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 no departures or supplements.

11.2 LIQUID WASTE MANAGEMENT SYSTEM

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

Replace the last paragraph in DCD Subsection 11.2.1.2.4 with the following information:

DCD

The monitored radwaste discharge pipeline is engineered to preclude leakage to the environment. This pipe is routed from the auxiliary building to the radwaste building (the short section of pipe between the two buildings is fully available for visual inspection as noted above) and then out of the radwaste building to the licensed release point for dilution and discharge. The discharge radiation monitor and isolation valve are located inside the auxiliary building. The exterior piping is designed to preclude inadvertent or unidentified releases to the environment. No valves, vacuum breakers, or other fittings are incorporated outside of buildings. This greatly reduces the potential for undetected leakage from this discharge to the environment at a non-licensed release point, and supports compliance with 10 CFR 20.1406 (Reference 5) .

Add the following new paragraph to the end of DCD Subsection 11.2.1.2.4:

HAR SUP 11.2-2

The HAR site WLS effluent discharge release point is where the WLS effluent discharge pipe connects to the cooling tower blowdown pipe.

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:

STD 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 do not exceed the A_2 quantities for radionuclides specified in Appendix A to 10 CFR Part 71, the liquid effluent may be processed with mobile or temporary equipment in the Radwaste Building. When the A_2 quantities are exceeded, the liquid effluent may be processed in the Seismic Category I auxiliary building.

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

Mobile and temporary equipment has 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.

11.2.3.3 Dilution Factor

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

HAR COL 11.2-2

Liquid radioactive releases are diluted by the cooling tower blowdown flow prior to being released to the Main Reservoir. For drinking water supply both at the plant site and for intakes downstream of Harris Lake the water is assumed to be well mixed. For the liquid radioactive releases from the plant to nearest drinking water intake at Lillington, NC (approximately 17 miles), the downstream dilution factor is based on the minimum average annual release from the Harris Lake to the Cape Fear river of 20 cfs and the average annual mean Cape Fear river flow at Lillington of 3363 cfs. Use of these values results in a dilution factor of 168. This dilution factor is also conservatively used for estimating population doses to towns downstream of Lillington even though longer transit times and more dilution results. No dilution is applied to the drinking water dose for site workers as part of the population dose estimate. Dilution factors are given in Table 11.2-201.

11.2.3.4 Release Concentrations

Add the following information at the end of DCD Subsection 11.2.3.4:

HAR SUP 11.2-1

To demonstrate compliance with the Reference 1 effluent concentration limits, the discharge concentrations have been evaluated for the release of the annual expected activity diluted with the average annual discharge flow of 20 cfs for 292 days from Harris Lake to Cape Fear River. The dilution factors are presented in Table 11.2-201. Table 11.2-204 lists the annual average nuclide release concentrations and the fraction of the effluent concentration limits using base GALE code assumptions. As shown in Table 11.2-204, the overall fraction of the effluent concentration limit is 0.15, which is below the allowable value of 1.0.

The annual releases from the plant have also been evaluated based on operation with the maximum defined fuel defect level. The maximum defined fuel defect level corresponds to the Technical Specification limit on coolant activity which is based on 0.25 percent fuel defects. Table 11.2-205 lists the annual average nuclide release concentrations and the fractions of the effluent concentration limits for the maximum defined fuel defects. As shown in Table 11.2-205, the overall fraction of the effluent concentration limit for the maximum defined fuel defect level is 0.69, which is below the allowable value of 1.0.

11.2.3.5 Estimated Doses

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

HAR 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.
HAR 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.

Table 11.2-201 contains dilution factors and related site and population data used in dose rate calculations. Table 11.2-202 contains LADTAP II input data used for individual and population dose rate calculations.

11.2.3.5.1 Estimated Individual Dose Rates

Dose rates to individuals are calculated for drinking water, fish consumption, and recreational activities. Table 11.2-203 gives the individual dose rates by age group, pathway and organ. Table 11.2-207 list the liquid pathways consumption factors that were used in determining the dose to the maximum exposed individual.

In order to demonstrate compliance with the requirements of 40 CFR 190 (per 10 CFR 20.1301(e)), the liquid and gaseous effluent doses presented in Tables 11.2-203 and 11.3-206 were adjusted to reflect the whole body dose equivalent. The total effective dose equivalent (TEDE) for the whole body was determined using the adult dose values given in the tables and the applicable organ dose weighting factor. The liquid effluent doses per unit were added to the gaseous effluent doses per unit and the resulting maximum doses to whole body, thyroid, and organ multiplied by two (2) to account for the operation of the Harris Units 2 & 3 at the site.

In addition to the exposures from Unit 2 & 3, the liquid and gaseous doses due to the operation of Unit 1 contribute to the total public dose. Unit 1 doses are based on an average of actual plant effluent releases during the period 1999 to 2006. Direct radiation exposure from containment and other plant buildings is negligible based on information documented in AP1000 DCD, Tier 2, Chapter 12, Subsection 12.4.2.1.

The sum of the annual doses due to the releases of liquid and gaseous radioactive materials from all units at the Harris site are presented in Table 11.2-206 and are below the 40 CFR Part 190 limits for whole body dose equivalent, thyroid, and maximum organ.

11.2.3.5.2 Estimated Population Dose

The population dose is based on the fraction of the 81 km (50 mile) resident population that may be exposed to the evaluated pathways. These pathways are drinking water and recreational activities. The drinking water pathways include the residents in the towns of Lillington, Dunn and Fayetteville who receive their drinking water supply from the Cape Fear River downstream of Harris Lake and an estimated 1000 site workers who may receive their drinking water supply directly from the Harris Lake. Harris Lake offers recreational activities to area residents which include sport fishing, swimming, boating, and shoreline use. Estimated recreational usage data is given in Table 11.2-202.

The population doses from liquid effluents by pathway and organ are given in Table 11.2-208.

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

HAR COL 11.2-2
HAR COL 11.5-3

The population doses are given in Table 11.2-208 which shows population exposures of 6.65 person-rem total body and 1.89 person-rem thyroid. As discussed above, the lowest cost liquid radwaste system augment is $11,400. Assuming 100% 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 $1,675 per person-rem total body ($11,400/6.65 person-rem) and $5,894 per person-rem thyroid ($11,140/1.89 person-rem). These costs per person-rem reductions exceed the $1,000 per person-rem criterion prescribed in Appendix I to 10 CFR 50 and are therefore not beneficial.

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

This COL Item is 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.

HAR 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.

HAR COL 11.2-2

Table 11.2-201
Dilution Factors and Population Data

Parameter	Average Annual Condition
Discharge Flow From Harris Lake to Cape Fear River (cfs)	20
Annual Average Flow in Cape Fear River at Lillington (cfs)	3363
Distance to Nearest Drinking Water Extraction (mi.)	17(Lillington)
Dilution Factor for Drinking Water	168 (Lillington)[a] 1 (Site Workers)[b]
Dilution Factor for Recreational Activities	1
Dilution Factor for Fish	1
Lillington Population[c]	4,328
Dunn Population[c]	13,654
Fayetteville Population[c]	133,084
50-Mile Residential Population[c]	3,003,458 (Table 2.1.3-203 and Table 2.1.3-204)

a) Dilution Factor for Lillington conservatively used for Dunn and Fayetteville even though both are further downstream with more dilution and longer transit times.

b) Site worker population conservatively estimated at 1,000 for Units 2 and 3.

c) Population data projected to year 2020.

HAR COL 11.2-2
HAR COL 11.5-3

Table 11.2-202
LADTAP II Input

Input Parameter	Value
Freshwater Site	Selected
Discharge Flow Rate from two AP1000 units to Harris Lake (gpm)	12,000
Source Term	DCD Table 11.2-7
Reconcentration Model	Partial Mixing
Harris Lake Storage Capacity (acre-ft)	177,563
Shore Width Factor	0.3
Dilution Factors	Table 11.2-201
Transit Time – Drinking (hr)	1.0
Transit time – Fish and Recreational Uses (hr)	0
Liquid Pathway Consumption Factors	Table 11.2-207
Recreational Exposure for Shoreline, Swimming, and Boating (person-hrs/yr)	1,379,591
Sport Fish Catch at Harris Reservoir (kg/yr)	53,710

HAR COL 11.2-2
HAR COL 11.5-3

Table 11.2-203 (Sheet 1 of 2)
Individual Dose Rates (mrem/year)

				Adult				
Pathway	Total Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Fish Consumption	1.98E+00	9.35E-02	2.04E+00	2.94 E+00	1.02 E+00	3.55E-02	3.62E-01	-
Drinking Water	8.37E-03	8.22E-03	2.27E-04	8.47E-03	8.27E-03	8.17E-03	8.20E-03	-
Shoreline	3.75E-03	3.75E-03	3.75E-03	3.75E-03	3.75E-03	3.75E-03	3.75E-03	4.38E-03
Swimming	9.09E-06	9.09E-06	9.09E-06	9.09E-06	9.09E-06	9.09E-06	9.09E-06	-
Boating	3.79E-05	3.79E-05	3.79E-05	3.79E-05	3.79E-05	3.79E-05	3.79E-05	-
Total	2.00E+00	1.06E-01	2.04E+00	2.95E-00	1.03E+00	4.75E-02	3.74E-01	4.38E-03
				Teenager				
Pathway	Total Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Fish Consumption	1.11E+00	7.15E-02	2.18E+00	3.04E+00	1.05E+00	2.73E-02	4.23E-01	-
Drinking Water	5.86E-03	5.79E-03	2.20E-04	6.04E-03	5.85E-03	5.76E-03	5.79E-03	-
Shoreline	2.10E-02	2.10E-02	2.10E-02	2.10E-02	2.10E-02	2.10E-02	2.10E-02	-
Swimming	5.07E-05	5.07E-05	5.07E-05	5.07E-05	5.07E-05	5.07E-05	5.07E-05	2.44E-02
Boating	2.54E-05	2.54E-05	2.54E-05	2.54E-05	2.54E-05	2.54E-05	2.54E-05	-
Total	1.14E+00	9.83E-02	2.20E+00	3.07E+00	1.07E+00	5.41E-02	4.50E-01	2.44E-02
				Child				
Pathway	Total Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Fish Consumption	4.38E-01	4.01E-02	2.73E+00	2.74E+00	9.03E-01	2.26E-02	3.39E-01	-
Drinking Water	1.11E-02	1.11E02	6.36E-04	1.17E-02	1.13E-02	1.11E-02	1.11E-02	-
Shoreline	4.38E-03	4.38E-03	4.38E-03	4.38E-03	4.38E-03	4.38E-03	4.38E-03	5.11E-03

HAR COL 11.2-2
HAR COL 11.5-3

Table 11.2-203 (Sheet 2 of 2)
Individual Dose Rates (mrem/year)

Swimming	1.06E-05	1.06E-05	1.06E-05	1.06E-05	1.06E-05	1.06E-05	1.06E-05	-
Boating	5.30E-06	5.30E-06	5.30E-06	5.30E-06	5.30E-06	5.30E-06	5.30E-06	-
Total	4.54E-01	5.56E-01	2.74E+00	2.75E+00	9.19E-01	3.81E-02	3.55E-01	5.11E-03

Infant

Pathway	Total Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Fish Consumption	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-
Drinking Water	1.09E-02	1.09E-02	6.47E-04	1.16E-02	1.11E-02	1.09E-02	1.09E-02	-
Shoreline	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-
Total	1.09E-02	1.09E-02	6.47E-04	1.16E-02	1.11E-02	1.09E-02	1.09E-02	-

HAR SUP 11.2-1

Table 11.2-204 (Sheet 1 of 3)
Comparison of Annual Average Liquid Release Concentrations with 10 CFR 20 Effluent Concentration Limits for Expected Releases – Two Units

Nuclide	Discharge Concentration (µCi/ml)[(a)]	Effluent Concentration Limit (µCi/ml)[(b)]	Fraction of Concentration Limit
Na-24	2.3E-10	5.0E-05	4.6E-06
Cr-51	2.6E-10	5.0E-04	5.2E-07
Mn-54	1.8E-10	3.0E-05	6.1E-06
Fe-55	1.4E-10	1.0E-04	1.4E-06
Fe-59	2.8E-11	1.0E-05	2.8E-06
Co-58	4.7E-10	2.0E-05	2.4E-05
Co-60	6.2E-11	3.0E-06	2.1E-05
Zn-65	5.7E-11	5.0E-06	1.1E-05
W-187	1.8E-11	3.0E-05	6.1E-07
Np-239	3.4E-11	2.0E-05	1.7E-06
Br-84	2.8E-12	4.0E-04	7.0E-09
Rb-88	3.8E-11	4.0E-04	9.4E-08
Sr-89	1.4E-11	8.0E-06	1.7E-06
Sr-90	1.4E-12	5.0E-07	2.8E-06
Sr-91	2.8E-12	2.0E-05	1.4E-07
Y-91m	1.4E-12	2.0E-03	7.0E-10
Y-93	1.3E-11	2.0E-05	6.3E-07
Zr-95	3.2E-11	2.0E-05	1.6E-06
Nb-95	2.9E-11	3.0E-05	9.8E-07
Mo-99	8.0E-11	2.0E-05	4.0E-06

HAR SUP 11.2-1

Table 11.2-204 (Sheet 2 of 3)
Comparison of Annual Average Liquid Release Concentrations with 10 CFR 20 Effluent Concentration Limits for Expected Releases – Two Units

Nuclide	Discharge Concentration (μCi/ml)[(a)]	Effluent Concentration Limit (μCi/ml)[(b)]	Fraction of Concentration Limit
Tc-99m	7.7E-11	1.0E-03	7.7E-08
Ru-103	6.9E-10	3.0E-05	2.3E-05
Rh-103m	6.9E-10	6.0E-03	1.2E-07
Ru-106	1.0E-08	3.0E-06	3.4E-03
Ag-110m	1.5E-10	6.0E-06	2.4E-05
Te-129m	1.7E-11	7.0E-06	2.4E-06
Te-129	2.1E-11	4.0E-04	5.2E-08
Te-131m	1.3E-11	8.0E-06	1.6E-06
Te-131	4.2E-12	8.0E-05	5.2E-08
I-131	2.0E-09	1.0E-06	2.0E-03
Te-132	3.4E-11	9.0E-06	3.7E-06
I-132	2.3E-10	1.0E-04	2.3E-06
I-133	9.4E-10	7.0E-06	1.3E-04
I-134	1.1E-10	4.0E-04	2.8E-07
Cs-134	1.4E-09	9.0E-07	1.5E-03
I-135	7.0E-10	3.0E-05	2.3E-05
Cs-136	8.8E-11	6.0E-06	1.5E-05
Cs-137	1.9E-09	1.0E-06	1.9E-03
Ba-140	7.7E-10	8.0E-06	9.7E-05
La-140	1.0E-09	9.0E-06	1.2E-04
Ce-141	1.3E-11	3.0E-05	4.2E-07

HAR SUP 11.2-1

Table 11.2-204 (Sheet 3 of 3)
Comparison of Annual Average Liquid Release Concentrations with 10 CFR 20 Effluent Concentration Limits for Expected Releases – Two Units

Nuclide	Discharge Concentration (µCi/ml)[a]	Effluent Concentration Limit (µCi/ml)[b]	Fraction of Concentration Limit
Ce-143	2.7E-11	2.0E-05	1.3E-06
Pr-143	1.8E-11	7.0E-05	2.6E-07
Ce-144	4.4E-10	3.0E-06	1.5E-04
Pr-144	4.4E-10	2.0E-05	2.2E-05
H-3	1.4E-04	1.0E-03	1.4E-01
			Total = 0.15

Notes:

a) Annual average discharge concentration based on release of average daily discharge for 292 days per year with 20 ft3/sec dilution flow.

b) Effluent concentration limits are from 10 CFR 20, Appendix B.

HAR SUP 11.2-1

Table 11.2-205 (Sheet 1 of 3)
Comparison of Annual Average Liquid Release Concentrations with 10 CFR 20 Effluent Concentration Limits for Releases with Maximum Defined Fuel Defects – Two Units

Nuclide	Discharge Concentration (µCi/ml)[(a)]	Effluent Concentration Limit (µCi/ml)[(b)]	Fraction of Concentration Limit
Na-24	2.3E-10	5.0E-05	4.5E-06
Cr-51	2.1E-10	5.0E-04	4.3E-07
Mn-54	1.9E-10	3.0E-05	6.2E-06
Fe-55	1.3E-10	1.0E-04	1.3E-06
Fe-59	2.8E-11	1.0E-05	2.8E-06
Co-58	4.7E-10	2.0E-05	2.3E-05
Co-60	6.1E-11	3.0E-06	2.0E-05
Zn-65	5.7E-11	5.0E-06	1.1E-05
W-187	1.9E-11	3.0E-05	6.2E-07
Np-239	3.3E-11	2.0E-05	1.7E-06
Br-84	6.1E-12	4.0E-04	1.5E-08
Rb-88	3.9E-10	4.0E-04	9.7E-07
Sr-89	2.4E-10	8.0E-06	3.0E-05
Sr-91	1.2E-11	2.0E-05	6.1E-07
Y-91m	9.4E-12	2.0E-03	4.7E-07
Y-93	1.6E-11	2.0E-05	8.0E-09
Zr-95	5.7E-11	2.0E-05	2.9E-06
Nb-95	6.1E-11	3.0E-05	3.1E-06
Mo-99	7.2E-09	2.0E-05	2.4E-04
Tc-99m	6.5E-09	1.0E-03	3.3E-04
Ru-103	4.5E-10	3.0E-05	4.5E-07

HAR SUP 11.2-1

Table 11.2-205 (Sheet 2 of 3)
Comparison of Annual Average Liquid Release Concentrations with 10 CFR 20 Effluent Concentration Limits for Releases with Maximum Defined Fuel Defects – Two Units

Nuclide	Discharge Concentration (µCi/ml)[(a)]	Effluent Concentration Limit (µCi/ml)[(b)]	Fraction of Concentration Limit
Rh-103m	4.5E-10	6.0E-03	1.5E-05
Ru-106	2.1E-08	3.0E-06	3.6E-06
Ag-110m	1.9E-10	6.0E-06	6.2E-05
Te-129m	5.2E-10	7.0E-06	7.4E-05
Te-129	2.1E-11	4.0E-04	5.3E-08
Te-131m	9.9E-11	8.0E-06	1.2E-05
Te-131	5.3E-12	8.0E-05	6.7E-08
I-131	1.6E-08	1.0E-06	1.6E-02
Te-132	3.1E-09	9.0E-06	3.4E-04
I-132	4.8E-10	1.0E-04	4.8E-06
I-133	4.4E-09	7.0E-06	6.3E-04
I-134	1.1E-10	4.0E-04	2.8E-07
Cs-134	2.7E-07	9.0E-07	3.0E-01
I-135	1.2E-09	3.0E-05	4.1E-05
Cs-136	2.0E-07	6.0E-06	3.3E-02
Cs-137	2.0E-07	1.0E-06	2.0E-01
Ba-140	7.8E-10	8.0E-06	9.7E-05
La-140	1.0E-09	9.0E-06	1.2E-04
Ce-141	3.9E-11	3.0E-05	1.3E-06
Ce-143	2.7E-11	2.0E-05	1.3E-06
Pr-143	1.9E-11	7.0E-05	2.7E-07

HAR SUP 11.2-1

**Table 11.2-205 (Sheet 3 of 3)
Comparison of Annual Average Liquid Release Concentrations with 10 CFR 20 Effluent Concentration Limits for Releases with Maximum Defined Fuel Defects – Two Units**

Nuclide	Discharge Concentration (μCi/ml)[(a)]	Effluent Concentration Limit (μCi/ml)[(b)]	Fraction of Concentration Limit
Ce-144	4.4E-10	3.0E-06	1.5E-04
Pr-144	4.4E-10	2.0E-05	2.2E-05
H-3	1.4E-04	1.0E-03	1.4E-01
			Total = 0.69

Notes:

a) Annual average discharge concentration based on release of average daily discharge for 292 days per year with 20 ft^3/sec dilution flow.

b) Effluent concentrations limits are from 10 CFR 20, Appendix B.

Table 11.2-206
Comparison of Maximum Exposed Individual Doses from the HAR Site with the 40 CFR Part 190 Criteria (mrem/yr)

Type of Dose	Dose Limit (40 CFR 190)	Unit 1 Total Liquid and Gaseous Dose[a]	Unit 2 & 3 Calculated Liquid Dose	Unit 2 & 3 Calculated Gaseous Dose	Total Dose (All Pathways)
Whole Body Dose Equivalent[b]	25	0.53	5.08[b]	1.42[b]	7.0
Dose to Thyroid	75	0.54	0.11 (teen)	4.00 (infant)	4.7
Dose to Any Other Organ	25	0.54	6.14 (teen liver)	4.42 (child bone)	11.1

Notes:

(a) HNP operating data

(b) Whole body dose equivalent assumed equal to TEDE

Table 11.2-207
Liquid Pathways Consumption Factors for the Maximum Exposed Individual

Pathway	Adult	Teen	Children	Infant
Drinking water[a] (L/yr)	730	510	510	330
Fish consumption[a] (kg/yr)	21	16	6.9	N/A
Shoreline usage[a] (hr/yr)	12	67	14	N/A
Swimming exposure (hr/yr) (assumed same as shoreline)	12	67	14	N/A
Boating (hr/yr)	100 (assumed)	67	14	N/A

Notes:
a) LADTAP default values

FSAR Table 11.2-208
Population Doses from Liquid Effluents
(person rem /yr)

Pathway	Total Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Fish Consumption	4.82E+00	2.44E-01	6.50E+00	8.70E+00	2.99E+00	9.66E-02	1.09E+00	-
Drinking Water [(a)]	1.39E+00	1.37E+00	2.56E-02	1.42E+00	1.38E+00	1.36E+00	1.37E+00	-
Hydrosphere Tritium	7.70E-03	7.70E-03	-	7.70E-03	7.70E-03	7.70E-03	7.70E-03	
Shoreline	4.31E-01	-	-	-	-	4.31E-01		5.03E-01
Swimming	1.04E-03		-	-	-	1.04E-03		
Boating	5.22E-04	-	-	-	-	5.22E-04		
Total	6.65E+00	1.62E+00	6.53E+00	1.01E+01	4.37E+00	1.89E+00	2.46E+00	5.03E-01

Note:

(a) Drinking water pathway doses reflect 1000 site workers as well as downstream residents in the towns of Lillington, Dunn, and Fayetteville.

11.3 GASEOUS WASTE MANAGEMENT SYSTEM

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.

HAR COL 11.3-1
HAR COL 11.5-3

The HAR 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 exclusion area boundary are 0.64 mrad for gamma radiation and 3.03 mrad for beta radiation. These doses are based on the annual average atmospheric dispersion factor from FSAR Section 2.3. As shown in Table 11.3-208 these doses are below the 10 CFR 50 Appendix I design objectives of 10 mrad per year for gamma radiation or 20 mrad per year beta radiation.

Dose and dose rate to man was calculated using the GASPAR II computer code. This code is based on the methodology presented in the 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 (both cow and goat).

Based on site meteorological conditions, the highest rate of plume exposure and ground deposition occurs at the exclusion area boundary (EAB) 1.6 km (0.99 mi.) SSW of the plant.

Agricultural products are estimated from U. S. Department of Agriculture (USDA) National Agricultural Statistics Service.

Population distribution within 81 km (50-mi.) radius is presented in FSAR Tables 2.1.3-202 and 2.1.3-204. Table 11.3-201 contains GASPAR II input data for dose rate calculations. Information regarding the locations for the nearest man, milk animal, garden, and the EAB is located in Section 2.3.

11.3.3.4.1 Estimated Individual Doses

Dose rates to individuals are calculated for airborne decay and deposition, inhalation, and ingestion of milk (cow and goat), meat and vegetables. Dose from plume and ground deposition are calculated as affecting all age groups equally. Table 11.3-206 summarizes the maximum exposed individual annual organ dose by pathway and age group.

Plume exposure approximately 1.6 km (0.99 mi.) SSW of the HAR produced a maximum dose rate to a single organ of 2.14 mrem/yr to skin. The maximum total body dose rate was calculated to be 3.84E-1 mrem/yr.

Ground deposition approximately 1.6 km (0.99 mi.) SSW of the HAR produced a maximum dose rate to a single organ of 7.34E-2 mrem/yr to skin. The maximum total body dose rate was calculated to be 6.25E-2 mrem/yr.

Inhalation dose at the nearest residence, 6.6 km (4.1 mi) SSW of the HAR, results in a maximum dose rate to a single organ of 9.54E-2 mrem/yr to a child's thyroid. The maximum total body dose rate is calculated to be 8.11E-3 mrem/yr to a teenager.

Vegetable consumption assumes that the dose is received from the gardens, approximately 6.6 km (4.1 mi.) SSW 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 1.08 mrem/yr to a child's bone. The maximum total body dose rate is calculated to be 2.37E-1 mrem/yr to a child.

Meat consumption assumes that the dose is received from an animal, approximately 5 km (3.1 mi.) SW of the HAR. 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 1.18E-1 mrem/yr to a child's bone. The maximum total body dose rate is calculated to be 2.50E-2 mrem/yr to a child.

Cow milk consumption assumes that the dose is received from an animal, approximately 8.5 km (5.3 mi.) SSW of the HAR. 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 0.64 mrem/yr to an infant's thyroid. The maximum body dose rate is calculated to be 1.26E-1 mrem/yr to an infant.

Goat milk consumption assumes that the dose is received from an animal, approximately 8.5 km (5.3 mi.) SSW of HAR. 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 0.83 mrem/yr to an infant's thyroid. The maximum total body dose rate is calculated to be 1.38E-1 mrem/yr to an infant.

The maximum dose rate to any organ considering every pathway is calculated to be 1.86 mrem/yr to a child's bone. The maximum total body dose rate is calculated to be 1.09 mrem/yr to a child which includes the pathway doses (milk, meat, vegetable, and inhalation) plus the plume and ground deposition doses (Table 11.3-206). These doses 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 11.3-208).

Table 11.3-207 contains total air dose at each special location.

11.3.3.4.2 Estimated Population Dose

Table 11.3-209 presents a listing of the estimated population doses by pathway and organ. The estimated population dose within 81 km (50 miles) is calculated as 6.5 person-rem whole body and 12.9 person-rem thyroid.

STD COL 11.3-1

11.3.3.4.3 Gaseous Radwaste Cost Benefit Analysis Methodology

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

HAR COL 11.3-1

As shown in FSAR Section 11.3.3.4.2 and Table 11.3-209 and the table below, the HAR gaseous population doses are 6.52 person-rem total body and 12.9 person-rem thyroid which exceed the 6.32 person-rem threshold value.

Source	**Total Body (person-rem)**	**% of Total Total Body**	**Thyroid (person-rem)**	**% of Total Thyroid**
Noble Gases	2.77E+00	42%	2.77E+00	22%
Iodine	1.33E-02	0%	6.37E+00	50%
Particulates	4.09E-01	6%	3.87E-01	3%
C-14	2.21E+00	34%	2.21E+00	17%
H-3	1.12E+00	17%	1.12E+00	9%
Total	6.52E+00	100%	1.29E+01	100%

Based on the estimated 12.9 person-rem thyroid dose, those augments with a "Total Annual Cost" less than $12,900 are considered below.

PWR Air Ejector Charcoal/HEPA Filtration Unit

The Total Annual Cost (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 12.9 person-rem (initial level) to a final level of 3.76 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. Therefore, this augment does not affect the iodine discharged by the plant which accounts for 6.37 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 Absorber

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 12.9 person-rem (initial level) to a final level of 4.13 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 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 6.37 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 12.9 person rem to a final level of 5.21 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 6.37 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 12.9 person rem to a final level of 5.32 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 6.1 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 ft^3 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 12.9 person-rem to a final level of 5.44 person-rem. The 600 cubic foot Gas Decay Tank suggested as an augment in the draft Regulatory Guide would be part of a conventional high pressure waste gas holding system.

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 6.37 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 or whole body); that is decrease the person-rem thyroid dose from an initial level of 12.9 person-rem thyroid to a final level of 6.58 person-rem thyroid or decrease the whole body from an initial level of 6.52 person-rem whole body to a final level of 0.2 person-rem whole body. 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 HAR.

11.3.3.6 Quality Assurance

Add the following to the end of DCD Subsection 11.3.3.6:

STD SUP 11.3-1 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 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.

HAR 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.

HAR COL 11.5-3 This COL Item is addressed in Subsection 11.3.3.4.

HAR COL 11.3-1

HAR COL 11.5-3

Table 11.3-201 (Sheet 1 of 2)
GASPAR II Input for Dose Rates

Input Parameter	Value
Site Specific Data Values	
Distance from site to NE Corner of the United States (mi.)	1100
Fraction of the year leafy vegetables are grown	0.42
Fraction of the year milk cows are on pasture	0.67
Fraction of max individual's vegetable intake from own garden	1.0
Fraction of milk-cow feed intake from pasture while on pasture	1.0
Humidity over growing season (g/m^3) Absolute Humidity)	8
Average temperature over growing season	0
Fraction of the year goats are on pasture	0.75
Fraction of goat feed intake from pasture while on pasture	1.0
Fraction of the year beef cattle are on pasture	0.67
Fraction of beef-cattle feed intake from pasture while on pasture	1.0
Population Data*	Table 11.3-202
Total Agriculture Production Rate (50-mile)*	
-Vegetables (kg/yr)	Table 11.3-203
-Milk (L/yr)	Table 11.3-204
-Meat (kg/yr)	Table 11.3-205
Source Term	
Source Term Multiplier	1
Nuclide Release Data	DCD Table 11.3-3
Meteorological Data*	
Met Data for XOQDOQ	Sector Average X/Q

Table 11.3-201 (Sheet 2 of 2)
GASPAR II Input for Dose Rates

Input Parameter	Value
Special Location Data:	Section 2.3.5 Table 2.3.5-201 Table 2.3.5-202 Table 2.3.5-203 Table 2.3.5-204

HAR COL 11.3-1
HAR COL 11.5-3

Table 11.3-202 (Sheet 1 of 2)
Population Data

Population Data					**Distance (mi)**					
Direction	1	2	3	4	5	10	20	30	40	50
N	1	40	149	158	209	1601	35,620	198,100	33,700	17,020
NNE	0	36	218	299	304	14,000	40,360	65,160	29,160	16,510
NE	0	42	147	162	250	22,770	193,700	271,800	59,930	28,970
ENE	1	9	36	43	42	12,630	137,100	195,600	57,570	28,860
E	0	5	21	25	191	16,250	50,220	57,790	41,980	30,060
ESE	0	6	7	52	93	14,770	29,920	28,020	39,740	21,830
SE	0	6	5	25	93	3570	18,480	40,010	23,560	13,120
SSE	0	1	5	3	33	1348	10,360	12,740	11,730	20,300
S	0	0	0	1	3	420	7167	25,700	151,700	152,200
SSW	0	0	2	20	45	846	11,030	17,240	13,220	34,610
SW	0	0	7	28	33	425	34,720	13,690	27,340	43,790
WSW	0	0	10	30	93	1341	7896	5981	9826	12,320
W	0	1	43	99	108	1554	3705	9992	11,270	55,930

HAR COL 11.3-1
HAR COL 11.5-3

Table 11.3-202 (Sheet 2 of 2)
Population Data

Population Data	**Distance (mi)**									
Direction	1	2	3	4	5	10	20	30	40	50
WNW	0	11	52	87	117	383	6337	12,830	18,200	39,210
NW	3	31	55	76	76	655	9931	10,030	54,220	95,200
NNW	3	610	79	36	50	409	53,010	48,480	38,030	12,790

HAR COL 11.3-1
HAR COL 11.5-3

Table 11.3-203 (Sheet 1 of 2)
Vegetable Production

Vegetable Production (kg/yr)	**Distance (mi)**									
Direction	1	2	3	4	5	10	20	30	40	50
S	484	1300	1840	1650	2110	88,100	483,000	825,000	1,400,000	1,500,000
SSW	484	1300	1630	1650	2110	77,700	453,000	744,000	321,000	73,900
SW	484	1300	1650	1650	2110	84,600	429,000	523,000	447,000	573,000
WSW	484	1130	1200	1650	2110	89,000	316,000	349,000	421,000	526,000
W	484	913	1190	1650	2110	28,100	74,200	115,000	281,000	431,000
WNW	484	354	1190	1650	2110	1,7500	69,400	120,000	271,000	463,000
NW	484	991	1190	1650	2110	17,500	69,500	159,000	259,000	411,000
NNW	484	1260	469	1650	2110	17,500	73,800	2,810,000	203,000	285,000
N	484	1300	2110	2640	2990	20,600	65,000	106,000	158,000	119,000
NNE	484	1300	2110	2930	3740	30,900	107,000	117,000	590,000	951,000
NE	484	1300	2110	2930	3740	30,900	123,000	204,000	616,000	1,290,000
ENE	484	1300	2110	2930	3740	30,900	123,000	204,000	509,000	8,200,000

HAR COL 11.3-1
HAR COL 11.5-3

Table 11.3-203 (Sheet 2 of 2)
Vegetable Production

Vegetable Production (kg/yr)	**Distance (mi)**									
Direction	1	2	3	4	5	10	20	30	40	50
E	484	1300	2110	2930	3740	30,900	128,000	901,000	1,670,000	3,680,000
ESE	484	1300	2110	2930	3740	30,900	322,000	1,190,000	1,670,000	2,410,000
SE	484	1300	2110	2930	4200	89,800	480,000	858,000	4,070,000	8,880,000
SSE	484	1300	2110	2350	4690	120,000	483,000	841,000	2,090,000	5,470,000

HAR COL 11.3-1
HAR COL 11.5-3

Table 11.3-204 (Sheet 1 of 2)
Milk Production

Milk Production (l/yr)	**Distance (mi)**									
Direction	1	2	3	4	5	10	20	30	40	50
S	725	1940	5620	15,900	20,400	140,000	523,000	802,000	374,000	519,000
SSW	725	1940	7530	15,900	20,400	124,000	456,000	780,000	544,000	793,000
SW	725	1940	7360	15,900	20,400	119,000	403,000	465,000	344,000	455,000
WSW	725	3490	11,400	15,900	20,400	115,000	486,000	631,000	605,000	528,000
W	725	5410	11,500	15,900	20,400	161,000	666,000	1,110,000	3,130,000	4,850,000
WNW	725	5660	11,500	15,900	20,400	168,000	670,000	1,060,000	2,340,000	4,960,000
NW	725	4710	11,500	15,900	20,400	168,000	684,000	1,200,000	574,000	2,630,000
NNW	725	2240	9640	15,900	20,400	168,000	1,070,000	2,810,000	3,190,000	1,330,000
N	725	1940	3150	6990	12,400	140,000	553,000	1,270,000	2,280,000	1,790,000
NNE	725	1940	3160	4380	5600	46,300	225,000	524,000	960,000	1,440,000
NE	725	1940	3160	4380	5600	46,300	184,000	306,000	538,000	728,000

HAR COL 11.3-1
HAR COL 11.5-3

Table 11.3-204 (Sheet 2 of 2)
Milk Production

Milk Production (l/yr)					**Distance (mi)**					
Direction	1	2	3	4	5	10	20	30	40	50
ENE	725	1940	3160	4380	5600	46,300	184,000	306,000	415,000	578,000
E	725	1940	3160	4380	5600	46,300	184,000	246,000	309,000	554,000
ESE	725	1940	3160	4380	5600	46,300	204,000	224,000	309,000	710,000
SE	725	1940	3160	4380	6030	102,000	520,000	778,000	650,000	963,000
SSE	725	1940	3160	9600	18,700	132,000	523,000	755,000	432,000	723,000

HAR COL 11.3-1
HAR COL 11.5-3

Table 11.3-205 (Table 1 of 2)
Meat Production

Meat Production (kg/yr)	**Distance (mi)**									
Direction	1	2	3	4	5	10	20	30	40	50
S	3200	8560	50,700	192,000	246,000	1,980,000	8,080,000	12,400,000	5,780,000	8,300,000
SSW	3200	8560	79,300	192,000	246,000	1,590,000	6,620,000	12,900,000	11,800,000	9,520,000
SW	3200	8560	76,800	192,000	246,000	1,540,000	546,000	11,700,000	20,200,000	25,200,000
WSW	3200	31,700	138,000	192,000	246,000	1,510,000	6,280,000	12,800,000	20,200,000	19,900,000
W	3200	60,500	139,000	192,000	246,000	1,950,000	8,050,000	13,400,000	21,800,000	29,400,000
WNW	3200	2340	139,000	192,000	246,000	2,030,000	8,080,000	12,900,000	16,600,000	18,700,000
NW	3200	50,000	139,000	192,000	246,000	2,030,000	7,990,000	5,980,000	7,540,000	6,890,000
NNW	3200	13,100	3100	192,000	246,000	2,030,000	5,560,000	2,810,000	4,650,000	6,330,000
N	3200	8560	14,400	58,400	126,000	1,610,000	4,650,000	2,860,000	3,960,000	4,780,000
NNE	3200	8560	13,900	19,300	24,700	204,000	1,040,000	2,590,000	2,850,000	3,670,000
NE	3200	8560	13,900	19,300	24,700	204,000	81,2000	1,350,000	2,790,000	5,600,000
ENE	3200	8560	13,900	19,300	24,700	204,000	812,000	1,350,000	3,290,000	9,390,000

HAR COL 11.3-1
HAR COL 11.5-3

Table 11.3-205 (Table 2 of 2)
Meat Production

Meat Production (kg/yr)	**Distance (mi)**									
Direction	1	2	3	4	5	10	20	30	40	50
E	3200	8560	13,900	19,300	24,700	204,000	850,000	6,170,000	11,500,000	13,600,000
ESE	3200	8560	13,900	19,300	24,700	204,000	2,670,000	8,240,000	11,500,000	32,500,000
SE	3200	8560	13,900	19,300	34,000	1,390,000	8,030,000	12,700,000	36,700,000	80,900,000
SSE	3200	8560	13,900	97,500	234,000	2,030,000	8,080,000	11,700,000	13,100,000	44,900,000

HAR COL 11.3-1
HAR COL 11.5-3

Table 11.3-206 (Sheet 1 of 3)
Individual Dose Rates (mrem/yr)

Pathway	Age Group	T.Body (mrem/yr)	GI-Tract (mrem/yr)	Bone (mrem/yr)	Liver (mrem/yr)	Kidney (mrem/yr)	Thyroid (mrem/yr)	Lung (mrem/yr)	Skin (mrem/yr)	Location
Plume		3.84E-01	3.84E-01	3.84E-01	3.84E-01	3.84E-01	3.84E-01	4.14E-01	2.14E+00	EAB(a)
Ground		6.25E-02	6.25E-02	6.25E-02	6.25E-02	6.25E-02	6.25E-02	6.25E-02	7.34E-02	EAB(a)
Cow Milk	Adult	1.60E-02	1.56E-02	6.13E-02	1.63E-02	1.61E-02	8.33E-02	1.56E-02	1.55E-02	Nearest Milk Cow(b)
	Teen	2.73E-02	2.69E-02	1.13E-01	2.81E-02	2.77E-02	1.34E-01	2.68E-02	2.67E-02	
	Child	6.25E-02	6.19E-02	2.77E-01	6.40E-02	6.34E-02	2.75E-01	6.20E-02	6.18E-02	
	Infant	1.26E-01	1.25E-01	5.41E-01	1.30E-01	1.28E-01	6.42E-01	1.25E-01	1.25E-01	
Goat Milk	Adult	2.05E-02	1.93E-02	6.28E-02	2.11E-02	2.02E-02	1.10E-01	1.93E-02	1.91E-02	Nearest Goat Milk (c)
	Teen	3.29E-02	3.16E-02	1.15E-01	3.49E-02	3.33E-02	1.76E-01	3.18E-02	3.14E-02	
	Child	7.07E-02	6.94E-02	2.83E-01	7.51E-02	7.22E-02	3.55E-01	6.98E-02	6.92E-02	
	Infant	1.38E-01	1.36E-01	5.49E-01	1.48E-01	1.41E-01	8.31E-01	1.37E-01	1.36E-01	
Vegetable	Adult	6.76E-02	6.78E-02	2.69E-01	6.76E-02	6.69E-02	1.94E-01	6.59E-02	6.57E-02	Nearest Garden(d)
	Teen	1.05E-01	1.05E-01	4.48E-01	1.06E-01	1.05E-01	2.81E-01	1.03E-01	1.03E-01	
	Child	2.37E-01	2.36E-01	1.08E+00	2.39E-01	2.37E-01	5.78E-01	2.34E-01	2.34E-01	

HAR COL 11.3-1
HAR COL 11.5-3

Table 11.3-206 (Sheet 2 of 3)
Individual Dose Rates (mrem/yr)

Pathway	Age Group	T.Body (mrem/yr)	GI-Tract (mrem/yr)	Bone (mrem/yr)	Liver (mrem/yr)	Kidney (mrem/yr)	Thyroid (mrem/yr)	Lung (mrem/yr)	Skin (mrem/yr)	Location
Inhalation	Adult	8.02E-03	8.09E-03	1.07E-03	8.17E-03	8.29E-03	6.65E-02	1.01E-02	7.81E-03	Nearest Residence(e)
	Teen	8.11E-03	8.17E-03	1.30E-03	8.37E-03	8.54E-03	8.25E-02	1.13E-02	7.88E-03	
	Child	7.17E-03	7.09E-03	1.58E-03	7.44E-03	7.58E-03	9.54E-02	9.78E-03	6.96E-03	
	Infant	4.14E-03	4.05E-03	7.94E-04	4.42E-03	4.41E-03	8.52E-02	5.97E-03	4.00E-03	
Meat	Adult	1.69E-02	1.76E-02	7.42E-02	1.69E-02	1.68E-02	2.12E-02	1.68E-02	1.67E-02	Nearest Meat Cow(f)
	Teen	1.37E-02	1.41E-02	6.27E-02	1.38E-02	1.37E-02	1.69E-02	1.37E-02	1.37E-02	
	Child	2.50E-02	2.51E-02	1.18E-01	2.50E-02	2.50E-02	2.98E-02	2.49E-02	2.49E-02	
Total	Adult	1.92E-01	1.91E-01	5.31E-01	1.93E-01	1.91E-01	5.38E-01	1.90E-01	1.98E-01	
without plume	Teen	2.50E-01	2.48E-01	8.03E-01	2.54E-01	2.51E-01	7.53E-01	2.49E-01	2.56E-01	
	Child	4.65E-01	4.62E-01	1.82E+00	4.73E-01	4.68E-01	1.40E+00	4.63E-01	4.70E-01	
	Infant	3.31E-01	3.28E-01	1.15E+00	3.45E-01	3.36E-01	1.62E+00	3.30E-01	3.38E-01	
	Max	4.65E-01	4.62E-01	1.82E+00	4.73E-01	4.68E-01	1.62E+00	4.63E-01	4.70E-01	

HAR COL 11.3-1
HAR COL 11.5-3

Table 11.3-206 (Sheet 3 of 3)
Individual Dose Rates (mrem/yr)

Pathway	Age Group	T.Body (mrem/yr)	GI-Tract (mrem/yr)	Bone (mrem/yr)	Liver (mrem/yr)	Kidney (mrem/yr)	Thyroid (mrem/yr)	Lung (mrem/yr)	Skin (mrem/yr)	Location
Total	Adult	5.76E-01	5.75E-01	9.15E-01	5.77E-01	5.75E-01	9.22E-01	6.04E-01	2.34E+00	
with plume	Teen	6.34E-01	6.32E-01	1.19E+00	6.38E-01	6.35E-01	1.14E+00	6.63E-01	2.40E+00	
	Child	8.49E-01	8.46E-01	2.21E+00	8.57E-01	8.52E-01	1.78E+00	8.77E-01	2.61E+00	
	Infant	7.15E-01	7.12E-01	1.54E+00	7.29E-01	7.20E-01	2.00E+00	7.44E-01	2.48E+00	
	Max	8.49E-01	8.46E-01	2.21E+00	8.57E-01	8.52E-01	2.00E+00	8.77E-01	2.61E+00	

Notes:
a) EAB – 0.99 mi SSW
b) Nearest Milk Cow – 5.28 mi SSW
c) Nearest Goat – 5.28 mi SSW
d) Nearest Garden – 4.08 mi SSW
e) Nearest Residence – 4.08 mi SSW
f) Nearest Meat Cow – 3.06 mi SW

HAR COL 11.5-3

Table 11.3-207
Dose in Millirads at Special Locations

Special Location	Beta Air Dose	Gamma Air Dose
EAB	3.03	6.36E-01
Nearest Residence/Garden	4.80E-01	8.31E-02
Nearest Cow/Goat Milk	3.46E-01	5.83E-02
Nearest Meat Animal	4.71E-01	8.72E-02

HAR COL 11.5-3

Table 11.3-208
Maximum Individual Doses
Compared to 10 CFR 50 Appendix I

	Appendix I Criteria	Harris Unit 2 and 3	
Type of Dose	Design Objective	Calculated Dose	Highest Offsite Dose Location
Gaseous Effluents (Noble Gases)			
Gamma Air	10 mrad	0.64 mrad	EAB
Beta Air	20 mrad	3.03 mrad	EAB
Total Body D	5 mrem	0.38 mrem	EAB
Skin	15 mrem	2.14 mrem	EAB
Radioiodines and Particulates			
Dose to any Organ from all pathways	15 mrem	2.21 mrem (Child - bone)	

HAR COL 11.3-1

Table 11.3-209
Population Doses
(person-rem)

Pathway	Total Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Plume	2.77E+00	2.77E+00	2.77E+00	2.77E+00	2.77E+00	2.77E+00	3.24E+00	2.97E+01
Ground	3.89E-01	3.89E-01	3.89E-01	3.89E-01	3.89E-01	3.89E-01	3.89E-01	4.56E-01
Inhalation	8.32E-01	8.35E-01	9.41E-02	8.46E-01	8.55E-01	6.09E+00	1.01E+00	8.15E-01
Vegetable	3.67E-01	3.67E-01	1.54E+00	3.67E-01	3.64E-01	3.70E-01	3.63E-01	3.62E-01
Cow Milk	2.61E-01	2.57E-01	1.09E+00	2.66E-01	2.63E-01	1.08E+00	2.57E-01	2.56E-01
Meat	1.90E+00	1.93E+00	8.53E+00	1.90E+00	1.89E+00	2.16E+00	1.89E+00	1.89E+00
Total	6.52E+00	6.55E+00	1.44E+01	6.54E+00	6.53E+00	1.29E+01	7.15E+00	3.34E+01

11.4 SOLID WASTE MANAGEMENT

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

Add the following after DCD Subsection 11.4.2.4.2:

HAR COL 11.4-2

11.4.2.4.3 Temporary Storage of Low-Level Radioactive Waste

In the event that off-site shipping is disrupted or facilities are not available to accept radwaste when HAR Units 2 and 3 become operational, as described in DCD Section 11.4.2.1 paragraph ten, temporary storage capability on-site is available for greater than two years at the expected rate of radwaste generation and greater than one year at the maximum rate of radwaste generation. During this period, the implementation of additional waste minimization strategies could extend the duration of temporary radwaste storage capability.

If additional temporary radwaste storage is eventually required, then on-site facilities could be constructed utilizing the design guidance provided in NUREG-0800, Standard Review Plan Chapter 11 Radioactive Waste Management Appendix 11.4-A, Design Guidance for Temporary Storage of Low-Level Radioactive Waste.

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 (LLW) disposal site that is licensed in accordance with 10 CFR Part 61.

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.

HAR SUP 11.4-1 All packaged and stored radwaste will be shipped to offsite disposal/storage facilities and temporary storage of radwaste is only provided until routine offsite shipping can be performed. Accordingly, there is no expected need for permanent on-site storage facilities at HAR 2 and 3.

If additional storage capacity for Class B and C waste is required, further temporary storage would be developed in accordance with NUREG-0800, Standard Review Plan 11.4, Appendix 11.4-A. To the extent that additional storage could be needed sometime in the future, the existing regulatory framework would allow Progress Energy to conduct written safety analyses under 10 CFR 50.59. If the additional storage does not satisfy 10 CFR 50.59, a license amendment would be required.

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 (WAC) 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, WAC 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.

11.5 RADIATION MONITORING

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

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.

11.5.2.4 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.

HAR COL 11.5-2

Progress Energy is extending the existing Shearon Harris program for quality assurance of radiological effluent and environmental monitoring that is based on Regulatory Guide 4.15, Revision 1, to apply to Shearon Harris Nuclear Power Plant, Units 2 and 3. 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 will create an undue burden and may lead to an increased possibility for human error. Therefore, Progress Energy commits to use Regulatory Guide 4.15, Revision 1, methodology for Shearon Harris Nuclear Power Plant, Units 2 and 3 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

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 absorption 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 conform to Regulatory Guide 4.15, Revision 1 (See Appendix 1AA).

11.5.7 COMBINED LICENSE INFORMATION

STD COL 11.5-1 An Offsite Dose Calculation Manual (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.

HAR COL 11.5-2

This COL item is addressed in Subsection 11.5.3.

HAR 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 11.5.7.

11.5.8 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.

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

STD COL 11.5-2

Table 11.5-201 (Sheet 1 of 2)
Minimum Sampling Frequency

Stream	Sampled Medium	Frequency
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-89and Sr-90.
		Monthly for gross alpha.

STD COL 11.5-2

Table 11.5-201 (Sheet 2 of 2)
Minimum Sampling Frequency

Stream	Sampled Medium	Frequency
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.
		Quarterly, a composite sample for Sr-89, Sr-90, and Fe-55.
	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, Sr-90 and Fe-55.

STD COL 11.5-2

Table 11.5-202
Minimum Sensitivities

Stream	Nuclide	Sensitivity
Gaseous	Fission & Activation Gases	1.0E-04 µCi/cc
	Tritium	1.0E-06 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-07 µCi/ml
	Gamma-emitters	5.0E-07 µCi/ml
	Dissolved & Entrained Gases	1.0E-05 µCi/ml
	Gross Alpha	1.0E-07 µCi/ml
	Tritium	1.0E-05 µCi/ml
	Sr-89 & Sr-90	5.0E-08 µCi/ml
	Fe-55	1.0E-06 µCi/ml