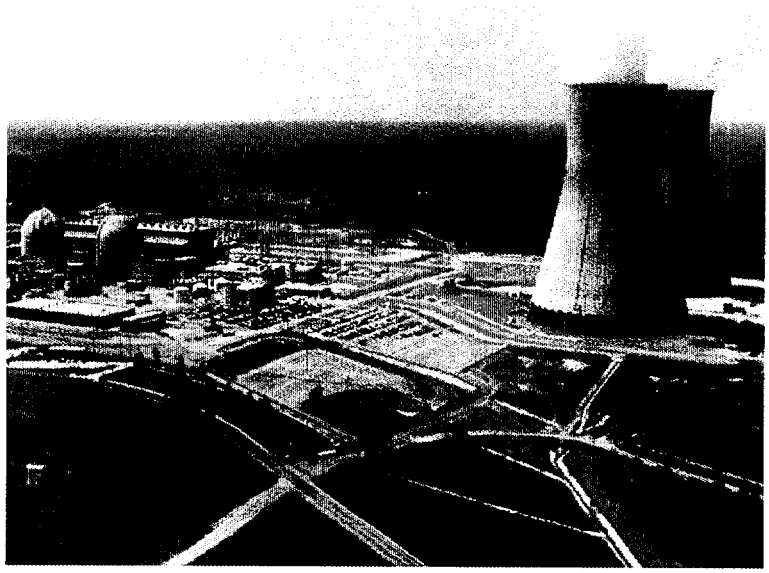
II
VOGTLE ELECTRIC GENERATING PLANT - UNITS 1 AND 2
1999 ANNUAL REPORT

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

VOGTLE ELECTRIC GENERATING PLANT ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT FOR 1999



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LIST OF ACRONYMS

Acronyms presented in alphabetical order.

Acronym	Definition
A2LA	American Association of Laboratory Accreditation
ASTM	American Society for Testing and Materials
CL	Confidence Level
EL	Georgia Power Company Environmental Laboratory
EPA	Environmental Protection Agency
GPC	Georgia Power Company
ICP	Interlaboratory Comparison Program
MDC	Minimum Detectable Concentration
MDD	Minimum Detectable Difference
MWe	MegaWatts Electric
NA	Not Applicable
NDM	No Detectable Measurement(s)
NRC	Nuclear Regulatory Commission
ODCM	Offsite Dose Calculation Manual
Po	Preoperation
PWR	Pressurized Water Reactor
REMP	Radiological Environmental Monitoring Program
RL	Reporting Level
RM	River Mile
TLD	Thermoluminescent Dosimeter
TS	Technical Specification
VEGP	Alvin W. Vogtle Electric Generating Plant

1.0 INTRODUCTION

The Radiological Environmental Monitoring Program (REMP) is conducted in accordance with Chapter 4 of the Offsite Dose Calculation Manual (ODCM). The REMP activities for 1999 are reported herein in accordance with Technical Specification (TS) 5.6.2 and ODCM 7.1.

The objectives of the REMP are to:

1) Determine the levels of radiation and the concentrations of radioactivity in the environs and;

2) Assess the radiological impact (if any) to the environment due to the operation of the Alvin W. Vogtle Electric Generating Plant (VEGP).

The assessments include comparisons between results of analyses of samples obtained at locations where radiological levels are not expected to be affected by plant operation (control stations) and at locations where radiological levels are more likely to be affected by plant operation (indicator stations), as well as comparisons between preoperational and operational sample results.

VEGP is owned by Georgia Power Company (GPC), Oglethorpe Power Corporation, the Municipal Electric Authority of Georgia, and the City of Dalton, Georgia. It is located on the southwest side of the Savannah River approximately 23 river miles upstream from the intersection of the Savannah River and U.S. Highway 301. The site is in the eastern sector of Burke County, Georgia, and across the river from Barnwell County, South Carolina. The VEGP site is directly across the Savannah River from the Department of Energy Savannah River Site. Unit 1, a Westinghouse Electric Corporation Pressurized Water Reactor (PWR), with a licensed core thermal power of 3565 MegaWatts (MWt), received its operating license on January 16, 1987 and commercial operation started on May 31, 1987. Unit 2, also a Westinghouse PWR rated for 3565 MWt, received its operating license on February 9, 1987 and began commercial operation on May 19, 1989.

The preoperational stage of the REMP began with initial sample collections in August of 1981. The transition from the pre-operational to the operational stage of the REMP occurred as Unit 1 reached initial criticality on March 9, 1987.

A description of the REMP is provided in Section 2 of this report. Maps showing the sampling stations are keyed to a table which indicates the direction and distance of each station from a point midway between the two reactors. Section 3 provides a summary of the results of the analyses of REMP samples for the year. The results are discussed, including an assessment of any radiological impacts upon the environment and the results of the land use census and the river survey, in Section 4. The results of the Interlaboratory Comparison Program (ICP) are provided in Section 5. Conclusions are provided in Section 6.

2.0 REMP DESCRIPTION

A summary description of the REMP is provided in Table 2-1. This table summarizes the program as it meets the requirements outlined in ODCM Table 4-1. It details the sample types to be collected and the analyses to be performed in order to monitor the airborne, direct radiation, waterborne and ingestion pathways, and also delineates the collection and analysis frequencies. In addition, Table 2-1 references the locations of stations as described in ODCM Section 4.2 and in Table 2-2 of this report. The stations are also depicted on maps in Figures 2-1 through 2-3.

REMP samples are collected by Georgia Power Company's (GPC) Environmental Laboratory (EL) personnel. The same lab performs all the laboratory analyses at their headquarters in Smyrna, Georgia. Since 1988, the EL has been accredited by the American Association of Laboratory Accreditation (A2LA) for radiochemistry. Accreditation is based upon internationally accepted criteria for laboratory competence (ISO/IEC Guide 25, 1990, General Requirements for the Competence of Calibration and Testing Laboratories).

TABLE 2-1 (SHEET 1 of 5)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations	Sampling and Collection Frequency	Type and Frequency of Analysis
1. Direct Radiation	Thirty nine routine monitoring stations with two or more dosimeters placed as follows: An inner ring of stations, one in each compass sector in the general area of the site boundary; An outer ring of stations, one in each compass sector at approximately 5 miles from the site; and Special interest areas, such as population centers, nearby recreation areas, and control stations.	Quarterly	Gamma dose, quarterly
2. Airborne Radioiodine and Particulates	Samples from seven locations: Five locations close to the site boundary in different sectors; A community having the highest calculated annual average ground level D/Q; and	Continuous sampler operation with sample collection weekly, or more frequently if required by dust loading.	Radioiodine canister: I-131 analysis, weekly. Particulate sampler: Gross beta analysis[1] following filter change and gamma isotopic analysis[2] of composite (by location), quarterly.

TABLE 2-1 (SHEET 2 of 5)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations	Sampling and Collection Frequency	Type and Frequency of Analysis
2. Airborne Radioiodine and Particulates (cont.)	A control location near a population center at a distance of about 14 miles.		
3. Waterborne			
a. Surface[3]	One sample upriver. Two samples downriver.	Composite sample over one month period[4].	Gamma isotopic analysis[2], monthly. Composite for tritium analysis, quarterly.
b. Drinking	Two samples at each of the two nearest water treatment plants that could be affected by plant discharges. Two samples at a control location.	Composite sample of river water near the intake of each water treatment plant over two week period[4] when I-131 analysis is required for each sample; monthly composite otherwise; and grab sample of finished water at each water treatment plant every two weeks or monthly, as appropriate.	I-131 analysis on each sample when the dose calculated for the consumption of the water is greater than 1 mrem per year[5]. Composite for gross beta and gamma isotopic analysis[2] on raw water, monthly. Gross beta, gamma isotopic and I-131 analyses on grab sample of finished water, monthly. Composite for tritium analysis on raw and finished water, quarterly.
c. Sediment from Shoreline	One sample from downriver area with existing or potential recreational value.	Semiannually	Gamma isotopic analysis[2], semiannually.

TABLE 2-1 (SHEET 3 of 5)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations	Sampling and Collection Frequency	Type and Frequency of Analysis
c. Sediment from Shoreline (cont.)	One sample from upriver area with existing or potential recreational value.		
4. Ingestion			
a. Milk	Two samples from milking animals[6] at control locations at a distance of about 10 miles or more.	Biweekly	Gamma isotopic analysis[2,7], biweekly.
b. Fish	At least one sample of any commercially or recreationally important species near the plant discharge.	Semiannually	Gamma isotopic analysis[2] on edible portions, semiannually.
	At least one sample of any commercially or recreationally important species in an area not influenced by plant discharges.		
	At least one sample of any anadromous species near the plant discharge.	During the spring spawning season.	Gamma isotopic analysis[2] on edible portions, annually.

TABLE 2-1 (SHEET 4 of 5)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Representative Samples and Sample Locations	Sampling and Collection Frequency	Type and Frequency of Analysis
c. Grass or Leafy Vegetation	One sample from two onsite locations near the site boundary in different sectors. One sample from a control location at a distance of about 17 miles.	Monthly during growing season.	Gamma isotopic analysis[2, 7], monthly.

TABLE 2-1 (SHEET 5 of 5)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Notes:

(1) Airborne particulate sample filters shall be analyzed for gross beta radioactivity 24 hours or more after sampling to allow for radon and thoron daughter decay. If gross beta activity in air particulate samples is greater than 10 times the yearly mean of control samples, gamma isotopic analysis shall be performed on the individual samples.

(2) Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.

(3) Upriver sample is taken at a distance beyond significant influence of the discharge. Downriver samples are taken beyond but near the mixing zone.

(4) Composite sample aliquots shall be collected at time intervals that are very short (e.g., hourly) relative to the compositing period (e.g., monthly) to assure obtaining a representative sample.

(5) The dose shall be calculated for the maximum organ and age group, using the methodology and parameters in the ODCM.

(6) A milking animal is a cow or goat producing milk for human consumption.

(7) If the gamma isotopic analysis is not sensitive enough to meet the Minimum Detectable Concentration (MDC) for I-131, a separate analysis for I-131 may be performed.

TABLE 2-2 (SHEET 1 of 3)

RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATIONS

Station Number	Station Type	Descriptive Location	Direction[1]	Distance (miles)[1]	Sample Type
1	Indicator	River Bank	N	1.1	Direct Rad.
2	Indicator	River Bank	NNE	0.8	Direct Rad.
3	Indicator	Discharge Area	NE	0.6	Airborne Rad.
3	Indicator	River Bank	NE	0.7	Direct Rad
4	Indicator	River Bank	ENE	0.8	Direct Rad.
5	Indicator	River Bank	E	1.0	Direct Rad.
6	Indicator	Plant Wilson	ESE	1.1	Direct Rad.
7	Indicator	Simulator Building	SE	1.7	Airborne Rad. Direct Rad. Vegetation
8	Indicator	River Road	SSE	1.1	Direct Rad.
9	Indicator	River Road	S	1.1	Direct Rad.
10	Indicator	Met Tower	SSW	0.9	Airborne Rad.
10	Indicator	River Road	SSW	1.1	Direct Rad.
11	Indicator	River Road	SW	1.2	Direct Rad.
12	Indicator	River Road	WSW	1.2	Airborne Rad. Direct Rad.
13	Indicator	River Road	W	1.3	Direct Rad.
14	Indicator	River Road	WNW	1.8	Direct Rad.
15	Indicator	Hancock Landing Road	NW	1.5	Direct Rad. Vegetation
16	Indicator	Hancock Landing Road	NNW	1.4	Airborne Rad. Direct Rad.
17	Other	Sav. River Site (SRS), River Road	N	5.4	Direct Rad.
18	Other	SRS, D Area	NNE	5.0	Direct Rad.
19	Other	SRS, Road A.13	NE	4.6	Direct Rad.
20	Other	SRS, Road A.13.1	ENE	4.8	Direct Rad.
21	Other	SRS, Road A.17	E	5.3	Direct Rad.
22	Other	River Bank	ESE	5.2	Direct Rad.
23	Other	River Road	SE	4.6	Direct Rad.
24	Other	Chance Road	SSE	4.9	Direct Rad.
25	Other	Chance Road near Highway 23	S	5.2	Direct Rad.
26	Other	Highway 23 and Ebenezer Church Road	SSW	4.6	Direct Rad.
27	Other	Highway 23 opposite Boll Weevil Road	SW	4.7	Direct Rad.
28	Other	Thomas Road	WSW	5.0	Direct Rad.

TABLE 2-2 (SHEET 2 of 3)

RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATIONS

Station Number	Station Type	Descriptive Location	Direction[1]	Distance (miles)[1]	Sample Type
29	Other	Claxton-Lively Road	W	5.1	Direct Rad.
30	Other	Nathaniel Howard Road	WNW	5.0	Direct Rad.
31	Other	River Road at Allen's Chapel Fork	NW	5.0	Direct Rad.
32	Other	River Bank	NNW	4.7	Direct Rad.
35	Other	Girard	SSE	6.6	Airborne Rad. Direct Rad.
36	Control	GPC Waynesboro Op. HQ	WSW	13.9	Airborne Rad. Direct Rad.
37	Control	Substation Waynesboro, GA	WSW	16.7	Direct Rad Vegetation
43	Other	Employee's Rec. Center	SW	2.2	Direct Rad.
47	Control	Oak Grove Church	SE	10.4	Direct Rad.
48	Control	McBean Cemetery	NW	10.2	Direct Rad.
51	Control	SGA School Sardis, GA	S	11.0	Direct Rad.
52	Control	Oglethorpe Substation; Alexander, GA	SW	10.7	Direct Rad.
80	Control	Augusta Water Treatment Plant	NNW	29.0	Drinking Water[2]
81	Control	Sav River	N	2.5	Fish[3] Sediment[4]
82	Control	Sav River (RM 151.2)	NNE	0.8	River Water
83	Indicator	Sav River (RM 150.4)	ENE	0.8	River Water Sediment[4]
84	Other	Sav River (RM 149.5)	ESE	1.6	River Water
85	Indicator	Sav River	ESE	4.3	Fish[3]
87	Indicator	Beaufort-Jasper County Water Treatment Plant	SE	76	Drinking Water[5]
88	Indicator	Cherokee Hill Water Treatment Plant, Port Wentworth, Ga	SSE	72	Drinking Water[6]
98	Control	W.C. Dixon Dairy	SE	9.8	Milk
99	Control	Boyceland Dairy	W	20.9	Milk

TABLE 2-2 (SHEET 3 of 3)

RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATIONS

Notes:

(1) Direction and distance are determined from a point midway between the two reactors.

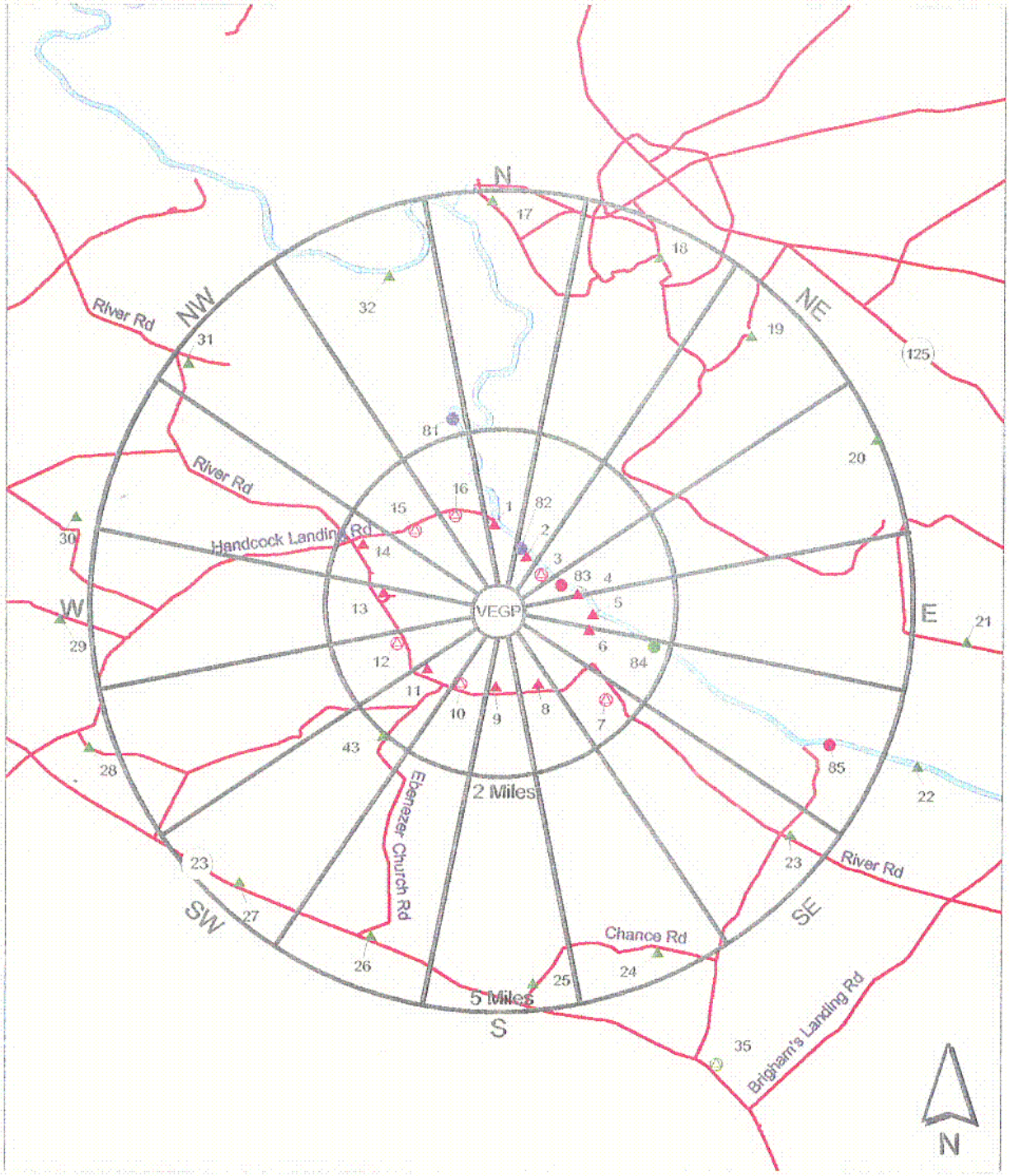
(2) The intake for the Augusta Water Treatment Plant is located on the Augusta Canal. The entrance to the canal is at River Mile (RM) 207 on the Savannah River. The canal effectively parallels the river. The intake to the pumping station is about 4 miles down the canal.

(3) A 5 mile stretch of the river is generally needed to obtain adequate fish samples. Samples are normally gathered between RM 153 and 158 for upriver collections and between RM 144 and 149.4 for downriver collections.

(4) Sediment is collected at locations with existing or potential recreational value. Because high water, shifting of the river bottom, or other reasons could cause a suitable location for sediment collections to become unavailable or unsuitable, a stretch of the river between RM 148.5 and 150.5 was designated for downriver collections while a stretch between RM 153 and 154 was designated for upriver collections. In practice, collections are normally made at RM 150.2 for downriver collections and RM 153.3 for upriver collections.

(5) The intake for the Beaufort-Jasper County Water Treatment Plant is located at the end of a canal that begins at RM 39.3 on the Savannah River. This intake is about 16 miles by line of sight down the canal from its beginning on the Savannah River.

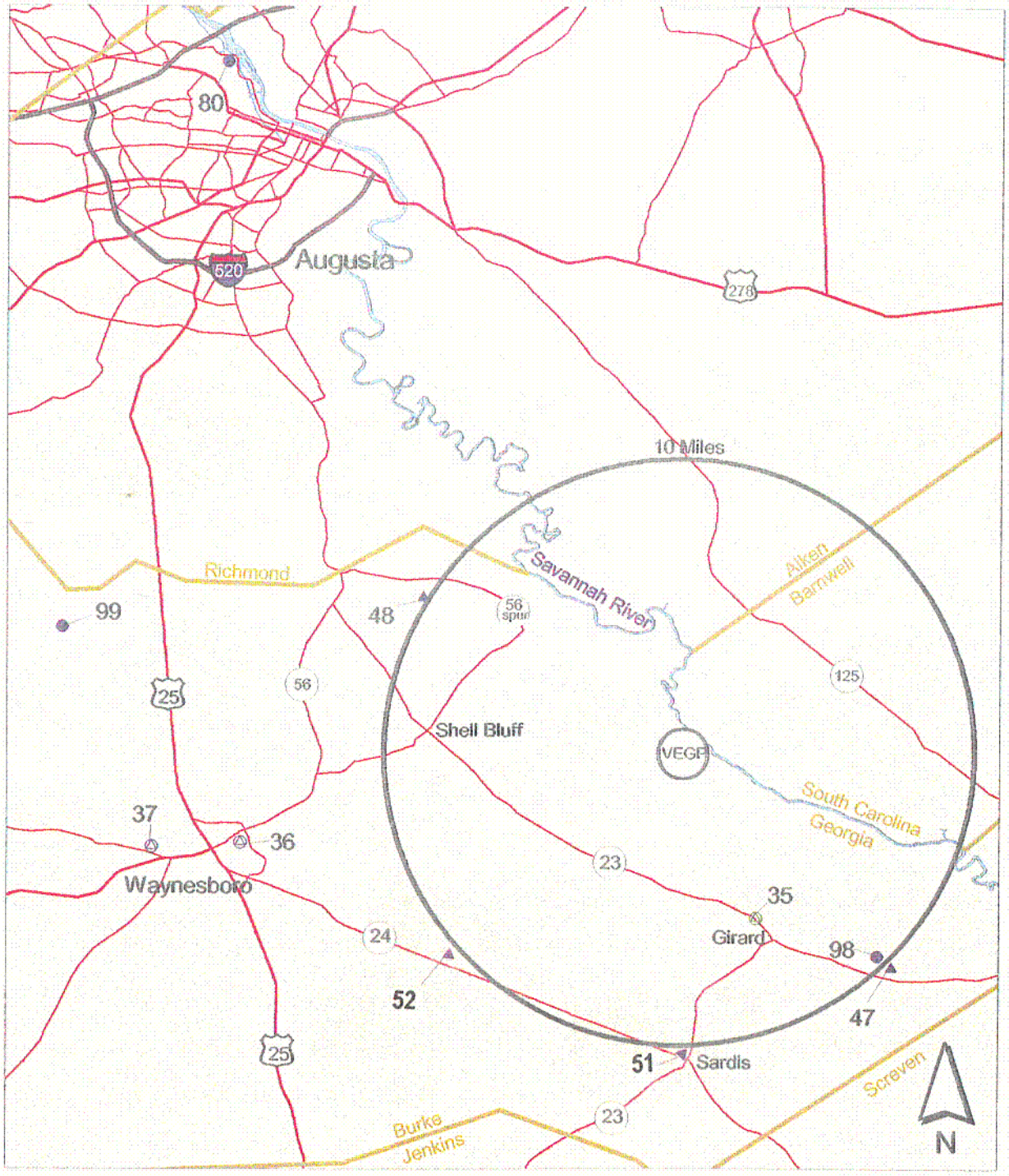
(6) The intake for the Cherokee Hill Water Treatment Plant is located on Abercorn Creek which is about one and a quarter creek miles from its mouth on the Savannah River at RM 29.



Radiological Environmental Sampling Locations	Indicator	Control	Additional
TLD	▲	▲	▲
Other	●	●	●
TLD & Other	△	△	△

REMP Stations in the Plant Vicinity

Figure 2-1

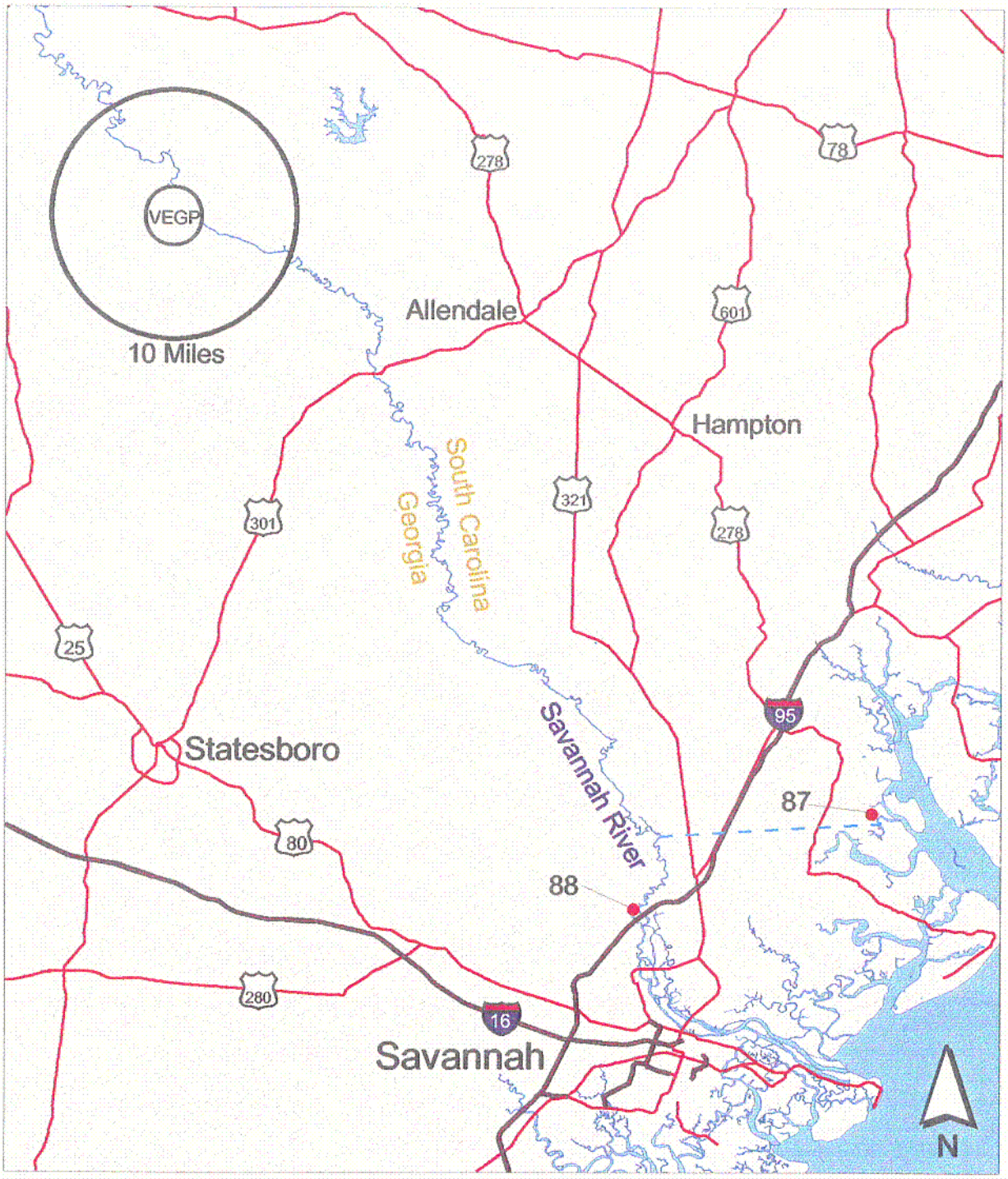


Radiological Environmental Sampling Locations	Indicator	Control	Additional
TLD	▲	▲	▲
Other	●	●	●
TLD & Other	△	△	△

REMP Control Stations for the Plant

Figure 2-2

C2



Radiological Environmental Sampling Locations	Indicator	Control	Additional
TLD	▲	▲	▲
Other	●	●	●
TLD & Other	⊿	⊿	⊿

REMP Indicator Drinking Water Stations

Figure 2-3

C3

3.0 RESULTS SUMMARY

In accordance with ODCM 7.1.2.1, the summarized and tabulated results for all of the regular samples collected for the year at the designated indicator and control stations are presented in Table 3-1. The format of Table 3-1 is similar to Table 3 of the Nuclear Regulatory Commission (NRC) Branch Technical Position, "An Acceptable Radiological Environmental Monitoring Program", Revision 1, November 1979. Results for samples collected at locations other than indicator or control stations are discussed in Section 4 under the particular sample type.

As indicated in ODCM 7.1.2.1, the results for naturally occurring radionuclides that are also found in plant effluents must be reported along with man-made radionuclides. The radionuclide Be-7 which occurs abundantly in nature is found in the plant's liquid effluent. No other naturally occurring radionuclides are found in any of the plant's other effluent releases. Therefore, the only radionuclides of interest in the samples monitoring liquid releases (surface water, fish, and river sediment) are the man-made radionuclides and Be-7. Only man-made radionuclides are of interest for the other REMP samples.

TABLE 3-1 (SHEET 1 of 7)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Vogtle Electric Generating Plant, Docket Nos. 50-424 and 50-425
Burke County, Georgia

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean: Name Distance & Direction (Fraction)	Location with the Highest Annual Mean: Mean (b), Range	Control Locations Mean (b), Range (Fraction)
Airborne Particulates (fCi/m3)	Gross Beta 310	10	22.5 5-48 (258/258)	Station 12 River Road 1.2 miles WSW	22.9 9-48 (52/52)	21.9 7-44 (52/52)
	Gamma Isotopic 24					
	Cs-134	50	NDM (c)		NDM	NDM
	Cs-137	60	NDM		NDM	NDM
Airborne Radioiodine (fCi/m3)	I-131 310	70	NDM		NDM	NDM
Direct Radiation (mR/91 days)	Gamma Dose 87	NA (d)	13.6 10.9-18.3 (63/63)	Station 20 SRS Road A.13.1 4.8 miles ENE	18.0 17.3-18.9 (4/4)	13.5 11.5-16.1 (24/24)
Milk (pCi/l)	Gamma Isotopic 52					
	Cs-134	15	NA		NDM	NDM
	Cs-137	18	NA		NDM	NDM
	Ba-140	60	NA		NDM	NDM
	La-140	15	NA		NDM	NDM
	I-131 52	1	NA		NDM	NDM

TABLE 3-1 (SHEET 2 of 7)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY
Vogtle Electric Generating Plant, Docket Nos. 50-424 and 50-425
Burke County, Georgia

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean: Name Distance & Direction (Fraction)	Location with the Highest Annual Mean: Mean (b), Range	Control Locations Mean (b), Range (Fraction)
Vegetation (pCi/kg-wet)	Gamma Isotopic 36					
	I-131	60	NDM		NDM	NDM
	Cs-134	60	NDM		NDM	NDM
	Cs-137	80	37.2 35.2-39.2 (2/24)	Station 07 Simulator Bldg. 1.7 miles SE	37.2 35.2-39.2 (2/12)	NDM
River Water (pCi/l)	Gamma Isotopic 24					
	Be-7	124	NDM		NDM	NDM
	Mn-54	15	NDM		NDM	NDM
	Fe-59	30	NDM		NDM	NDM
	Co-58	15	NDM		NDM	NDM
	Co-60	15	NDM		NDM	NDM
	Zn-65	30	NDM		NDM	NDM
	Zr-95	30	NDM		NDM	NDM
	Nb-95	15	NDM		NDM	NDM
	I-131	15	NDM		NDM	NDM
	Cs-134	15	NDM		NDM	NDM
	Cs-137	18	NDM		NDM	NDM
	Ba-140	60	NDM		NDM	NDM
	La-140	15	NDM		NDM	NDM
	Tritium 8	3000	2005 1650-2750 (4/4)	Station 83 Downriver 0.8 miles 0.4 RM	2005 1650-2750 (4/4)	389 194-591 (3/4)

TABLE 3-1 (SHEET 3 of 7)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Vogtle Electric Generating Plant, Docket Nos. 50-424 and 50-425
Burke County, Georgia

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean: Name Distance & Direction (Fraction)	Location with the Highest Annual Mean: Mean (b), Range	Control Locations Mean (b), Range (Fraction)
Water Near Intakes to Water Treatment Plants (pCi/l)	Gross Beta 36	4	4.10 2.0-9.6 (24/24)	Station 87 Beaufort Downriver 76 miles (112 RM)	4.74 2.9 –9.6 (12/12)	4.37 2.3-10.5 (12/12)
	Gamma Isotopic 36					
	Be-7	124 (e)	NDM		NDM	NDM
	Mn-54	15	NDM		NDM	NDM
	Fe-59	30	NDM		NDM	NDM
	Co-58	15	NDM		NDM	NDM
	Co-60	15	NDM		NDM	NDM
	Zn-65	30	NDM		NDM	NDM
	Zr-95	30	NDM		NDM	NDM
	Nb-95	15	NDM		NDM	NDM
	I-131(f)	15	NDM		NDM	NDM
	Cs-134	15	NDM		NDM	NDM
	Cs-137	18	NDM		NDM	NDM
	Ba-140	60	NDM		NDM	NDM
	La-140	15	NDM		NDM	NDM
	Tritium 12	3000	908 591-1140 (8/8)	Station 88 Port Wentworth Downriver 72 miles (122 RM)	920 591-1140 (4/4)	NDM

TABLE 3-1 (SHEET 4 of 7)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY
Vogtle Electric Generating Plant, Docket Nos. 50-424 and 50-425
Burke County, Georgia

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean: Name Distance & Direction (Fraction)	Location with the Highest Annual Mean: Mean (b), Range	Control Locations Mean (b), Range (Fraction)
Finished Water at Water Treatment Plants (pCi/l)	Gross Beta 36	4	3.23 1.0 –9.3 (24/24)	Station 88 Port Wentworth Downriver 72 miles (122 RM)	3.32 1.0-9.3 (12/12)	3.21 1.4-6.3 (11/12)
	Gamma Isotopic 36					
	Be-7	124 (e)	NDM		NDM	NDM
	Mn-54	15	NDM		NDM	NDM
	Fe-59	30	NDM		NDM	NDM
	Co-58	15	NDM		NDM	NDM
	Co-60	15	NDM		NDM	NDM
	Zn-65	30	NDM		NDM	NDM
	Zr-95	30	NDM		NDM	NDM
	Nb-95	15	NDM		NDM	NDM
	I-131	1	NDM		NDM	NDM
	Cs-134	15	NDM		NDM	NDM
	Cs-137	18	NDM		NDM	NDM
	Ba-140	60	NDM		NDM	NDM
	La-140	15	NDM		NDM	NDM
	Tritium 12	2000	920 649-1220 (8/8)	Station 88 Port Wentworth Downriver 72 miles (122 RM)	1042 699-1220 (4/4)	263 263-263 (1/4)

TABLE 3-1 (SHEET 5 of 7)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Vogtle Electric Generating Plant, Docket Nos. 50-424 and 50-425
Burke County, Georgia

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean: Name Distance & Direction (Fraction)	Location with the Highest Annual Mean: Mean (b), Range	Control Locations Mean (b), Range (Fraction)
Anadromous Fish (pCi/kg-wet)	Gamma Isotopic 1					
	Be-7	655 (e)	NDM		NDM	NA
	Mn-54	130	NDM		NDM	NA
	Fe-59	260	NDM		NDM	NA
	Co-58	130	NDM		NDM	NA
	Co-60	130	NDM		NDM	NA
	Zn-65	260	NDM		NDM	NA
	Cs-134	130	NDM		NDM	NA
	Cs-137	150	NDM		NDM	NA
Fish (pCi/kg-wet)	Gamma Isotopic 8					
	Be-7	655 (e)	NDM		NDM	NDM
	Mn-54	130	NDM		NDM	NDM
	Fe-59	260	NDM		NDM	NDM
	Co-58	130	NDM		NDM	NDM
	Co-60	130	NDM		NDM	NDM
	Zn-65	260	NDM		NDM	NDM
	Cs-134	130	NDM		NDM	NDM
	Cs-137	150	847.8 57.2-2520 (4/4)	Station 85 Downriver 4.3 miles (4.2 RM)	847.8 57.2-2520 (4/4)	221 40.3-600 (4/4)

TABLE 3-1 (SHEET 6 of 7)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Vogtle Electric Generating Plant, Docket Nos. 50-424 and 50-425
Burke County, Georgia

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean: Name Distance & Direction (Fraction)	Location with the Highest Annual Mean: Mean (b), Range	Control Locations Mean (b), Range (Fraction)
Sediment (pCi/kg-dry)	Gamma Isotopic 4					
	Be-7	655(e)	622 372-952 (2/2)	Station 81 Upriver 2.5 miles	769 518-1020 (2/2)	769 518-1020 (2/2)
	Co-60	70(e)	49.5 42.9-56.1 (2/2)	Station 83 Downriver 0.6 miles	49.5 42.9-56.1 (2/2)	NDM
	Cs-134	150	NDM		NDM	NDM
	Cs-137	180	196.5 166-227 (2/2)	Station 83 Downriver 0.6 miles	196.5 166-227 (2/2)	96.9 77.7 -116 (2/2)

TABLE 3-1 (SHEET 7 of 7)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Vogtle Electric Generating Plant, Docket Nos. 50-424 and 50-425
Burke County, Georgia

Notes:

a. The MDC is defined in ODCM 10.1. Except as noted otherwise, the values listed in this column are the detection capabilities required by ODCM Table 4-3. The values listed in this column are a priori (before the fact) MDCs. In practice, the a posteriori (after the fact) MDCs are generally lower than the values listed. Any a posteriori MDC greater than the value listed in this column is discussed in Section 4.

b. Mean and range are based upon detectable measurements only. The fraction of all measurements at a specified location that are detectable is placed in parenthesis.

c. No Detectable Measurement(s).

d. Not Applicable.

e. The EL has determined that this value may be routinely attained under normal conditions. No value is provided in ODCM Table 4-3.

f. Item 3 of ODCM Table 4-1 implies that an I-131 analysis is not required to be performed on water samples when the dose calculated from the consumption of water is less then 1 mrem per year. However, I-131 analyses have been performed on the finished drinking water samples.

4.0 DISCUSSION OF RESULTS

Included in this section are evaluations of the laboratory results for the various sample types. Comparisons were made between the difference in mean values for pairs of station groups (e.g., indicator and control stations) and the calculated Minimum Detectable Difference (MDD) between these pairs at the 99% Confidence Level (CL). The MDD was determined using the standard Student's t-test. A difference in the mean values that was less than the MDD was considered to be statistically indiscernible.

The 1999 results were compared with past results, including those obtained during preoperation. As appropriate, results were compared with their Minimum Detectable Concentrations (MDC) and Reporting Levels (RL) which are listed in Tables 4-1 and 4-2 of this report, respectively. The required MDC's were achieved during laboratory sample analysis. Any anomalous results are explained within this report.

Results of interest are graphed to show historical trends. The data points are tabulated and included in this report. The points plotted and provided in the tables represent mean values of only detectable results. Periods for which no detectable measurements (NDM) were observed or periods for which values were not applicable (e.g., milk indicator, etc.) are plotted as and listed in the tables as 0's.

Table 4-1

Minimum Detectable Concentrations (MDC)

Analysis	Water (pCi/l)	Airborne Particulate or Gases (fCi/m3)	Fish (pCi/kg-wet)	Milk (pCi/l)	Grass or Leafy Vegetation (pCi/kg-wet)	Sediment (pCi/kg)
Gross Beta	4	10				
H-3	2000 (a)					
Mn-54	15		130			
Fe-59	30		260			
Co-58	15		130			
Co-60	15		130			
Zn-65	30		260			
Zr-95	30					
Nb-95	15					
I-131	1 (b)	70		1	60	
Cs-134	15	50	130	15	60	150
Cs-137	18	60	150	18	80	180
Ba-140	60			60		
La-140	15			15		

(a) If no drinking water pathway exists, a value of 3000 pCi/l may be used.

(b) If no drinking water pathway exists, a value of 15 pCi/l may be used.

Table 4-2

Reporting Levels (RL)

Analysis	Water (pCi/l)	Airborne Particulate or Gases (fCi/m3)	Fish (pCi/kg-wet)	Milk (pCi/l)	Grass or Leafy Vegetation (pCi/kg-wet)
H-3	20,000 (a)				
Mn-54	1000		30,000		
Fe-59	400		10,000		
Co-58	1000		30,000		
Co-60	300		10,000		
Zn-65	300		20,000		
Zr-95	400				
Nb-95	700				
I-131	2 (b)	900		3	100
Cs-134	30	10,000	1000	60	1000
Cs-137	50	20,000	2000	70	2000
Ba-140	200			300	
La-140	100			400	

(a) This is the 40 CFR 141 value for drinking water samples. If no drinking water pathway exists, a value of 30,000 may be used.

(b) If no drinking water pathway exists, a value of 20 pCi/l may be used.

Atmospheric nuclear weapons tests from the mid 1940's through 1980 distributed man-made nuclides around the world. The most recent atmospheric tests in the 1970's and in 1980 had a significant impact upon the radiological concentrations found in the environment prior to and during preoperation, and the earlier years of operation. Some long lived radionuclides, such as Cs-137, continue to have some impact. A significant component of the Cs-137 which has often been found in various samples over the years (and continues to be found) is attributed to the nuclear weapons tests.

Data in this section has been modified to remove any obvious non-plant short term impacts. The specific short term impact data that has been removed includes: the nuclear atmospheric weapon test in the fall of 1980; abnormal releases from the Savannah River Site (SRS) during 1987 and 1991; and the Chernobyl incident in the spring of 1986.

In accordance with ODCM 4.1.1.2.1, deviations from the required sampling schedule are permitted, if samples are unobtainable due to hazardous conditions, unavailability, inclement weather, equipment malfunction or other just reasons. Deviations from conducting the REMP as described in Table 2-1 are summarized in Table 4-3 along with their causes and resolutions.

All results were tested for conformance with Chauvenet's criterion (G. D. Chase and J. L. Rabinowitz, Principles of Radioisotope Methodology, Burgess Publishing Company, 1962, pages 87-90) to identify values which differed from the mean of a set by a statistically significant amount. Identified outliers were investigated to determine the reason(s) for the difference. If equipment malfunction or other valid physical reasons were identified as causing the variation, the anomalous result was excluded from the data set as non-representative. No data were excluded exclusively for failing Chauvenet's criterion. Data exclusions are discussed in this section under the appropriate sample type.

TABLE 4-3 (SHEET 1 of 2)

DEVIATIONS FROM RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

COLLECTION PERIOD	AFFECTED SAMPLES	DEVIATION	CAUSE	RESOLUTION
01/05/99 - 01/12/99	Simulator, Discharge, Met Tower and River Road Air Filter and Air Cartridge Stations	Airborne particulates and radioiodine monitoring were not performed for 2.6 hours on 01/06/99.	Power outage due to problem at substation serving the affected air sample station.	Power was restored and air sampler returned to service.
03/02/99 - 03/09/99	Girard Air Filter and Air Cartridge Station	Airborne particulates and radioiodine monitoring were not performed for 6.3 hours on 03/03/99.	Power outage due to severe weather.	Power was restored and air sampler returned to service.
07/27/99 - 08/03/99	Simulator, Discharge, Met Tower and River Road Air Filter and Air Cartridge Stations	Airborne particulates and radioiodine monitoring were not performed for 5.0 hours on 08/01/99.	Power outage due to blown transformer.	Power was restored and air sampler returned to service.
08/10/99 – 08/17/99	Girard Air Filter and Air Cartridge Station	Airborne particulates and radioiodine monitoring were not performed for 1.9 hours on 08/14/99.	Power outage due to severe weather.	Power was restored and air sampler returned to service.
08/10/99 – 08/17/99	Simulator and River Road Air Filter and Air Cartridge Stations	Airborne particulates and radioiodine monitoring were not performed for 3.3 hours on 08/14/99.	Power outage due to severe weather.	Power was restored and air sampler returned to service.

TABLE 4-3 (SHEET 2 of 2)

DEVIATIONS FROM RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

COLLECTION PERIOD	AFFECTED SAMPLES	DEVIATION	CAUSE	RESOLUTION
09/07/99 – 10/05/99	Raw Drinking Water at Beaufort, SC	Raw Drinking Water sampling was not performed for 46 hours from 09/15 to 09/17/99.	Water samplers moved to a sheltered area due to hurricane.	Samplers returned to service following severe weather.
09/07/99 – 10/05/99	Raw Drinking Water at Port Wentworth, GA	Raw Drinking Water sampling was not performed for 51 hours from 09/15 to 09/17/99.	Water samplers moved to a sheltered area due to hurricane.	Samplers returned to service following severe weather.
Quarter 3	TLD 15	Direct radiation results for the third quarter were not obtained.	TLD was discovered vandalized at collection time.	TLD replaced.
12/07/99 – 12/14/99	Discharge Air Filter and Air Cartridge station.	Airborne particulates and radioiodine monitoring were not performed for 0.7 hours on 12/14/99.	Power outage.	Power was restored and air sampler returned to service.
12/14/99 – 12/21/99	Discharge Air Filter and Air Cartridge station.	Airborne particulates and radioiodine monitoring were not performed for 4.9 hours on 12/14/99.	Power outage.	Power was restored and air sampler returned to service.

4.1 Land Use Census and River Survey

In accordance with ODCM 4.1.2, a land use census was conducted on December 14, 1999 to determine the locations of the nearest permanent residence, milk animal, and garden of greater than 500 square feet producing broad leaf vegetation, in each of the 16 compass sectors within a distance of 5 miles; the locations of the nearest beef cattle in each sector were also determined. A milk animal is a cow or goat producing milk for human consumption. Land within SRS was excluded from the census. The census results are tabulated in Table 4.1-1.

Table 4.1-1

LAND USE CENSUS RESULTS

Distance in Miles to the Nearest Location in Each Sector

SECTOR	RESIDENCE	MILK ANIMAL	BEEF CATTLE	GARDEN
N	None	None	None	None
NNE	None	None	None	None
NE	None	None	None	None
ENE	None	None	None	None
E	None	None	None	None
ESE	4.2	None	None	None
SE	4.4	None	5.0	None
SSE	4.6	None	4.6	None
S	4.4	None	None	None
SSW	4.7	None	4.5	None
SW	2.7	None	2.7	4.8
WSW	1.2	None	2.7	2.7
W	3.7	None	4.9	4.5
WNW	1.8	None	1.8	3.3
NW	1.6	None	1.9	4.2
NNW	1.5	None	None	None

ODCM 4.1.2.2.1 requires a new controlling receptor to be identified, if the land use census identifies a location that yields a calculated receptor dose greater than the one in current use. It was determined that no change in the controlling receptor was required in 1999.

ODCM 4.1.2.2.2 requires that whenever the land use census identifies a location which yields a calculated dose (via the same ingestion pathway) 20% greater than that of a current indicator station, the new location must become a REMP station (if samples are available). None of the identified locations yielded a calculated dose 20% greater than that for any of the current indicator stations. No milk animals were identified within five miles of the plant.

A survey of the Savannah River downstream of the plant for approximately 100 miles was conducted on September 21, 1999 to identify any withdrawal of water from the river for drinking or irrigation purposes. No such usage was identified. These results were corroborated by checking with the Georgia Department of Natural Resources and the South Carolina Department of Health and Environmental Control. Each of these agencies confirmed that no water withdrawal permits for drinking or irrigation purposes had been issued for this stretch of the Savannah River. The two water treatment plants used as indicator stations for drinking water are located farther downriver.

4.2 Airborne

As specified in Table 2-1 and shown in Figures 2-1 through 2-3, airborne particulate filters and charcoal canisters are collected weekly at 5 indicator stations (Stations 3, 7, 10, 12 and 16) which encircle the plant at the site periphery, at a nearby community station (Station 35) approximately 7 miles from the plant, and at a control station (Station 36) which is approximately 14 miles from the plant. At each location, air is continuously drawn through a glass fiber filter to retain airborne particulate and an activated charcoal canister is placed in series with the filter to adsorb radioiodine.

Each particulate filter is counted for gross beta activity. A quarterly gamma isotopic analysis is performed on a composite of the air particulate filters for each station. Each charcoal canister is analyzed for I-131.

As provided in Table 3-1, the 1999 annual average weekly gross beta activity of 22.5 fCi/m^3 for the indicator stations was 0.6 fCi/m^3 greater than the control stations' average. This difference is not statistically discernible, since it is less than the calculated MDD of 2.6 fCi/m^3.

The 1999 annual average weekly gross beta activity at the Girard community station was 22.2 fCi/m^3 which was 0.5 fCi/m^3 greater than the control stations' average. This difference is not statistically discernible since it is less than the calculated MDD of 3.3 fCi/m^3.

The historical trending of the average weekly gross beta air concentrations for each year of operation and the preoperational period (September, 1981 to January, 1987) at the indicator, control and community stations is plotted in Figure 4.2-1 and listed in Table 4.2-1. In general, there is close agreement between the results for the indicator, control and community stations. This close agreement supports the position that the plant is not contributing significantly to the gross beta concentrations in air.

The table and graph show the average concentrations for all the station groups were relatively flat for the 11 year period (1989 through 1999), except that the 1996 average for the indicator stations was a little higher. This was due to a single measurement of 527 fCi/m3 at one of the indicator stations. Plant releases were ruled out as a cause; however, laboratory contamination was a possibility. If this result were excluded, the average for the indicator stations would become 21.4 fCi/m3 which is only 0.4 fCi/m3 greater than the control station average and the difference would not be statistically discernible since it is less than the MDD of 1.9 fCi/m3.

Figure 4.2-1

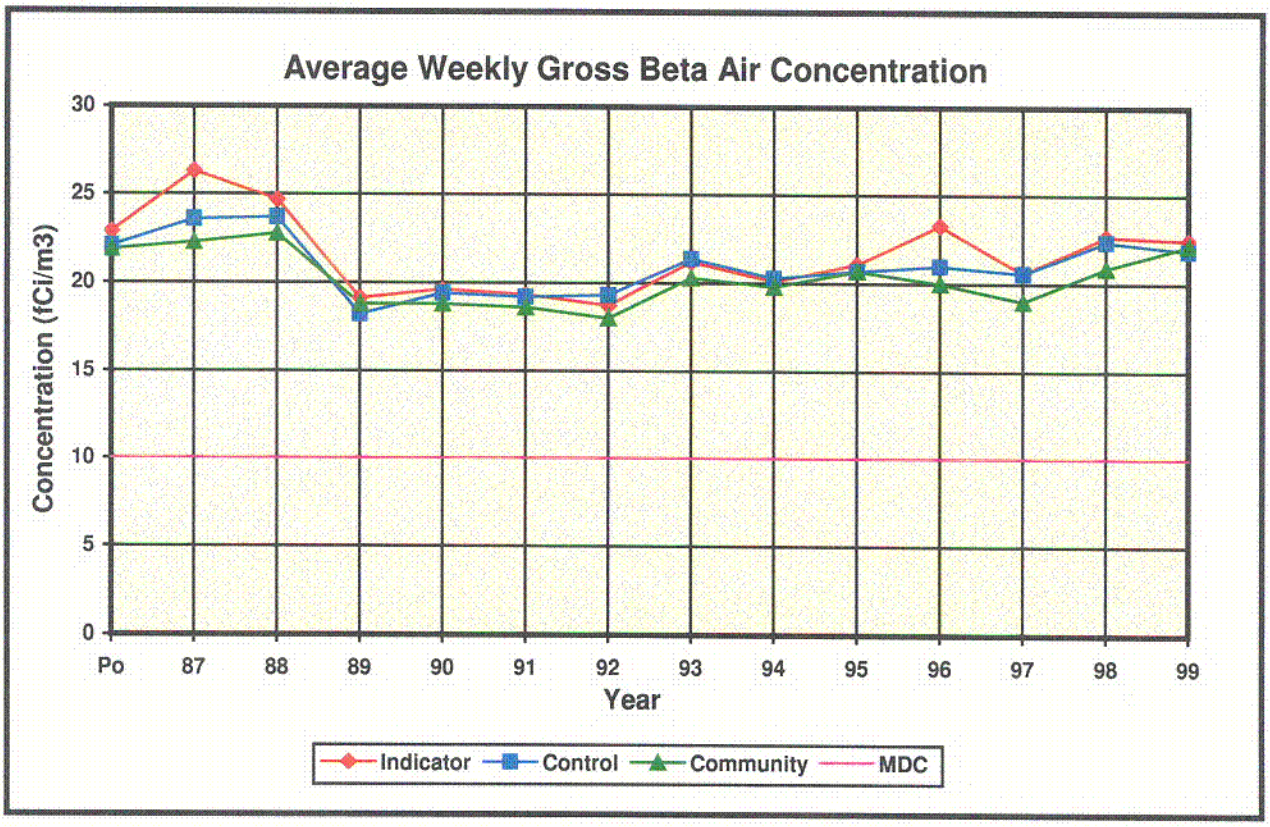


Table 4.2-1

Average Weekly Gross Beta Air Concentration

Period	Indicator (fCi/m3)	Control (fCi/m3)	Community (fCi/m3)
Pre-op	22.9	22.1	21.9
1987	26.3	23.6	22.3
1988	24.7	23.7	22.8
1989	19.1	18.2	18.8
1990	19.6	19.4	18.8
1991	19.3	19.2	18.6
1992	18.7	19.3	18.0
1993	21.2	21.4	20.3
1994	20.1	20.3	19.8
1995	21.1	20.7	20.7
1996	23.3	21.0	20.0
1997	20.6	20.6	19.0
1998	22.7	22.4	20.9
1999	22.5	21.9	22.2

C4

During 1999, no man-made radionuclides were detected from the gamma isotopic analysis of the quarterly composites of the air particulate filters. In 1987, Cs-137 was found in one indicator composite at a concentration of 1.7 fCi/m^3. During preoperation, Cs-137 was found in approximately 12% of the indicator composites and 14% of the control composites with average concentrations of 1.7 and 1.0 fCi/m^3, respectively. The MDC for airborne Cs-137 is 60 fCi/m^3. Also, during preoperations, Cs-134 was found in about 8% of the indicator composites. The average Cs-134 concentration was 1.2 fCi/m3. Its MDC is 50 fCi/m3.

Airborne I-131 was not detected in any sample during 1999. During preoperation, positive results were obtained only during the Chernobyl incident when concentrations as high as 182 fCi/m^3 were observed. The MDC and RL for airborne I-131 are 70 and 900 fCi/m^3, respectively.

Table 4-3 lists REMP deviations that occurred in 1999. Not all of the deviations listed in Table 4-3 required data to be excluded from the calculation of the mean detectable values. The following air sample results were excluded for failing Chauvenet's criterion following equipment malfunction.

The Girard air sampling station experienced low sample volume of air collection for the period 3/02/99 – 3/09/99, due to loss of electrical power caused by severe weather. Because of the low volume of air collected, the results were checked for conformance with Chauvenet's criterion and failed. These results were removed from the data set. Operation of the Girard air sampling station resumed when electrical power was restored to the station.

The Simulator air sampling station experienced low sample volume of air collection for the period 7/28/99 – 8/03/99, due to loss of electrical power caused by a failed transformer. Because of the low volume of air collected, the results were checked for conformance with Chauvenet's criterion and failed. These results were removed from the data set. Operation of the Simulator air sampling station resumed when electrical power was restored to the station.

The Simulator air sampling station experienced low sample volume of air collection for the period 8/10/99 – 8/17/99, due to loss of electrical power caused by severe weather. Because of the low volume of air collected, the results were checked for conformance with Chauvenet's criterion and failed. These results were removed from the data set. Operation of the Simulator air sampling station resumed when electrical power was restored to the station.

4.3 Direct Radiation

Direct (external) radiation is measured with thermoluminescent dosimeters (TLDs). Two Panasonic UD-814 TLD badges are placed at each station. Each badge contains three phosphors composed of calcium sulfate crystals (with thulium impurity). The gamma dose at each station is based upon the average readings of the phosphors from the two badges. The badges for each station are placed in thin plastic bags for protection from moisture while in the field. The badges are nominally exposed for periods of a quarter of a year (91 days). An inspection is performed near mid-quarter to assure that all badges are on-station and to replace any missing or damaged badges.

Two TLD stations are established in each of the 16 compass sectors, to form 2 concentric rings. The inner ring (Stations 1 through 16) is located near the plant perimeter as shown in Figure 2-1 and the outer ring (Stations 17 through 32) is located at a distance of approximately 5 miles from the plant as shown in Figure 2-2. The 16 stations forming the inner ring are designated as the indicator stations. The two ring configuration of stations was established in accordance with NRC Branch Technical Position "An Acceptable Radiological Environmental Monitoring Program", Revision 1, November 1979. The 6 control stations (Stations 36, 37, 47, 48, 51 and 52) are located at distances greater than 10 miles from the plant as shown in Figure 2-2. Monitored special interest areas consist of the following: Station 35 at the town of Girard, and Station 43 at the employee recreational area.

As provided in Table 3-1 the average quarterly exposure measured at the indicator stations was 13.6 mR with a range of 10.9 to 18.3 mR. This average was 0.1 mR greater than the average quarterly exposure measured at the control stations. This difference is not statistically discernible since it is less than the MDD of 1.0 mR. Over the operational history of the site, the annual average quarterly exposures shows a variation of no more than 0.7 mR difference between the indicator and control stations. The overall average quarterly exposure for the control stations during preoperation was 1.2 mR greater than that for the indicator stations.

The quarterly exposures acquired at the outer ring stations during 1999 ranged from 10.7 to 18.9 mR with an average of 13.4 mR which was 0.1 mR less than that for the control stations. However, this difference is not discernible since it is less than the MDD of 1.1 mR. For the entire period of operation, the annual average quarterly exposures at the outer ring stations vary by no more than 1.2 mR from those at the control stations. The overall average quarterly exposure for the outer ring stations during preoperation was 1.8 mR less than that for the control stations.

The historical trending of the average quarterly exposures for the indicator inner ring, outer ring, and the control stations are plotted in Figure 4.3-1 and listed in Table 4.3-1. The decrease between 1991 and 1992 values is attributed to a change in TLDs from Teledyne to Panasonic. It should be noted however that the differences between indicator and control and outer ring values did not change. The close agreement between the station groups supports the position that the plant is not contributing significantly to direct radiation in the environment.

Figure 4.3-1

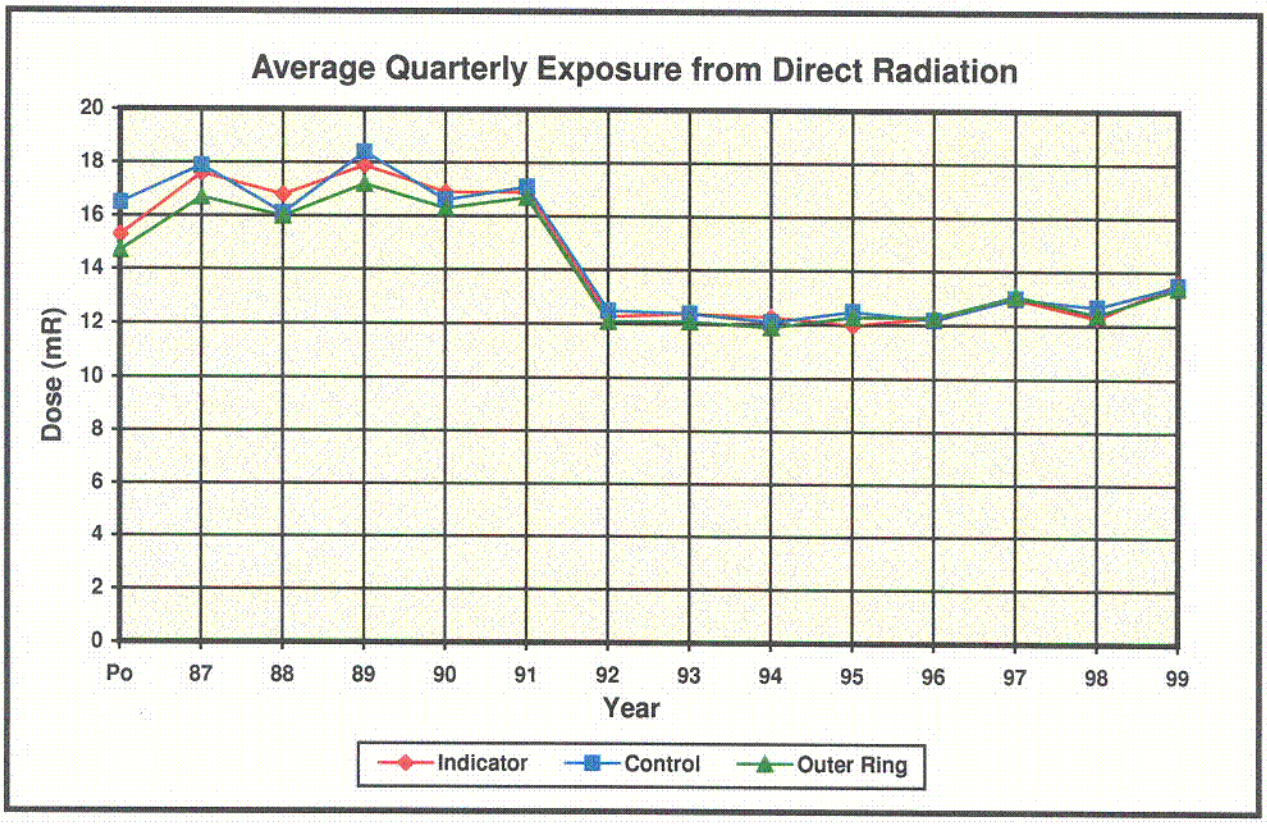


Table 4.3-1

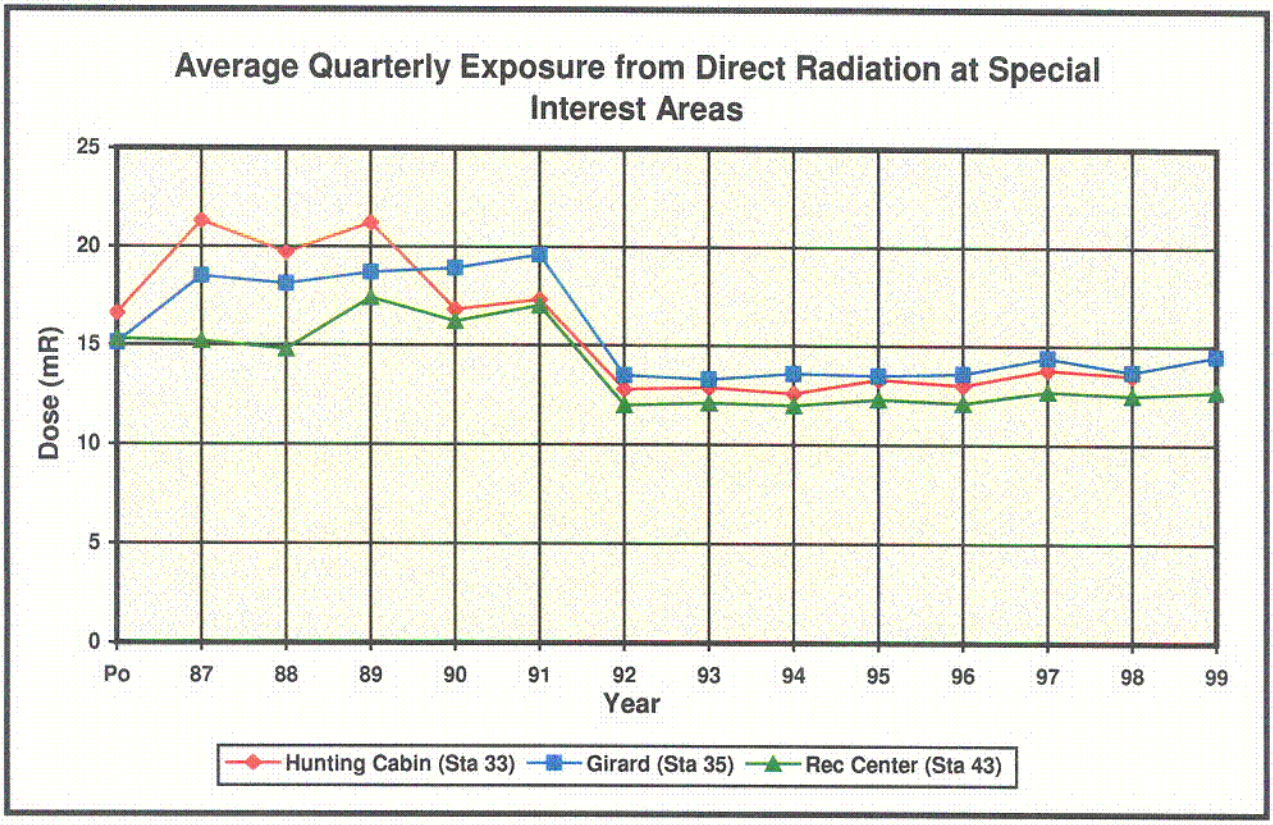
Average Quarterly Exposure from Direct Radiation

Period	Indicator (mR)	Control (mR)	Outer Ring (mR)
Pre-op	15.3	16.5	14.7
1987	17.6	17.9	16.7
1988	16.8	16.1	16.0
1989	17.9	18.4	17.2
1990	16.9	16.6	16.3
1991	16.9	17.1	16.7
1992	12.3	12.5	12.1
1993	12.4	12.4	12.1
1994	12.3	12.1	11.9
1995	12.0	12.5	12.3
1996	12.3	12.2	12.3
1997	13.0	13.0	13.1
1998	12.3	12.7	12.4
1999	13.6	13.5	13.4

C5

The historical trending of the average quarterly exposures at the special interest areas for the same periods are provided in Figure 4.3-2 and listed in Table 4.3-2. These exposures are within the range of those acquired at the other stations. They too, show that the plant is not contributing significantly to direct radiation at the special interest areas.

Figure 4.3-2



C6

Table 4.3-2

Average Quarterly Exposure from Direct Radiation at Special Interest Areas

Period	Station 33 (mR)	Station 35 (mR)	Station 43 (mR)
Pre-op	16.6	15.1	15.3
1987	21.3	18.5	15.2
1988	19.7	18.1	14.8
1989	21.2	18.7	17.4
1990	16.8	18.9	16.2
1991	17.3	19.6	17.0
1992	12.8	13.5	12.0
1993	12.9	13.3	12.1
1994	12.6	13.6	12.0
1995	13.3	13.5	12.3
1996	13.0	13.6	12.1
1997	13.8	14.4	12.7
1998	13.5	13.7	12.5
1999	NA	14.5	12.7

The hunting cabin activities at Station 33 have been discontinued and, consequently, this location is no longer considered as an area of special interest. Monitoring at this location was discontinued at the end of 1998. Beginning with the third quarter of 1997, TLDs were placed on a trial basis at the SGA Elementary School in Sardis, Ga. (S at 11.0 miles) and near the center of Alexander, Ga. (SW at 10.7 miles). The quarterly doses found at these two locations were within the range of those found at the control stations during the year. The Sardis and Alexander locations were added as control stations in 1999, as Stations 51 and 52, respectively.

There was one deviation from the REMP in obtaining a measurement of the quarterly gamma dose during 1999. The deviation occurred in the 3rd Quarter at Station 15. At the time of dosimeter collection at the end of the quarter, it was found that the station had been vandalized and both badges A and B were destroyed. This resulted in the direct radiation measurements for the 3rd Quarter at Station 15 not being available. This deviation is listed in Table 4-3.

The standard deviation for the quarterly result for each badge was subjected to a self imposed limit of 1.4. This limit is based upon the standard deviations obtained with the Panasonic UD-814 badges during 1992 and is calculated using a method developed by the American Society of Testing and Materials (ASTM Special Technical Publication 15D, ASTM Manual on Presentation of Data and Control Chart Analysis, Fourth Revision, Philadelphia, PA, October 1976).

The limit serves as a flag to initiate an investigation. To be conservative, readings with a standard deviation greater than 1.4 are excluded since the high standard deviation is interpreted as an indication of unacceptable variation in TLD response.

The readings for 7 badges (TLDs 03A, 28B, 35A, and 37A for the second quarter; TLDs 20B, 23A and 29A for the third quarter) were deemed unacceptable since the standard deviation for each badge was greater than the self imposed limit of 1.4.

Consequently, only the readings for the companion badges were used for determining the quarterly dose in these cases. The badges were visually inspected under a microscope and the glow curve and test results for the anneal data and the element correction factors were reviewed. No reason was evident for the high standard deviation.

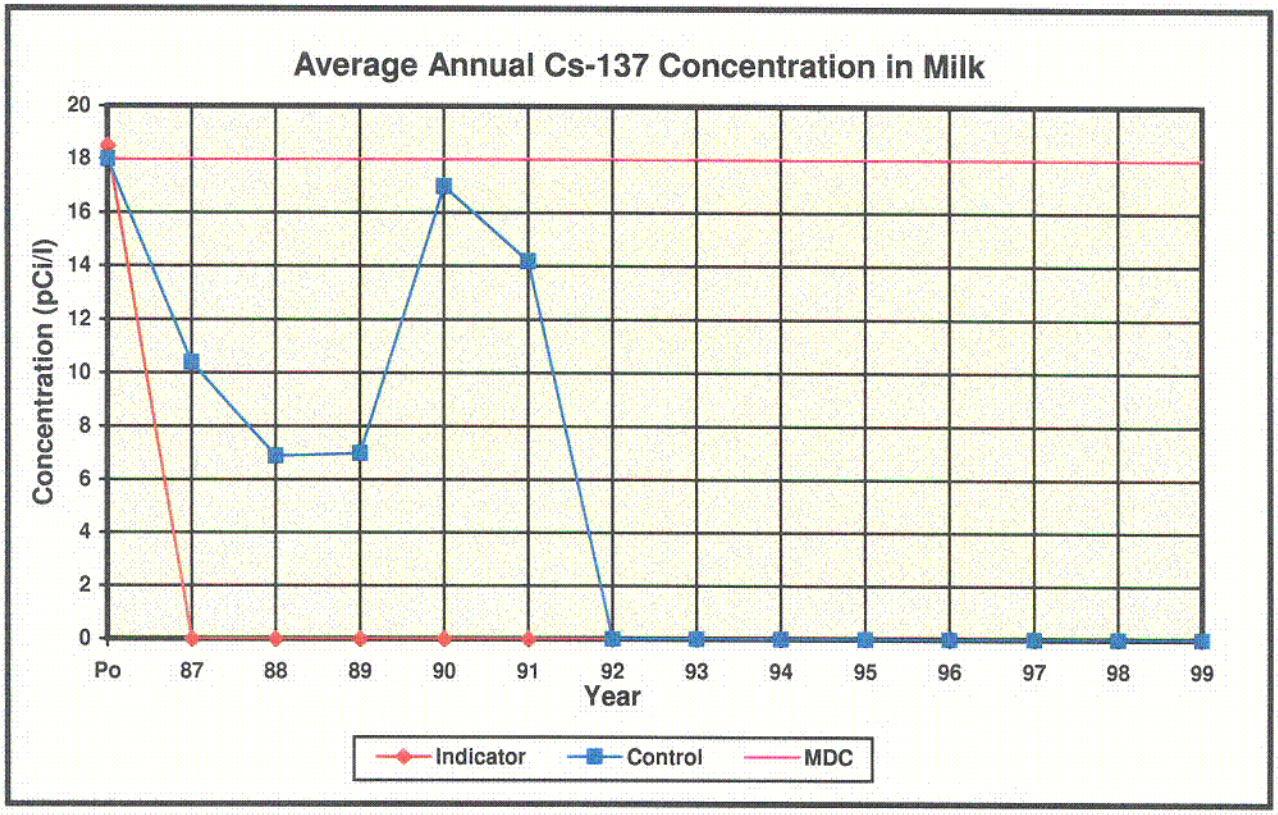
4.4 Milk

In accordance with Tables 2-1 and 2-2, milk samples are collected biweekly from two control locations, the W. C. Dixon Dairy (Station 98) and the Boyceland Dairy (Station 99). Gamma isotopic and I-131 analyses are performed on each sample.

No indicator station (a location within 5 miles of the plant) for milk has been available since April 1986. As discussed in Section 4.1, no milk animal was found during the 1999 land use census.

No man-made radionuclides were identified during the gamma isotopic analysis of the milk samples in 1999. The MDC and RL for Cs-137 in milk are 18 and 70 pCi/l, respectively. During preoperation and each year of operation through 1991, Cs-137 was found in 2 to 6% of the samples at concentrations ranging from 5 to 27 pCi/l. During preoperation, Cs-134 was detected in one sample and in the first year of operation, Zn-65 was detected in one sample. Figure 4.4-1 and Table 4.4-1 provide the historical trending of the Cs-137 concentration in milk.

Figure 4.4-1



c7

Table 4.4-1

Average Annual Cs-137 Concentration in Milk

Year	Indicator (pCi/l)	Control (pCi/l)
Pre-op	18.5	18
1987	0	10.4
1988	0	6.9
1989	0	7
1990	0	17
1991	0	14.2
1992	0	0
1993	0	0
1994	0	0
1995	0	0
1996	0	0
1997	0	0
1998	0	0
1999	0	0

During 1999, I-131 was not detected in any of the milk samples. Since operations began in 1987, I-131 may have been detected in one sample in 1996 and two during 1990; however, its presence in these cases was questionable, due to large counting uncertainties. During preoperation, positive I-131 results were found only during the Chernobyl incident with concentrations ranging from 0.53 to 5.07 pCi/l. The MDC and RL for I-131 in milk are 1 and 3 pCi/l, respectively.

4.5 Vegetation

In accordance with Tables 2-1 and 2-2, grass samples are collected monthly at two indicator locations onsite near the site boundary (Stations 7 and 15) and at one control station located about 17 miles from the plant (WSW - Station 37). Gamma isotopic analyses are performed on the samples.

Cs-137 was detected in two of twenty-four indicator samples in 1999. The average concentration was 37.2 pCi/kg-wet. Although Cs-137 is routinely detected in environmental samples, as a result of atmospheric nuclear weapons testing and the Chernobyl incident, since no Cs-137 was measured in the samples collected at the control station, plant contribution to the 1999 indicator samples cannot be ruled out.

The potential dose from the Cs-137 detected in vegetation at the indicator station to the most limiting member of the public was calculated using the methodology and parameters of "Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance With 10 CFR Part 50, Appendix I," NRC Regulatory Guide 1.109, Revision 1, October 1977. An adult who consumed 584 kg of garden vegetation from the indicator station would receive a potential dose of approximately 0.129 mrem in a year. This dose is about 0.9% of the limit for annual gaseous releases to a member of the public as specified by ODCM 3.1.4.

The historical trending of the average concentration of Cs-137 at the indicator and control stations is provided in Figure 4.5-1 and listed in Table 4.5-1. No trend is recognized in these data. The MDC and RL for Cs-137 in vegetation samples are 80 and 2000 pCi/kg-wet, respectively. Cs-137 is the only manmade radionuclide that has been identified in vegetation samples during the operational history of the plant. During preoperation, Cs-137 was found in approximately 60% of the samples from indicator stations and in approximately 20% of the samples from the control station. These percentages have generally decreased during operation.

In May and June of 1986 during preoperation, as a consequence of the Chernobyl incident, I-131 was found in nearly all the samples collected for a period of several weeks in the range of 200 to 500 pCi/kg-wet. The MDC and RL for I-131 in vegetation are 60 and 100 pCi/kg-wet, respectively. Also during this time period, Co-60 was found in one of the samples at a concentration of 62.5 pCi/kg-wet. There is no specified MDC or RL for Co-60 in vegetation.

Figure 4.5-1

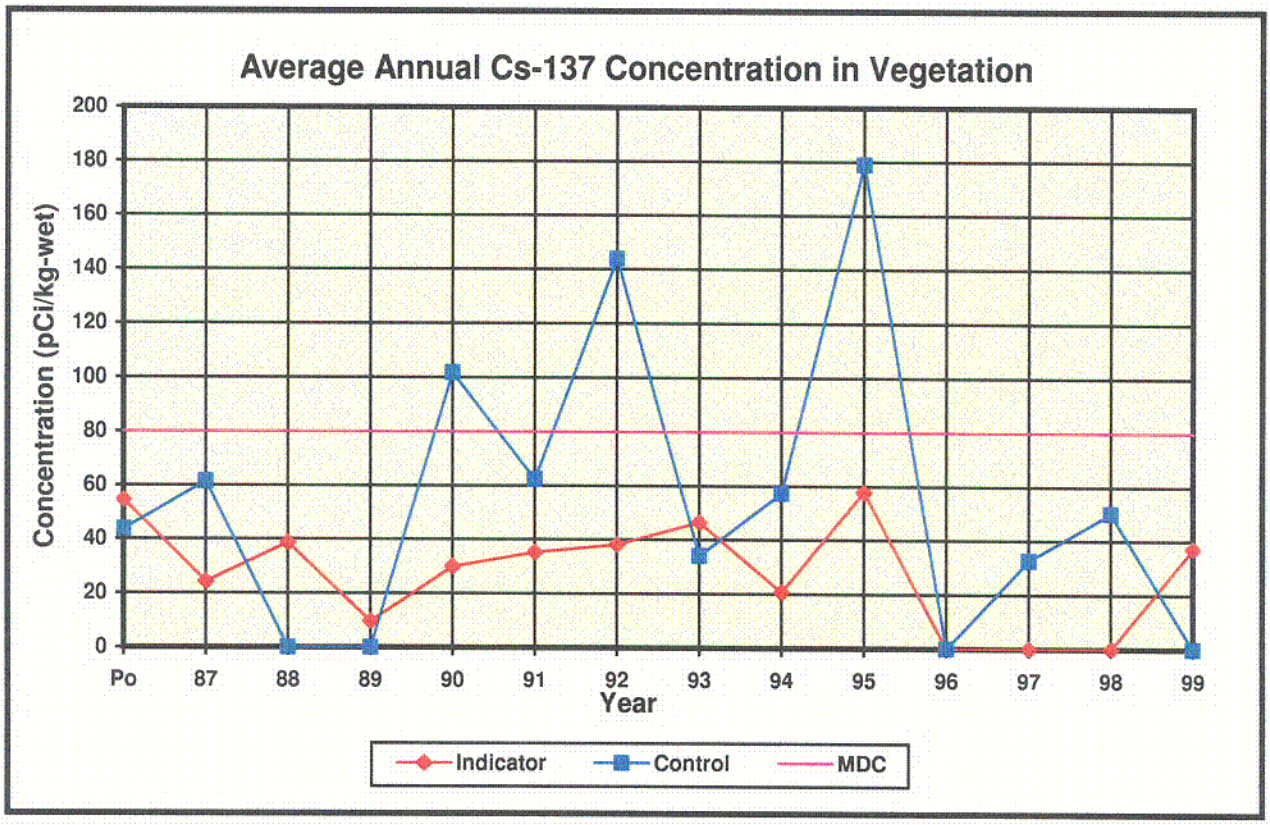


Table 4.5-1

Average Annual Cs-137 Concentration in Vegetation

Year	Indicator (pCi/kg-wet)	Control (pCi/kg-wet)
Pre-op	54.6	43.7
1987	24.4	61.5
1988	38.7	0.0
1989	9.7	0.0
1990	30.0	102.0
1991	35.3	62.4
1992	38.1	144.0
1993	46.4	34.1
1994	20.7	57.4
1995	57.8	179.0
1996	0	0
1997	0	32.6
1998	0	50.1
1999	37.2	0

c8

4.6 River Water

Surface water from the Savannah River is obtained at three locations using automatic samplers. Small quantities are drawn at intervals not exceeding a few hours. The samples drawn are collected monthly; quarterly composites are produced from the monthly collections.

The collection points consist of a control location (Station 82) which is located about 0.4 miles upriver of the plant intake structure, an indicator location (Station 83) which is located about 0.4 miles downriver of the plant discharge structure, and a special location (Station 84) which is located approximately 1.3 miles downriver of the plant discharge structure. A statistically significant increase in the concentrations found in samples collected at the indicator station compared to those collected at the control station could be indicative of plant releases. Concentrations found at the special station are more likely to represent the activity in the river as a whole, which might include plant releases combined with those from other sources along the river.

A gamma isotopic analysis is conducted on each monthly sample. As in all previous years, there were no gamma emitting radionuclides of interest detected in the 1999 river water samples.

Each quarterly composite is analyzed for tritium. As indicated in Table 3-1, the average concentration found at the indicator station was 1616 pCi/l greater than that found at the control station. This difference is statistically discernible since it is greater than the calculated MDD of 1079 pCi/l. On this basis, a contribution from the plant to the tritium levels found at the indicator station cannot be ruled out. At the special station, the results ranged from 679 pCi/l to 959 pCi/l with an average of 859 pCi/l. The MDC for tritium in river water is 3000 pCi/l and the RL is 30,000 pCi/l.

The potential dose from 1616 pCi/l of tritium in river water (the amount that can be attributed to the plant) to the most limiting member of the public was calculated using the methodology and parameters of "Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance With 10 CFR Part 50, Appendix I," NRC Regulatory Guide 1.109, Revision 1, October 1977. Because the radiological significance of tritium on drinking water is evaluated at the drinking water treatment locations (finished drinking water indicator stations), the river water samples are evaluated only for the consumption of fish taken from the river. An adult who consumed 21 kg/yr of fish taken at the indicator station would receive a potential dose of approximately 0.0032 mrem in a year. This dose is about 0.1% of the annual limit for liquid releases to a member of the public as specified by ODCM 2.1.3. Although calculable, this dose is insignificant with respect to regulatory limits.

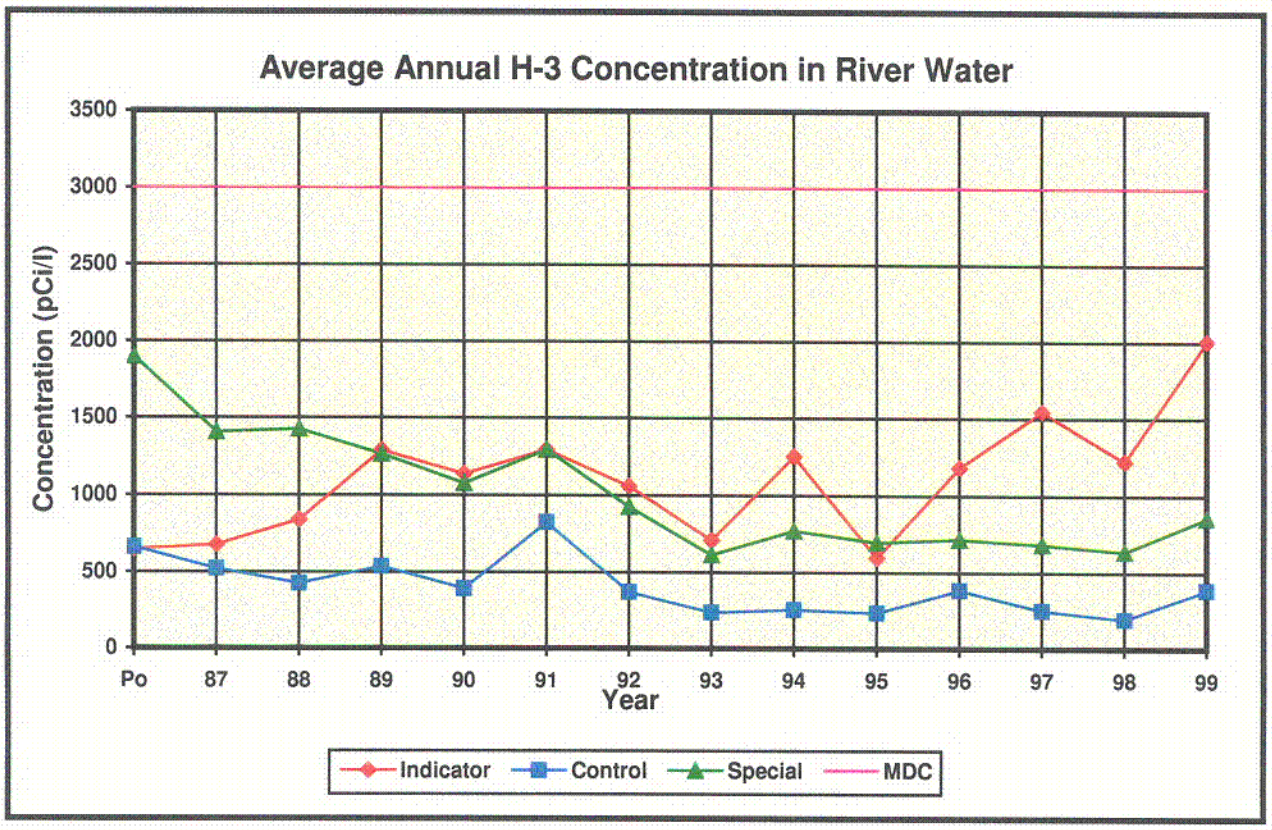
The historical trending of the average tritium concentrations found at the special, indicator and control stations along with the MDC for tritium is plotted on Figure 4.6-1. The data for the plot is listed in Table 4.6-1. Also included in the table are data from the calculated difference between the indicator and control stations; the MDD between the indicator and control stations; and the total liquid releases of tritium from the plant.

There does not appear to be any good correlation between the plant tritium releases and the differential amount found in the river between the indicator and control stations. The average concentration at the indicator station and its increase over that at the control station for 1999 are about the same as in previous years of operation.

In the first two years of operation, the tritium concentration at the special station was somewhat greater than that at the indicator station. Whereas in recent years, the level at the special station has generally become less than the level at the indicator station.

The annual downriver survey of the Savannah River showed that river water is not being used for purposes of drinking or irrigation for at least 100 miles downriver (discussed in Section 4.1).

Figure 4.6-1



C9

Table 4.6-1

Average Annual H-3 Concentration in River Water

Year	Special (pCi/l)	Indicator (pCi/l)	Control (pCi/l)	Difference Between Indicator and Control (pCi/l)	MDD (pCi/l)	Annual Site Tritium Released (Ci)
Pre-op	1900	650	665	-15	145	NA
1987	1411	680	524	156	416	321
1988	1430	843	427	416	271	390
1989	1268	1293	538	755	518	918
1990	1081	1142	392	750	766	1172
1991	1298	1299	828	471	626	1094
1992	929	1064	371	693	714	1481
1993	616	712	238	474	1526	761
1994	774	1258	257	1001	2009	1052
1995	699	597	236	361	766	968
1996	719	1187	387	800	2147	1637
1997	686	1547	254	1293	1566	1449
1998	640	1226	196	1030	1313	1669
1999	859	2005	389	1616	1079	1674

4.7 Drinking Water

Samples are collected at a control location (Station 80 - the Augusta Water Treatment Plant in Augusta, Georgia located about 56 river miles upriver), and at two indicator locations (Station 87 - the Beaufort-Jasper County Water Treatment Plant near Beaufort, South Carolina, 112 river miles downriver; and Station 88 - the Cherokee Hill Water Treatment Plant near Port Wentworth, Georgia, 122 river miles downriver). These upriver and downriver distances in river miles are the distances from the plant to the point on the river where water is diverted to the intake for each of these water treatment plants.

Water samples are taken near the intake of each water treatment plant (raw drinking water) using automatic samplers that take periodical small aliquots from the stream. These composite samples are collected monthly along with a grab sample of the processed water coming from the treatment plants (finished drinking water). Quarterly composites are made from these monthly collections for both raw and processed river water. Gross beta and gamma isotopic analyses are performed on each of the monthly samples while tritium analysis is conducted on the quarterly composites. An I-131 analysis is not required to be conducted on these samples, since the dose calculated from the consumption of water is less than 1 mrem per year (see ODCM Table 4-1). However, an I-131 analysis is conducted on each of the monthly finished water grab samples, since a drinking water pathway exists.

Provided in Figures 4.7-1 and 4.7-2 and Tables 4.7-1 and 4.7-2, are the historical trends of the average gross beta concentrations found in the monthly collections of raw and finished drinking water.

For 1999 the indicator station average gross beta concentration in the raw drinking water was 0.27 pCi/l greater than the average gross beta concentration at the control station. This difference is not statistically discernible, since it is less than the MDD of 1.6 pCi/l.

For 1999, the indicator station average gross beta concentration in the finished drinking water was 3.23 pCi/l, which was 0.02 pCi/l greater than the average gross beta concentration at the control station. This difference is less than the MDD of 1.6 pCi/l and not statistically discernible. The gross beta concentrations at the indicator stations ranged from 1.0 to 9.3 pCi/l while the concentrations at the control station ranged from 1.4 to 6.3 pCi/l. Although the indicator station concentration is the same as that measured in 1998, concentrations for these two years are higher than gross beta results for finished drinking water during previous years of plant operation. However, this concentration is only slightly higher than gross beta concentrations found during preoperation. Further, the concentration of 3.23 pCi/l is less than the required MDC of 4.0 pCi/l. There is no RL for gross beta in drinking water.

Figure 4.7-1

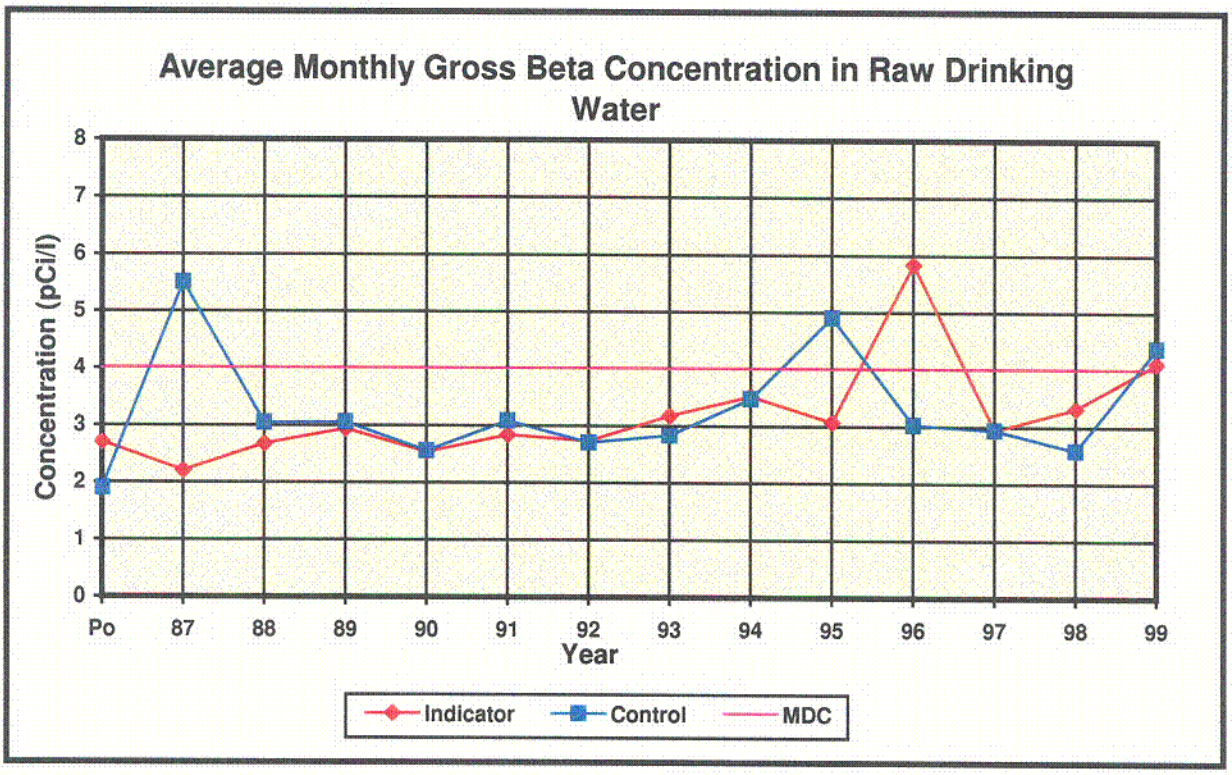


Table 4.7-1

Average Monthly Gross Beta Concentration in Raw Drinking Water

Period	Indicator (pCi/l)	Control (pCi/l)
Pre-op	2.70	1.90
1987	2.20	5.50
1988	2.67	3.04
1989	2.93	3.05
1990	2.53	2.55
1991	2.83	3.08
1992	2.73	2.70
1993	3.17	2.83
1994	3.51	3.47
1995	3.06	4.90
1996	5.83	3.02
1997	2.93	2.94
1998	3.31	2.58
1999	4.10	4.37

C10

Figure 4.7-2

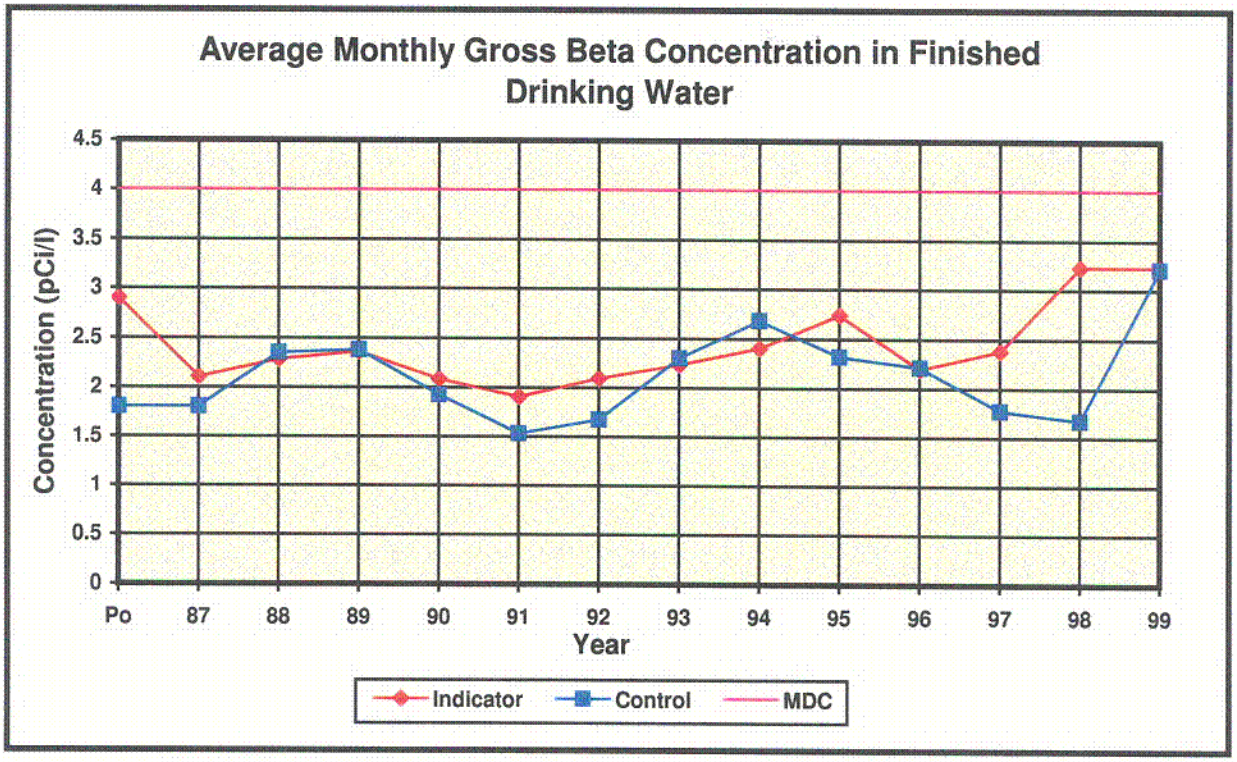


Table 4.7-2

Average Monthly Gross Beta Concentration in Finished Drinking Water

Period	Indicator (pCi/l)	Control (pCi/l)
Pre-op	2.90	1.80
1987	2.10	1.80
1988	2.28	2.35
1989	2.36	2.38
1990	2.08	1.92
1991	1.90	1.53
1992	2.09	1.67
1993	2.23	2.30
1994	2.40	2.68
1995	2.74	2.32
1996	2.19	2.21
1997	2.38	1.77
1998	3.23	1.67
1999	3.23	3.21

C11

As provided in Table 3-1, there were no positive results during 1999 for the radionuclides of interest from the gamma isotopic analysis of the monthly collections for both raw and finished drinking water. Only one positive result has been found since operation began. Be-7 was found at a concentration of 68.2 pCi/l in the sample collected for September 1987 at Station 87. During preoperation Be-7 was found in about 5% of the samples at concentrations ranging from 50 to 80 pCi/l. The MDC assigned for Be-7 in water is 124 pCi/l. Also during preoperation, Cs-134 and Cs-137 were detected in about 7% of the samples at concentrations on the order of their MDCs which are 15 and 18 pCi/l, respectively.

I-131 was detected in finished drinking water in 1997 at levels near the MDC. This was the first occurrence for detecting I-131 in finished drinking water since operation began. During preoperation, it was detected in only one of 73 samples at a concentration of 0.77 pCi/l at Port Wentworth. The MDC and RL for I-131 in drinking water are 1and 2 pCi/l, respectively.

Figures 4.7-3 and 4.7-4 and Tables 4.7-3 and 4.7-4 provide historical trending for the average tritium concentrations found in the quarterly composites of raw and finished drinking water collected at the indicator and control stations. The tables also list the calculated differences between the indicator and control stations, and list the MDDs between these two station groups.

The graphs and tables show that the tritium concentrations in the drinking water samples, both raw and finished, have been gradually trending downward since 1988. The small increase in average concentrations at the indicator stations for 1991 and 1992 reflect the impact of the inadvertent release from SRS of 7,500 Ci of tritium to the Savannah River about 10 miles downriver of VEGP, in December 1991 (SRS release data was obtained from "Release of 7,500 Curies of Tritium to the Savannah River from the Savannah River Site", Georgia Department of National Resources, Environmental Protection Division, Environmental Radiation Program, January 1992).

The 1999 raw drinking water indicator station tritium was less than approximately 38% of that found in preoperation samples and the first three years of operation. The finished drinking water indicator station tritium was less than approximately 36% of that found in preoperation and the first three years of operation. An "NA" in the MDD columns of Tables 4.7-3 and 4.7-4 indicates that an MDD could not be calculated between the indicator and control stations.

In 1999, an MDD was not applicable between the raw drinking water control and indicator stations because there was no control station sample with a positive tritium reading. No MDD was calculated between the finished drinking water control and indicator stations because there was only one control station sample with a positive tritium reading. Since an MDD could not be calculated, the indicator station sample average tritium concentration in finished water was compared with the control station tritium concentration using a modified t-test. It was determined that there was no statistically discernible difference between the indicator and control station finished drinking water samples.

Figure 4.7-3

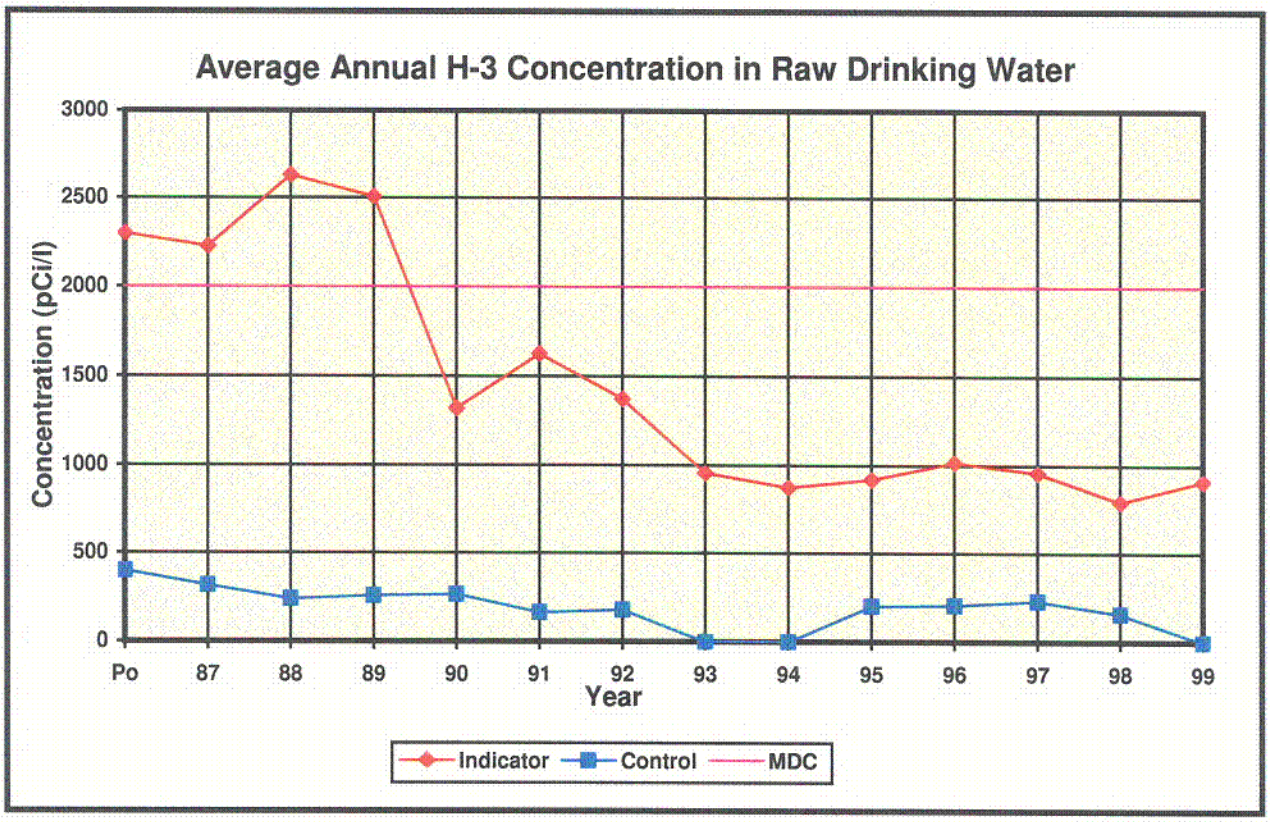


Table 4.7-3
Average Annual H-3 Concentration in Raw Drinking Water

Period	Indicator (pCi/l)	Control (pCi/l)	Difference Between Indicator and Control (pCi/l)	MDD (pCi/l)
Pre-op	2300	400	1900	
1987	2229	316	1913	793
1988	2630	240	2390	580
1989	2508	259	2249	1000
1990	1320	266	1054	572
1991	1626	165	1461	834
1992	1373	179	1194	353
1993	955	0	955	NA
1994	871	0	871	NA
1995	917	201	716	NA
1996	1014	207	807	151
1997	956	230	726	61
1998	791	160	631	NA
1999	908	0	908	NA

C12

Figure 4.7-4

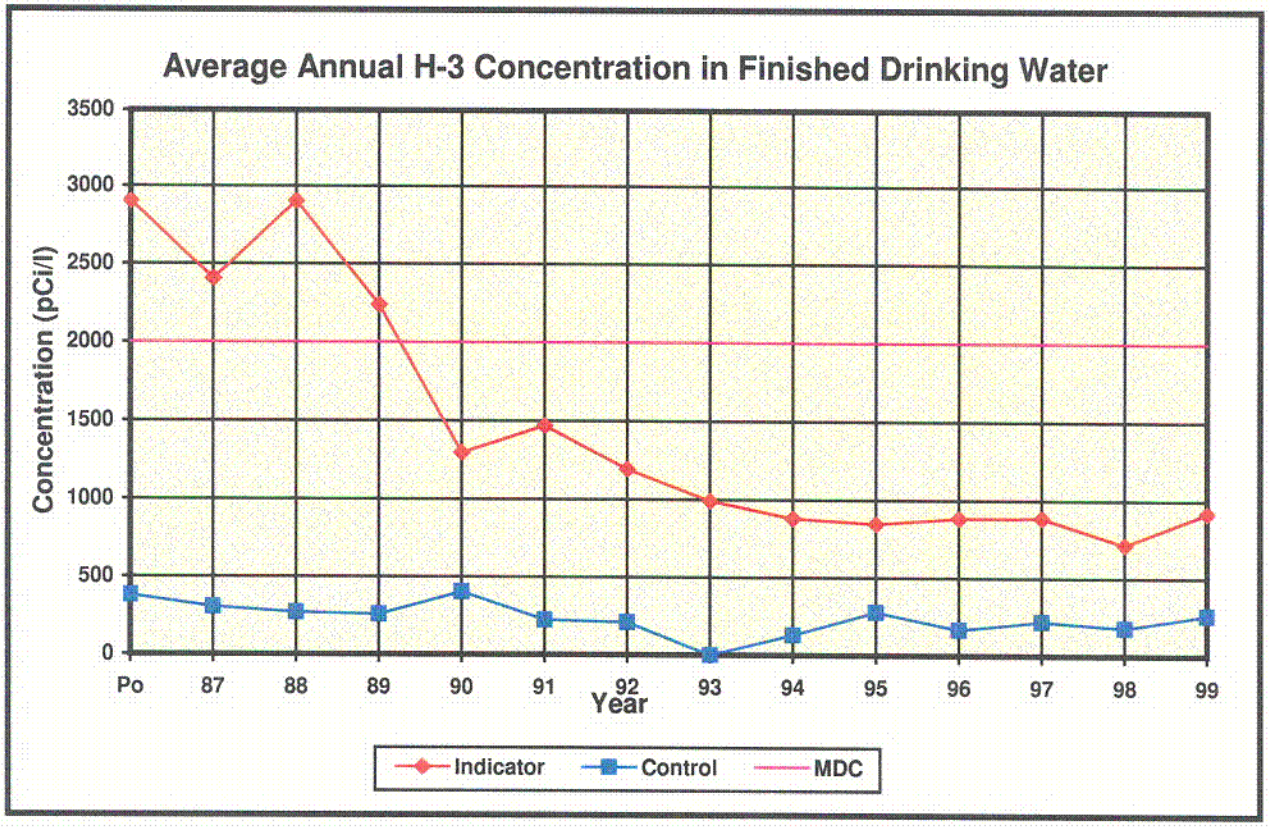


Table 4.7-4
Average Annual H-3 Concentration in Finished Drinking Water

Period	Indicator (pCi/l)	Control (pCi/l)	Difference Between Indicator and Control (pCi/l)	MDD (pCi/l)
Pre-op	2900	380	2520	
1987	2406	305	2101	1007
1988	2900	270	2630	830
1989	2236	259	1977	627
1990	1299	404	895	1131
1991	1471	225	1246	647
1992	1195	211	984	427
1993	993	0	993	NA
1994	880	131	749	270
1995	847	279	568	NA
1996	884	168	716	NA
1997	887	221	666	383
1998	713	180	533	NA
1999	920	263	657	NA

c13

4.8 Fish

Table 2-1 calls for the collection of at least one sample of any anadromous species of fish in the vicinity of the plant discharge during the spring spawning season, and for the semiannual collection of at least one sample of any commercially or recreationally important species in the vicinity of the plant discharge area and in an area not influenced by plant discharges. Table 2-1 specifies that a gamma isotopic analysis be performed on the edible portions of each sample collected.

As provided in Table 2-2, a 5 mile stretch of the river is generally needed to obtain adequate fish samples. For the semiannual collections, the control location (Station 81) extends from approximately 2 to 7 miles upriver of the plant intake structure, and the indicator location (Station 85) extends from about 1.4 to 7 miles downriver of the plant discharge structure. For anadromous species, all collection points can be considered as indicator stations.

American shad was collected as the anadromous species on March 9, 1999. As in all but two previous years of operation, no radionuclides were detected in 1999 from the gamma isotopic analysis of the anadromous species during the spring spawning season. In 1987, as well as in 1991, Cs-137 was found in a single sample of American shad at concentrations of 10 and 12 pCi/kg-wet, respectively.

The dates and compositions of the semiannual catches at the indicator and control stations during 1999 are shown below.

Date	Indicator	Control
April 13	Channel Catfish Largemouth Bass	Largemouth Bass Channel Catfish
October 12	Channel Catfish Largemouth Bass	Channel Catfish Largemouth Bass

As indicated in Table 3-1, Cs-137 was the only radionuclide found in the semiannual collections of a commercially or recreationally important species of fish. It has been found in all but 3 of the 93 samples collected during operation and in all but 5 of the 32 samples collected during preoperation. As provided in Table 3-1, the average concentration at the indicator station was 627 pCi/kg-wet greater than that at the control station. This difference is not statistically discernible, as it is less than the calculated MDD of 1866 pCi/kg-wet. A discernible difference has not occurred for any year of operation or during preoperation.

Figure 4.8-1 and Table 4.8-1 provide the historical trending of the average concentrations of Cs-137 in units of pCi/kg-wet found in fish samples at the indicator and control stations. No trend is recognized in this data. The MDC and RL for Cs-137 in fish are 150 and 2000 pCi/kg-wet, respectively.

Figure 4.8-1

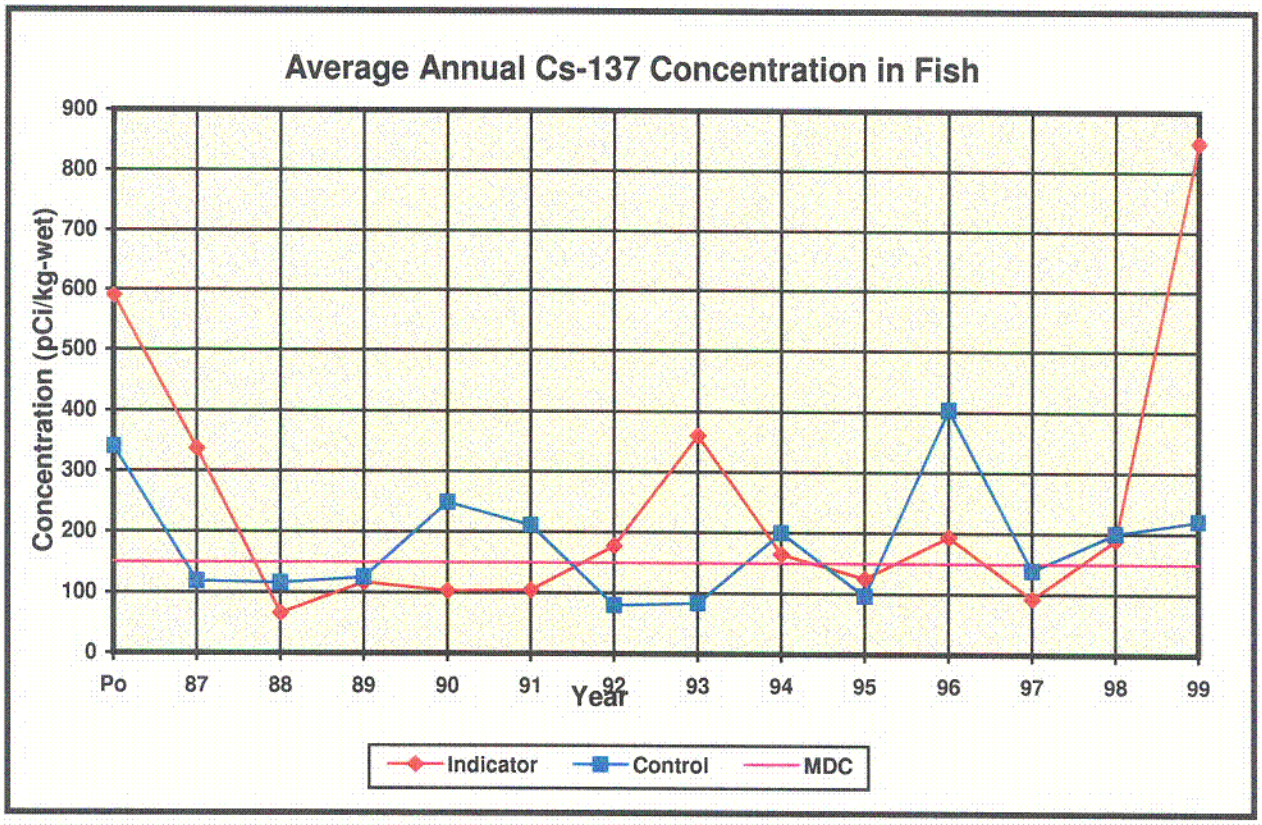


Table 4.8-1

Average Annual Cs-137 Concentration in Fish

Year	Indicator (pCi/kg-wet)	Control (pCi/kg-wet)
Pre-op	590	340
1987	337	119
1988	66	116
1989	117	125
1990	103	249
1991	105	211
1992	178	80
1993	360	84
1994	165	200
1995	125	96
1996	194	404
1997	93	139
1998	190	200
1999	848	221

C14

The only other radionuclide found in fish samples during operation is I-131. In 1989, it was found in one sample at the indicator station at a concentration of 18 pCi/kg-wet. In 1990, it was found in one sample at the indicator station and in one sample at the control station, at concentrations of 13 and 12 pCi/kg-wet, respectively. The MDC assigned to I-131 in fish is 53 pCi/kg-wet.

During preoperation, Cs-134 was found in two of the 17 samples collected at the control station at concentrations of 23 and 190 pCi/kg-wet. The MDC and RL for Cs-134 are 130 and 1000 pCi/kg-wet, respectively. Nb-95 was also found in one of the control station samples at a concentration of 34 pCi/kg-wet. The assigned MDC and calculated RL for Nb-95 are 50 and 70,000 pCi/kg-wet, respectively.

4.9 Sediment

Sediment was collected along the shoreline of the Savannah River on April 5 and October 5, 1999 at Stations 81 and 83. Station 81 is a control station located about 2.5 miles upriver of the plant intake structure while Station 83 is an indicator station located about 0.6 miles downriver of the plant discharge structure. A gamma isotopic analysis was performed on each sample. The three radionuclides identified in 1999 samples were Be-7, Co-60 and Cs-137.

For Be-7, the average level at the indicator station during 1999 was 107 pCi/kg-dry less than that at the control station; however, this difference is not statistically discernible since it is less than the calculated MDD of 2671 pCi/kg-dry. There continues to be no statistically discernible difference between the indicator and control stations for Be-7 and on this basis its presence at the indicator station is not attributed to plant releases.

For Cs-137, the average concentration at the indicator station during 1999 was 100 pCi/kg-dry greater than that at the control station. This difference is not statistically discernible, as it is less than the MDD of 251 pCi/l. The Cs-137 level at the indicator station has averaged nearly 150 pCi/kg-dry greater than that at the control station over the entire period of operation. During preoperation, the Cs-137 was 170 pCi/kg-dry greater at the indicator station than at the control station.

For Co-60, the average concentration at the indicator station in 1999 was 49.5 pCi/kg dry. No MDD between the control and indicator stations could be calculated because there was no detectable concentration of Co-60 at the control station for 1999.

The potential dose from the Co-60 detected at the indicator station to the most limiting member of the public was calculated using the methodology and parameters of "Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance With 10 CFR Part 50, Appendix I," NRC Regulatory Guide 1.109, Revision 1, October 1977. The total body dose to a teenager from direct radiation was determined to be approximately 0.002 mrem in a year. This dose is about 0.08% of the annual limit for liquid releases to a member of the public as specified by ODCM 2.1.3. Although calculable, this dose is insignificant with respect to regulatory limits.

The historical average concentrations of Be-7, Co-58, Co-60, and Cs-137 in sediment are plotted in Figures 4.9-1 through 4.9-4 along with listings of their concentrations in Tables 4.9-1 through 4.9-4. The concentrations of the solely man-made nuclides (Co-58, Co-60, & Cs-137) are consistent with past average concentrations. No pattern has been detected. Be-7, produced by man and nature, is also within the range that is typically seen.

During preoperation, Zr-95, Nb-95, Cs-134, and Ce-141 were detected in at least one of the control station samples and Nb-95 was detected in one of the indicator station samples. Be-7 and Cs-137 were found in several of the samples. The concentrations of these preoperational nuclides were on the order of their respective MDC values. The presence of these preoperational nuclides could be attributed to atmospheric weapons testing and the Chernobyl incident.

Mn-54 and I-131 were found sporadically over several years of operation. A summary of the positive results for these nuclides along with their applicable MDC's is provided in Table 4.9-5.

Figure 4.9-1

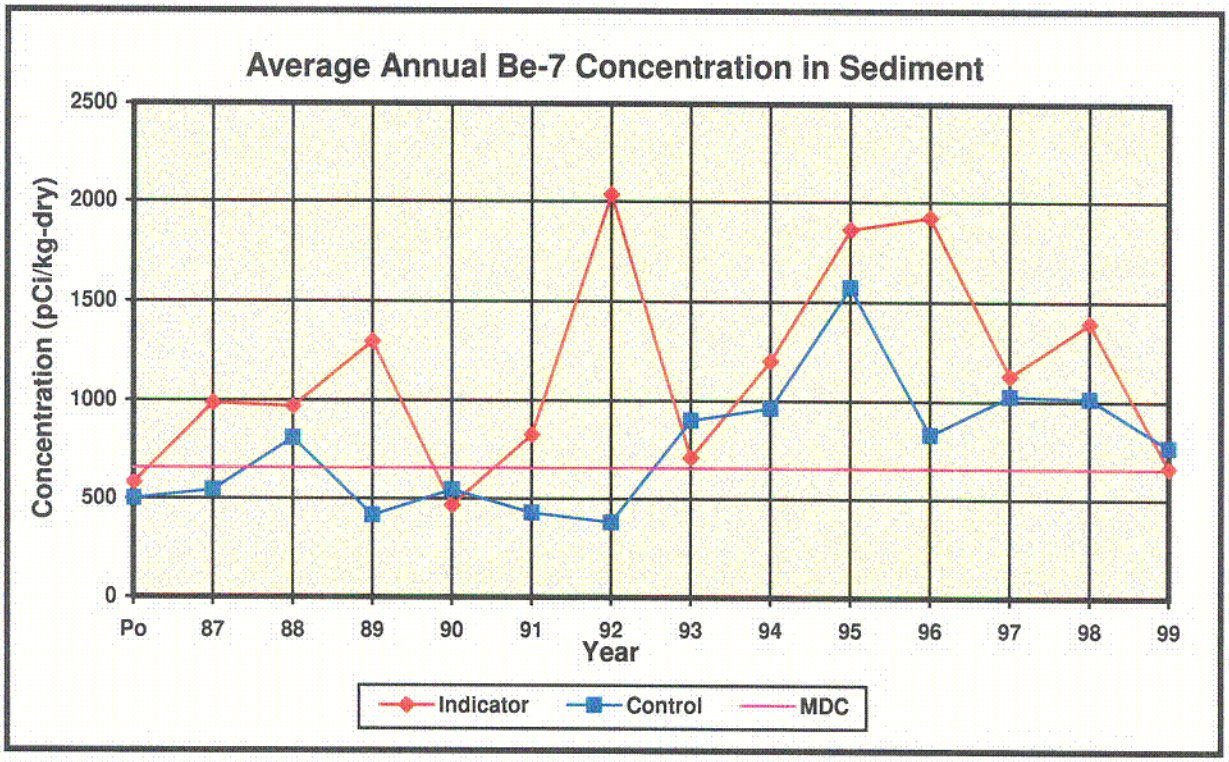


Table 4.9-1

Average Annual Be-7 Concentration in Sediment

MDC=655 pCi/kg-dry		
Year	**Indicator (pCi/kg-dry)**	**Control (pCi/kg-dry)**
Pre-op	580	500
1987	987	543
1988	970	810
1989	1300	415
1990	465	545
1991	826	427
1992	2038	380
1993	711	902
1994	1203	964
1995	1865	1575
1996	1925	831
1997	1130	1028
1998	1396	1016
1999	662	769

C15

Figure 4.9-2

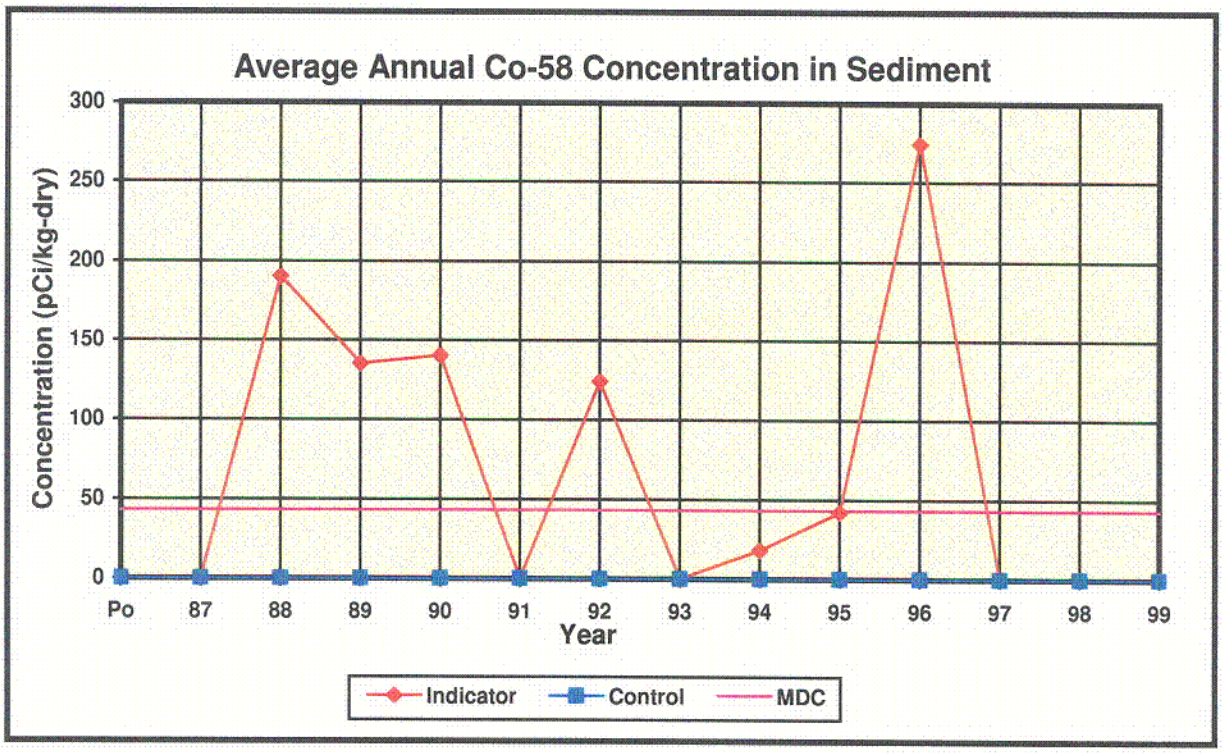


Table 4.9-2

Average Annual Co-58 Concentration in Sediment

MDC=43 pCi/kg-dry		
Year	**Indicator (pCi/kg-dry)**	**Control (pCi/kg-dry)**
Pre-op	0	0
1987	0	0
1988	190	0
1989	135	0
1990	140	0
1991	0	0
1992	124	0
1993	0	0
1994	18.4	0
1995	42.4	0
1996	274	0
1997	0	0
1998	0	0
1999	0	0

C16

Figure 4.9-3

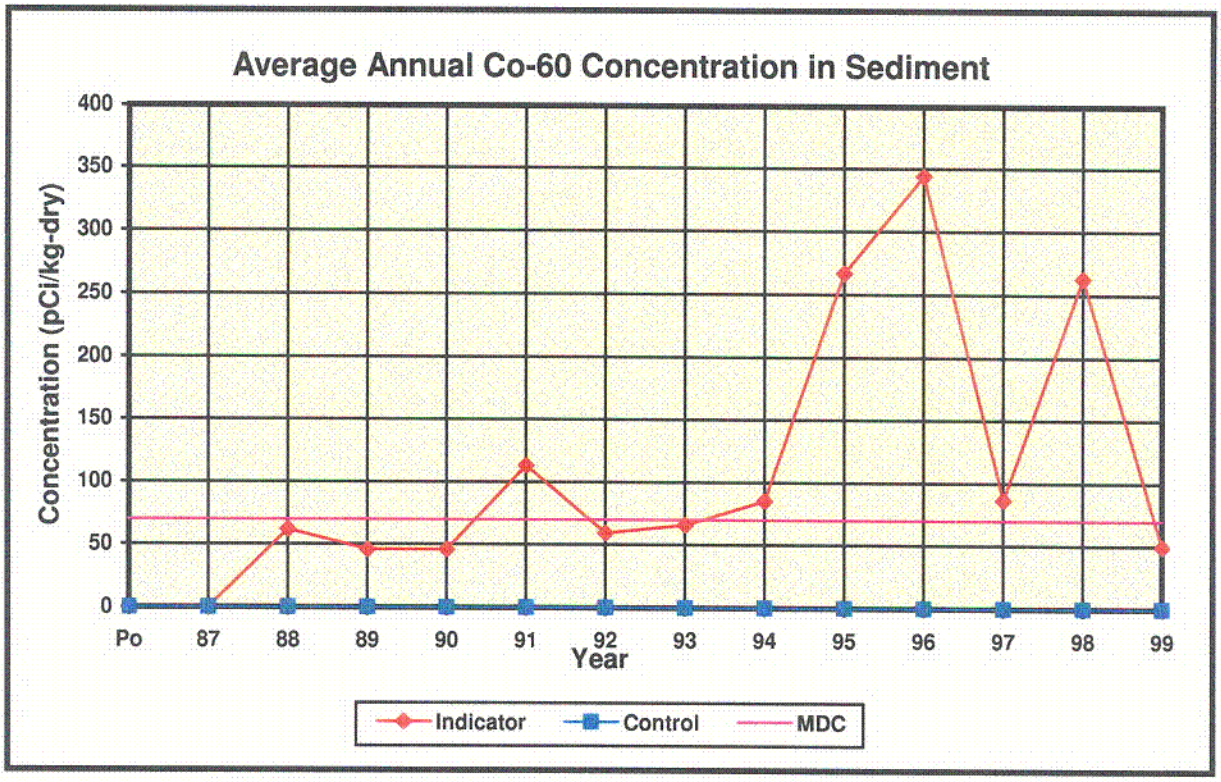


Table 4.9-3

Average Annual Co-60 Concentration in Sediment

MDC=70 pCi/kg-dry		
Year	**Indicator (pCi/kg-dry)**	**Control (pCi/kg-dry)**
Pre-op	0	0
1987	0	0
1988	62	0
1989	46	0
1990	46	0
1991	113	0
1992	59.5	0
1993	65.9	0
1994	85.2	0
1995	267	0
1996	344	0
1997	86	0
1998	263	0
1999	49.5	0

C17

Figure 4.9-4

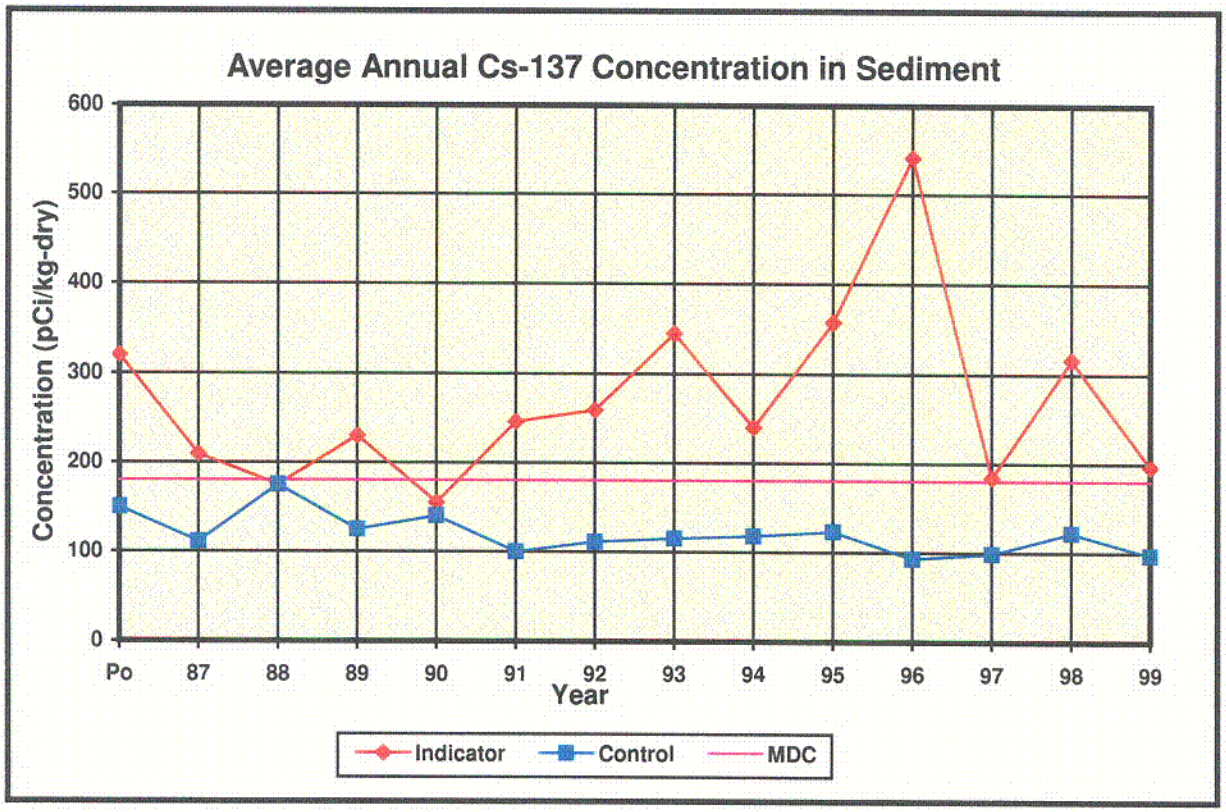


Table 4.9-4

Average Annual Cs-137 Concentration in Sediment

MDC=180 pCi/kg		
Year	**Indicator (pCi/kg)**	**Control (pCi/kg)**
Pre-op	320	150
1987	209	111
1988	175	175
1989	230	125
1990	155	140
1991	246	100
1992	259	111
1993	345	115
1994	240	118
1995	357	123
1996	541	93
1997	184	98
1998	316	122
1999	197	97

C18

Table 4.9-5

Additional Sediment Nuclide Concentrations

Nuclide	YEAR	Indicator (pCi/kg-dry)	Control (pCi/kg-dry)	MDC (pCi/kg-dry)
Mn-54	1988	22	0	42
	1989	18	0	
	1994	32	0	
I-131	1992	194	20	53
	1994	51	41	

5.0 INTERLABORATORY COMPARISON PROGRAM

In accordance with ODCM 4.1.3, the EL participates in an ICP which satisfies the requirements of Regulatory Guide 4.15, Revision 1, "Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment", February 1979. The guide indicates that the ICP is to be conducted with the EPA (Environmental Protection Agency) Environmental Radioactivity Laboratory Intercomparison Studies (Cross-check) Program or an equivalent program, and that the ICP should include all of the determinations (sample medium/radionuclide combinations) that are offered by the EPA and included in the REMP.

The ICP is conducted by Analytics, Inc. of Atlanta, Georgia. Analytics has a documented QA (Quality Assurance) program and the capability to prepare QC (Quality Control) materials traceable to the National Institute of Standards and Technology. The ICP is a third party blind testing program which provides a means to ensure independent checks are performed on the accuracy and precision of the measurements of radioactive materials in environmental sample matrices. Analytics supplies the crosscheck samples to the EL which performs the laboratory analyses in a normal manner. Each of the specified analyses is performed three times. The results are then sent to Analytics who performs an evaluation which may be helpful to the EL in the identification of instrument or procedural problems.

The accuracy of each result is measured by the normalized deviation, which is the ratio of the reported average less the known value to the total error. The total error is the square root of the sum of the squares of the uncertainties of the known value and of the reported average. The uncertainty of the known value includes all analytical uncertainties (counting statistics, calibration uncertainties, chemical yield etc.). The uncertainty of the reported average is the standard deviation of the analysis results performed by the EL. The precision of each result is measured by the coefficient of variation, which is defined as the standard deviation divided by the reported average. An investigation is undertaken whenever the absolute value of the normalized deviation is greater than three or whenever the coefficient of variation is greater than 15% for all radionuclides other than Cr-51 and Fe-59. For Cr-51 and Fe-59, an investigation is undertaken when the coefficient of variation exceeds the values shown as follows:

Nuclide	Concentration (pCi/Liter)	Total Sample Activity (pCi)	Percent Coefficient of Variation
Cr-51	<300	NA	25
Cr-51	NA	>1000	25
Cr-51	>300	<1000	15
Fe-59	<80	NA	25
Fe-59	>80	NA	15

As required by ODCM 4.1.3.3 and 7.1.2.3, a summary of the results of the EL's participation in the ICP is provided in Table 5-1 for: the gross beta analysis of an air filter; the gamma isotopic analysis of an air filter, milk, and water samples; and the tritium analysis of water samples. Delineated in this table for each of the

media/analysis combinations, are: the specific radionuclides; Analytics' preparation dates; the known values with their uncertainties supplied by Analytics; the reported averages with their standard deviations; and the resultant normalized deviations and coefficients of variation expressed as a percentage. Since 1997, Co-58 has not been available to Analytics, Inc., from radionuclide suppliers. Therefore, Co-58 was not included in the crosscheck samples supplied to the EL by Analytics, Inc. For this reason, no results for Co-58 were included in Table 5-1 for gamma isotopic analyses for the air filter, milk or water samples.

It may be seen from Table 5-1 that of the 50 analyses performed, all results were satisfied for normalized deviation, with one exception. The analysis of Cs-134 in an air filter prepared on 09/23/99 exceeded the normalized deviation acceptance criterion of three. None of the analysis results exceeded the acceptance criteria for the coefficient of variation. The outcome of the investigation into the result that failed to meet ICP acceptance criteria is provided in the following paragraph.

The activity recovery for the gamma analysis of Cs-134 in an air filter for the sample prepared on 09/23/99 exceeded the accuracy control limit. A similar problem was identified for Cs-134 in water samples in 1997. Investigation revealed that the software was summing the two major gamma peaks for Cs-134 in the water samples and causing the activity in the sample to be underestimated. This problem was corrected by developing curves to correct for the summing loss in liquid samples. This approach was determined to be adequate for the air filter geometry as well.

TABLE 5-1 (SHEET 1 of 3)

INTERLABORATORY COMPARISON PROGRAM RESULTS

GROSS BETA ANALYSIS OF AN AIR FILTER (pCi/filter)

Analysis or Radionuclide	Date Prepared	Known Value	Uncertainty of Known	Reported Average	Standard Deviation	Normalized Deviation	Percent Coef of Variation
Gross Beta	09/23/99	52	1	54	2.55	0.73	4.72

GAMMA ISOTOPIC ANALYSIS OF AN AIR FILTER (pCi/filter)

Analysis or Radionuclide	Date Prepared	Known Value	Uncertainty of Known	Reported Average	Standard Deviation	Normalized Deviation	Percent Coef of Variation
Cr-51	09/23/99	63	1	65	9.78	0.20	15.05
Mn-54	09/23/99	72	1.33	71	3.88	-0.24	5.46
Fe-59	09/23/99	33	0.67	37	3.19	1.23	8.62
Co-60	09/23/99	55	1	50	2.21	-2.06	4.42
Zn-65	09/23/99	70	1.33	73	5.14	0.57	7.03
Cs-134	09/23/99	41	0.67	32	1.67	-5.00	5.22
Cs-137	09/23/99	93	1.67	93	3.85	0.00	4.14
Ce-141	09/23/99	84	1.33	77	2.93	-2.18	3.80

GAMMA-ISOTOPIC ANALYSIS OF A MILK SAMPLE (pCi/liter)

Analysis or Radionuclide	Date Prepared	Known Value	Uncertainty of Known	Reported Average	Standard Deviation	Normalized Deviation	Percent Coef of Variation
Cr-51	03/18/99	306	5.00	309	39.57	0.08	12.81
	06/24/99	215	3.67	200	40.01	-0.37	20.00
Mn-54	03/18/99	117	2.00	116	7.66	- 0.13	6.60
	06/24/99	85	1.33	83.4	7.38	- 0.21	8.84
Fe-59	03/18/99	61	1	78.5	12.28	1.42	15.65
	06/24/99	48	0.67	59.4	9.95	1.14	16.76
Co-60	03/18/99	139	2.33	142	6.81	0.42	4.80
	06/24/99	214	3.67	215	8.94	0.10	4.16

TABLE 5-1 (SHEET 2 of 3)

INTERLABORATORY COMPARISON PROGRAM RESULTS

GAMMA-ISOTOPIC ANALYSIS OF A MILK SAMPLE (pCi/liter)

Analysis or Radionuclide	Date Prepared	Known Value	Uncertainty of Known	Reported Average	Standard Deviation	Normalized Deviation	Percent Coef of Variation
Zn-65	03/18/99	150	2.67	158	16.13	0.49	10.21
	06/24/99	122	2	127	14.38	0.34	11.32
Cs-134	03/18/99	88	1.33	79.4	4.58	-1.80	5.76
	06/24/99	115	2	114	5.36	-0.17	4.71
Cs-137	03/18/99	185	3	177	9.44	-0.81	5.33
	06/24/99	188	3	194	9.62	0.60	4.96
Ce-141	03/18/99	136	2.33	134	10.82	-0.18	8.07
	06/24/99	168	2.67	168	11.27	0.00	6.71
I-131	03/18/99	96	1.67	103	8.11	0.85	7.88
	06/24/99	72	1.33	74.7	7.34	0.36	9.82

GROSS BETA ANALYSIS OF WATER SAMPLE (pCi/liter)

Analysis or Radionuclide	Date Prepared	Known Value	Uncertainty of Known	Reported Average	Standard Deviation	Normalized Deviation	Percent Coef of Variation
Gross Beta	03/18/99	201	3.33	223	9.39	2.21	4.21
	06/24/99	290	5	294	11.76	0.31	4.00
	09/23/99	271	4.67	281	9.92	0.91	3.53

TABLE 5-1 (SHEET 3 of 3)

INTERLABORATORY COMPARISON PROGRAM RESULTS

GAMMA ISOTOPIC ANALYSIS OF WATER SAMPLES (pCi/liter)

Analysis or Radionuclide	Date Prepared	Known Value	Uncertainty of Known	Reported Average	Standard Deviation	Normalized Deviation	Percent Coef of Variation
Cr-51	03/18/99	398	6.67	409	83.42	0.13	20.40
	06/24/99	172	3	142	35.72	-0.84	25.00
Mn-54	03/18/99	152	2.67	157	8.88	0.54	5.66
	06/24/99	68	1	63.8	5.73	-0.72	8.98
Fe-59	03/18/99	79	1.33	91.7	14.92	0.85	16.27
	06/24/99	38	0.67	46.9	9.20	0.96	19.62
Co-60	03/18/99	181	3	176	7.77	-0.60	4.41
	06/24/99	171	3	165	7.49	-0.74	4.54
Zn-65	03/18/99	195	3.33	200	15.62	0.31	7.81
	06/24/99	98	1.67	110	14.81	0.81	13.46
Cs-134	03/18/99	114	2	101	5.34	-2.28	5.29
	06/24/99	92	1.67	84.4	5.3	-1.37	6.27
Cs-137	03/18/99	240	4	243	10.91	0.26	4.49
	06/24/99	151	2.67	149	8.17	-0.23	5.48
Ce-141	03/18/99	177	3	173	19.72	-0.20	11.40
	06/24/99	134	2.33	138	9.99	0.39	7.24
I-131	03/18/99	91	1.67	95.6	4.08	1.04	4.27
	06/24/99	68	1	78.1	6.3	1.58	8.07

TRITIUM ANALYSIS OF WATER SAMPLES (pCi/liter)

Analysis or Radionuclide	Date Prepared	Known Value	Uncertainty of Known	Reported Average	Standard Deviation	Normalized Deviation	Percent Coef of Variation
H-3	03/18/99	2698	45	2470	112.42	-1.88	4.55
	06/24/99	9349	156	9910	174.83	2.40	1.76

6.0 CONCLUSIONS

This report confirms the licensee's conformance with the requirements of Chapter 4 of the ODCM during 1999. It provides summaries of data collection activities and a discussion of the results of the laboratory analyses for the samples.

There were four instances in 1999 where the difference between the control and indicator stations was statistically discernible. These four instances are discussed in the following paragraphs.

Tritium was detected in raw drinking water at an average level of 908 pCi/liter. However, the raw drinking water is not consumed; the finished drinking water is consumed, therefore, potential radiological impact should be determined based on sample results for finished drinking water. There was no discernible difference between tritium concentrations in indicator finished drinking water samples and control finished drinking water samples in 1999.

Cs-137 was detected in two of twenty-four indicator station vegetation samples, at an average concentration, for positive results, of 37.2 pCi/kg-wet. If a member of the public in the adult age group, the age group for which the dose would be highest under these circumstances, annually consumed leafy garden vegetation containing Cs-137 at this level, the annual dose to the total body would be 0.129 mrem, which is 0.9% of the regulatory limit.

H-3 was detected in river water samples at an average concentration of 2005 pCi/liter, which was discernible from the concentration found at control river water sample locations. Since the radiological significance of tritium on drinking water is evaluated at the drinking water treatment locations (finished drinking water indicator stations), the river water samples are evaluated only for the consumption of fish taken from the river. The potential total body dose to a member of the public in the adult age group, which is the age group expected to receive the highest annual dose, was calculated. An adult annually consuming fish taken from river water containing tritium at 1616 pCi/l, which is the amount that could attributed to plant activities, would receive an annual total body dose of 0.0032 mrem, which is 0.1% of the regulatory limits.

In sediment, Co-60 was found at the indicator stations in 1999. The average concentration was 49.5 pCi/kg-dry. There was no Co-60 detected in sediment at a control station in 1999, therefore an MDD could not be determined. The activity found at the indicator stations could be indicative of plant releases, therefore a potential dose was calculated. The consequent total body dose to the member of the public expected to receive the highest dose was determined to be approximately 0.002 mrem in a year, or 0.08% of the ODCM limits.

No discernible radiological impact upon the environment or the public as a consequence of plant discharges to the atmosphere and to the river was established for any other REMP samples.