-02	5.32E-02	2.69E-02	2.61E-02	2.80E-02

WLS COL 11.2-2
WLS COL 11.5-3

TABLE 11.2-204
ANNUAL POPULATION DOSE FROM LIQUID EFFLUENTS (PER UNIT)

	Dose (person-rem per yr)							
Pathway	Skin	Total Body	Thyroid	Kidney	Lung	GI-LLI	Liver	Bone
Fish	-	1.25E-02	9.58E-04	6.90E-03	2.45E-03	1.31E-03	2.05E-02	1.25E-02
Drinking	-	2.60E-01	3.69E-01	2.59E-01	2.54E-01	3.06E-01	2.66E-01	1.15E-02
Shoreline	2.60E-02	2.23E-02	2.23E-02	-	-	-	-	-
Swimming	-	5.39E-04	5.39E-04	-	-	-	-	-
Boating	-	2.69E-04	2.69E-04	-	-	-	-	-
Total	2.60E-02	2.96E-01	3.93E-01	2.66E-01	2.56E-01	3.07E-01	2.87E-01	2.40E-02

TABLE 11.2-205
LIQUID PATHWAY DOSES COMPARED TO 40 CFR PART 190 LIMITS

Dose (mrem/yr, per site)

Dose	40 CFR 190 Requirements	Assessment of Both Units
Whole Body Dose Equivalent	25	1.22E-01[(a)]
Thyroid Dose	75	1.06E-01[(b)]
Dose to Another Organ	25	1.55E-01[(c)]

a) an adult receives the maximum individual whole body dose

b) an infant receives the maximum thyroid dose

c) a child receives the maximum individual organ dose which is to the liver

TABLE 11.2-206
LIQUID AND GASEOUS PATHWAY DOSES COMPARED TO
40 CFR PART 190 LIMITS

Dose	Dose (mrem/yr, per site)[a]	
	40 CFR 190 Requirements	Assessment of Both Units
Whole Body Dose Equivalent	25	3.74E+00[b]
Thyroid Dose	75	2.00E+01[c]
Dose to Another Organ	25	9.05E+00[d]

a) Direct radiation from containment and other plant buildings is negligible based on information presented in the AP1000 DCD, Tier 2, Chapter 12, Subsection 12.4.2.1.

b) This value was conservatively calculated by summing the maximum whole body dose due to the liquid pathway (to an adult) and the maximum whole body dose due to the gaseous pathway (to a child).

c) An infant receives the maximum thyroid dose.

d) A child receives the maximum other individual organ dose which is to the bone.

WLS COL 11.2-2

TABLE 11.2-207
LIQUID PATHWAY COMPARISON OF MAXIMUM INDIVIDUAL DOSE TO 10 CFR PART 50, APPENDIX I CRITERIA

Dose (mrem/yr, per unit)

Dose	Appendix I Objective	Unit 1 or 2 Assessment
Total Body		
Shoreline		4.03E-05
Drinking		2.02E-02
Fish		4.06E-02
Total	3	6.09E-02[(a)]
Maximum Organ		
Shoreline		4.71E-05
Drinking		2.82E-02
Fish		4.92E-02
Total	10	7.75E-02[(b)]

a) An adult receives the maximum individual total body dose.

b) A child receives the maximum individual organ dose which is to the liver.

WLS COL 11.2-2

TABLE 11.2-208
LIQUID PATHWAY COMPARISON OF MAXIMUM INDIVIDUAL DOSE TO 10 CFR PART 20.1301 CRITERIA

Dose (mrem/yr, per unit)		
Dose	10 CFR 20.1301 Objective	Unit 1 or 2 Assessment
Total Body	-	6.09E-02[(a)]
Thyroid Dose	-	5.32E-02[(b)]
TEDE	100	6.25E-02[(c)]
Maximum dose in any hour (mrem/hr)	2	7.13E-06

a) An adult receives the maximum individual total body dose.

b) An infant receives the maximum thyroid dose.

c) Per the guidance of Regulatory Guide 1.183, the total effective dose equivalent (TEDE) is approximated by the sum of the total body dose and 3% of the thyroid dose.

11.3 GASEOUS WASTE MANAGEMENT SYSTEMS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

11.3.3 RADIOACTIVE RELEASES

Add the following new paragraph at the end of DCD Subsection 11.3.3:

STD SUP 11.3-2 There are no gaseous effluent site interface parameters outside of the Westinghouse scope.

11.3.3.4 Estimated Doses

Add the following information at the end of DCD subsection 11.3.3.4.

WLS COL 11.3-1 WLS COL 11.5-3 The calculated gaseous doses for the maximum exposed individual are compared to the regulatory criteria in Appendix I of 10 CFR Part 50 and 10 CFR Part 20.1301 for acceptance. Table 11.3-205 and Table 11.3-206 display this comparison and demonstrate that the calculated gaseous doses for the maximally exposed individual are less than the regulatory criteria. The Lee Nuclear Station site-specific values are bounded by the DCD identified acceptable releases. With the annual airborne releases listed in DCD Table 11.3-3, the site-specific air doses at ground level at the site boundary are 1.25 mrad per year for gamma radiation and 7.32 mrad per year for beta radiation. These doses are based on the annual average atmospheric dispersion factor from Section 2.3. These doses are below the 10 CFR Part 50, Appendix I design objectives of 10 mrad per year for gamma radiation or 20 mrad per year for beta radiation.

Dose and dose rate to man were calculated using the GASPAR II computer code. This code is based on the methodology presented in Regulatory Guide 1.109. Factors common to both estimated individual dose rates and estimated population dose are addressed in this subsection. Unique data are discussed in the respective subsections.

Activity pathways considered are plume, ground deposition, inhalation, and ingestion of vegetables, meat, and milk (cow or goat).

Based on site meteorological conditions, the highest combined dose rate from plume exposure and ground deposition occurs at the site boundary 0.27 mi. (427 m) NW of the Effluent Release Boundary.

Agricultural products are estimated from U.S. Department of Agriculture National Agricultural Statistics Service. GASPAR II evenly distributes the food production over the entire 50 miles when given a total production for calculating dose.

Population distribution within the 50-mi. radius is presented in FSAR Tables 2.1-203 and 2.1-204.

11.3.3.4.1 Estimated Individual Doses

WLS COL 11.3-1 Dose rates to individuals are calculated for airborne decay and deposition, inhalation, and ingestion of milk (goat or cow), meat and vegetables. Dose from plume and ground deposition are calculated as affecting all age groups equally.

Plume exposure approximately 0.27 mi. NW of the Effluent Release Boundary produced a maximum dose rate to a single organ of 4.90 mrem/yr to skin. The maximum total body dose rate was calculated to be 7.32E-1 mrem/yr.

Ground deposition approximately 0.27 mi. NW of the Effluent Release Boundary produced a maximum dose rate to a single organ of 2.98E-1 mrem/yr to skin. The maximum total body dose rate was calculated to be 2.53E-1 mrem/yr.

Inhalation Dose at the site boundary, 0.27 mi. NW of the Effluent Release Boundary, results in a maximum dose rate to a single organ of 1.54 mrem/yr to a child’s thyroid. The maximum total body dose rate is calculated to be 1.24E-1 mrem/yr to a teenager.

Vegetable consumption assumes that the dose is received from the garden special location, approximately 1.0 mi. SSE of the plant. GASPAR II default vegetable consumption values are used in lieu of site-specific vegetable consumption data as permitted by Regulatory Guide 1.109. The estimated maximum dose rate to a single organ is 2.42 mrem/yr to a child’s thyroid. The maximum total body dose rate is calculated to be 4.59E-1 mrem/yr to a child.

Meat consumption assumes that the dose is received from the cow special location, approximately 1.65 mi. SE of the plant. GASPAR II default meat consumption values are used in lieu of site-specific meat consumption data as permitted by Regulatory Guide 1.109. The estimated maximum dose rate to a single organ is 2.74E-1 mrem/yr to a child’s bone. The maximum total body dose rate is calculated to be 5.81E-2 mrem/yr to a child.

Cow milk consumption assumes that the dose is received from the cow special location, approximately 1.65 mi. SE of the plant. GASPAR II default cow milk consumption values are used in lieu of site-specific cow milk consumption data as permitted by Regulatory Guide 1.109. The estimated maximum dose rate to a single organ is 6.23 mrem/yr to an infant’s thyroid. The maximum total body dose rate is calculated to be 3.99E-1 mrem/yr to an infant.

Goat milk consumption assumes that the dose is received from the nearest milk goat special location, approximately 1.05 mi. SSW of the plant. GASPAR II default goat milk consumption values are used in lieu of site-specific goat milk consumption data as permitted by Regulatory Guide 1.109. The estimated maximum dose rate to a single organ is 7.58 mrem/yr to an infant's thyroid. The maximum total body dose rate is calculated to be 3.26E-1 mrem/yr to an infant.

The maximum dose rate to any organ considering every pathway is calculated to be 9.95 mrem/yr to an infant's thyroid. The maximum total body dose rate is calculated to be 1.81 mrem/yr to a child. These are below the 10 CFR 50, Appendix I design objectives of 5 mrem/yr to total body, and 15 mrem/yr to any organ, including skin.

Table 11.3-201 contains GASPAR II input data for dose rate calculations. Information regarding the special locations for cow, goat, garden, site boundary and the EAB is located in Section 2.3. Table 11.3-202 contains total organ dose rates based on age group and pathway. Table 11.3-203 contains total air dose at each special location.

11.3.3.4.2 Estimated Population Dose

WLS COL 11.3-1 The population dose analysis performed to determine off-site dose from gaseous effluents is based upon the AP1000 generic site parameters included in DCD Chapter 1 and DCD Tables 11.3-1, 11.3-2 and 11.3-4, and the year 2056 population data in FSAR Tables 2.1-203 and 2.1-204. The population doses are shown in Table 11.3-204.

11.3.3.4.3 Gaseous Radwaste Cost Benefit Analysis Methodology

STD COL 11.3-1 The guidance for performing cost-benefit analysis for the gaseous radwaste system is similar to that used and described for the liquid radwaste system in Section 11.2. The gaseous radwaste treatment system augments annual costs were determined and the lowest annual cost considered a threshold value. The lowest-cost option for gaseous radwaste treatment system augments is the Steam Generator Flash Tank Vent to Main Condenser at $6,320 per year, which yields a threshold value of 6.32 person-rem total body or thyroid from gaseous effluents.

For AP1000 sites with population dose estimates less than 6.32 person-rem total body or thyroid dose from gaseous effluents, no further cost-benefit analysis is needed to demonstrate compliance with 10 CFR 50, Appendix I, Section II.D.

11.3.3.4.4 Gaseous Radwaste Cost Benefit Analysis

WLS COL 11.3-1 The population doses are given in Tables 11.3-204 and 11.3-208. The lowest cost gaseous radwaste system augment is $6,320. Assuming 100 percent efficiency of this augment, the minimum possible cost per person-rem is determined by dividing the cost of the augment by the population dose. This is $1,264 per person-rem total body ($6,320/5.00 person-rem). The total body exposure-related costs per person-rem reduction exceed the $1,000 per person-rem criterion prescribed in Appendix I to 10 CFR Part 50 and are therefore not cost beneficial. Realistic efficiencies would increase the cost per person-rem further above the $1,000 criterion.

As shown in Tables 11.3-204 and 11.3-208, the Lee thyroid dose from gaseous effluents is 9.80 person-rem, which exceeds the 6.32 person-rem threshold value. Based on the estimated 9.80 person-rem/year thyroid dose, those augments with a “Total Annual Cost” (TAC) less than $9,800 are considered below.

PWR Air Ejector Charcoal/HEPA Filtration Unit

The TAC for this augment is $9,140. To be cost beneficial at $1000 per person-rem, this augment must remove sufficient activity to decrease the population dose by at least 9.14 person-rem (thyroid); that is, decrease the thyroid dose from 9.80 person-rem (initial level) to a final level of 0.66 person-rem. No iodine is released through the condenser air removal (offgas) system as shown in DCD Table 11.3-3, sheet 2 of 3. This augment does not affect the iodine discharged by the plant which accounts for a total 4.85 person-rem in the thyroid population dose. Therefore, it would be impossible to achieve the necessary dose reduction, and this augment is not cost-beneficial.

3-Ton Charcoal Adsorber

The TAC for this augment is $8,770. To be cost beneficial at $1,000 per person-rem, this augment must remove sufficient activity to decrease the population dose by at least 8.77 person-rem (thyroid); that is, decrease the thyroid dose from 9.80 person-rem (initial level) to a final level of 1.03 person-rem.

The 3-Ton Charcoal Adsorber unit in Regulatory Guide 1.110 is based on a 200 cubic foot charge of activated charcoal for an “add-on” vessel to an existing system per the information contained within that document’s Total Direct Cost Estimate Sheet attachments. For the AP1000, it is assumed that this augment would be appended to the Gaseous Radwaste System where it would increase the delay time of noble gases exiting the existing activated carbon delay beds. No iodine is released through the Gaseous Radwaste System as shown in DCD Table 11.3-3, sheet 2 of 3. This augment does not affect the iodine discharged from the plant which accounts for 4.85 person-rem in the thyroid population dose. Therefore, it would be impossible to achieve the necessary dose reduction, and this augment is not cost-beneficial.

Main Condenser Vacuum Pump Charcoal/HEPA Filtration System

The TAC for this augment is $7,690. To be cost beneficial at $1,000 per person-rem, this augment must remove sufficient activity to decrease the population dose by at least 7.69 person-rem (thyroid); that is, decrease the thyroid dose from an initial level of 9.80 person rem to a final level of 2.11 person-rem. However, no iodine is released through the condenser air removal system as shown in DCD Table 11.3-3, sheet 2 of 3. This augment does not affect the iodine discharged by the plant which accounts for 4.85 person-rem in the thyroid population dose. 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 TAC for this augment is $7,580. To be cost beneficial at $1,000 per person-rem, this augment must remove sufficient activity to decrease the population dose by at least 7.58 person-rem (thyroid); that is, decrease the thyroid dose from an initial level of 9.80 person rem to a final level of 2.22 person-rem.

Conservatively assuming that this rather small capacity augment could be placed in the ventilation system at some point that would eliminate all iodine and particulate releases, it would not be effective in reducing the noble gas releases, the carbon-14 release, or the airborne tritium release. The noble gases, carbon-14, and tritium discharged by the plant account for 4.67 person-rem in the thyroid population dose. Therefore, it would be impossible to achieve the necessary dose reduction, and this augment is not cost-beneficial.

600 ft3 Gas Decay Tank

The TAC for this augment is $7,460. Thus, to be cost beneficial at $1,000 per person-rem, this augment must remove at least 7.46 person-rem (thyroid); that is, decrease the thyroid dose from an initial level of 9.80 person-rem to a final level of 2.34 person-rem.

No iodine is released through the AP1000 waste gas system as shown in DCD Table 11.3-3. This augment would not affect the iodine discharged by the plant which accounts for 4.85 person-rem in the thyroid 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 TAC for this augment is $6,320. Thus, to be cost beneficial at $1,000 per person-rem, this augment must remove at least 6.32 person-rem (thyroid); that is decrease the thyroid dose from an initial level of 9.80 person-rem to a final level of 3.48 person-rem. Addition of this augment presumes that the design already includes a steam generator flash tank; the augment being evaluated is the installation of vent piping and instrumentation from the tank to the main condenser. However, the AP1000 design does not include a steam generator flash tank. Therefore, the TAC of $6,320 for this augment is underestimated. As

shown in DCD Figure 10.4.8-1, the AP1000 design includes steam generator blowdown heat exchangers that provide cooling of the blowdown fluid and prevent flashing prior to the blowdown flow entering the main condenser. Therefore, this augment would not provide any additional dose reduction, and this augment is not cost-beneficial.

Conclusion

Based on the above evaluation, none of the radwaste augments are cost-beneficial in reducing the annual thyroid dose from gaseous effluents for Lee.

11.3.3.6 Quality Assurance

STD SUP 11.3-1 Add the following to the end of DCD Subsection 11.3.3.6:

Since 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 Regulatory Guide 1.143.

11.3.5 COMBINED LICENSE INFORMATION

11.3.5.1 Cost Benefit Analysis of Population Doses

STD COL 11.3-1 This COL Item is addressed in Subsection 11.3.3.4.3.

WLS COL 11.3-1 This COL Item is addressed in Subsections 11.3.3.4, 11.3.3.4.1, 11.3.3.4.2, and 11.3.3.4.4.

WLS COL 11.3-1
WLS COL 11.5-3

TABLE 11.3-201
GASPAR II INPUT PARAMETERS[a]

Input Parameter	Value
Number of Source Terms	1
Distance from site to NE Corner of the US (mi)	1088
Source Term	DCD Table 11.3-3
Population Data	Table 2.1-203 and Table 2.1-204, year 2056
Fraction of the year leafy vegetables are grown	0.58
Fraction of max individual's vegetable intake from own garden	0.76
Fraction of the year milk cows are on pasture	0.75
Fraction of milk-cow feed intake from pasture while on pasture	1
Fraction of the year goats are on pasture	0.83
Fraction of goat feed intake from pasture while on pasture	1
Fraction of the year beef cattle are on pasture	0.75
Fraction of beef-cattle feed intake from pasture while on pasture	1
Total Production Rate for the 50-mile area	
-Vegetables (kg/yr)	151,333,289
-Milk (L/yr)	84,765,807
-Meat (kg/yr)	354,508,878
Special Location Data	Section 2.3
Meteorological Data	Section 2.3

a) Input parameters not specified use default GASPAR II values.

WLS COL 11.3-1
WLS COL 11.5-3

TABLE 11.3-202 (Sheet 1 of 3)
INDIVIDUAL DOSE RATES

	Dose (mrem/yr)							
Pathway	Total Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Adult								
Plume	7.32E-01	7.32E-01	7.32E-01	7.32E-01	7.32E-01	7.32E-01	8.04E-01	4.90E+00
Ground	2.53E-01	2.53E-01	2.53E-01	2.53E-01	2.53E-01	2.53E-01	2.53E-01	2.98E-01
Vegetable	1.38E-01	1.39E-01	6.09E-01	1.38E-01	1.34E-01	9.08E-01	1.28E-01	1.27E-01
Meat	3.96E-02	4.36E-02	1.73E-01	3.96E-02	3.92E-02	6.59E-02	3.89E-02	3.88E-02
Goat Milk	5.72E-02	4.47E-02	1.60E-01	6.28E-02	5.38E-02	9.96E-01	4.49E-02	4.31E-02
Cow Milk	5.37E-02	4.95E-02	1.98E-01	5.62E-02	5.41E-02	8.13E-01	4.87E-02	4.81E-02
Inhalation	1.23E-01	1.24E-01	1.86E-02	1.26E-01	1.27E-01	1.07E-00	1.59E-01	1.20E-01
Total[(a)]	1.34E+00	1.34E+00	1.98E+00	1.35E+00	1.34E+00	4.02E+00	1.43E+00	5.53E+00
Teen								
Plume	7.32E-01	7.32E-01	7.32E-01	7.32E-01	7.32E-01	7.32E-01	8.04E-01	4.90E+00
Ground	2.53E-01	2.53E-01	2.53E-01	2.53E-01	2.53E-01	2.53E-01	2.53E-01	2.98E-01
Vegetable	2.07E-01	2.09E-01	9.76E-01	2.12E-01	2.06E-01	1.23E+00	1.97E-01	1.96E-01
Meat	3.21E-02	3.44E-02	1.46E-01	3.23E-02	3.20E-02	5.13E-02	3.17E-02	3.16E-02

WLS COL 11.3-1
WLS COL 11.5-3

TABLE 11.3-202 (Sheet 2 of 3)
INDIVIDUAL DOSE RATES

	Dose (mrem/yr)							
Pathway	Total Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Goat Milk	8.56E-02	7.30E-02	2.91E-01	1.05E-01	8.96E-02	1.58E+00	7.45E-02	7.08E-02
Cow Milk	8.93E-02	8.47E-02	3.63E-01	9.71E-02	9.34E-02	1.29E+00	8.41E-02	8.28E-02
Inhalation	1.24E-01	1.26E-01	2.25E-02	1.29E-01	1.31E-01	1.33E+00	1.80E-01	1.21E-01
Total[(a)]	1.44E+00	1.44E+00	2.49E+00	1.46E+00	1.45E+00	5.18E+00	1.55E+00	5.63E+00
Child								
Plume	7.32E-01	7.32E-01	7.32E-01	7.32E-01	7.32E-01	7.32E-01	8.04E-01	4.90E+00
Ground	2.53E-01	2.53E-01	2.53E-01	2.53E-01	2.53E-01	2.53E-01	2.53E-01	2.98E-01
Vegetable	4.59E-01	4.52E-01	2.31E+00	4.69E-01	4.59E-01	2.42E+00	4.45E-01	4.43E-01
Meat	5.81E-02	5.91E-02	2.74E-01	5.85E-02	5.80E-02	8.73E-02	5.77E-02	5.76E-02
Goat Milk	1.71E-01	1.58E-01	7.07E-01	2.14E-01	1.87E-01	3.15E+00	1.62E-01	1.56E-01
Cow Milk	1.99E-01	1.93E-01	8.88E-01	2.16E-01	2.09E-01	2.60E+00	1.93E-01	1.91E-01
Inhalation	1.10E-01	1.09E-01	2.73E-02	1.14E-01	1.17E-01	1.54E+00	1.56E-01	1.07E-01
Total[(a)]	1.81E+00	1.80E+00	4.48E+00	1.84E+00	1.83E+00	8.18E+00	1.91E+00	6.00E+00

WLS COL 11.3-1

WLS COL 11.5-3

TABLE 11.3-202 (Sheet 3 of 3)
INDIVIDUAL DOSE RATES

	Dose (mrem/yr)							
Pathway	Total Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Infant								
Plume	7.32E-01	7.32E-01	7.32E-01	7.32E-01	7.32E-01	7.32E-01	8.04E-01	4.90E+00
Ground	2.53E-01	2.53E-01	2.53E-01	2.53E-01	2.53E-01	2.53E-01	2.53E-01	2.98E-01
Vegetable	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Meat	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Goat Milk	3.26E-01	3.09E-01	1.34E+00	4.23E-01	3.58E-01	7.58E+00	3.17E-01	3.07E-01
Cow Milk	3.99E-01	3.89E-01	1.72E+00	4.38E-01	4.17E-01	6.23E+00	3.91E-01	3.88E-01
Inhalation	6.35E-02	6.21E-02	1.36E-02	6.82E-02	6.78E-02	1.38E+00	9.58E-02	6.13E-02
Total[a]	1.45E+00	1.44E+00	2.72E+00	1.49E+00	1.47E+00	9.95E+00	1.54E+00	5.65E+00

a) The milk pathway contribution for the total dose of each receptor is conservatively assumed to be the higher of the two milk pathways, either goat milk or cow milk.

WLS COL 11.3-1
WLS COL 11.5-3

TABLE 11.3-203
DOSE IN MILLIRADS AT SPECIAL LOCATIONS

Special Location	Beta Air Dose	Gamma Air Dose
Cow (Meat, Milk)	1.09E-00	1.99E-01
Goat (Milk)	8.25E-01	1.96E-01
EAB	3.25E-00	7.73E-01
Site Boundary	7.32E+00	1.25E+00
Garden	1.24E-00	2.94E-01

WLS COL 11.3-1

WLS COL 11.5-3

TABLE 11.3-204
POPULATION DOSES

(person-rem)

Pathway	Total Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Plume	1.45E+00	1.45E+00	1.45E+00	1.45E+00	1.45E+00	1.45E+00	1.69E+00	1.48E+01
Ground	2.75E-01	2.75E-01	2.75E-01	2.75E-01	2.75E-01	2.75E-01	2.75E-01	3.23E-01
Inhalation	4.09E-01	4.10E-01	4.60E-02	4.16E-01	4.21E-01	3.07E+00	4.97E-01	4.01E-01
Vegetable	7.61E-01	7.60E-01	3.34E+00	7.63E-01	7.49E-01	7.75E-01	7.45E-01	7.43E-01
Cow Milk	2.75E-01	2.68E-01	1.15E+00	2.85E-01	2.79E-01	1.82E+00	2.68E-01	2.66E-01
Meat	1.83E+00	1.90E+00	8.22E+00	1.83E+00	1.82E+00	2.41E+00	1.82E+00	1.81E+00
Total	5.00E+00	5.07E+00	1.45E+01	5.02E+00	5.00E+00	9.80E+00	5.29E+00	1.84E+01

WLS COL 11.3-1
WLS COL 11.5-3

TABLE 11.3-205
CALCULATED MAXIMUM INDIVIDUAL DOSES COMPARED TO 10 CFR PART 50 APPENDIX I DESIGN OBJECTIVES

Description	Design Objective	Calculated Values
Noble Gases(1)		
Gamma Dose (mrad)	10	1.25E+00
Beta Dose (mrad)	20	7.32E+00
Total Body Dose (mrem)	5	7.32E-01
Skin Dose (mrem)	15	4.90E+00
Radioiodines and Particulates		
Total Body Dose (mrem)	-	1.08E+00
Max to Any Organ (mrem)(2)	15	9.21E+00
Maximum Doses to Any Organ Including Noble Gas Total Body Dose (mrem)(3)	15	9.95E+00

1) Doses due to noble gases in the released plume are calculated at the location of maximum dose at the site boundary (location of highest χ/Q values). This location is 0.27 miles (427 m) northwest of the Effluent Release Boundary.

2) The maximum dose to any organ is the dose to the thyroid of an infant.

3) The maximum organ dose listed here includes the dose due to ground exposure, inhalation, food pathways, and the total plume (noble gas) dose given above.

WLS COL 11.3-1
WLS COL 11.5-3

TABLE 11.3-206
MAXIMUM INDIVIDUAL DOSES FROM BOTH UNITS DUE TO ROUTINE GASEOUS EFFLUENTS COMPARED TO 10 CFR 20.1301 LIMITS

Description	Limit	Calculated Values
TEDE (mrem)[(a)]	100	4.11E+00
Maximum Dose per Hour (mrem/hr)	2	4.70E-04

a) Consistent with Regulatory Guide 1.183, the TEDE reported here is 3% of the thyroid dose plus the total body dose from Table 11.3-202. The maximum TEDE is to a child.

TABLE 11.3-207
COLLECTIVE GASEOUS DOSES COMPARED TO
40 CFR PART 190 LIMITS

Description	Limit	Calculated Values for Both Units
Total Body Dose[a] Equivalent (mrem)	25	3.62E+00
Thyroid Dose (mrem)	75	1.99E+01
Max to Any Other Organ (mrem)[b]	25	8.97E+00

a) The total body dose resulting from plume (noble gas) and radioiodine and particulate exposure pathways due to radiological releases from both units.

b) Note that the maximum dose to any organ other than the thyroid is the dose to the bone of a child. The max dose to any other organ listed here includes the dose due to ground exposure, inhalation, food pathways, and the total body plume (noble gas) as given in Table 11.3-202.

WLS COL 11.3-1
WLS COL 11.5-3

TABLE 11.3-208
POPULATION DOSE BY ISOTOPIC GROUP

Source	Total Body (person-rem)	% of Total Total Body	Thyroid (person-rem)	% of Total Thyroid
Noble Gases	1.45E+00	29%	1.45E+00	15%
Iodines	1.00E-02	0%	4.85E+00	49%
Particulates	3.16E-01	6%	2.74E-01	3%
C-14	2.45E+00	49%	2.45E+00	25%
H-3	7.70E-01	15%	7.70E-01	8%
Total	5.00E+00	100%	9.80E+00	100%

11.4 SOLID WASTE MANAGEMENT

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

11.4.5 QUALITY ASSURANCE

Add the following to the end of DCD Subsection 11.4.5:

STD SUP 11.4-1 Since 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 Regulatory Guide 1.143.

11.4.6 COMBINED LICENSE INFORMATION FOR SOLID WASTE MANAGEMENT SYSTEM PROCESS CONTROL PROGRAM

Add the following information to the end of DCD Subsection 11.4.6.

This COL Item is addressed below.

STD COL 11.4-1 A Process Control Program (PCP) is developed and implemented in accordance with the recommendations and guidance of NEI 07-10A (Reference 201). The PCP describes the administrative and operational controls used for the solidification of liquid or wet solid waste and the dewatering of wet solid waste. Its purpose is to provide the necessary controls such that the final disposal waste product meets applicable federal regulations (10 CFR Parts 20, 50, 61, 71, and 49 CFR Part 173), state regulations, and disposal site waste form requirements for burial at a low level waste disposal site that is licensed in accordance with 10 CFR Part 61.

WLS COL 11.4-1 When the disposable media is removed from mobile radwaste processing system, the process control program is utilized to move the media from the system and place the media into a package suitable for shipping. The mobile radwaste processing system is not placed back into service until the media that has been removed is packaged and ready for shipment.

STD COL 11.4-1 Waste processing (solidification or dewatering) equipment and services may be provided by the plant or by third-party vendors. Each process used meets the applicable requirements of the PCP.

No additional onsite radwaste storage is required beyond that described in the DCD.

Table 13.4-201 provides milestones for PCP implementation.

11.4.6.1 Procedures

STD SUP 11.4-1 Operating procedures specify the processes to be followed to ship waste that complies with the waste acceptance criteria of the disposal site, 10 CFR 61.55 and 61.56, and the requirements of third party waste processors.

Each waste stream process is controlled by procedures that specify the process for packaging, shipment, material properties, destination (for disposal or further processing), testing to verify compliance, the process to address non-conforming materials, and required documentation.

Where materials are to be disposed of as non-radioactive waste (as described in DCD Subsection 11.4.2.3.3) final measurements of each package are performed to verify there has not been an accumulation of licensed material resulting from a buildup of multiple, non-detectable quantities. These measurements are obtained using sensitive scintillation detectors, or instruments of equal sensitivity, in a low-background area.

Procedures document maintenance activities, spill abatement, upset condition recovery, and training.

Procedures document the periodic review and revision, as necessary, of the PCP based on changes to the disposal site, waste acceptance criteria regulations, and third party PCPs.

11.4.6.2 Third Party Vendors

Third party equipment suppliers and/or waste processors are required to supply approved PCPs. Third party vendor PCPs describe compliance with Regulatory Guide 1.143, Generic Letter 80-09, and Generic Letter 81-39. Third party vendor PCPs are referenced appropriately in the plant PCP before commencement of waste processing.

11.4.7 REFERENCES

201. NEI 07-10A, “Generic FSAR Template Guidance for Process Control Program (PCP),” Revision 0, March 2009 (ML091460627).

11.5 RADIATION MONITORING

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

11.5.1.1 Safety Design Basis

Revise the third and fourth bullets in the third paragraph of DCD Subsection 11.5.1.1 to read as follows:

WLS DEP 6.4-1

- Initiate main control room supplemental filtration in the event of abnormally high particulate, iodine, or gaseous radioactivity in the main control room supply air (High-1)
- Initiate main control room ventilation isolation and actuate the main control room emergency habitability system in the event of abnormally high particulate or iodine radioactivity in the main control room supply air (High-2)

11.5.1.2 Power Generation Design Basis

Revise the fourth bullet in DCD Subsection 11.5.1.2 as follows:

STD COL 11.5-2

- Data collection and data storage to support compliance reporting for the applicable NRC requirements and guidelines, such as General Design Criterion 64 and Regulatory Guide 1.21 and Regulatory Guide 4.15, Revision 1.

11.5.2.3.1 Fluid Process Monitors

Revise the second to last sentence of the first paragraph of the Main Control Room Supply Air Duct Radiation Monitors section of DCD Subsection 11.5.2.3.1 to read as follows:

WLS DEP 6.4-1 When predetermined setpoints are exceeded, the monitors provide signals to initiate the supplemental air filtration system on a High-1 gaseous, particulate, or iodine concentration, and to isolate the main control room air intake and exhaust ducts and activate the main control room emergency habitability system on High-2 particulate or iodine concentrations.

11.5.2.4 Inservice Inspection, Calibration, and Maintenance

Add the following information at the end of DCD Subsection 11.5.2.4.

STD COL 11.5-2 Daily checks of effluent monitoring system operability are made by observing channel behavior. Detector response is routinely observed with a remotely-positioned check source in accordance with plant procedures. Instrument background count rate is also observed to determine proper functioning of the monitors. Any detector whose response cannot be verified by observation during normal operation or by using the remotely-positioned check source can have its response checked with a portable check source. A record is maintained showing the background radiation level and the detector response.

Calibration of the continuous radiation monitors is done with commercial radionuclide standards that have been standardized using a measurement system traceable to the National Institute of Standards and Technology.

11.5.3 EFFLUENT MONITORING AND SAMPLING

Add the following information at the end of DCD Subsection 11.5.3.

WLS COL 11.5-2 Duke Energy is extending the existing Duke Energy program for quality assurance of radiological effluent and environmental monitoring that is based on Regulatory Guide 4.15, Revision 1, to apply to Lee Nuclear Station. Regulatory Guide 4.15, Revision 1, is a proven methodology for quality assurance of radiological effluent and environmental monitoring programs that is acceptable to the NRC staff as a method for demonstrating compliance with applicable requirements of 10 CFR Parts 20, 50, 52, 61, and 72. Use of Revision 2 of Regulatory Guide 4.15 would necessitate conducting two separate programs involving the use of common staff, facilities and equipment, which would create an undue burden and could lead to an increased possibility for human error. Therefore, Duke Energy commits to use Regulatory Guide 4.15, Revision 1, methodology for Lee Nuclear Station for optimal consistency, efficiency and practicality.

11.5.4 PROCESS AND AIRBORNE MONITORING AND SAMPLING

STD COL 11.5-2 Add the following information at the end of the first paragraph in DCD Subsection 11.5.4.

The sampling program for liquid and gaseous effluents will conform to Regulatory Guide 4.15, Revision 1 (See Appendix 1AA).

Add the following information at the end of DCD Subsection 11.5.4.

11.5.4.1 Effluent Sampling

STD COL 11.5-2 Effluent sampling of potential radioactive liquid and gaseous effluent paths is conducted on a periodic basis to verify effluent processing meets the discharge limits to offsite areas. The effluent sampling program provides the information for the effluent measuring and reporting required by 10 CFR 50.36a and 10 CFR Part 20, and implemented through the Offsite Dose Calculation Manual (ODCM) and plant procedures. The frequency of the periodic sampling and analyses described herein are nominal and may be increased as permitted by procedure. Tables 11.5-201 and 11.5-202 summarize the sample and analysis schedules and sensitivities, respectively. The information contained in Tables 11.5-201 and 11.5-202 are derived from Regulatory Guide 1.21.

Laboratory isotopic analyses are performed on continuous and batch effluent releases in accordance with the ODCM. Results of these analyses are compiled and appropriate portions are utilized to produce the Radioactive Effluent Release Report.

11.5.4.2 Representative Sampling

STD COL 11.5-2 Representative samples are obtained from well-mixed streams or volumes of effluent liquid through the use of proper sampling equipment, proper location of sampling points, and the development and use of sampling procedures. The recommendations of ANSI N 42.18 (Reference 203) are considered for the selection of instrumentation specific to the continuous monitoring of radioactivity in liquid effluents.

Sampling of effluent liquids is consistent with guidance in Regulatory Guide 1.21. When practical, effluent releases are batch-controlled, and prior to sampling, large volumes of liquid waste are mixed, in as short a time span as practicable, so that solid particulates are uniformly distributed in the liquid volume. Sampling and analysis is performed, and release conditions set, before release. Sample points are located to minimize flow disturbance due to fittings and other characteristics of equipment and components. Sample lines are flushed consistent with plant procedures to remove sediment deposits.

Representative sampling of process effluents is attained through sample and monitor locations and methods and criteria detailed in plant procedures.

Composite sampling is employed to analyze for hard to measure radionuclides and to monitor effluent streams that normally are not expected to contain significant amounts of radioactive contamination. Composite liquid samples are collected in proportion to the volume of each batch of effluent release. The composite is thoroughly mixed prior to analysis. Collection periods for composites are as short as practicable and periodic checks are performed to identify changes in composite samples. When grab samples are collected instead of composite samples, the time of the sample, location, and frequency are considered to provide a representative sample of the radioactive materials.

The pressure head of the fluid, if available, is used for taking samples. If sufficient pressure head is not available to take samples, then sample pumps are used to draw the sample from the process fluid to the detector panels and back to the process.

Testing and obtaining representative samples using the radiation monitors described in DCD Subsection 11.5 will be performed in accordance with ANSI N13.1 (Reference 201).

For obtaining representative samples in unfiltered ducts, isokinetic probes are tested and used in accordance with ANSI N13.1 (Reference 201).

Analytical Procedures

Typically, samples of process and effluent gases and liquids are analyzed in the station laboratory or by an outside laboratory via the following techniques:

- Gross alpha/beta counting
- Gamma spectrometry
- Liquid scintillation counting

"Available" instrumentation and counting techniques change as other instruments and techniques become available. For this reason, the frequency of sampling and the analysis of samples are generalized in this subsection.

Gross alpha/beta analysis may be performed directly on unprocessed samples (e.g., air filters) or on processed samples (e.g., evaporated liquid samples). Sample volume, counting geometry, and counting time are chosen to match measurement capability with sample activity. Correction factors for sample-detector geometry, self-absorption and counter resolving time are applied to provide the required accuracy.

Liquid effluent samples are prepared for alpha/beta counting by evaporation onto steel planchets. Gamma analysis may be done on any type of sample (gas, solid or liquid) in a gamma spectrometer.

Tritiated water vapor samples are collected by condensation or adsorption, and the resultant liquid is analyzed by liquid scintillation counting techniques.

Radiochemical separations are used for the routine analysis of Sr-89 and Sr-90.

Liquid samples are collected in polyethylene bottles to minimize adsorption of nuclides onto container walls.

11.5.6.5 Quality Assurance

Add the following information at the end of DCD Subsection 11.5.6.5.

STD COL 11.5-2 The sampling program and the associated monitors will conform to Regulatory Guide 4.15 (See Appendix 1AA).

11.5.8 COMBINED LICENSE INFORMATION

STD COL 11.5-1 An ODCM is developed and implemented in accordance with the recommendations and guidance of NEI 07-09A (Reference 202). The ODCM contains the methodology and parameters used for calculating doses resulting from liquid and gaseous effluents. The ODCM addresses operational setpoints, including planned discharge rates, for radiation monitors and monitoring programs (process and effluent monitoring and environmental monitoring) for the control and assessment of the release of radioactive material to the environment. The ODCM provides the limitations on operation of the radwaste systems, including functional capability of monitoring instruments, concentrations of effluents, sampling, analysis, 10 CFR Part 50, Appendix I dose and dose commitments, and reporting. The ODCM will be finalized prior to fuel load with site-specific information.

Table 13.4-201 provides milestones for ODCM implementation.

STD COL 11.5-2 This COL Item is addressed in Subsections 11.5.1.2, 11.5.2.4, 11.5.4, 11.5.4.1, 11.5.4.2, and 11.5.6.5.

WLS COL 11.5-2 This COL item is addressed in Subsection 11.5.3.

WLS COL 11.5-3 This COL Item is addressed in Subsections 11.2.3.5 and 11.3.3.4 for liquid and gaseous effluents, respectively.

Add the following subsection after DCD Subsection 11.5.8.

11.5.9 REFERENCES

201. ANSI N13.1-1969, "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities."

202. NEI 07-09A, “Generic FSAR Template Guidance for Offsite Dose Calculation Manual (ODCM) Program Description,” Revision 0, March 2009 (ML091050234).

203. ANSI N42.18-2004, “Specification and Performance of On-Site Instrumentation for Continuous Monitoring Radioactivity in Effluents.”

TABLE 11.5-201
MINIMUM SAMPLING FREQUENCY

	Stream	Sampled Medium	Frequency
STD COL 11.5-2	Gaseous	Continuous Release	A sample is taken within one month of initial criticality, and at least weekly thereafter to determine the identity and quantity for principal nuclides being released. A similar analysis of samples is performed following each refueling, process change, or other occurrence that could alter the mixture of radionuclides.
			When continuous monitoring shows an unexplained variance from an established norm.
			Monthly for tritium.
		Batch Release	Prior to release to determine the identity and quantity of the principal radionuclides (including tritium).
		Filters (particulates)	Weekly.
			Quarterly for Sr-89 and Sr-90.
			Monthly for gross alpha.
	Liquid	Continuous Releases	Weekly for principal gamma-emitting radionuclides.
			Monthly, a composite sample for tritium and gross alpha.
			Monthly, a representative sample for dissolved and entrained fission and activation gases.
WLS COL 11.5-2			Quarterly, a composite sample for Sr-89 and Sr-90.
STD COL 11.5-2		Batch Releases	Prior to release for principal gamma-emitting radionuclides.
			Monthly, a composite sample for tritium and gross alpha.
			Monthly, a representative sample from at least one representative batch for dissolved and entrained fission and activation gases.
			Quarterly, a composite sample for Sr-89 and Sr-90.

STD COL 11.5-2

TABLE 11.5-202
MINIMUM SENSITIVITIES

Stream	Nuclide	Sensitivity
Gaseous	Fission & Activation Gases	1.0E-4 μCi/cc
	Tritium	1.0E-6 μCi/cc
	Iodines & Particulates	Sufficient to permit measurement of a small fraction of the activity that would result in annual exposures of 15 mrem to thyroid for iodines, and 15 mrem to any organ for particulates, to an individual in an unrestricted area.
	Gross Radioactivity	Sufficient to permit measurement of a small fraction of the activity that would result in annual air dose of 1) 10 mrad due to gamma, and 2) 20 mrad of beta at any location near ground level at or beyond the site boundary.
Liquid	Gross Radioactivity	1.0E-7 μCi/ml
	Gamma-emitters	5.0E-7 μCi/ml
	Dissolved & Entrained Gases	1.0E-5 μCi/ml
	Gross Alpha	1.0E-7 μCi/ml
	Tritium	1.0E-5 μCi/ml
	Sr-89 & Sr-90	5.0E-8 μCi/ml

WLS COL 11.5-2 (applies to Sr-89 & Sr-90 row)