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SOUTHERN COMPANY
Energy to Serve Your World℠

April 21, 2000

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50-366

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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC. 20555

Edwin I. Hatch Nuclear Plant
Annual Radiological Environmental Operating Report for 1999

Gentlemen:

In accordance with Plant Hatch Units 1 and 2 Technical Specifications, Section 5.6.2, Southern Nuclear Operating Company hereby submits the enclosed Annual Radiological Environmental Operating Report for 1999

If you have any questions in this regard, please contact this office at any time.

Sincerely,

H. L. Sumner, Jr.

HLS/RGK:ahl

ENV-00-097

Enclosure: Annual Radiological Environmental Operating Report for 1999

cc: (See next page.)

C001

cc: Southern Nuclear Operating Company
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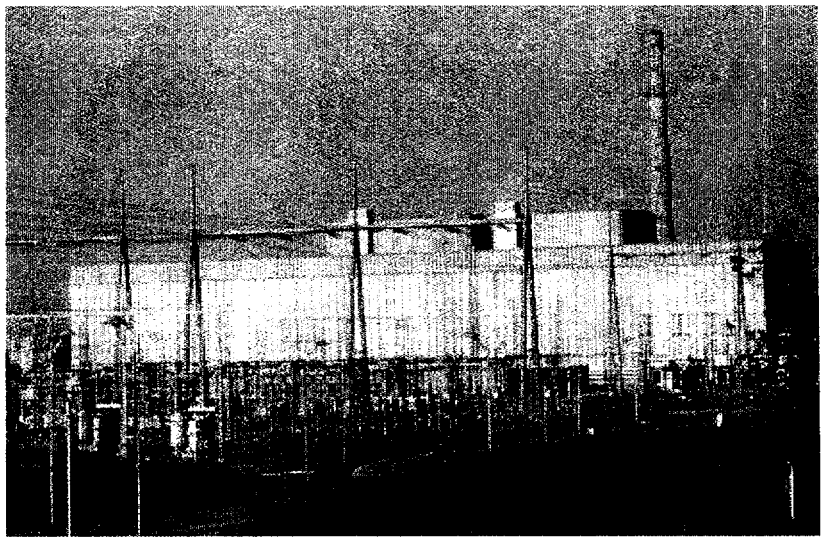
EDWIN I. HATCH NUCLEAR PLANT
ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT FOR 1999



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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
HNP	Edwin I. Hatch Nuclear Plant
ICP	Interlaboratory Comparison Program
MDC	Minimum Detectable Concentration
MDD	Minimum Detectable Difference
NA	Not Applicable
NDM	No Detectable Measurement(s)
NRC	Nuclear Regulatory Commission
ODCM	Offsite Dose Calculation Manual
Po	Preoperation
REMP	Radiological Environmental Monitoring Program
RL	Reporting Level
TLD	Thermoluminescent Dosimeter
TS	Technical Specification

1.0 INTRODUCTION

The Radiological Environmental Monitoring Program (REMP) is conducted in accordance with Chapter 4 of the Offsite Dose Calculation Manual (ODCM). 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 Edwin I. Hatch Nuclear Plant (HNP).

The assessments include comparisons between the 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.

The preoperational stage of the REMP began with the establishment and activation of the environmental monitoring stations in January of 1972. The operational stage of the REMP began on September 12, 1974 with Unit 1 initial criticality.

A description of the REMP is provided in Section 2 of this report. An annual summary of the results of the analyses of REMP samples is provided in Section 3. A discussion of the results, including assessments of any radiological impacts upon the environment, and the results of the land use census and the river survey, are provided 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. The sampling locations (stations) specified by ODCM 4.2 are depicted on maps in Figures 2-1 and 2-2. These maps are keyed to Table 2-2 which delineates the direction and distance of each station from the main stack.

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 3)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Approximate Number of Sample Locations	Sampling and Collection Frequency	Type of Analysis and Frequency
1. Airborne Radioiodine and Particulates	6	Continuous operation of the sampler with sample collection weekly.	Radioiodine canister: I-131 analysis, weekly. Particulate sampler: analyze for gross beta radioactivity not less than 24 hours following filter change, weekly; perform gamma isotopic analysis on affected sample when gross beta activity is 10 times the yearly mean of control samples; and composite (by location) for gamma isotopic analysis, quarterly.
2. Direct Radiation	37	Quarterly	Gamma dose, quarterly.
3. Ingestion			
Milk (a)	1	Biweekly	Gamma isotopic and I-131 analysis, biweekly.
Fish or Clams (b)	2	Semiannually	Gamma isotopic analysis on edible portions, semiannually.
Grass or Leafy Vegetation	3	Monthly during growing season.	Gamma isotopic analysis, monthly. (c)
4. Waterborne			
Surface	2	Composite sample collected monthly. (d)	Gamma isotopic analysis, monthly. Composite (by location) for tritium analysis, quarterly.
Sediment	2	Semiannually.	Gamma isotopic analysis, semiannually.

TABLE 2-1 (SHEET 2 of 3)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Approximate Number of Sample Locations	Sampling and Collection Frequency	Type of Analysis and Frequency
Drinking Water (e & f)	One sample of river water near the intake and one sample of finished water from each of one to three of the nearest water supplies which could be affected by HNP discharges.	River water collected near the intake will be a composite sample; the finished water will be a grab sample. These samples will be collected monthly unless the calculated dose due to consumption of the water is greater than 1 mrem/year; then the collection will be biweekly. The collections may revert to monthly should the calculated doses become less than 1 mrem/year.	I-131 analysis on each sample when biweekly collections are required. Gross beta and gamma isotopic analysis on each sample; composite (by location) for tritium analysis, quarterly.

TABLE 2-1 (SHEET 3 of 3)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Notes:

a. Up to three sampling locations within 5 miles and in different sectors will be used as available. In addition, one or more control locations beyond 10 miles will be used.

b. Commercially or recreationally important fish may be sampled. Clams may be sampled if difficulties are encountered in obtaining sufficient fish samples.

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

d. The composite samples shall be composed of a series of aliquots collected at intervals not exceeding a few hours.

e. If it is found that river water downstream of the plant is used for drinking, drinking water samples will be collected and analyzed as specified herein.

f. A survey shall be conducted annually at least 50 river miles downstream of the plant to identify those who use water from the Altamaha River for drinking.

TABLE 2-2 (SHEET 1 of 2)

RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATIONS

Station Number	Station Type	Descriptive Location	Direction (a)	Distance (a) (miles)	Sample Type
064	Other	Roadside Park	WNW	0.8	Direct Rad
101	Indicator	Inner Ring	N	1.9	Direct Rad
102	Indicator	Inner Ring	NNE	2.5	Direct Rad
103	Indicator	Inner Ring	NE	1.8	Airborne Rad Direct Rad
104	Indicator	Inner Ring	ENE	1.6	Direct Rad
105	Indicator	Inner Ring	E	3.7	Direct Rad
106	Indicator	Inner Ring	ESE	1.1	Direct Rad Vegetation
107	Indicator	Inner Ring	SE	1.2	Airborne Rad Direct Rad
108	Indicator	Inner Ring	SSE	1.6	Direct Rad
109	Indicator	Inner Ring	S	0.9	Direct Rad
110	Indicator	Inner Ring	SSW	1.0	Direct Rad
111	Indicator	Inner Ring	SW	0.9	Direct Rad
112	Indicator	Inner Ring	WSW	1.0	Airborne Rad Direct Rad Vegetation
113	Indicator	Inner Ring	W	1.1	Direct Rad
114	Indicator	Inner Ring	WNW	1.2	Direct Rad
115	Indicator	Inner Ring	NW	1.1	Direct Rad
116	Indicator	Inner Ring	NNW	1.6	Airborne Rad Direct Rad
170	Control	Upstream	WNW	(c)	River (b)
172	Indicator	Downstream	E	(c)	River (b)
201	Other	Outer Ring	N	5.0	Direct Rad
202	Other	Outer Ring	NNE	4.9	Direct Rad
203	Other	Outer Ring	NE	5.0	Direct Rad
204	Other	Outer Ring	ENE	5.0	Direct Rad
205	Other	Outer Ring	E	7.2	Direct Rad
206	Other	Outer Ring	ESE	4.8	Direct Rad
207	Other	Outer Ring	SE	4.3	Direct Rad
208	Other	Outer Ring	SSE	4.8	Direct Rad
209	Other	Outer Ring	S	4.4	Direct Rad
210	Other	Outer Ring	SSW	4.3	Direct Rad
211	Other	Outer Ring	SW	4.7	Direct Rad
212	Other	Outer Ring	WSW	4.4	Direct Rad
213	Other	Outer Ring	W	4.3	Direct Rad
214	Other	Outer Ring	WNW	5.4	Direct Rad
215	Other	Outer Ring	NW	4.4	Direct Rad
216	Other	Outer Ring	NNW	4.8	Direct Rad
301	Other	Toombs Central School	N	8.0	Direct Rad
304	Control	State Prison	ENE	11.2	Airborne Rad Direct Rad
304	Control	State Prison	ENE	10.3	Milk
309	Control	Baxley Substation	S	10.0	Airborne Rad Direct Rad
416	Control	Emergency News Center	NNW	21.0	Direct Rad Vegetation

TABLE 2-2 (SHEET 2 of 2)

RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATIONS

Notes:

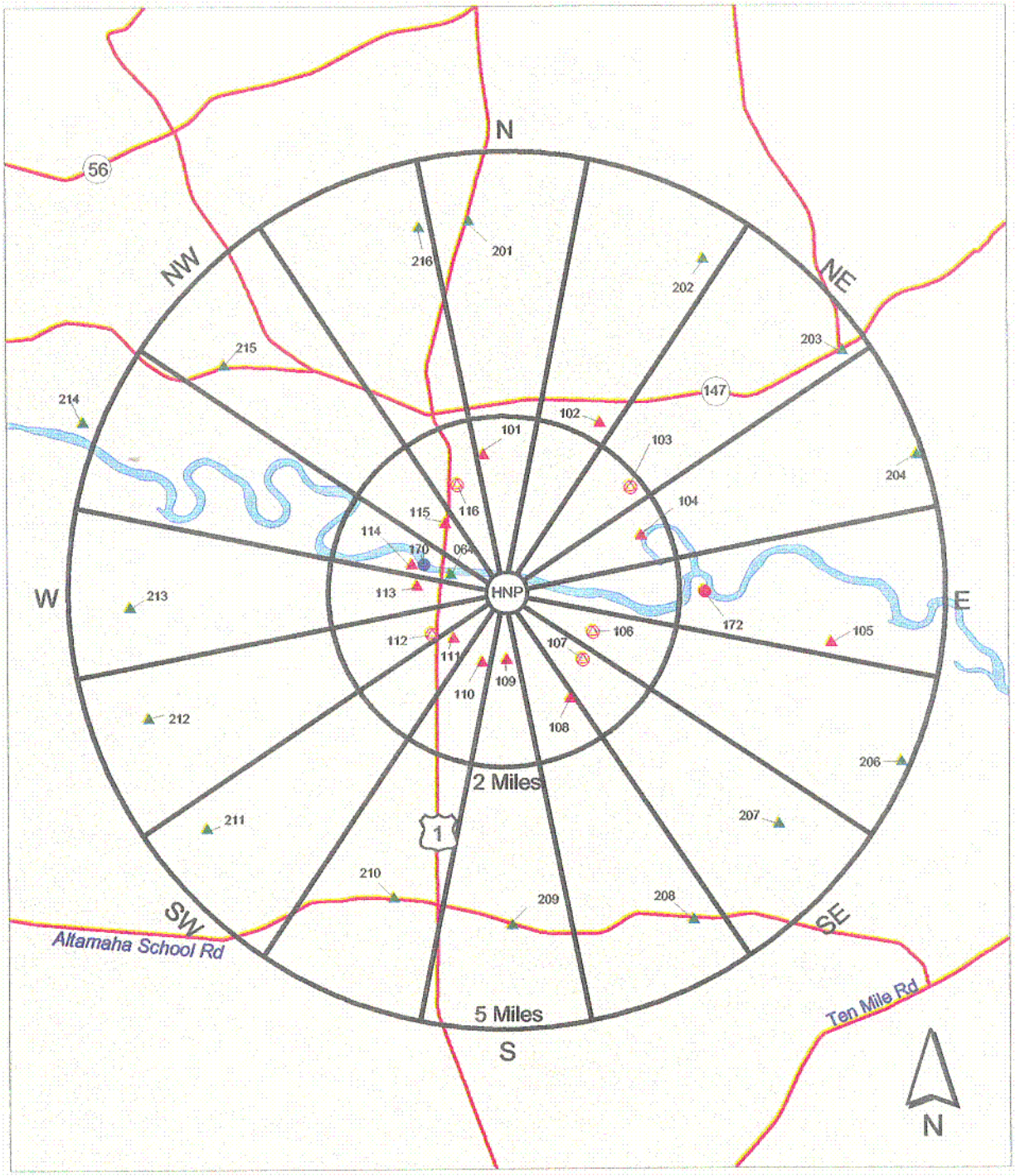
a. Direction and distance are determined from the main stack.

b. River (fish or clams, shoreline sediment, and surface water)

c. Station 170 is located approximately 0.6 river miles upstream of the intake structure for river water, 1.1 river miles for sediment and clams, and 1.5 river miles for fish.

   Station 172 is located approximately 3.0 river miles downstream of the discharge structure for river water, sediment and clams, and 1.7 river miles for fish.

   The locations from which river water and sediment may be taken can be sharply defined. However, the sampling locations for clams often have to be extended over a wide area to obtain a sufficient quantity. High water adds to the difficulty in obtaining clam samples and may also make an otherwise suitable location for sediment sampling unavailable. A stretch of the river of a few miles or so is generally needed to obtain adequate fish samples. The mile locations given above represent approximations of the locations where samples are collected.

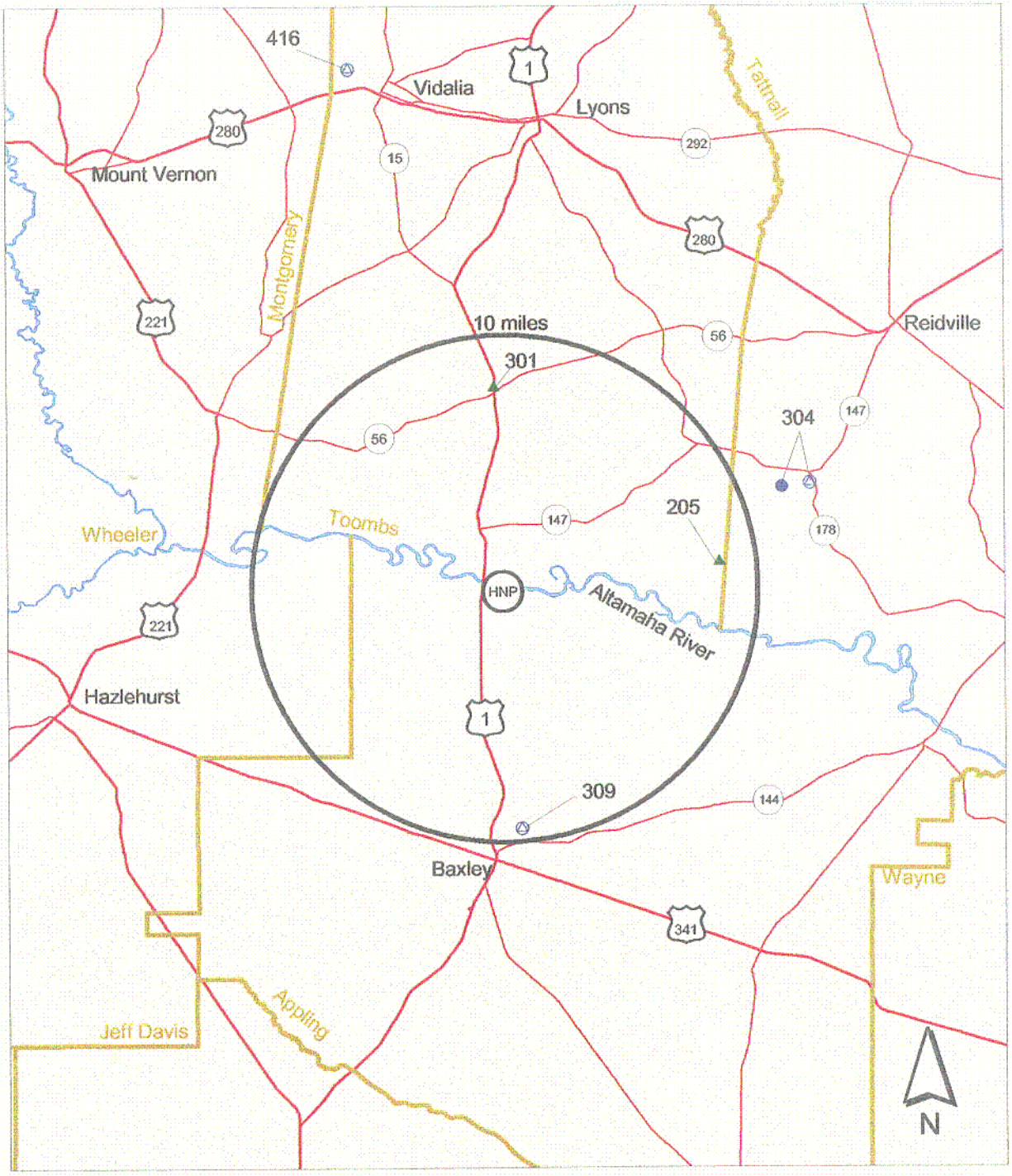


Radiological Environmental Sampling Locations	Indicator	Control	Additional
TLD	▲	▲	▲
Other	●	●	●
TLD & Other	△	△	△

REMP Stations Near the Plant

Figure 2-1

C-1



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

REMP Stations Beyond Six Miles from the Plant

Figure 2-2

C-2

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. Since no naturally occurring radionuclides were found in the plant's effluent releases, only man-made radionuclides are reported as permitted by ODCM 7.1.2.1. Results for samples collected at locations other than control or indicator stations are discussed in Section 4 under the particular sample type.

TABLE 3-1 (SHEET 1 of 4)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Edwin I. Hatch Nuclear Plant, Docket Nos. 50-321 and 50-366
Appling 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	Location with the Highest Annual Mean: Mean (b), Range (Fraction)	Control Locations Mean (b), Range (Fraction)
Airborne Particulates (fCi/m3)	Gross Beta 312	10	21.3 6-46 (208/208)	No. 116 Indicator 1.6 miles, NNW	21.8 7-46 (52/52)	21.3 8-48 (104/104)
	Gamma Isotopic 24					
	Cs-134	50	NDM (c)		NDM	NDM
	Cs-137	60	NDM		NDM	NDM
Airborne Radioiodine (fCi/m3)	I-131 312	70	NDM		NDM	NDM
Direct Radiation (mR/91 days)	Gamma Dose 71	NA (d)	12.8 10.6-16.9 (59/59)	No. 214 (e) Outer Ring 5.4 miles, WNW	16.9 15.9 -17.5 (4/4)	13.2 11.8-14.1 (12/12)
Milk (pCi/l)	Gamma Isotopic 26					
	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 26	1	NA		NDM	NDM

TABLE 3-1 (SHEET 2 of 4)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Edwin I. Hatch Nuclear Plant, Docket Nos. 50-321 and 50-366
Appling 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	Location with the Highest Annual Mean: Mean (b), Range (Fraction)	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	26.9 26.9-26.9 (1/24)	No. 112 Inner Ring 1.0 miles, WSW	26.9 26.9-26.9 (1/12)	NDM
River Water (pCi/l)	Gamma Isotopic 24					
	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 (f)	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 (g)	NDM		NDM	NDM

TABLE 3-1 (SHEET 3 of 4)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Edwin I. Hatch Nuclear Plant, Docket Nos. 50-321 and 50-366
Appling 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	Location with the Highest Annual Mean: Mean (b), Range (Fraction)	Control Locations Mean (b), Range (Fraction)
Fish (pCi/kg-wet)	Gamma Isotopic 8					
	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	22.3 18.2-24.7 (4/4)	No. 172 1.7 miles Downstream	22.3 18.2-24.7 (4/4)	13.5 9.4-17.3 (4/4)
Sediment (pCi/kg-dry)	Gamma Isotopic 4					
	Cs-134	150	NDM		NDM	NDM
	Cs-137	180	92.0 92.0-92.0 (1/2)	No. 170 1.1 miles Upstream	111.8 94.5-129.0 (2/2)	111.8 94.5-129.0 (2/2)

TABLE 3-1 (SHEET 4 of 4)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Edwin I. Hatch Nuclear Plant, Docket Nos. 50-321 and 50-366
Appling County, Georgia

NOTATIONS

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 specified locations that are detectable is placed in parenthesis.

c. No Detectable Measurement(s).

d. Not Applicable.

e. This station is in the outer ring and is not considered an indicator station or a control station. See section 4.3 Direct Radiation for results from the outer ring.

f. If a drinking water pathway were to exist, a MDC of 1 pCi/l would have been used (see Notation c of ODCM Table 4-3).

g. If a drinking water pathway were to exist, a MDC of 2000 pCi/l would have been used (see Notation b of ODCM Table 4-3).

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 which 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 analyses. 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-dry)
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.

Significant upward trends also followed the Chernobyl incident which began on April 26, 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 to 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
DEVIATIONS FROM RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

COLLECTION PERIOD	AFFECTED SAMPLES	DEVIATION	CAUSE	RESOLUTION
2nd Quarter 1999	TLD 104	Direct radiation exposure results for the second quarter were not obtained.	TLDs missing at the end of the quarter.	The TLDs were replaced and relocated to a less conspicuous nearby location.
3rd Quarter 1999	TLD 064	Direct radiation exposure results for the third quarter were not obtained.	TLD results were statistically invalid due to standard deviation for both badges > 1.4.	The TLDs were replaced.
3rd Quarter 1999	TLD 102	Direct radiation exposure results for the third quarter were not obtained.	TLDs missing at mid-quarter.	The TLDs were replaced on 9/7/99, but replacement TLDs results were invalid in that both badge results failed Chauvenet's criterion and could not be used.
3rd Quarter 1999	TLD 116	Direct radiation exposure results for the third quarter were not obtained.	TLDs missing at mid-quarter.	The TLDs were replaced on 8/9/99, but replacement TLDs results were invalid in that both badge results failed Chauvenet's criterion and could not be used.
4th Quarter 1999	TLD 105	Direct radiation exposure results for the fourth quarter were not obtained.	TLDs missing at the end of the quarter.	The TLDs were replaced.
4th Quarter 1999	TLD 110	Direct radiation exposure results for the fourth quarter were not obtained.	TLDs missing at the end of the quarter.	The TLDs were replaced.

4.1 Land Use Census and River Survey

In accordance with ODCM 4.1.2, a land use census was conducted on November 8, 1999 and November 9, 1999 to determine the locations of the nearest permanent residence and milk animal in each of the 16 compass sectors within a distance of 5 miles, and the locations of all milk animals within a distance of 3 miles. A milk animal is defined as a cow or goat producing milk for human consumption. The locations of beef cattle and of gardens greater than 500 square feet producing broad leaf vegetation were also included in the census. The census results are tabulated in the Table 4.1-1.

Table 4.1-1

LAND USE CENSUS RESULTS

Distance in Miles to Nearest Location in Each Sector

SECTOR	RESIDENCE	MILK ANIMAL	BEEF CATTLE	GARDEN
N	2.1	None	None	2.9
NNE	2.9	None	None	2.9
NE	3.3	None	None	3.5
ENE	4.2	None	4.1	4.7
E	None	None	None	None
ESE	3.8	None	None	None
SE	1.9	None	4.9	3.3
SSE	2.0	None	2.2	2.1
S	1.0	None	2.5	1.0
SSW	1.1	None	2.0	None
SW	1.0	None	2.3	1.6
WSW	1.0	None	3.7	2.3
W	1.1	None	2.8	None
WNW	1.1	None	None	None
NW	3.6	None	4.4	None
NNW	1.8	4.8	4.3	2.7

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. No change in the controlling receptor was required as a result of the 1999 land use census. The current controlling receptor as described in ODCM Table 3-7 is a child in the WSW Sector at 1.2 miles

ODCM 4.1.2.2.2 requires that whenever the land use census identifies a location which would yield 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). The 1999 land use census did not identify a garden which yielded a calculated dose 20% greater than that for any of the current indicator stations for vegetation. One milk animal was found during the land use census, however a reliable supply of milk samples was not available from this location during 1999. This location will be noted for further observation. The results of the census were corroborated by inquiries to the county extension agents in the 5 counties in the vicinity of the plant.

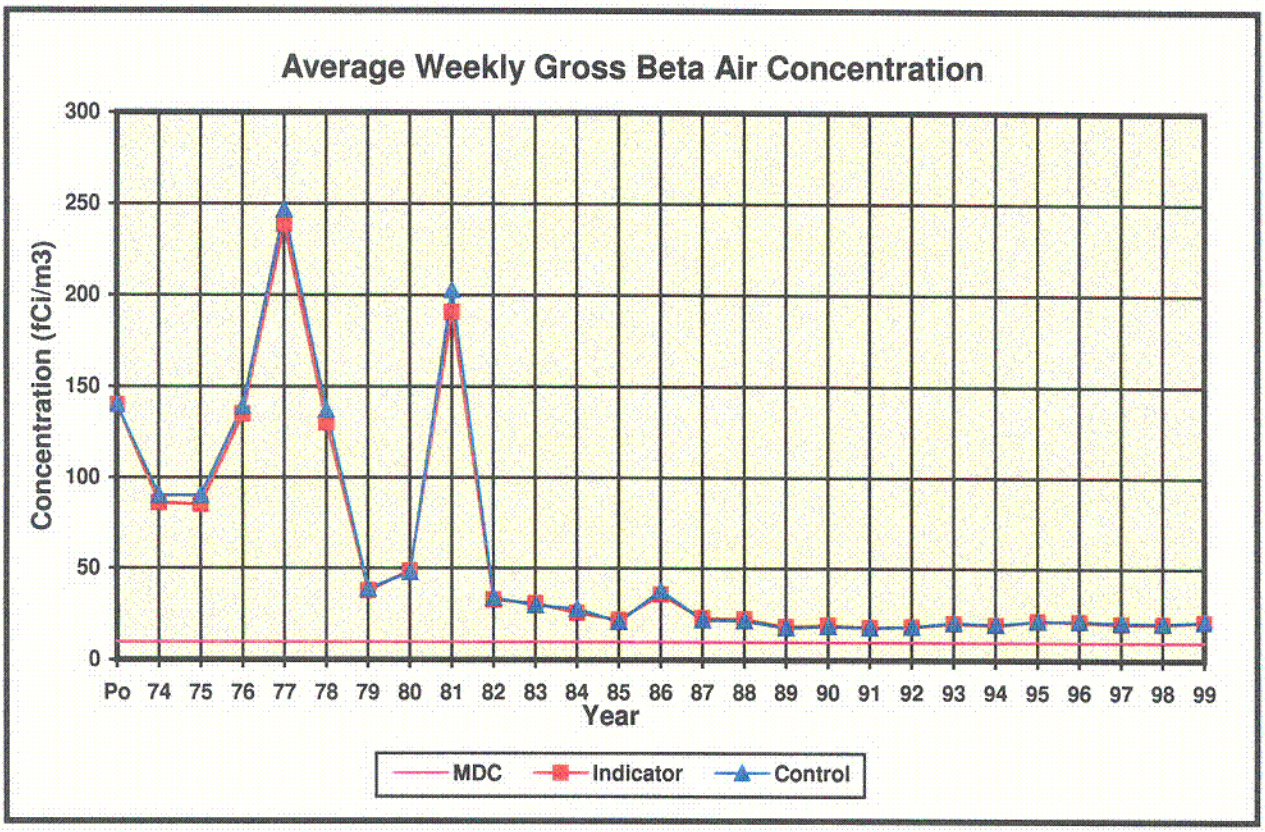
As required by Note f of Table 2-1, the annual survey of the Altamaha River for 50 miles downstream of the plant was conducted on September 20, 1999 to identify any withdrawal of river water for drinking purposes. No sources of withdrawal for drinking water were identified. One source of withdrawal for irrigation purposes was found at a location approximately three and three-quarter miles downstream of the plant discharge. Further investigation revealed that the water was being used for cotton irrigation. Information obtained from the Georgia Department of Natural Resources on October 26, 1999 indicated that the identified withdrawal location for irrigation was the only surface water withdrawal permit for drinking purposes or irrigation that had been issued for this stretch of the Altamaha River. Should it be determined that river water downstream of the plant is being used for drinking, the sampling and analysis requirements for drinking water found in Table 2-1 would be implemented.

4.2 Airborne

As indicated in Table 2-2 and Figures 2-1 and 2-2, airborne particulates and airborne radioiodine are collected at 4 indicator stations (Nos. 103, 107, 112 and 116) which encircle the plant near the site periphery and at 2 control stations (Nos. 304 and 309) which are located approximately 10 miles from the main stack. At each location, air is continuously drawn through a glass fiber filter and a charcoal canister placed in series to collect airborne particulates and radioiodine. The filters and canisters are collected weekly and analyzed for gross beta and I-131, respectively. A gamma isotopic analysis is performed quarterly on a composite of the filters for each station.

The 1999 annual average weekly gross beta concentration of 21.34 fCi/m^3 for the indicator stations was 0.07 fCi/m^3 greater than that for the control stations. This difference is not statistically discernible, since it is less than the calculated MDD of 1.95 fCi/m^3. This difference is not reflected in the values shown in Table 3-1 because both the indicator and the control calculations were rounded to the nearest tenth of a fCi/m^3. Figure 4.2-1 and Table 4.2-1 provide the historical trending of the average weekly gross beta concentrations in air. In general, there is close agreement between the results for the indicator and control stations. This close agreement supports the position that the plant is not contributing significantly to the gross beta concentration in air.

Figure 4.2-1



C-3

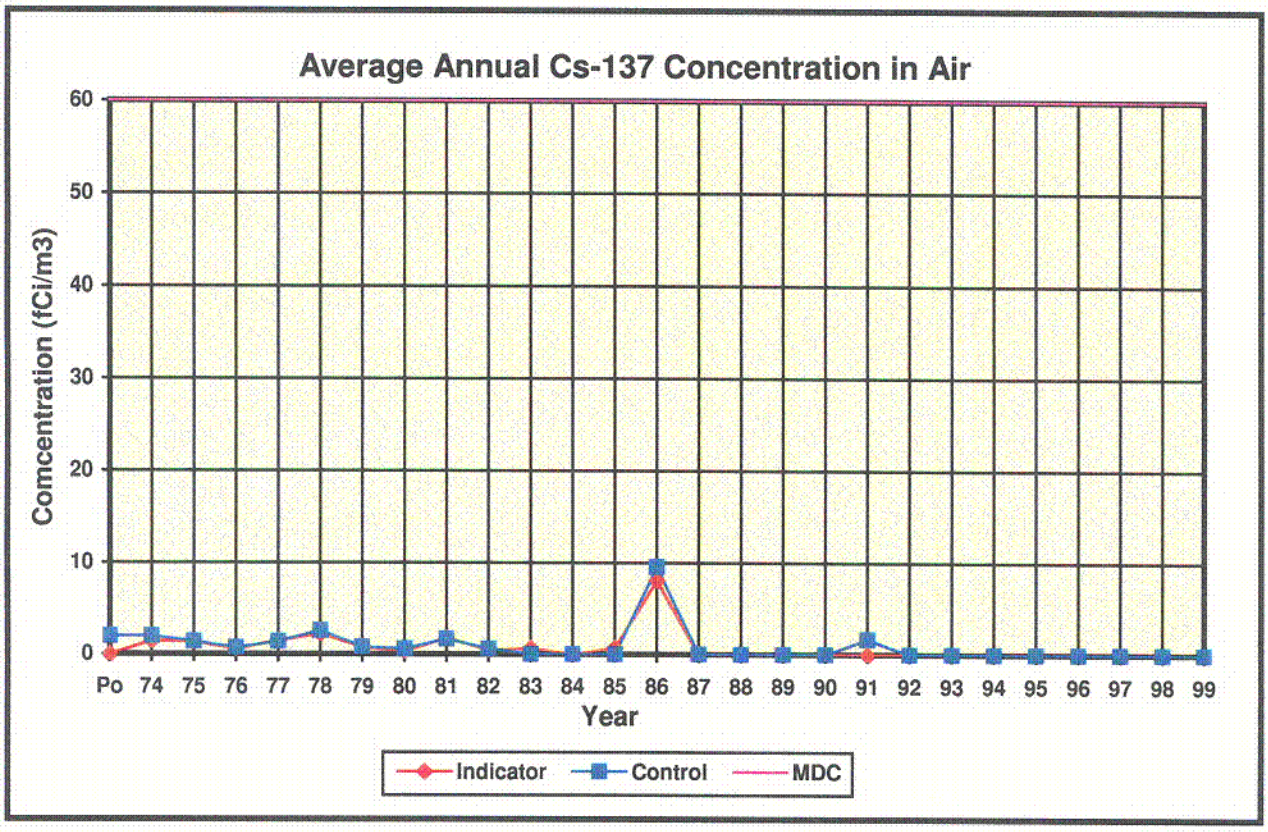
Table 4.2-1

Average Weekly Gross Beta Air Concentration

Year	Indicator (fCi/m3)	Control (fCi/m3)
Pre-op	140	140
1974	87	90
1975	85	90
1976	135	139
1977	239	247
1978	130	137
1979	38	39
1980	49	48
1981	191	203
1982	33	34
1983	31	30
1984	26	28
1985	22	21
1986	36	38
1987	23	22
1988	22.6	21.7
1989	18.4	17.8
1990	19.3	18.7
1991	18.1	18
1992	18.5	18.4
1993	20.4	20.7
1994	19.5	19.7
1995	21.7	21.7
1996	21.3	21.4
1997	20.3	20.7
1998	20.0	20.5
1999	21.3	21.3

During 1999, no man-made radionuclides were detected from the gamma isotopic analysis of the quarterly composites of the particulate air filters. During preoperation and during operation through 1986, a number of fission products and activation products were detected. These were generally attributed to the nuclear weapons tests and to the Chernobyl incident. On only one occasion since 1986, has a man-made radionuclide been detected in a quarterly composite. A small amount of Cs-137 (1.7 fCi/m3) was identified in the first quarter of 1991 at Station 304. The MDC and RL for Cs-137 in air are 60 and 20,000 fCi/m3, respectively. The historical trending of the average annual concentrations of detectable Cs-137 from quarterly air filter composites is provided in Figure 4.2-2 and Table 4.2-2.

Figure 4.2-2



C-4

Table 4.2-2

Average Annual Cs-137 Concentration In Air

Year	Indicator (fCi/m3)	Control (fCi/m3)
Pre-op	0	2.0
1974	1.5	2.0
1975	1.4	1.4
1976	0.6	0.7
1977	1.5	1.4
1978	2.3	2.6
1979	0.8	0.8
1980	0.4	0.6
1981	1.8	1.7
1982	0.5	0.6
1983	0.7	0
1984	0	0
1985	0.7	0
1986	8.1	9.6
1987	0	0
1988	0	0
1989	0	0
1990	0	0
1991	0	1.7
1992	0	0
1993	0	0
1994	0	0
1995	0	0
1996	0	0
1997	0	0
1998	0	0
1999	0	0

No airborne I-131 was detected in the charcoal canisters in 1999. During 1976, 1977, and 1978, positive levels of I-131 were found in nearly all of the samples collected for a period of a few weeks following atmospheric nuclear weapons tests. Some of the concentrations were on the order of 70 fCi/m^3. In 1986, the same phenomenon occurred following the Chernobyl incident. The highest airborne I-131 concentration found to date in an individual charcoal canister was 217 fCi/m^3 in 1977. The MDC and RL for airborne I-131 are 70 fCi/m^3 and 900 fCi/m^3, respectively.

Table 4-3 lists REMP deviations which occurred in 1999. None of these deviations affected air sampling.

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.

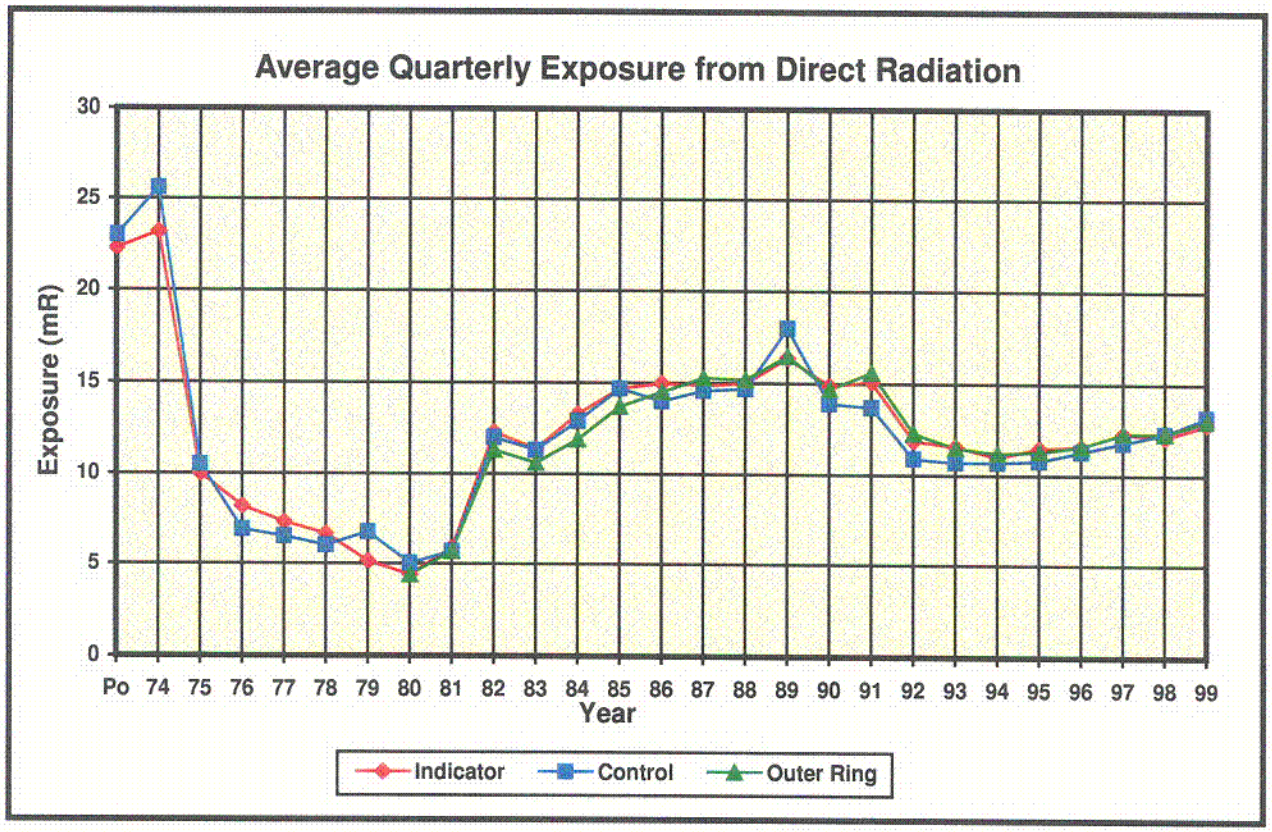
Two TLD stations are established in each of the 16 compass sectors around the plant to form 2 concentric rings, as seen in Figures 2-1 and 2-2. The two ring configuration of stations was established in 1980, in accordance with NRC Branch Technical Position "An Acceptable Radiological Environmental Monitoring Program", Revision 1, 1979. With the exception of the East sector, the inner ring stations (Nos. 101 through 116) are located near the site boundary and the outer ring stations (Nos. 201 through 216) are located at distances of 4 to 5 miles from the plant. The stations in the East sector are a few miles farther out than the other stations in their respective rings due to large swamps making normal access extremely difficult. The 16 stations forming the inner ring are designated as the indicator stations. The 3 control stations (Nos. 304, 309 and 416) are located 10 miles or more from the plant. Stations 064 and 301 monitor special interest areas. Station 064 is located at the onsite roadside park, while Station 301 is located near the Toombs Central School. Station 210, in the outer ring, is located near the Altamaha School (the only other nearby school).

As provided in Table 3-1, the average quarterly exposure of 12.8 mR measured at the indicator stations (inner ring) during 1999 was 0.4 mR less than the 13.2 mR measured at the control stations. This difference is not statistically discernible since it is less than the MDD of 1.0 mR.

The quarterly exposures acquired at the outer ring stations during 1999 ranged from 9.7 to 17.7 mR, with an average of 13.0 mR. The average for the outer ring stations was 0.2 mR less than the average for the control stations. This difference is not discernible since it is less than the MDD of 0.8 mR.

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



C-5

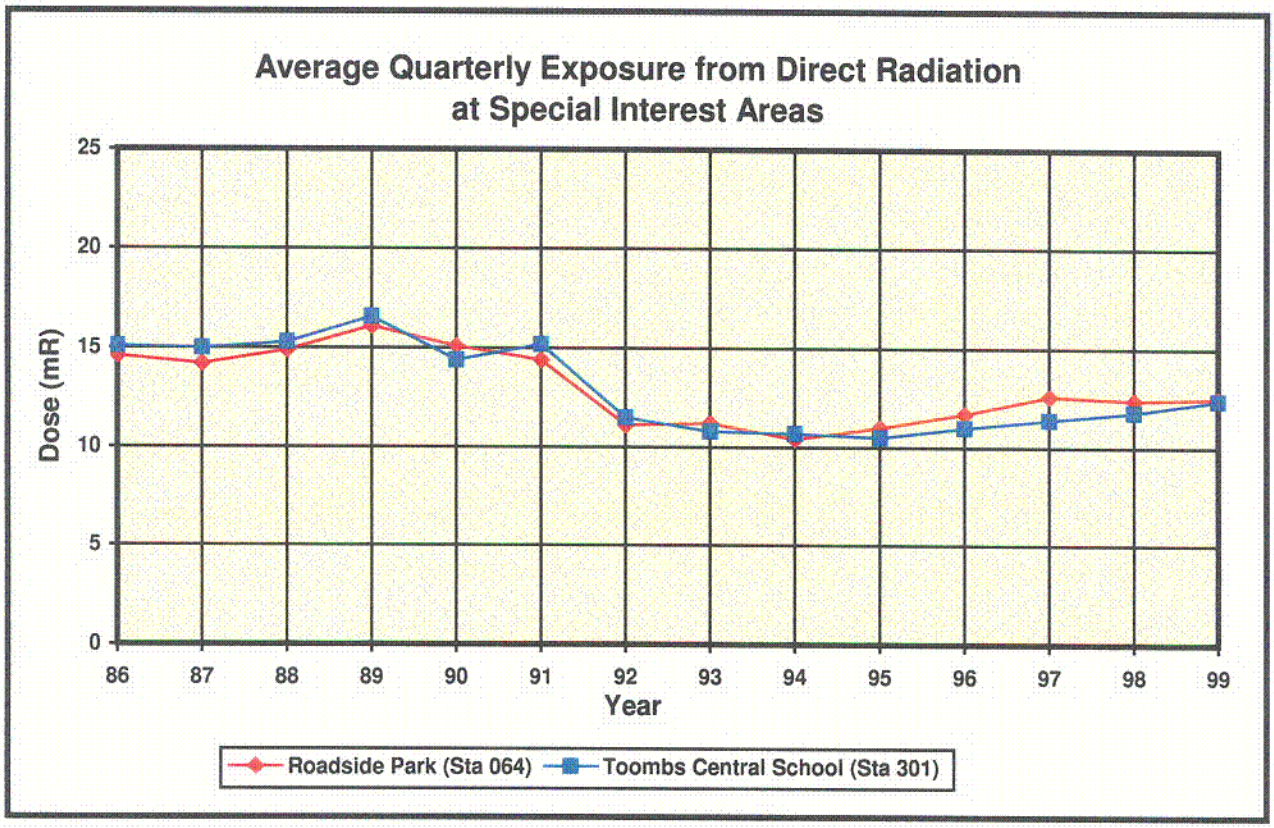
Table 4.3-1

Average Quarterly Exposure from Direct Radiation

Year	Indicator (mR)	Control (mR)	Outer Ring (mR)
Pre-op	22.3	23	0
1974	23.2	25.6	0
1975	10.0	10.5	0
1976	8.18	6.9	0
1977	7.31	6.52	0
1978	6.67	6.01	0
1979	5.16	6.77	0
1980	4.44	5.04	4.42
1981	5.9	5.7	5.7
1982	12.3	12	11.3
1983	11.4	11.3	10.6
1984	13.3	12.9	11.9
1985	14.7	14.7	13.7
1986	15	14	14.5
1987	14.9	14.6	15.3
1988	15.0	14.7	15.2
1989	16.4	18.0	16.5
1990	14.9	13.9	14.7
1991	15.1	13.7	15.6
1992	11.9	10.9	12.3
1993	11.6	10.7	11.5
1994	11	10.7	11.2
1995	11.5	10.8	11.3
1996	11.6	11.3	11.6
1997	12.3	11.8	12.3
1998	12.1	12.3	12.3
1999	12.8	13.2	13.0

The historical trending of the average quarterly exposures at the special interest areas for the past 13 years 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



C-6

Table 4.3-2

Average Quarterly Exposure from Direct Radiation at Special Interest Areas

Period	Station 064 (mR)	Station 301 (mR)
1986	14.6	15.1
1987	14.2	15.0
1988	14.9	15.3
1989	16.1	16.6
1990	15.1	14.4
1991	14.4	15.2
1992	11.1	11.5
1993	11.2	10.8
1994	10.4	10.7
1995	11.0	10.5
1996	11.7	11.0
1997	12.6	11.4
1998	12.4	11.8
1999	12.5	12.4

As seen in Table 4-3, there were 6 failures in obtaining a quarterly direct radiation exposure reading during 1999. The badges at Station 104 were missing when badge exchanges were made at the end of the second quarter. Therefore, data were unavailable at this location for the second quarter. The badges at this station were replaced, and the new badges were relocated nearby at a less conspicuous location. Both TLDs at Station 064 had a standard deviation greater that the self-imposed limit of 1.4 for the third quarter and were excluded from the data set. These badges were replaced. Near mid-quarter of the third quarter, the badges at Stations 102 and 116 were stolen. The badges at these two locations were replaced for the remainder of the third quarter, but the replacement TLDs failed Chauvenet's criterion when tested for statistical validity at the end of the quarter. Therefore, third quarter data from these two locations were excluded from the data set. At the end of the fourth quarter, it was discovered that badges from Stations 105 and 110 had been stolen. Therefore, no data were available for these two locations for the fourth quarter.

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 from the data set since the

high standard deviation is interpreted as an indication of unacceptable variation in TLD response.

As stated above, both badge readings for the third quarter at Station 064 had standard deviations that were greater than the self-imposed limit of 1.4. Consequently, since neither badge reading was acceptable, no TLD reading was available for Station 064 for the third quarter. This deviation is listed in Table 4-3. These 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 deviations.

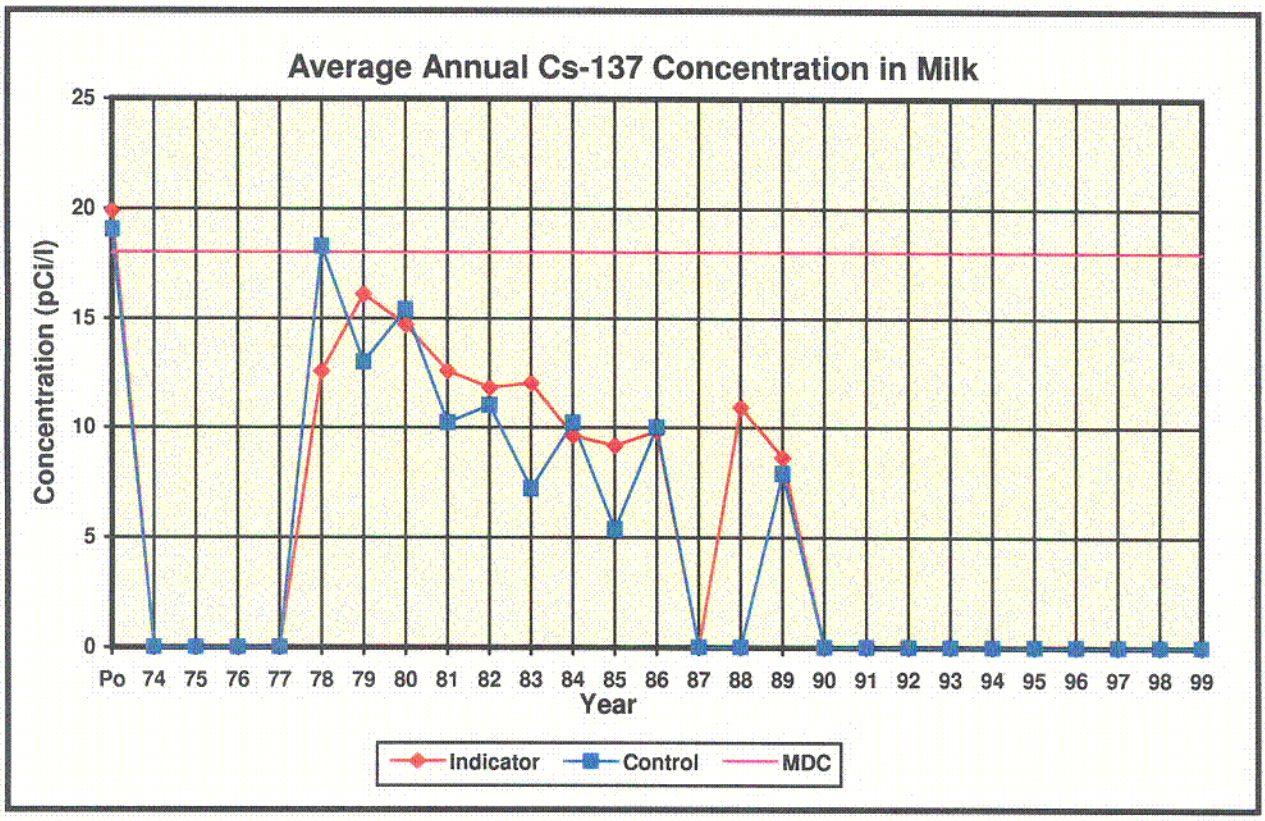
4.4 Milk

Milk samples are obtained biweekly from Station 304 (the state prison dairy) which is a control station located more than 10 miles from the plant. Gamma isotopic and I-131 analyses are performed on each sample as specified in Tables 2-1 and 2-2. As discussed in Section 4.1-1, the land use census discovered that there is one milk animal located within 5 miles of the plant, but a reliable supply of milk samples from this location was not available in 1999. This location will be noted for further observation. Since 1989, efforts to locate a reliable milk sample source within 5 miles of the plant have been unsuccessful.

During 1999, as in the previous 9 years, no man-made radionuclides were detected from the gamma isotopic analysis of the milk samples. Except for 1987, Cs-137 was found in some of the samples each year from 1978 (when this analysis became a requirement) through 1989. No other man-made radionuclides have been detected by this analysis.

The MDC and RL for Cs-137 in milk are 18 and 70 pCi/l, respectively. The historical trending of the average annual detectable Cs-137 concentration in milk is provided in Figure 4.4-1 and Table 4.4-1.

Figure 4.4-1



C-7

Table 4.4-1

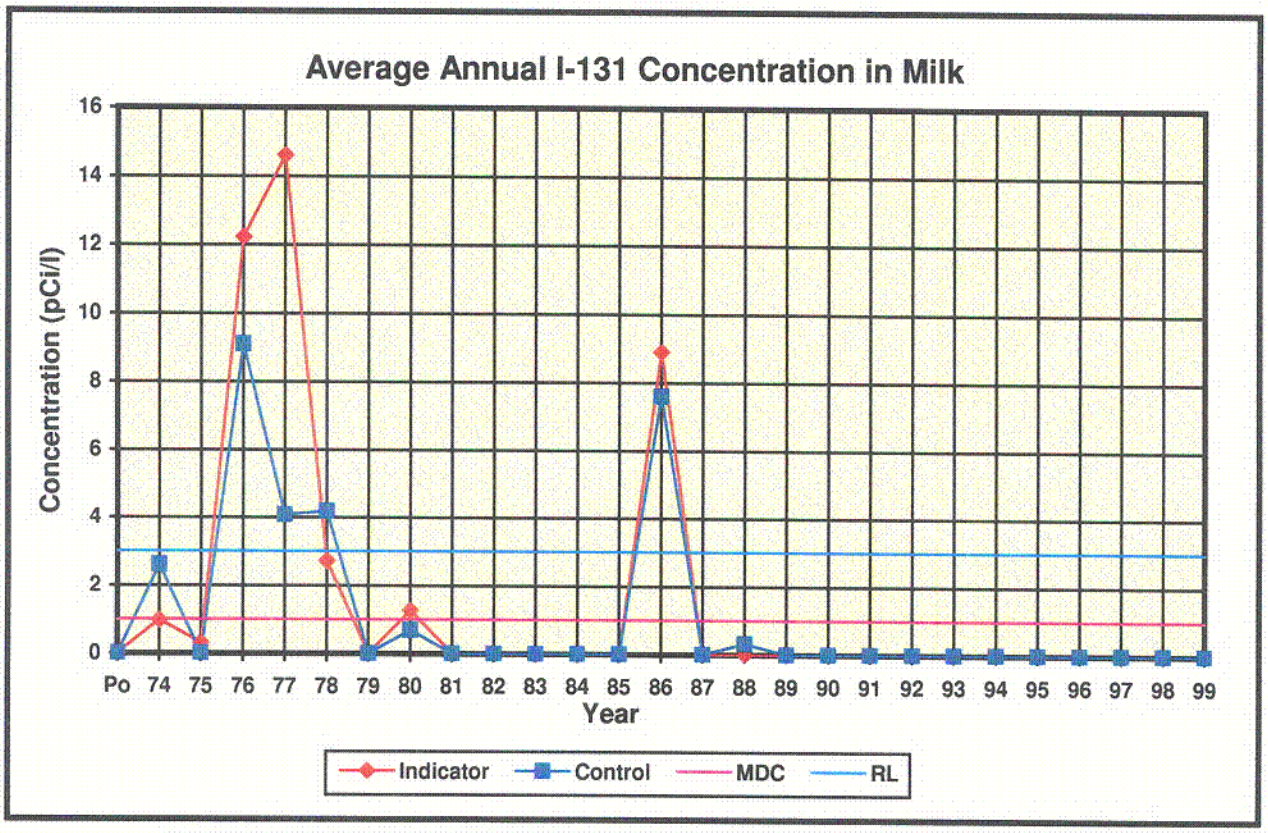
Average Annual Cs-137 Concentration in Milk

Year	Indicator (pCi/l)	Control (pCi/l)
Pre-op	19.9	19.4
1974	0	0
1975	0	0
1976	0	0
1977	0	0
1978	12.1	18.3
1979	16.1	13
1980	14.7	15.4
1981	12.57	10.2
1982	11.8	11
1983	12	7.2
1984	9.6	10.2
1985	9.14	5.35
1986	9.8	10
1987	0	0
1988	10.9	0
1989	8.6	7.9
1990	0	0
1991	0	0
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 as in the previous 10 years, I-131 was not detected in any of the milk samples. During preoperation, all readings were less than 2 pCi/l which was the allowed MDC at that time. Figure 4.4-2 and Table 4.4-2 provide the historical trending of the average annual detectable concentration of I-131 in milk. In 1988, a single reading of 0.32 pCi/l, which was believed to have resulted from a procedural deficiency, was reported. The MDC and RL for I-131 in milk are 1 and 3 pCi/l, respectively.

All the detectable results for Cs-137 and I-131 are attributed to fallout from the nuclear weapons tests and the Chernobyl incident.

Figure 4.4-2



C-8

Table 4.4-2

Average Annual I-131 Concentration in Milk

Year	Indicator (pCi/l)	Control (pCi/l)
Pre-op	0	0
1974	0.98	2.6
1975	0.3	0
1976	12.23	9.1
1977	14.61	4.08
1978	2.72	4.18
1979	0	0
1980	1.26	0.69
1981	0	0
1982	0	0
1983	0	0
1984	0	0
1985	0	0
1986	8.9	7.6
1987	0	0
1988	0	0.32
1989	0	0
1990	0	0
1991	0	0
1992	0	0
1993	0	0
1994	0	0
1995	0	0
1996	0	0
1997	0	0
1998	0	0
1999	0	0

4.5 Vegetation

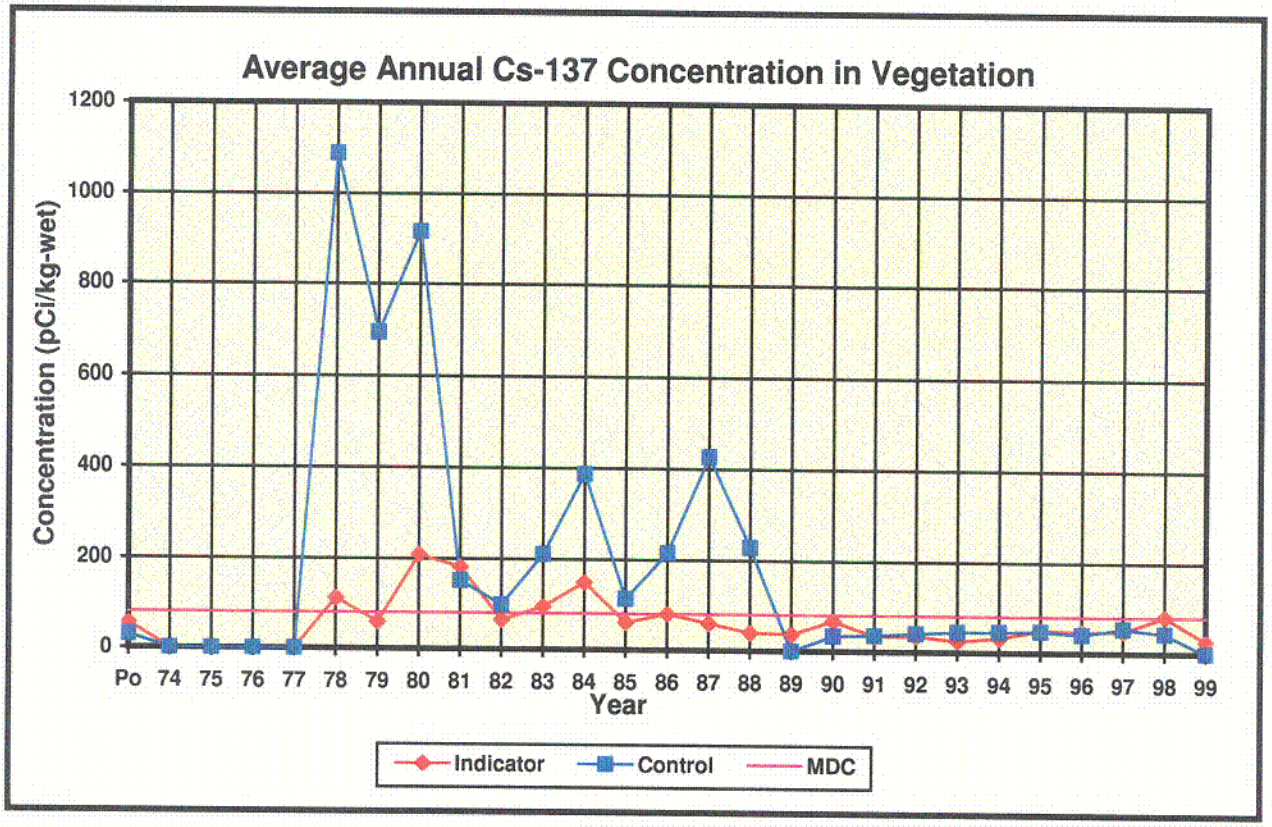
In accordance with Tables 2-1 and 2-2, grass samples are collected monthly from two indicator stations near the site boundary (Nos. 106 and 112) and at one control station located about 21 miles from the plant (No. 416). Gamma isotopic analyses are performed on each sample. Gamma isotopic analysis on vegetation samples began in 1978 when the analysis became a TS requirement.

The results presented in Table 3-1 show that Cs-137 was the only man-made radionuclide detected during 1999, as has been the case since 1986. Cs-137 was found in one indicator sample in 1999, at a value of 26.9 pCi/kg-wet. There were no positive results from the control station in 1999, so no MDD could be determined. The MDC and RL for Cs-137 in vegetation samples are 80 pCi/kg-wet and 2000 pCi/kg-wet, respectively. The presence of Cs-137 in the vegetation samples is attributed primarily to fallout from nuclear weapons tests and the Chernobyl incident. However, since no Cs-137 was detected in vegetation samples from the control station in 1999, some contribution from plant effluents 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. The total body dose to a member of the public from annual ingestion of garden vegetation containing Cs-137 as reflected by the vegetation samples would be 0.046 mrem annual dose. This dose is about 0.31% of the 15 mrem ODCM 3.1.4 limit for annual gaseous releases from one unit.

Figure 4.5-1 and Table 4.5-1 provide the historical trending of the average annual detectable Cs-137 concentration found in vegetation. Since 1978, the Cs-137 concentration has been on a general decline.

Figure 4.5-1



C-9

Table 4.5-1

Average Annual Cs-137 Concentration in Vegetation

Year	Indicator (pCi/kg-wet)	Control (pCi/kg-wet)
Pre-op	55	30
1974	0	0
1975	0	0
1976	0	0
1977	0	0
1978	112	1089
1979	59	695
1980	208	916
1981	182	152
1982	65	99
1983	95	211
1984	149	388
1985	60.9	113.3
1986	80	215
1987	60	428
1988	40.1	228.8
1989	37	0
1990	66.7	34.5
1991	34.1	36.1
1992	35.2	41.3
1993	24.7	45.8
1994	32.2	46.6
1995	49.8	47.6
1996	47.2	41.1
1997	48.4	54.9
1998	81.4	44.1
1999	26.9	0

4.6 River Water

Surface water from the Altamaha River is obtained at an upstream location (Station 170) and at a downstream location (Station 172) using automatic samplers. Small quantities are drawn at intervals not exceeding a few hours. The samples drawn are collected monthly and quarterly composites are produced from the monthly collections.

As specified in Table 2-1, a gamma isotopic analysis is conducted on each monthly sample. No man-made radionuclides were detected during 1999. The only man-made radionuclides previously detected are presented in the table below.

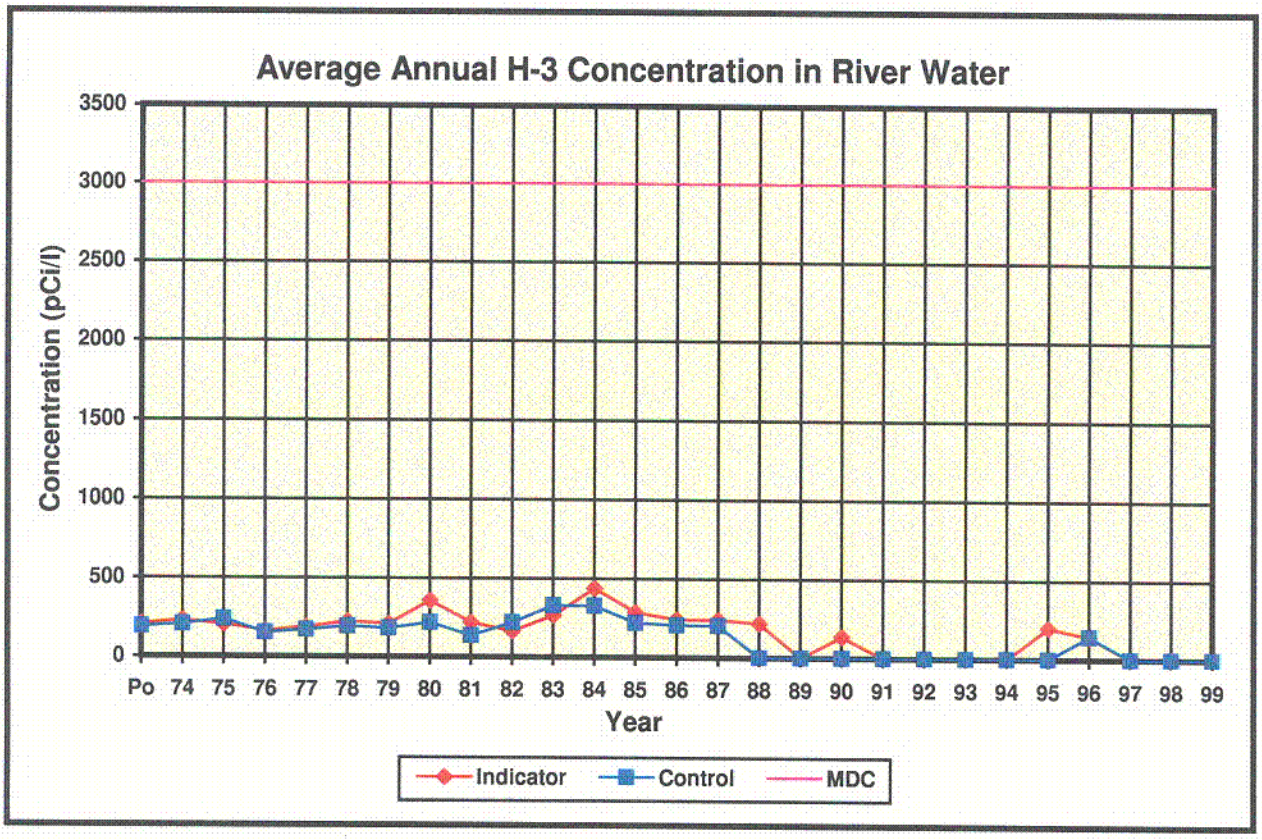
Year	Quarter	Station	Radionuclide	Level (pCi/l)
1975	4th	172	Ce-141	78.2
1986	2nd	170	La-140	18.0
1986	2nd	172	Cs-137	12.0
1988	2nd	170	Cs-137	6.8

The positive results for 1986 are attributed to the Chernobyl incident.

A tritium analysis is performed on the quarterly composite. Prior to 1986, positive results were usually found in each quarterly composite at levels generally ranging from 200 and 400 pCi/l. Subsequently, the number of positive results and their concentrations have diminished. In the 11 years since 1988, tritium was detected in only about 20% of the samples. In 1999, no detectable results were found. The MDC and RL for tritium in river water are 3000 and 30,000 pCi/l, respectively. Figure 4.6-1 and Table 4.6-1 provide the historical trending of the annual average detectable tritium concentration in river water.

The annual 50 mile downstream survey of the Altamaha River to determine if river water is being withdrawn for drinking purposes is discussed in Section 4.1.

Figure 4.6-1



C-10

Table 4.6-1

Average Annual H-3 Concentration in River Water

Year	Indicator (pCi/l)	Control (pCi/l)
Pre-op	210	191
1974	230	205
1975	205	238
1976	165	153
1977	189	170
1978	224	193
1979	210	180
1980	358	218
1981	220	135
1982	165	220
1983	265	328
1984	437	327
1985	288	220
1986	242	206
1987	241	204
1988	220	0
1989	0	0
1990	139	0
1991	0	0
1992	0	0
1993	0	0
1994	0	0
1995	200	0
1996	144	147
1997	0	0
1998	0	0
1999	0	0

4.7 Fish

Gamma isotopic analyses were performed on the edible portion of the fish samples collected at the river stations on April 12, 1999 and October 11, 1999. The control station (No. 170) is located upstream of the plant while the indicator station (No. 172) is located downstream.

As shown in Table 3-1, Cs-137 was the only man-made radionuclide detected during 1999. The average concentration of 22.3 pCi/kg-wet at the indicator station was 8.8 pCi/kg-wet more than that at the control station. This difference is statistically discernible since it is greater than the MDD of 7.2 pCi/kg-wet. Cs-137 in fish samples is attributed primarily to weapons testing and the Chernobyl incident. However, since the 1999 average concentration of Cs-137 in fish at the indicator station is statistically discernible from the concentration at the control station, some contribution due to plant releases cannot be ruled out. The MDC and RL for Cs-137 in fish are 150 and 2000 pCi/kg-wet, respectively.

The historical trending of the average annual detectable Cs-137 concentration in fish is provided in Figure 4.7-1 and Table 4.7-1.

Figure 4.7-1 indicates, in general, a decline in the Cs-137 levels after 1983. (Note: From 1979 through 1982, clams were collected rather than fish.)

Figure 4.7-1

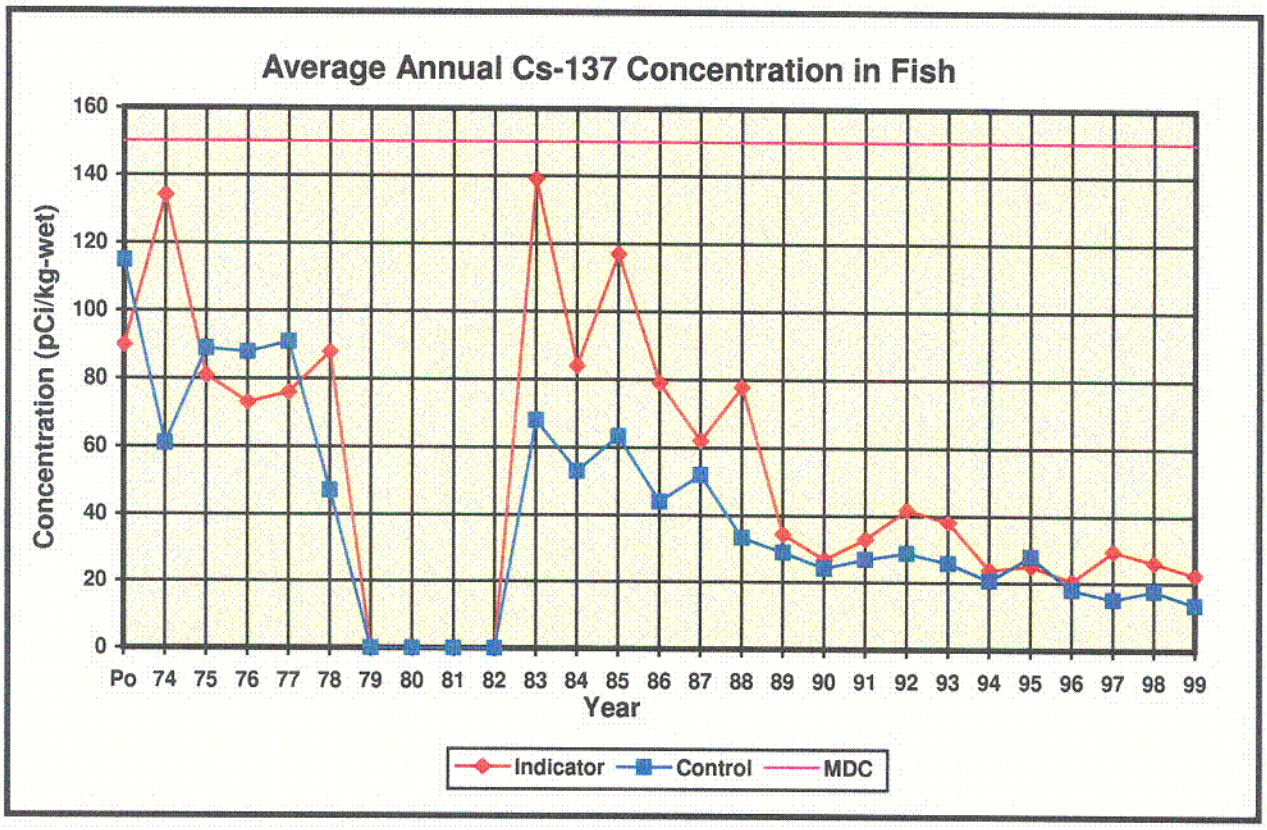


Table 4.7-1

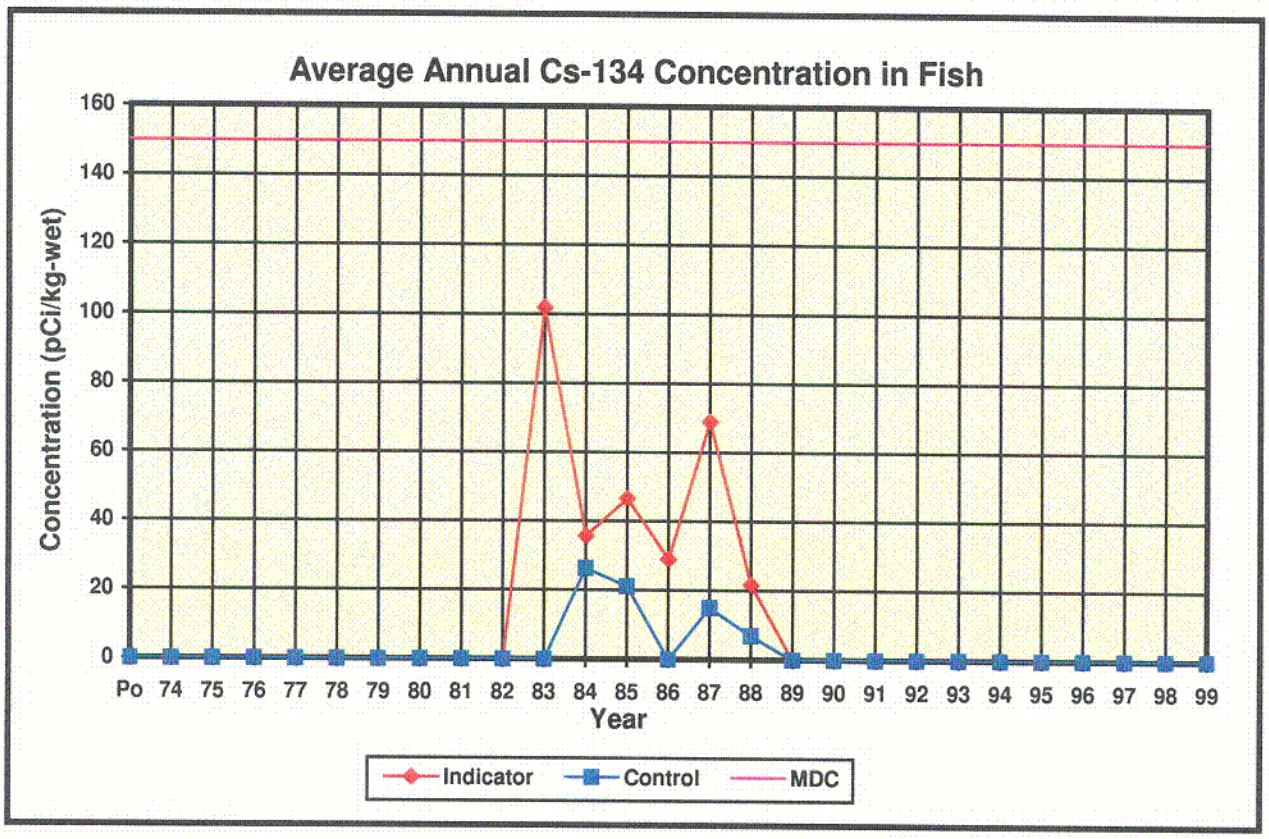
Average Annual Cs-137 Concentration in Fish

Year	Indicator (pCi/kg-wet)	Control (pCi/kg-wet)
Pre-op	90	115
1974	134	61
1975	80.6	89.4
1976	73	88
1977	76	91
1978	88	47
1979	0	0
1980	0	0
1981	0	0
1982	0	0
1983	138.6	67.5
1984	84	53
1985	117	63.3
1986	79	44
1987	62	52
1988	77.8	33.3
1989	34.3	28.9
1990	26.7	24.2
1991	32.9	26.9
1992	41.6	28.8
1993	38.0	25.9
1994	23.8	20.7
1995	25.0	27.9
1996	20.4	18.0
1997	29.4	15.1
1998	26.1	17.7
1999	22.3	13.5

The potential dose from the Cs-137 detected in fish 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 member of the public from ingestion of 21 kg/yr of fish taken at the indicator station was determined to be approximately 0.013 mrem in a year. This dose is about 0.5% of the 3 mrem ODCM 2.1.3 limit for annual liquid releases from one unit.

In the past, the only other man-made radionuclides detected in fish samples were Co-60 and Cs-134. During preoperation, Co-60 was detected in one fish sample at a very low concentration. During the period of 1983 through 1988, Cs-134 was found in about half of the samples at concentrations of the same order of magnitude as those found for Cs-137. The Co-60 and Cs-134 levels found in these samples are attributed to the nuclear weapons tests and the Chernobyl incident. Figure 4.7-2 and Table 4.7-2 show the historical trending of the annual average detectable concentration of Cs-134 in fish.

Figure 4.7-2



C-12

Table 4.7-2

Average Annual Cs-134 Concentration in Fish

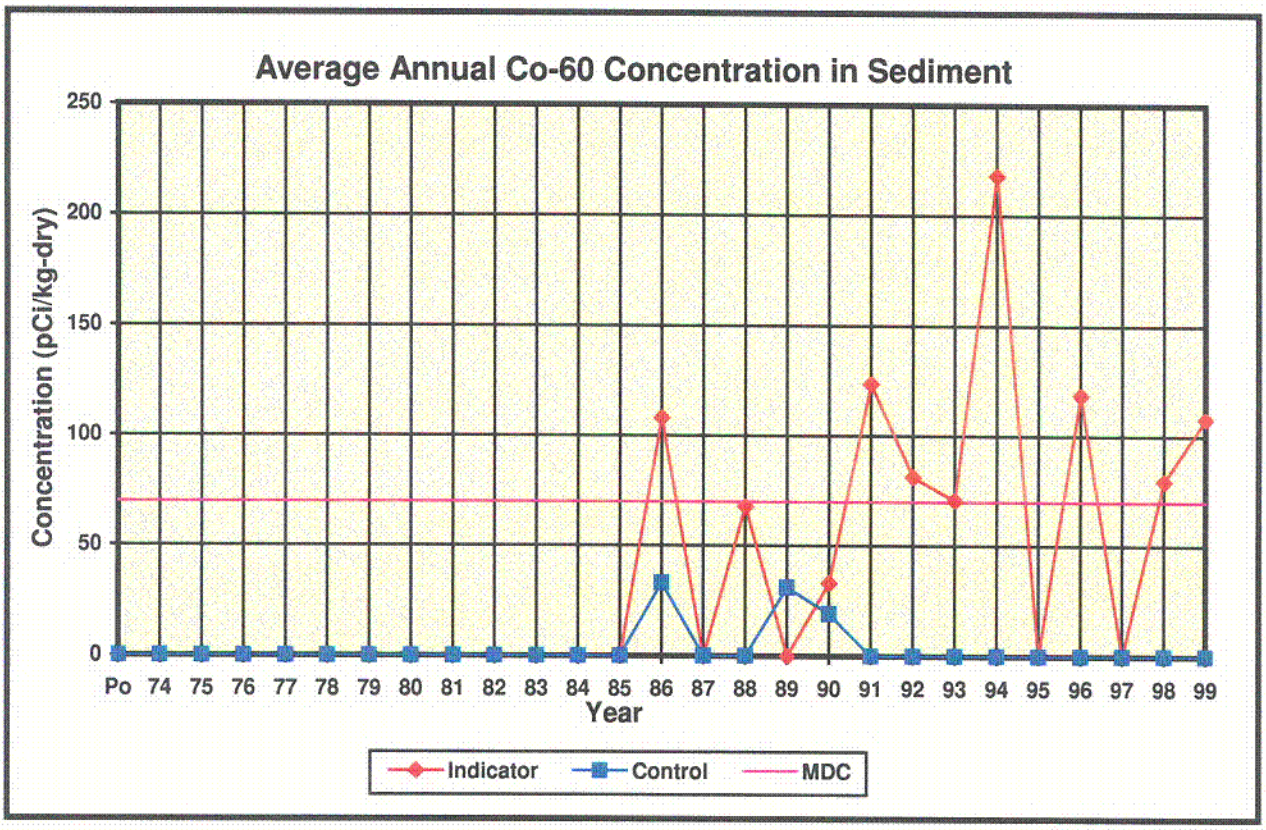
Year	Indicator (pCi/kg-wet)	Control (pCi/kg-wet)
Pre-op	0	0
1974	0	0
1975	0	0
1976	0	0
1977	0	0
1978	0	0
1979	0	0
1980	0	0
1981	0	0
1982	0	0
1983	101.8	0
1984	35.8	26.3
1985	46.7	21.1
1986	29	0
1987	69	15
1988	21.7	6.9
1989	0	0
1990	0	0
1991	0	0
1992	0	0
1993	0	0
1994	0	0
1995	0	0
1996	0	0
1997	0	0
1998	0	0
1999	0	0

4.8 Sediment

Sediment was collected along the shoreline of the Altamaha River on May 3, 1999 and November 1, 1999 at the upstream control station (No. 170) and the downstream indicator station (No. 172). A gamma isotopic analysis was performed on each sample.

Co-60 was found in the indicator station samples in 1999 at an average value of 107.7 pCi/kg-dry, with a range of 87.3 pCi/kg-dry to 128 pCi/kg-dry. There were no positive results from the control station in 1999, so no MDD could be determined. Co-60 has been found at either an indicator or a control station in all but three of the years since 1986. There is no RL or MDC assigned to Co-60 in sediment in ODCM Tables 4-2 and 4-3 (Tables 4-2 and 4-1 of this report). The MDC assigned by the EL for Co-60 in sediment is 70 pCi/kg-dry. The historical trending of the average annual detectable Co-60 concentration in sediment is provided in Figure 4.8-1 and Table 4.8-1.

Figure 4.8-1



i.13

Table 4.8-1

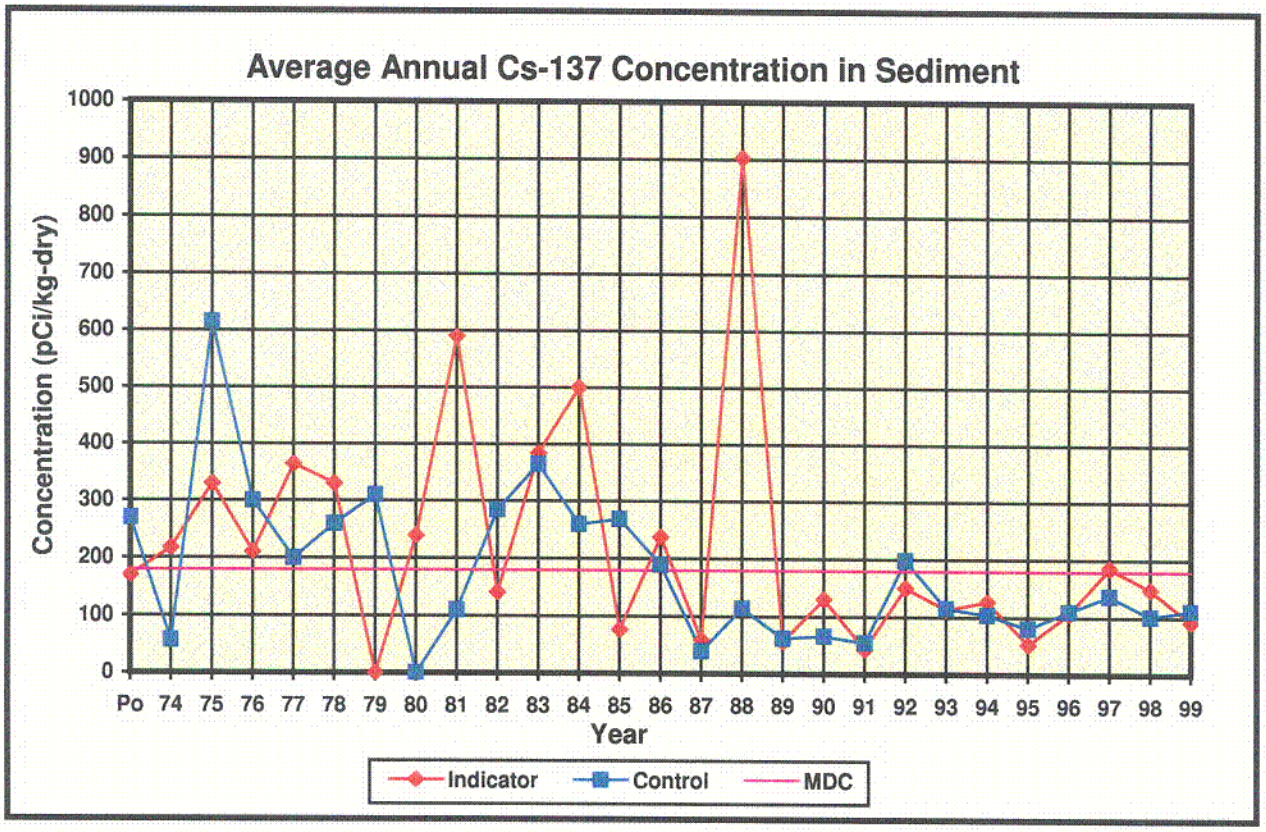
Average Annual Co-60 Concentration in Sediment

Year	Indicator (pCi/kg-dry)	Control (pCi/kg-dry)
Pre-op	0	0
1974	0	0
1975	0	0
1976	0	0
1977	0	0
1978	0	0
1979	0	0
1980	0	0
1981	0	0
1982	0	0
1983	0	0
1984	0	0
1985	0	0
1986	108	33
1987	0	0
1988	67.8	0
1989	0	31
1990	33	19
1991	123.6	0
1992	81.4	0
1993	70.7	0
1994	218	0
1995	0	0
1996	118.5	0
1997	0	0
1998	79.4	0
1999	107.7	0

Co-60 was not detected in sediment samples near the plant until 1986, the year of the Chernobyl incident. However, because Co-60 has been detected in indicator station samples more often than in control station samples in recent years, some contribution from plant effluents cannot be ruled out. 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 member of the public due to direct radiation from sediment was determined to be approximately 0.0049 mrem/yr. This dose is about 0.16% of the 3 mrem ODCM 2.1.3 limit for liquid releases from one unit. Although calculable, this dose is insignificant with respect to regulatory limits.

Cs-137 was detected in both indicator and control station samples in 1999. It has been found in over 95% of all of the sediment samples collected back through preoperation, and is generally attributed to the atmospheric nuclear weapons tests or to the Chernobyl incident. As shown in Table 3-1, the level of 92.0 pCi/kg-dry found at the indicator station was 19.8 pCi/kg-dry less than that found at the control station. However, this difference is not statistically discernible. The MDC for Cs-137 in sediment is 180 pCi/kg-dry. The historical trending of the average annual detectable Cs-137 concentration in sediment is provided in Figure 4.8-2 and Table 4.8-2.

Figure 4.8-2



C-14

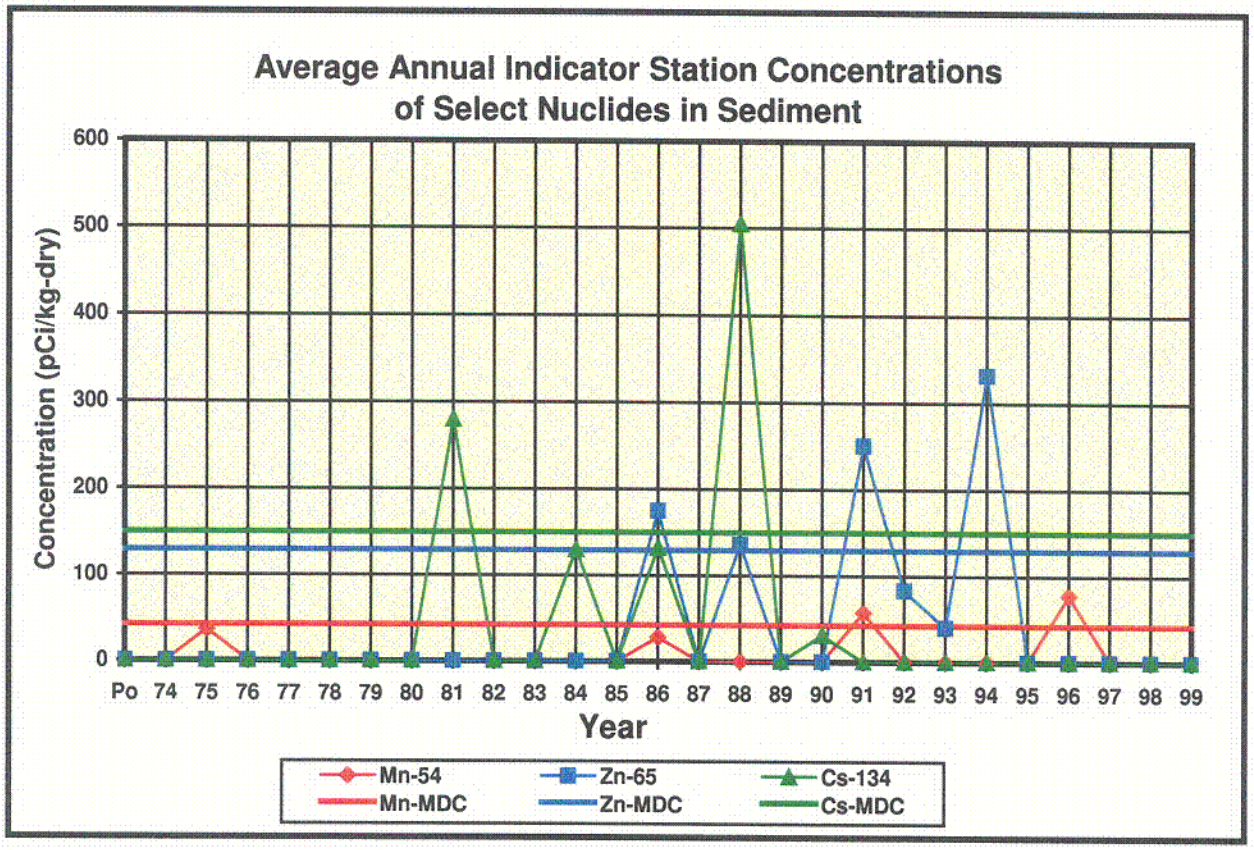
Table 4.8-2

Average Annual Cs-137 Concentration in Sediment

Year	Indicator (pCi/kg-dry)	Control (pCi/kg-dry)
Pre-op	170	270
1974	218	57
1975	330	615
1976	211	300
1977	364	200
1978	330	260
1979	0	310
1980	240	0
1981	590	110
1982	141	285
1983	384	365
1984	500	260
1985	76.5	269
1986	238	190
1987	59	39
1988	903	114
1989	56	62
1990	130.5	66
1991	43.1	54.5
1992	151	198.5
1993	113	115
1994	127	104
1995	52.3	80.6
1996	106	110
1997	186	137
1998	148.5	101.4
1999	92	111.8

Other man-made nuclides, besides Co-60 and Cs-137, were occasionally found in past years. Their presence was generally attributed to the nuclear weapons tests or to the Chernobyl incident, although plant releases were not ruled out. Mn-54, Co-58, and Zn-65, which have relatively short half-lives, are most likely a result of plant releases and have been plotted in Figure 4.8-3 along with their MDC's. All the man-made nuclides detected in sediment except for Co-60 and Cs-137 have been listed in Table 4.8-3. The Cs-134 MDC (150 pCi/kg-dry) is defined in ODCM Table 4-3 (Table 4-1 of this report). The MDC's for Mn-54 (42 pCi/kg-dry) and Zn-65 (129 pCi/kg-dry) were determined by the EL since no values are provided in ODCM Table 4-3.

Figure 4.8-3



C-15

Table 4.8-3

Sediment Nuclide Concentrations Other Than Co-60 & Cs-137

Nuclide	YEAR	Indicator (pCi/kg-dry)	Control (pCi/kg-dry)
Ce-141	1976	340	254
	1977	141	
Ce-144	Preop		720
	1974	363	
	1975	342	389
	1978	700	
	1981	1290	
Co-58	1994	22.2	
Cs-134	Preop		40
	1981	280	
	1984	130	40
	1986	132	
	1988	505	
	1990	31	
Mn-54	1975	36.1	
	1986	28	26
	1991	57.2	
	1996	77.7	
Ru-103	1974	81	
	1976	158	
	1977	195	
	1981	220	
Zn-65	1986	175	
	1988	136	
	1991	250.5	
	1992	83	
	1993	39.9	
	1994	332	
Zr-95	Preop		180
	1974	138	
	1976	427	170
	1977	349	294
	1978	220	230
	1981	860	280

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 a summary and discussion of the results of the laboratory analyses for each type of sample.

All of the radiological levels were low and are generally trending downward.

In 1999, there were three instances where the indicator station readings were statistically discernible from the control station readings. These instances are discussed in the following paragraphs.

Cs-137 was found in one vegetation indicator sample at a concentration of 26.9 pCi/kg-wet. No Cs-137 was detected in the vegetation samples collected at the control station. However, this result is very low as shown by a comparison with the required MDC and the RL values, which are 80 and 2000 pCi/kg-wet, respectively. If a member of the public in the adult age group, which is the age group that would receive the highest dose under these circumstances, annually consumed leafy garden vegetables containing this level of Cs-137, the annual dose would be 0.046 mrem to the total body, which is approximately 0.31% of the regulatory limit.

Cs-137 was found in all fish samples collected in 1999. The average concentration in fish collected at the indicator station was 22.3 pCi/kg-wet, which is statistically discernible from the average value determined from the control station fish samples. This result is small compared to the MDC and the RL, which are 150 and 2000 pCi/kg-wet, respectively. If a member of the public in the adult age group, which is the age group that would receive the highest dose in these circumstances, annually consumed fish containing this level of Cs-137, the annual dose would be 0.013 mrem to the total body, which is approximately 0.5% of the regulatory limit.

Co-60 was found in both sediment indicator station samples with an average concentration of 107.7 pCi/kg-dry. Since there was no positive reading at the sediment control station for 1999, the potential dose from the indicator station sample was calculated. As a result of the Co-60 found in sediment at the indicator station, the potential dose to the most limiting member of the public was approximately 0.0049 mrem/yr, or 0.16% of the regulatory limit.

Although statistically discernible from background, the instances noted above reflect very small percentages of regulatory limits. No discernible radiological impact upon the environment or the public as a consequence of plant discharges to the atmosphere or to the river was established for any other REMP samples.