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Subject: Catawba Nuclear Stations, Units 1 and 2
Docket Nos. 50-413 and 50-414
1999 Annual Radiological Environmental Operating Report

Pursuant to Technical Specification 5.6.2 and Selected Licensee Commitment 16.11-16.1, please find attached the 1999 Annual Radiological Environmental Operating Report. This report covers operation of Catawba Units 1 and 2 during the 1999 calendar year.

Any questions concerning this report may be directed to Kay Nicholson at 803-831-3237.

Sincerely,



Gary R. Peterson

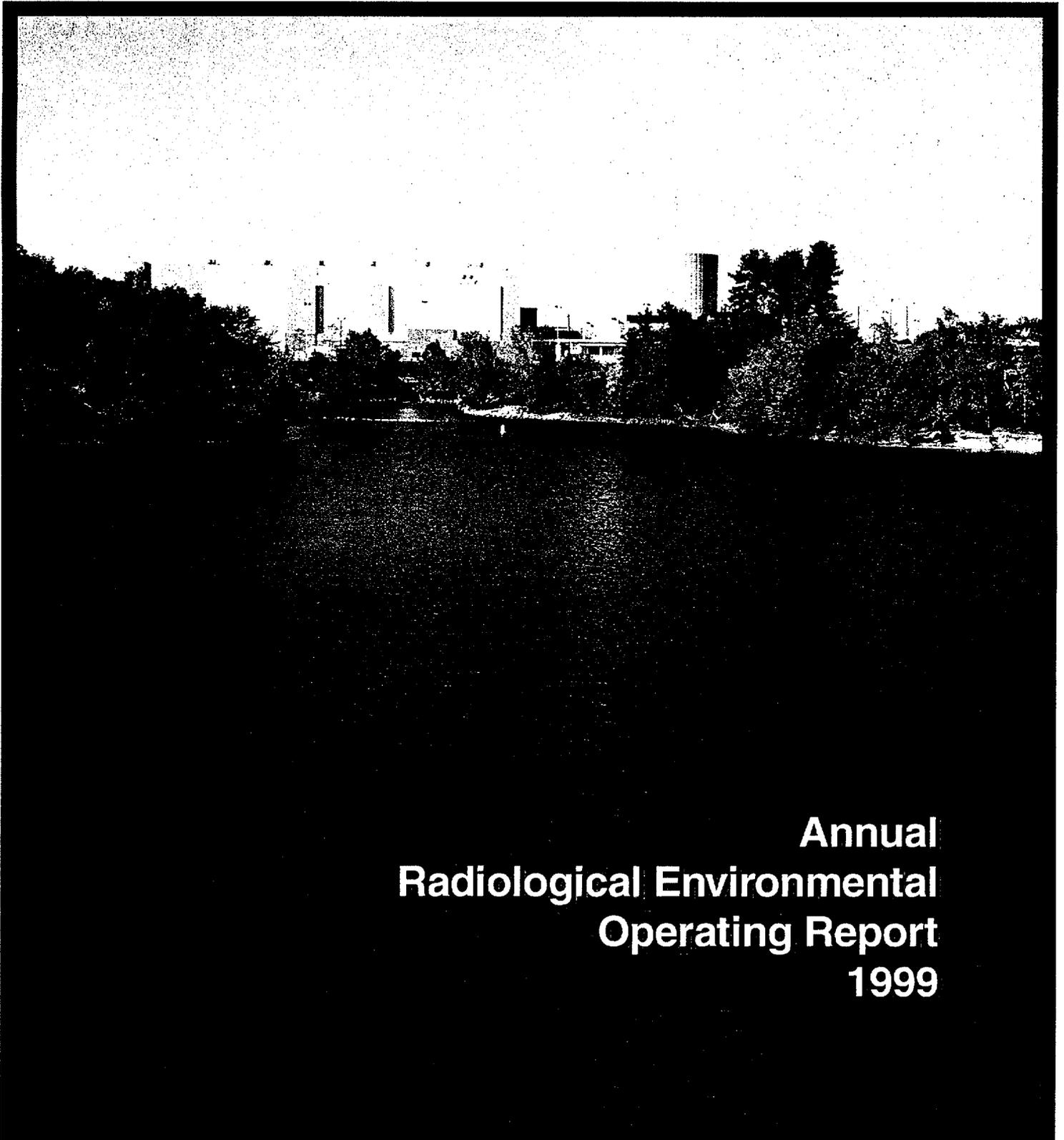
Attachment

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Catawba Nuclear Station Units 1 and 2



**Annual
Radiological Environmental
Operating Report
1999**



ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

DUKE POWER COMPANY
CATAWBA NUCLEAR STATION
Units 1 and 2

1999

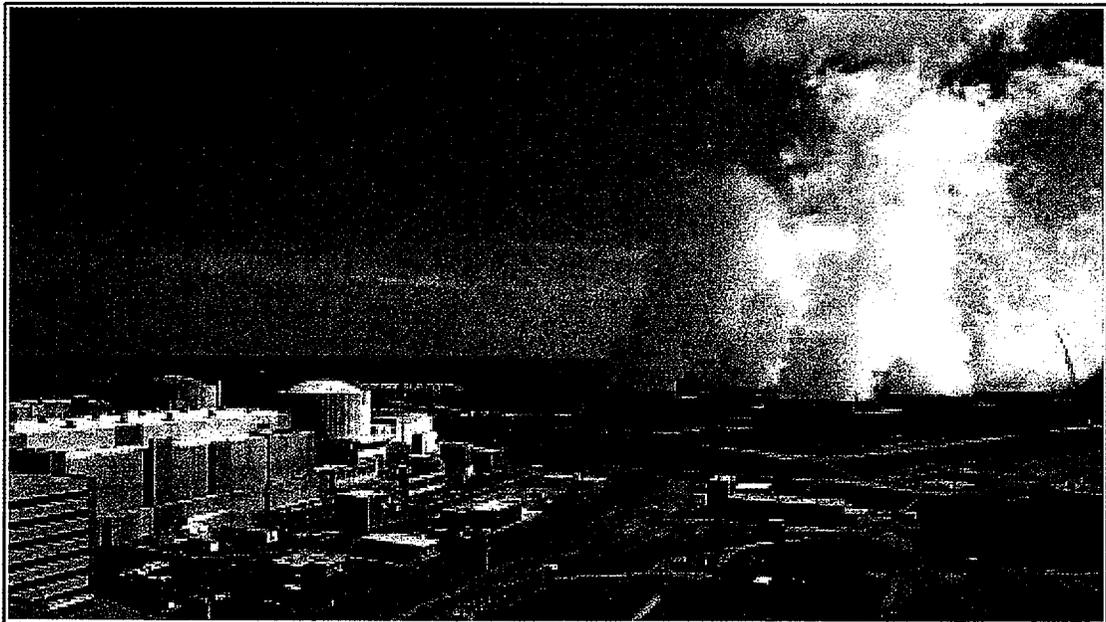


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LIST OF ACRONYMS USED IN THIS TEXT *(in alphabetical order)*

BW	BiWeekly
C	Control
CL	Critical Level
DEHNR	Department of Environmental Health and Natural Resources
DHEC	Department of Health and Environmental Control
EPA	Environmental Protection Agency
GI-LLI	Gastrointestinal – Lower Large Intestine
LLD	Lower Limit of Detection
M	Monthly
MDA	Minimum Detectable Activity
mrem	Millirem
NIST	National Institute of Standards and Technology
NRC	Nuclear Regulatory Commission
ODCM	Offsite Dose Calculation Manual
pCi/kg	picocurie per kilogram
pCi/l	picocurie per liter
pCi/m ³	picocurie per cubic meter
Q	Quarterly
REMP	Radiological Environmental Monitoring Program
SA	Semiannually
SLCs	Selected Licensee Commitments
SM	Semimonthly
TECH SPECS	Technical Specifications
TLD	Thermoluminescent Dosimeter
μCi/ml	microcurie per milliliter
UFSAR	Updated Final Safety Analysis Report
W	Weekly

1.0 EXECUTIVE SUMMARY

This Annual Radiological Environmental Operating Report describes the Catawba Nuclear Station Radiological Environmental Monitoring Program (REMP), and the program results for the calendar year 1999.

Included are the identification of sampling locations, descriptions of environmental sampling and analysis procedures, comparisons of present environmental radioactivity levels and pre-operational environmental data, comparisons of doses calculated from environmental measurements and effluent data, analysis of trends in environmental radiological data as potentially affected by station operations, and a summary of environmental radiological sampling results. Quality assurance practices, sampling deviations, unavailable samples, and program changes are also discussed.

Sampling activities were conducted as prescribed by Selected Licensee Commitments (SLCs). Required analyses were performed and detection capabilities were met for all collected samples as required by SLCs. Supplemental analyses were performed for some media for additional information. Nine-hundred seventy-three samples were analyzed comprising 1074 test results in order to compile data for the 1999 report. Based on the annual land use census, the current number of sampling sites for Catawba Nuclear Station is sufficient.

Concentrations observed in the environment in 1999 for station related radionuclides were generally within the ranges of concentrations observed in the past. Inspection of data showed that radioactivity concentrations in surface water, drinking water, shoreline sediment, and fish are higher than the activities reported for samples collected prior to the operation of the station. Measured concentrations were not higher than expected, and all positively identified measurements were within limits as specified in SLCs.

Additionally, environmental radiological monitoring data is consistent with effluents introduced into the environment by plant operations. The total body dose estimated to the maximum exposed member of the public as calculated by environmental sampling data, excluding TLD results, was $4.94E-01$ mrem for 1999. It is therefore concluded that station operations has had no significant radiological impact on the health and safety of the public or the environment.



Shoreline sediment sampling

2.0 INTRODUCTION

2.1 SITE DESCRIPTION AND SAMPLE LOCATIONS

Duke Power Company's Catawba Nuclear Station is a two-unit facility located on the shore of Lake Wylie in York County, South Carolina. Each of the two essentially identical units employs a pressurized water reactor nuclear steam supply system furnished by Westinghouse Electric Corporation. Each generating unit is designed to produce a net electrical output of approximately 1145 MWe. Units 1 and 2 achieved initial criticality on January 7, 1985, and May 8, 1986, respectively.

Condenser cooling is accomplished utilizing a closed system incorporating cooling towers, instead of using lake water directly. Liquid effluents are released into Lake Wylie via the station discharge canal and are not accompanied by the large additional dilution water flow associated with "once-through" condenser cooling. This design results in greater radionuclide concentrations in the discharge canal given comparable liquid effluent source terms.

The CNS Radiological Environmental Monitoring Program sampling locations are summarized in Tables 2.1-A and 2.1-B. Table 2.1-A lists the environmental Thermoluminescent Dosimeter locations. Table 2.1-B lists all other sampling locations. The REMP sampling and analysis procedures are summarized in Appendix A.

Figures 2.1-1 and 2.1-2 are maps depicting the specific positions of all REMP sampling locations. The location numbers shown on these maps correspond to those listed in Tables 2.1-A and 2.1-B. Figure 2.1-1 comprises all sample locations within one mile of CNS. Figure 2.1-2 comprises all remaining locations.

2.2 SCOPE AND REQUIREMENTS OF THE REMP

An environmental monitoring program has been in effect at Catawba Nuclear Station since 1981, four years prior to operation of Unit 1 in 1985. The preoperational program provides data on the existing environmental radioactivity levels for the site and vicinity which may be used to determine whether increases in environmental levels are attributable to the station. The operational program provides surveillance and backup support of detailed effluent monitoring which is necessary to evaluate the significance, if any, of the contributions to the existing environmental radioactivity levels that result from station operation.

This monitoring program is based on NRC guidance as reflected in the Selected Licensee Commitments Manual, with regard to sample media, sampling locations, sampling frequency and analytical sensitivity requirements. Indicator and control locations were established for comparison purposes to distinguish radioactivity of station origin from natural or other "man-made" environmental radioactivity. The environmental monitoring program also verifies

projected and anticipated radionuclide concentrations in the environment and related exposures from releases of radionuclides from Catawba Nuclear Station. This program satisfies the requirements of Section IV.B.2 of Appendix I to 10CFR50 and provides surveillance of all appropriate critical exposure pathways to man and protects vital interests of the company, public and state and federal agencies concerned with the environment. Reporting levels for activity found in environmental samples are listed in Table 2.2-A. Table 2.2-B lists the REMP analysis and frequency schedule.

The Annual Land Use Census, required by Selected Licensee Commitments, is performed to ensure that changes in the use of areas at or beyond the site boundary are identified and that modifications to the REMP are made if required by changes in land use. This census satisfies the requirements of Section IV.B.3 of Appendix I to 10CFR50. Results are shown in Table 3.12.

Participation in an interlaboratory comparison program as required by Selected Licensee Commitments provides for independent checks on the precision and accuracy of measurements of radioactive material in REMP sample matrices. Such checks are performed as part of the quality assurance program for environmental monitoring in order to demonstrate that the results are valid for the purposes of Section IV.B.2 of Appendix I to 10CFR50. A summary of the results obtained as part of this comparison program are in Section 5 of this annual report.

2.3 STATISTICAL AND CALCULATIONAL METHODOLOGY

2.3.1 ESTIMATION OF THE MEAN VALUE

There was one (1) basic statistical calculation performed on the raw data resulting from the environmental sample analysis program. The calculation involved the determination of the mean value for the indicator and the control samples for each sample medium. The mean is a widely used statistic. This value was used in the reduction of the data generated by the sampling and analysis of the various media in the REMP. The following equation was used to estimate the mean (reference 6.8):

$$\bar{x} = \frac{\sum_{i=1}^N x_i}{N}$$

Where:

\bar{x} = estimate of the mean,

i = individual sample,

N = total number of samples with a net activity (or concentration),

x_i = net activity (or concentration) for sample i .

NOTE: "Net activity (or concentration)" is the activity (or concentration) determined to be present in the sample. No "Minimum Detectable Activity", "Lower

Limit of Detection", "Less Than Level", or negative activities or concentrations are included in the calculation of the mean.

2.3.2 LOWER LEVEL OF DETECTION, MINIMUM DETECTABLE ACTIVITY, AND CRITICAL LEVEL

The Lower Level of Detection (LLD), Minimum Detectable Activity (MDA), and Critical Level (CL) are used throughout the REMP.

LLD - The LLD, as defined in the Selected Licensee Commitments Manual is the smallest concentration of radioactive material in a sample that will yield a net count, above the system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal. The LLD is an *a priori* lower limit of detection. The actual LLD is dependent upon the standard deviation of the background counting rate, the counting efficiency, the sample size (mass or volume), the radiochemical yield and the radioactive decay of the sample between sample collection and counting. The "required" LLD's for each sample medium and selected radionuclides are given in the Selected Licensee Commitments and are listed in Table 2.2-C.

MDA - The MDA may be thought of as an "actual" LLD for a particular sample measurement remembering that the MDA is calculated using a sample background instead of a system background.

CL - The CL is defined as the net count rate which must be exceeded before a sample is considered to contain any measurable activity above the background.

2.3.3 TREND IDENTIFICATION

One of the purposes of an environmental monitoring program is to determine if there is a buildup of radionuclides in the environment due to the operation of the nuclear station. Visual inspection of tabular or graphical presentations of data (including preoperational) is used to determine if a trend exists. A decrease in a particular radionuclide's concentration in an environmental medium does not indicate that reactor operations are removing radioactivity from the environment but that reactor operations are not adding that radionuclide to the environment in quantities exceeding the preoperational level and that the normal removal processes (radioactive decay, deposition, resuspension, etc.) are influencing the concentration.

Substantial increases or decreases in the amount of a particular radionuclide's release from the nuclear plant will greatly affect the resulting environmental levels; therefore, a knowledge of the release of a radionuclide from the nuclear plant is necessary to completely interpret the trends, or lack of trends, determined from the environmental data. Factors that may affect environmental levels of radionuclides include prevailing weather conditions (periods of drought, solar cycles or heavier than normal

precipitation), construction in or around either the nuclear plant or the sampling location, and addition or deletion of other sources of radioactive materials (such as the Chernobyl accident). Some of these factors may be obvious while others are sometimes unknown. Therefore, how trends are identified will include some judgment by plant personnel.

**TABLE 2.1-A
CATAWBA RADIOLOGICAL MONITORING PROGRAM
SAMPLING LOCATIONS**

(TLD SITES)

Site #	Location	Distance	Sector	Site #	Location	Distance	Sector
200	SITE BOUNDARY	0.6 miles	NNE	234	HOME FEDERAL BANK	4.5 miles	E
201	SITE BOUNDARY	0.5 miles	NE	235	LAKE WYLIE DAM	3.9 miles	ESE
203	SITE BOUNDARY	0.4 miles	ESE	236	SC WILDLIFE FEDERATION OFFICE	4.3 miles	SE
204	SITE BOUNDARY	0.5 miles	SSW	237	TWIN LAKES ROAD AND HOMESTEAD ROAD	4.8 miles	SSE
205	SITE BOUNDARY	0.3 miles	SW	238	PENNINGTON ROAD AND WEST OAK ROAD	4.0 miles	S
206	SITE BOUNDARY	0.7 miles	WNW	239	CARTER LUMBER COMPANY	4.5 miles	SSW
207	SITE BOUNDARY	0.9 miles	NNW	240	PARAHAM ROAD	4.1 miles	SW
212 SI	TEGA CAY AIR SITE	3.3 miles	E	241	CAMPBELL ROAD	4.6 miles	WSW
217 C	ROCK HILL AIR SITE	10.3 miles	SSE	242	TRANSMISSION TOWER ON PARAHAM ROAD	4.6 miles	W
222	SITE BOUNDARY	0.7 miles	N	243	KINGSBERRY ROAD	4.4 miles	WNW
223	SITE BOUNDARY	0.6 miles	E	244	BETHEL ELEMENTARY SCHOOL	4.0 miles	NW
225	SITE BOUNDARY	0.7 miles	SE	245	CROWDERS CREEK BOAT LANDING	4.1 miles	NNW
226	SITE BOUNDARY	0.5 miles	S	246 SI	CAROWINDS GUARD HOUSE	7.8 miles	ENE
227	SITE BOUNDARY	0.5 miles	WSW	247 C	FORT MILL	7.3 miles	ESE
228	SITE BOUNDARY	0.6 miles	W	248 SI	PIEDMONT MEDICAL CENTER	6.6 miles	S
229	SITE BOUNDARY	0.8 miles	NW	249 SI	YORK COUNTY OPERATIONS CENTER	8.1 miles	S
230	RIVER HILLS COMMUNITY CHURCH	4.4 miles	N	250 SI	YORK DUKE POWER OFFICE	10.4 miles	WSW
231	RIVER HILLS FRONT ENTRANCE	4.2 miles	NNE	251 C	CLOVER	9.7 miles	WNW
232	PLEASANT HILL ROAD	4.1 miles	NE	255	SITE BOUNDARY	0.6 miles	ENE
233	ZOAR ROAD AND THOMAS DRIVE	3.9 miles	ENE	256	SITE BOUNDARY	0.6 miles	SSE

C = Control

SI = Special Interest

TABLE 2.1-B

**CATAWBA RADIOLOGICAL MONITORING PROGRAM
SAMPLING LOCATIONS**

W	Weekly	SM	Semimonthly
BW	BiWeekly	Q	Quarterly
M	Monthly	SA	Semiannually
C	Control		

Site #	Location Description	Air Rad. & Part.	Surface Water	Drinking Water	Shoreline Sediment	Food Products (a)	Fish	Milk	Broad Leaf Veg. (b)	Ground Water
200	Site Boundary (0.6 mi NNE)	W							M	
201	Site Boundary (0.5 mi NE)	W							M	
205	Site Boundary (0.3 mi SW)	W								
208	Discharge Canal (0.5 mi S)		BW		SA		SA			
209	Dairy (6.0 mi SSW)							SM		
210	Ebenezer Access (2.3 mi SE)				SA					
211	Wylie Dam (4.0 mi ESE)		BW							
212	Tega Cay (3.3 mi E)	W								
214	Rock Hill Water Supply (7.3 mi SE)			BW						
215 C	River Pointe - Hwy 49 (4.2 mi NNE)		BW		SA					
216 C	Hwy 49 Bridge (4.0 mi NNE)						SA			
217 C	Rock Hill Substation (10.3 mi SSE)	W							M	
218 C	Belmont Water Supply (13.4 mi NNE)			BW						
219	Dairy (5.7 mi SW)							SM		
221 C	Dairy (14.5 mi NW)							SM		
222	Site Boundary (0.7 mi N)								M	
226	Site Boundary (0.5 mi S)								M	
252	Residence (0.7 mi SW)									Q
253	Irrigated Gardens (1.93 SSE)					M(a)				
254	Residence (0.8 mi N)									Q

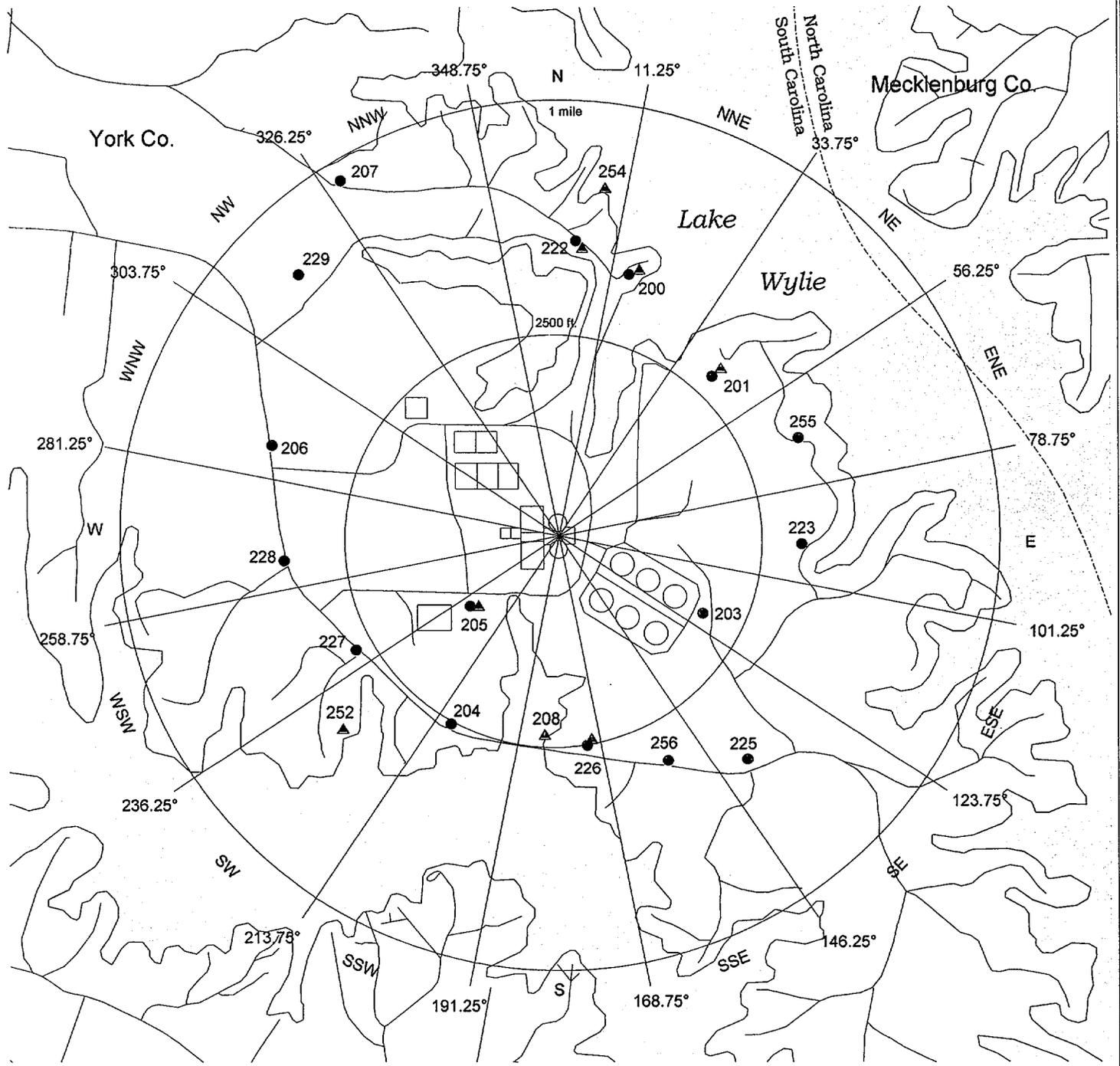
(a) During Harvest Season

(b) When Available

Catawba Nuclear Station

Figure 2.1-1

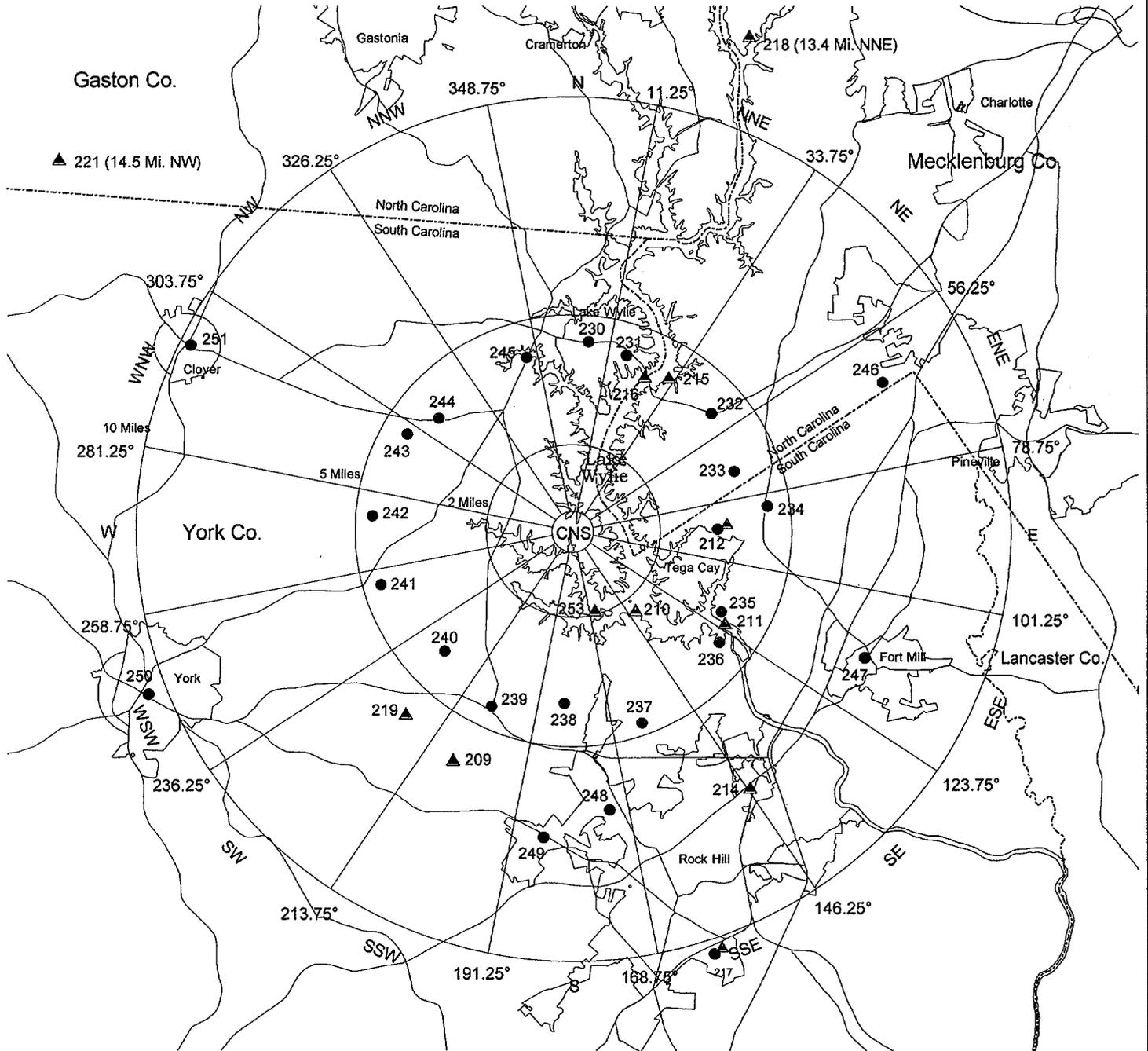
Sampling Locations Map (Site Boundary)



- TLD Locations
- ▲ All Other Locations



Catawba Nuclear Station Figure 2.1-2 Sampling Locations Map (Ten Mile Radius)



- TLD Locations
- ▲ All Other Locations



TABLE 2.2-A

**REPORTING LEVELS FOR RADIOACTIVITY
CONCENTRATIONS IN ENVIRONMENTAL SAMPLES**

Analysis	Water (pCi/liter)	Air Particulates or Gases (pCi/m ³)	Fish (pCi/kg-wet)	Milk (pCi/liter)	Food Products (pCi/kg-wet)
H-3	20,000 ^{(a),(b)}				
Mn-54	1,000		30,000		
Fe-59	400		10,000		
Co-58	1,000		30,000		
Co-60	300		10,000		
Zn-65	300		20,000		
Zr-Nb-95	400				
I-131	2	0.9		3	100
Cs-134	30	10	1,000	60	1,000
Cs-137	50	20	2,000	70	2,000
Ba-La-140	200			300	

(a) *If no drinking water pathway exists, a value of 30,000 pCi/liter may be used.*

(b) *H-3 Reporting level not applicable to surface water*

TABLE 2.2-B

REMP ANALYSIS FREQUENCY

Sample Medium	Analysis Schedule	Gamma Isotopic	Tritium	Low Level I-131	Gross Beta	TLD
Air Radioiodine	Weekly	X				
Air Particulates	Weekly				X	
	Quarterly Composite	X				
Direct Radiation	Quarterly					X
Surface Water	Monthly Composite	X				
	Quarterly Composite		X			
Drinking Water	Monthly Composite	X			X	
	Quarterly Composite		X			
Ground Water	Quarterly	X	X			
Shoreline Sediment	Semiannually	X				
Milk	Semimonthly	X		X		
Fish	Semiannually	X				
Broadleaf Vegetation	Monthly*	X				
Food Products	Monthly*	X				

* When Available

TABLE 2.2-C

MAXIMUM VALUES FOR THE LOWER LIMIT OF DETECTION

Analysis	Water (pCi/liter)	Air Particulates or Gases (pCi/m ³)	Fish (pCi/kg-wet)	Milk (pCi/liter)	Food Products (pCi/kg-wet)	Sediment (pCi/kg-dry)
Gross Beta	4	0.01				
H-3	2000 ^(a)					
Mn-54	15		130			
Fe-59	30		260			
Co-58, 60	15		130			
Zn-65	30		260			
Zr-Nb-95	15					
I-131	1 ^(b)	0.07		1	60	
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-La-140	15			15		

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

(b) If no drinking water pathway exists, the LLD of gamma isotopic analysis may be used.

3.0 INTERPRETATION OF RESULTS

In addition to the required sampling and analyses described in Selected Licensee Commitments Table 16.11-7, the following supplemental measures were taken in 1999. These measures were first adopted in 1986 to improve assessment of the impact of CNS operations on the environment.

- 1) Shoreline sediment (required collection at one point along CNS discharge canal, Location 208) was collected at three points (Locations 208-1S, 208-2S and 208-3S).
- 2) Shoreline sediment (required collection semiannually) was collected quarterly. The first and third quarter samples from Locations 208-1S, 210 and 215 are considered required samples and all remaining samples are considered supplemental.
- 3) Fish (required collection from Location 208 and 216 semiannually) were collected quarterly. Second and fourth quarter samples are the required samples and the first and third quarter samples are supplemental.
- 4) Bottom sediment (not required to be collected) was collected quarterly at Locations 208-1M, 208-2M and 208-3M. These are all supplemental samples.

Review of all 1999 REMP analysis results was performed to identify changes in environmental levels as a result of station operations. The following section depicts and explains the review of these results. Sample data for 1999 was compared to preoperational and historical data. Over the years of operation, analysis and collection changes have taken place that do not allow direct comparisons for some data collected from 1984 (preoperational) through 1999.

Summary tables containing 1999 information required by Technical Specification Administrative Control 5.6.2 are located in Appendix B. These tables contain data based upon required sample results and supplemental sample results.

Evaluation for significant trends was performed for radionuclides that are listed as required within Selected Licensee Commitments 16.11-8. The radionuclides include: H-3, Mn-54, Fe-59, Co-58, Co-60, Zn-65, Zr-95, Nb-95, I-131, Cs-134, Cs-137, Ba-140 and La-140. Gross beta analysis results were trended for drinking water and gross beta trending for air particulates was initiated in 1996. Other radionuclides detected that are the result of plant operation, but not required for reporting, are trended.

A comparison of annual mean concentrations of effluent-based detected radionuclides to historical results provided trending bases. Frequency of detection and concentrations related to NRC reporting levels (Table 2.2) were used as criteria for trending conclusions. All 1999 maximum percentages of reporting levels were well below the 100% action level. The highest

value noted during 1999 was 13.5% for a broadleaf vegetation sample collected at the Bluebird Lane location 201.

Selected Licensee Commitment section 16.11-13 addresses actions to be taken if radionuclides other than those required are detected in samples collected. The occurrences of these radionuclides are the result of CNS liquid effluents which contained the radionuclides.

During 1979-1986, all net activity results (sample minus background), both positive and negative were included in calculation of sample mean. A change in the EnRad gamma spectroscopy system on September 1, 1987, decreased the number of measurements yielding detectable low-level activity for indicator and control location samples. It was thought that the method used by the previous system was vulnerable to false-positive results.

All 1999 sample analysis results were reviewed to detect and identify any significant trends. Tables and graphs are used throughout this section to display data from effluent-based radionuclides identified since the system change in late 1987. All negative concentration values were replaced with zero for calculation purposes. Any zero concentrations used in tables or graphs represent activity measurements less than detectable levels.

Review of all 1999 data presented in this section supports the conclusion that there were no significant changes in environmental sample radionuclide concentrations of samples collected and analyzed from CNS site and surrounding areas that were attributable to plant operations.

3.1 AIRBORNE RADIOIODINE AND PARTICULATES

In 1999, 260 radioiodine and particulate samples were analyzed, 208 from four indicator locations and 52 at the control location. Particulate samples were analyzed for gross beta. Gamma analysis was performed on 20 particulate composite samples, 16 at the four indicator locations and four at the control location.

Gross beta analysis is performed on particulate filters. Figure 3.1 shows individual sample gross beta results for the indicator location with highest annual mean and the control location samples during 1999. The two sample locations' results are similar in concentration and have varied negligibly since preoperational periods.

There were no detectable gamma emitters identified for particulate filters analyzed during 1999. Table 3.1-A shows the highest indicator annual mean and control location annual mean for gross beta in air particulate.



Routine Air Sampling

There was no detectable I-131 in air radioiodine samples analyzed in 1999. Table 3.1-B shows the highest indicator annual mean and control location annual mean for I-131 since 1984 (preoperational period).

K-40 and Be-7 that occur naturally were routinely detected in charcoal cartridges collected during the year. Cs-137 activity was detected on two indicator cartridges during 1999. The detection of Cs-137 on the charcoal cartridge was determined in 1990 to be an active constituent of the charcoal (reference 6.5). Therefore, the Cs-137 activity was not used in any dose calculations in Section 4.0 of this report.

Figure 3.1

There is no reporting level for gross beta in air particulate

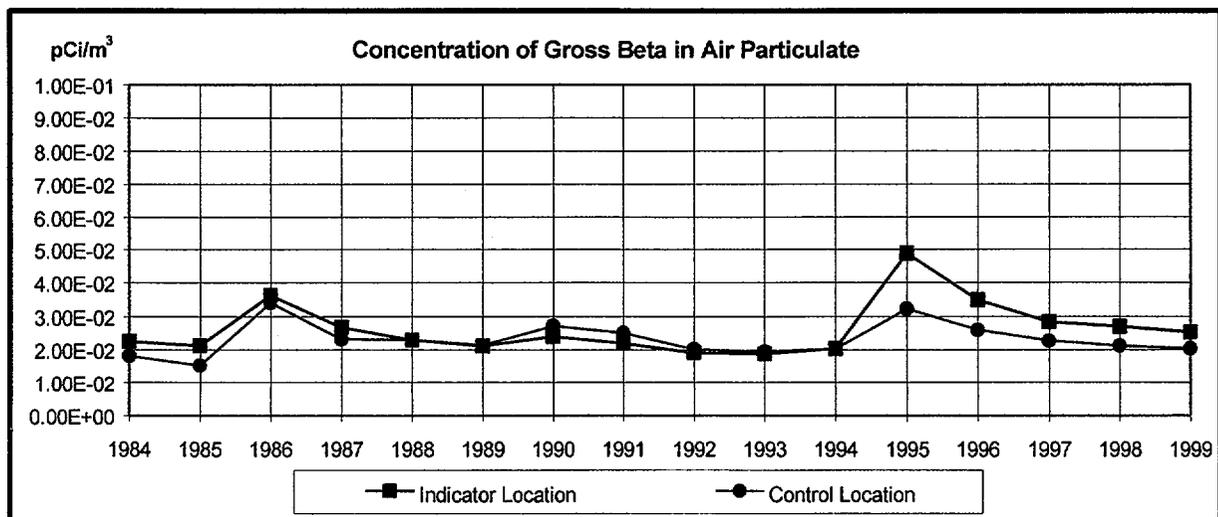


Table 3.1-A Mean Concentration of Gross Beta in Air Particulate

Year	Indicator Location (pCi/m ³)	Control Location (pCi/m ³)
1984	2.25E-2	1.82E-2
1985	2.12E-2	1.53E-2
1986	3.62E-2	3.41E-2
1987	2.67E-2	2.32E-2
1988	2.29E-2	2.30E-2
1989	2.11E-2	2.13E-2
1990	2.39E-2	2.72E-2
1991	2.19E-2	2.51E-2
1992	1.90E-2	2.01E-2
1993	1.87E-2	1.94E-2
1994	2.03E-2	2.03E-2
1995	4.88E-2	3.23E-2
1996	3.49E-2	2.60E-2
1997	2.83E-2	2.28E-2
1998	2.69E-2	2.12E-2
Average (1989 - 1998)	2.64E-2	2.36E-2
1999	2.53E-2	2.04E-2

Table 3.1-B Mean Concentration of Air Radioiodine (I-131)

Year	Indicator Location (pCi/m ³)	Control Location (pCi/m ³)
1984	1.30E-3	1.46E-2
1985	4.75E-3	2.38E-2
1986	1.43E-2	1.02E-2
1987	1.38E-2	0.00E0
1988	0.00E0	0.00E0
1989	0.00E0	0.00E0
1990	0.00E0	0.00E0
1991	0.00E0	0.00E0
1992	0.00E0	0.00E0
1993	0.00E0	0.00E0
1994	0.00E0	0.00E0
1995	0.00E0	0.00E0
1996	0.00E0	0.00E0
1997	0.00E0	0.00E0
1998	0.00E0	0.00E0
1999	0.00E0	0.00E0

0.00E0 = no detectable measurements

3.2 DRINKING WATER

Gross beta and gamma spectroscopy were performed on 26 drinking water samples. The samples were composited to create 8 quarterly samples that were analyzed for tritium. One indicator location was sampled, along with one control location.

Tritium was detected at low levels in four indicator samples and four control samples during 1999. The mean indicator tritium concentration for 1999 was 671 pCi/l, 3.36% of reporting level. The mean control tritium concentration for 1999 was 270 pCi/l, 1.35% of reporting level. Figure 3.2 and Table 3.2 display the highest indicator and control location annual mean concentrations for tritium since 1984.

Table 3.2 shows highest annual mean gross beta concentrations for the indicator location and control location since preoperation. The indicator location (downstream of the plant effluent release point) average concentration was 3.55 pCi/l in 1999 and the control location concentration was 2.48 pCi/l. The 1998 indicator mean was 2.51 pCi/l. The table shows that current gross beta levels are not statistically different from preoperational concentrations.

No gamma emitting radionuclides were identified in 1999 drinking water samples. There have been no gamma emitting radionuclides identified in drinking water samples since 1988.

Figure 3.2

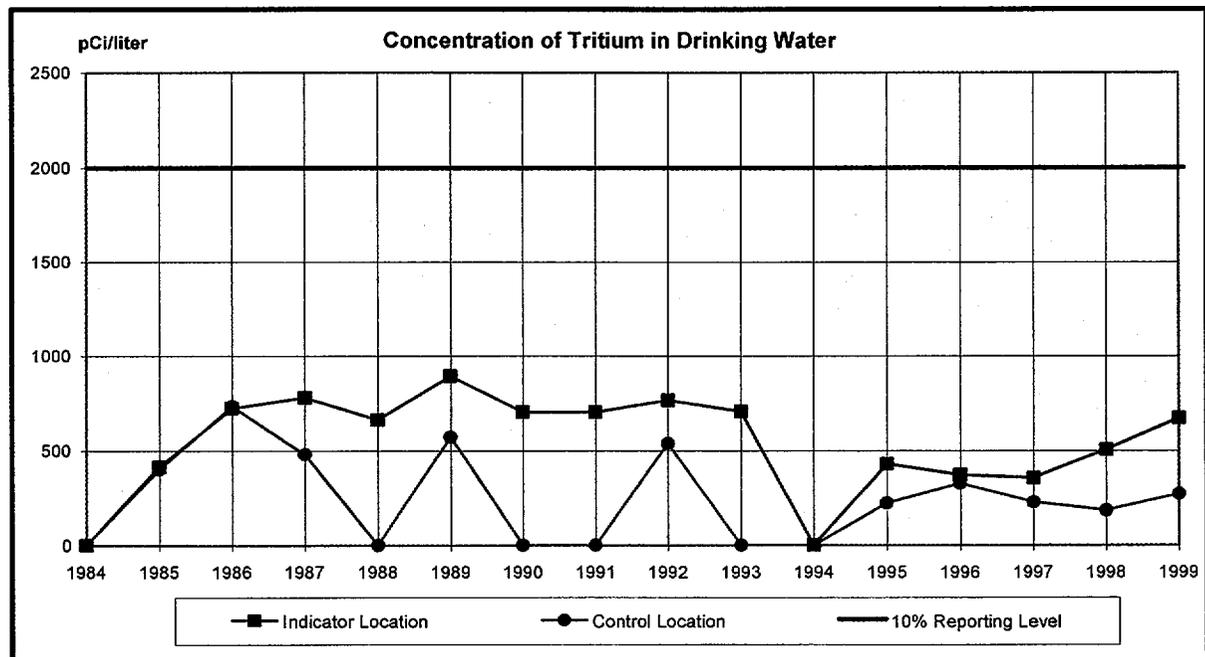


Table 3.2 Mean Concentration of Radionuclides in Drinking Water

YEAR	Gross Beta (pCi/l)		Tritium (pCi/l)	
	Indicator Location	Control Location	Indicator Location	Control Location
1984	4.72	1.83	3.10E-2	3.10E-2
1985	2.70	2.24	4.13E2	4.00E2
1986	3.11	2.26	7.23E2	7.33E2
1987	3.10	2.40	7.80E2	4.80E2
1988	3.60	2.60	6.64E2	0.00E0
1989	3.60	2.90	8.91E2	5.72E2
1990	4.50	3.20	7.03E2	0.00E0
1991	3.70	2.20	7.04E2	0.00E0
1992	3.20	2.40	7.65E2	5.38E2
1993	3.50	2.50	7.06E2	0.00E0
1994	3.30	2.70	0.00E0	0.00E0
1995	4.80	4.50	4.28E2	2.21E2
1996	3.08	3.14	3.71E2	3.27E2
1997	3.74	3.15	3.54E2	2.28E2
1998	2.51	2.44	5.07E2	1.83E2
1999	3.55	2.48	6.71E2	2.70E2

0.00E0 = no detectable measurements

1984 - 1986 mean based on all net activity

3.3 SURFACE WATER

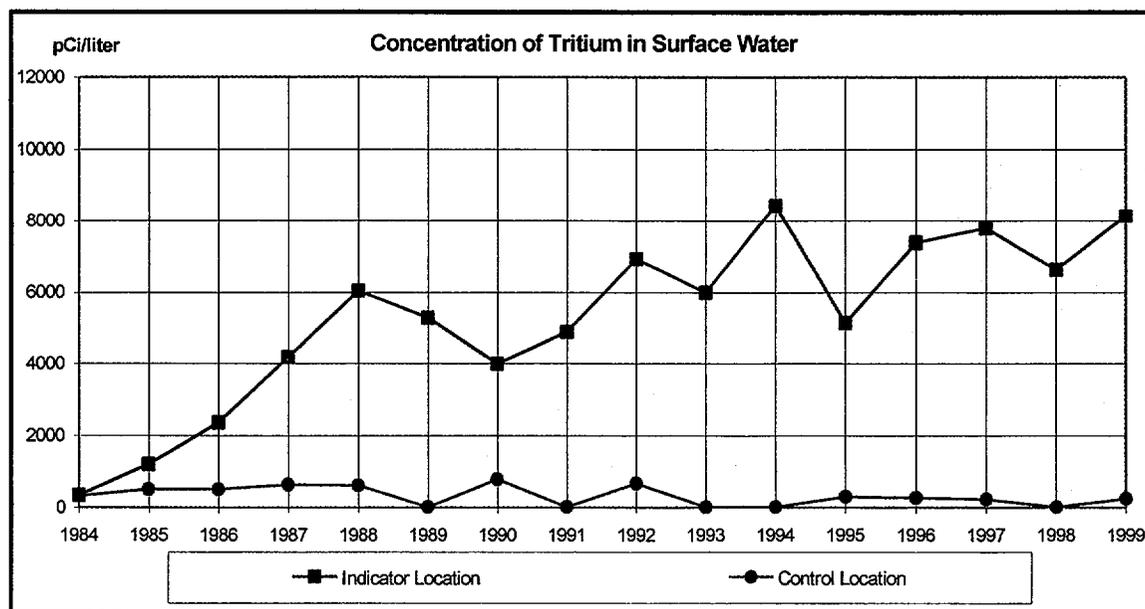
A total of 39 monthly surface water samples was analyzed for gamma emitting radionuclides. The samples were composited to create 12 quarterly samples for tritium analysis. Two indicator locations and one control location were sampled. One indicator location (208) is located near the liquid effluent discharge point.

Tritium was the only radionuclide identified in surface water samples collected during 1999. All indicator location samples contained tritium with an average concentration of all indicator locations of 4387 pCi/l. Indicator Location 208 (Discharge Canal) showed a range of activities from 6880 to 9925 pCi/l. The 1999 mean concentration was 8128 pCi/l. Tritium was detected in all control samples during 1999 with an average concentration of 241 pCi/l.

Figure 3.3 displays the indicator and control annual means for tritium since 1984. Table 3.3 lists indicator annual means.

Table 3.3 summarizes gamma spectroscopy results for surface water samples collected since 1984. Values shown on the table from 1988 through 1999 show a relatively stable to slightly increasing trend for tritium.

Figure 3.3



There is no reporting level for tritium in surface water

Table 3.3 Mean Concentrations of Radionuclides in Surface Water (pCi/l)

YEAR	Co-58	Co-60	Nb-95	Cs-137	H-3 Indicator	H-3 Control
1984	4.59E-1	5.71E-1	6.48E-1	9.08E-1	3.35E2	3.18E2
1985	3.46E0	4.83E-2	2.70E0	8.19E-1	1.19E3	5.05E2
1986	3.10E-1	-4.12E-2	2.05E0	4.85E-1	2.34E3	5.05E2
1987	0.00E0	3.10E0	4.30E0	9.90E0	4.17E3	6.20E2
1988	9.20E0	0.00E0	0.00E0	0.00E0	6.03E3	6.07E2
1989	0.00E0	0.00E0	0.00E0	0.00E0	5.27E3	0.00E0
1990	6.50E0	0.00E0	0.00E0	0.00E0	3.98E3	7.73E2
1991	0.00E0	0.00E0	0.00E0	0.00E0	4.87E3	0.00E0
1992	0.00E0	0.00E0	0.00E0	0.00E0	6.91E3	6.64E2
1993	4.70E0	1.80E0	0.00E0	0.00E0	5.98E3	0.00E0
1994	0.00E0	0.00E0	0.00E0	0.00E0	8.42E3	0.00E0
1995	0.00E0	0.00E0	0.00E0	0.00E0	5.13E3	2.89E2
1996	0.00E0	0.00E0	0.00E0	0.00E0	7.36E3	2.61E2
1997	0.00E0	0.00E0	0.00E0	0.00E0	7.77E3	2.20E2
1998	0.00E0	0.00E0	0.00E0	0.00E0	6.61E3	0.00E0
1999	0.00E0	0.00E0	0.00E0	0.00E0	8.13E3	2.41E2

0.00E0 = no detectable measurements

1984 - 1986 mean based on all net activity

3.4 GROUND WATER

A total of eight ground water samples was collected and analyzed for gamma emitters. There are two indicator locations and no control locations. Naturally occurring K-40 was the only radionuclide identified during 1999.

There have been no radionuclides identified in ground water samples since 1988. Only naturally occurring K-40 and Be-7 were noted.

3.5 MILK

A total of 75 milk samples was analyzed by gamma spectroscopy and low level iodine during 1999. There were two indicator locations and one control location sampled.

There were no gamma emitting radionuclides identified in milk during 1999.

There was one gamma emitting radionuclide identified in one indicator sample during 1996. Cs-137 was detected at a concentration of 6.05 pCi/l, which is 8.5% of the reporting level. The occurrence of Cs-137 in milk samples has been noted several times since 1984. During 1995 there was also one sample analyzed in which Cs-137 was identified with a concentration of 8.6 pCi/l. Cs-137 attributable to past nuclear weapons testing is known to exist in many environmental media at low, highly variable levels.

Table 3.5 lists highest indicator location annual mean and control location annual mean for Cs-137 since the preoperational period. Concentrations are similar for the two sample types. Cs-137 is the only radionuclide, other than K-40 and Be-7, reported in milk samples since 1988.

Table 3.5 Mean Concentration of Radionuclides in Milk

YEAR	Cs-137 Indicator (pCi/l)	Cs-137 Control (pCi/l)
1984	2.95E0	2.98E0
1985	2.11E0	2.12E0
1986	3.76E0	4.54E0
1987	5.00E0	5.50E0
1988	3.20E0	3.80E0
1989	0.00E0	0.00E0
1990	8.00E0	6.70E0
1991	0.00E0	0.00E0
1992	3.40E0	5.00E0
1993	5.00E0	0.00E0
1994	2.80E0	0.00E0
1995	8.60E0	0.00E0
1996	6.05E0	0.00E0
1997	0.00E0	0.00E0
1998	0.00E0	0.00E0
1999	0.00E0	0.00E0

0.00E0 = no detectable measurements

1984 - 1986 mean based on all net activity

3.6 BROADLEAF VEGETATION

Gamma spectroscopy was performed on 35 broadleaf vegetation samples during 1999. Four indicator locations and one control location were sampled.

Five of the twenty-eight samples collected at indicator locations contained detectable Cs-137 activity. Cs-137 was detected in five of the seven samples collected at Location 201. This location's highest concentration was 270 pCi/kg which is 13.5% of the reporting level. Cs-137 was not detected in the control location.

Figure 3.6 shows indicator and control annual means for Cs-137 in vegetation since 1984. Table 3.6 lists indicator and annual means. Values shown from 1984 to 1999 show a stable trend for Cs-137 in vegetation.

Cs-137 attributable to past nuclear weapons testing is known to exist in many environmental media at low and highly variable levels.



Broadleaf Vegetation Sampling

K-40 and Be-7 were observed in broadleaf vegetation samples.

Figure 3.6

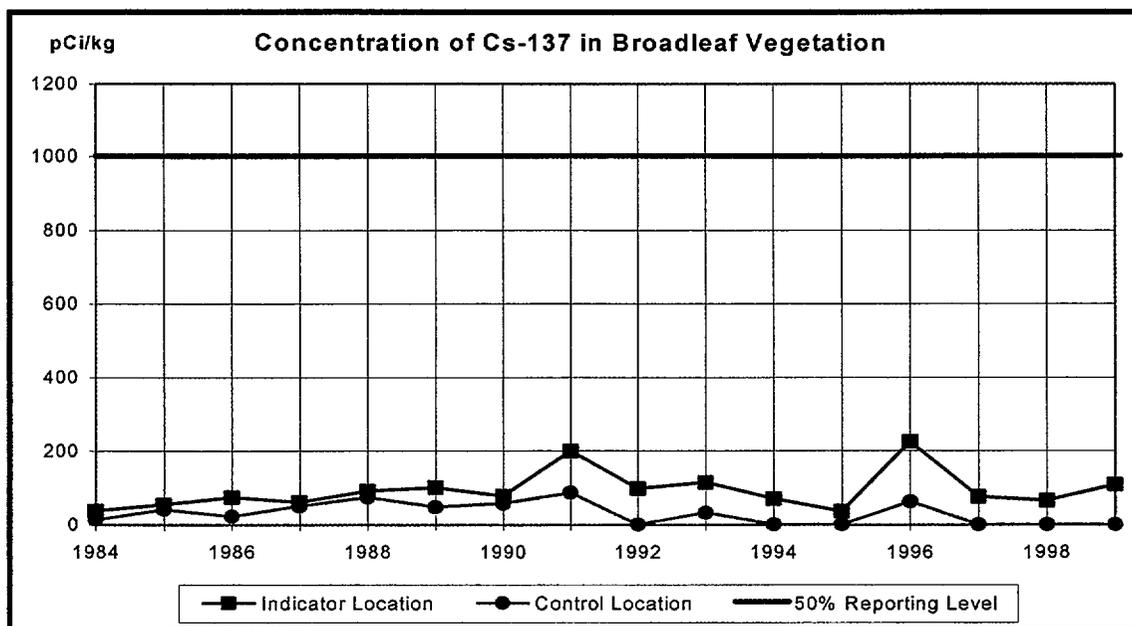


Table 3.6 Mean Concentration of Radionuclides in Broadleaf Vegetation

YEAR	Cs-137 Indicator (pCi/kg)	Cs-137 Control (pCi/kg)
1984	3.76E1	1.30E1
1985	5.48E1	4.16E1
1986	7.42E1	2.22E1
1987	6.10E1	5.10E1
1988	9.10E1	7.40E1
1989	1.00E2	4.80E1
1990	7.70E1	5.80E1
1991	1.98E2	8.60E1
1992	9.70E1	0.00E0
1993	1.13E2	3.20E1
1994	7.00E1	0.00E0
1995	3.60E1	0.00E0
1996	2.23E2	6.22E1
1997	7.57E1	0.00E0
1998	6.53E1	0.00E0
1999	1.08E2	0.00E0

0.00E0 = no detectable measurements

1984 - 1986 mean based on all net activity

3.7 FOOD PRODUCTS

Collection of food product samples (crops) from an irrigated garden began in 1989. The garden is located on Lake Wylie downstream from CNS, Location 253. During the 1999 growing season, eight samples were collected and analyzed for gamma radionuclides. There is no control location for this media type.

Table 3.7 shows Cs-137 indicator location highest annual mean concentrations since 1989.

Table 3.7 Mean Concentration of Radionuclides in Food Products

YEAR	Cs-137 Indicator (pCi/kg)
1989	0.00E0
1990	0.00E0
1991	0.00E0
1992	0.00E0
1993	2.50E1
1994	0.00E0
1995	0.00E0
1996	0.00E0
1997	0.00E0
1998	0.00E0
1999	0.00E0

0.00E0 = no detectable measurements

3.8 FISH

Gamma spectroscopy was performed on 24 fish samples collected during 1999. One downstream indicator location and one control location were sampled. Co-58, Co-60 and Cs-137 were the predominant radionuclides identified in fish samples. Two of twelve indicator location samples contained Co-58. One of twelve indicator location samples contained Co-60. Three of the twelve indicator location samples contained Cs-137. Cs-137 was identified in two of the twelve control location samples.

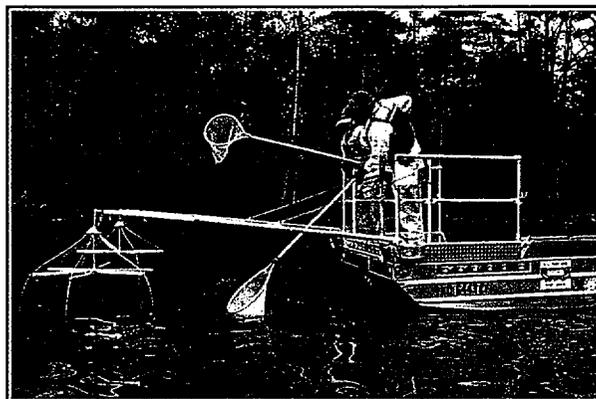
The highest average concentration for Co-58 in indicator location samples was 31.2 pCi/kg which represents 0.10% of the reporting level. The highest average concentration for Co-60 in indicator locations was 27.1 pCi/kg which represents 0.27% of the reporting level. For Cs-137 in indicator location samples, the highest average concentration was 18.7 pCi/kg which represents 0.94% of the reporting level. The highest individual sample concentrations were as follows: Co-58, 35.1 pCi/kg (0.12 % of reporting level), Co-60, 27.1 pCi/kg (0.27% of reporting level) and Cs-137, 35.0 pCi/kg (1.75% of reporting level).

Sample results for fish collected at indicator Location 208 were reviewed by type of fish. Results show that all radionuclide detection frequencies and concentrations are higher for forager fish than for predator and bottom feeding fish. Similar results have been noted from 1990 through 1998.

Figures 3.8-1 and 3.8-2 are graphs displaying annual mean concentrations for Co-58 and Co-60 which have been major calculated dose contributors from ingestion of fish since 1988. Concentrations of these radionuclides have followed a direct pattern along with their concentrations in liquid effluents released from the plant. The addition of supplemental samples in 1986, has provided additional data to assist in this continuing correlation between radionuclide concentration in indicator fish samples and radionuclide concentration released via the liquid effluent pathway.

Table 3.8 depicts the highest indicator location annual mean for radionuclides detected. In addition, radionuclides identified in fish samples since 1988 have been included in the table. Overall, radionuclides have not shown a significant trend or accumulation since 1988.

K-40 was observed in fish samples collected during 1999.



Fish Sampling

Figure 3.8-1

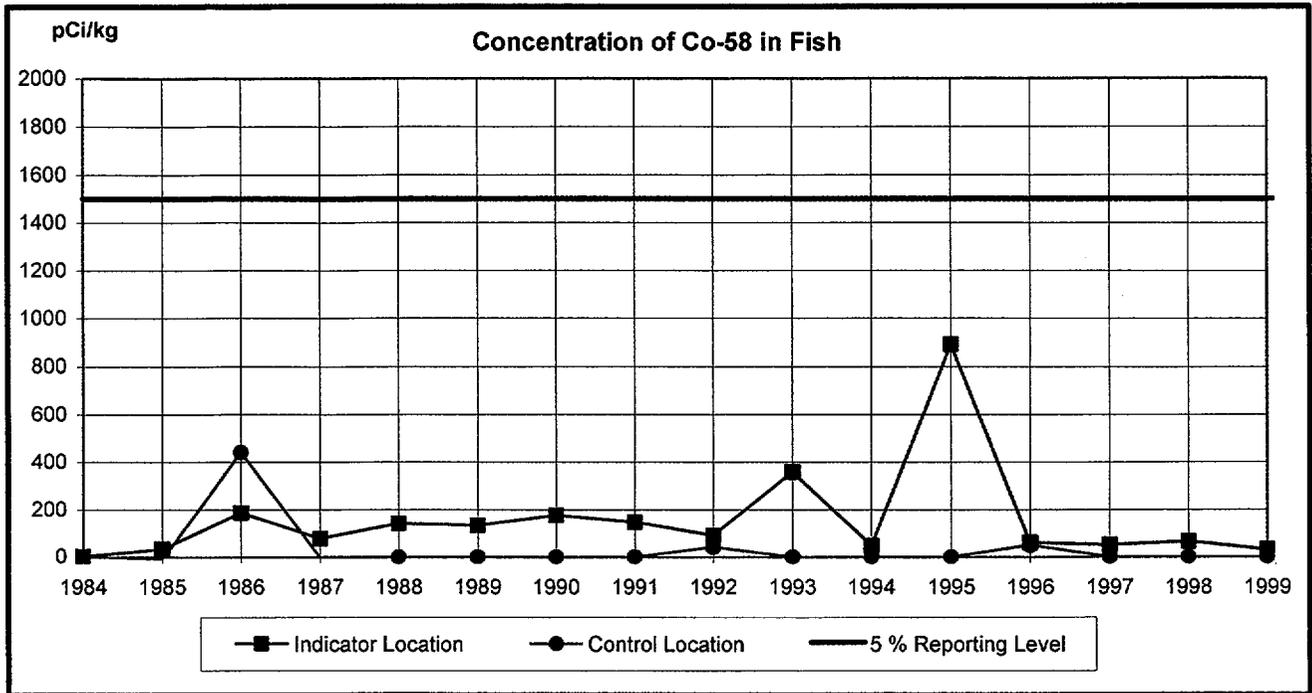


Figure 3.8-2

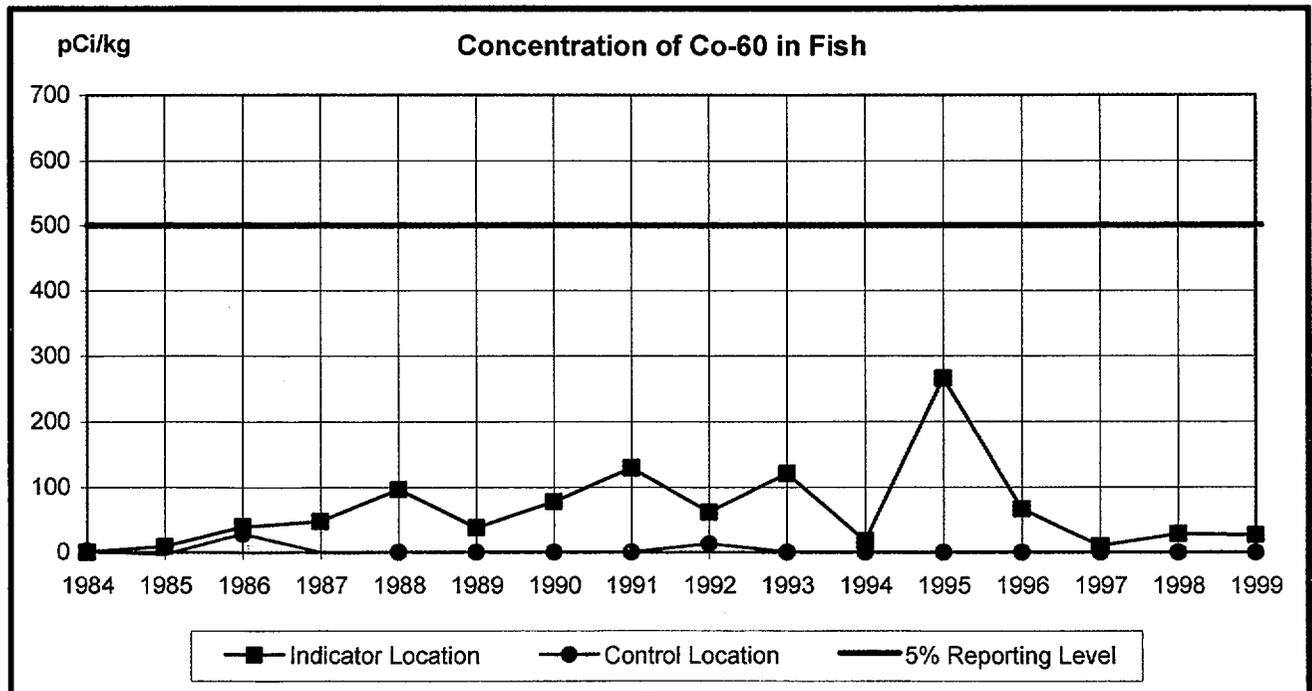


Table 3.8 Mean Concentrations of Radionuclides in Fish (pCi/kg)

Year	Mn-54	Co-58	Co-60	Cs-134	Cs-137	Nb-95	Fe-59	Sb-122	Sb-125
1984	3.07E0	3.00E0	6.11E-1	-5.32E0	1.83E0	0.00E0	0.00E0	0.00E0	0.00E0
1985	7.68E-1	3.40E1	9.11E0	3.22E0	1.28E1	5.07E0	0.00E0	0.00E0	0.00E0
1986	2.01E1	1.86E2	4.01E1	3.51E1	9.29E1	0.00E0	7.30E0	0.00E0	0.00E0
1987	7.24E0	7.57E1	4.81E1	3.83E0	4.27E1	5.40E0	0.00E0	0.00E0	0.00E0
1988	2.85E1	1.40E2	9.70E1	1.67E1	8.24E1	0.00E0	0.00E0	0.00E0	0.00E0
1989	8.28E0	1.33E2	3.83E1	1.47E1	4.37E1	8.58E-1	0.00E0	0.00E0	0.00E0
1990	2.51E1	1.75E2	7.77E1	1.32E1	4.66E1	3.33E0	0.00E0	7.00E0	9.25E0
1991	3.15E1	1.46E2	1.29E2	1.03E1	4.60E1	7.90E-1	2.30E0	0.00E0	7.45E0
1992	1.34E1	9.02E1	6.20E1	1.27E1	4.61E1	0.00E0	0.00E0	0.00E0	0.00E0
1993	2.14E1	3.58E2	1.21E2	2.73E0	2.56E1	0.00E0	0.00E0	0.00E0	0.00E0
1994	1.91E0	4.75E1	1.81E1	0.00E0	1.75E1	0.00E0	0.00E0	0.00E0	1.45E1
1995	5.65E1	8.90E2	2.66E2	0.00E0	6.77E1	1.38E1	0.00E0	0.00E0	0.00E0
1996	0.00E0	5.95E1	6.68E1	0.00E0	3.02E1	0.00E0	0.00E0	0.00E0	0.00E0
1997	0.00E0	4.93E1	9.88E0	0.00E0	2.74E1	0.00E0	0.00E0	0.00E0	0.00E0
1998	0.00E0	6.44E1	2.86E1	0.00E0	1.58E1	0.00E0	0.00E0	0.00E0	0.00E0
1999	0.00E0	3.12E1	2.71E1	0.00E0	1.87E1	0.00E0	0.00E0	0.00E0	0.00E0

0.00E0 = no detectable measurements

3.9 SHORELINE SEDIMENT

During 1999, a total of 20 shoreline sediment samples was analyzed, four from indicator location 210 and twelve from indicator location 208. Four control samples were analyzed from control location 215.

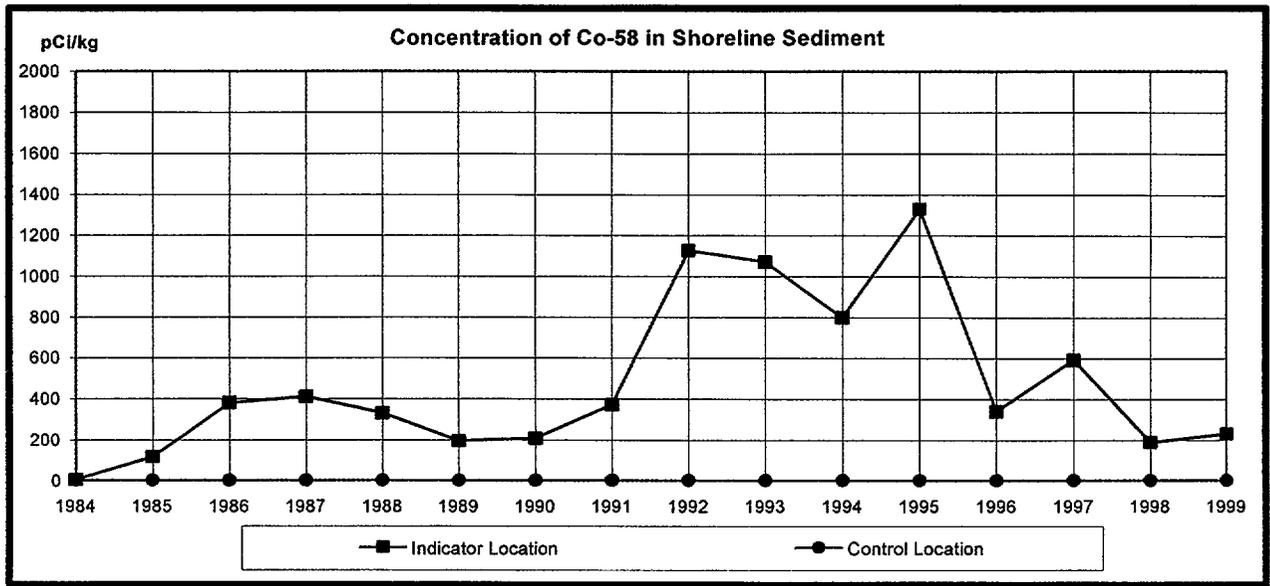
Co-58, Co-60, Cs-137, Mn-54, and Sb-125 were identified in samples collected from location 208, which is subdivided into three discharge canal areas (208-1S, 208-2S and 208-3S). These locations are closest to the plant's liquid effluent release point. Naturally occurring K-40 was identified in many of the indicator and control locations.

The shoreline sediment location with the highest annual mean for all detectable radionuclides was location 208-3S. Cs-137 was identified at location 208-3S with an annual mean concentration of 94.2 pCi/kg. Other radionuclides identified during 1999 at shoreline sediment location 208-3S included Co-58 with an annual mean of 229 pCi/kg, Co-60 with an annual mean of 439 pCi/kg, Mn-54 with an annual mean of 72.8 pCi/kg, and Sb-125 with an annual mean of 140 pCi/kg. Naturally occurring K-40 and Be-7 were also identified in samples from this location.

Table 3.9 lists highest indicator location annual mean since 1984. Included in the table are radionuclides that have been identified in shoreline sediment samples since 1988.

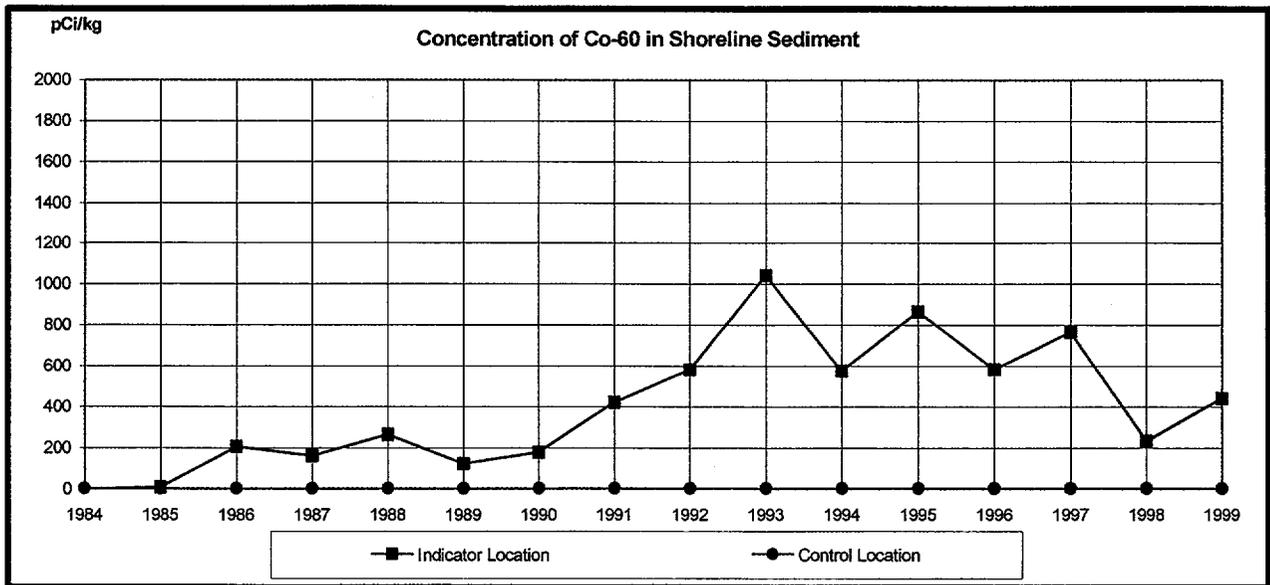
Figure 3.9-1 graphically depicts Co-58 annual mean concentrations. Figure 3.9-2 depicts Co-60 annual mean concentrations. Both radionuclides have been major contributors to the calculated dose from shoreline sediment since 1986.

Figure 3.9-1



There is no reporting level for Co-58 in Shoreline Sediment

Figure 3.9-2



There is no reporting level for Co-60 in Shoreline Sediment

Table 3.9 Mean Concentrations of Radionuclides in Shoreline Sediment (pCi/kg)

Year	Mn-54	Co-58	Co-60	Nb-95	Zr-95	Cs-134	Cs-137	Co-57	Sb-125
1984	1.03E0	4.40E0	-2.34E0	0.00E0	0.00E0	3.19E1	1.07E2	0.00E0	0.00E0
1985	-3.12E0	1.16E2	5.18E0	0.00E0	0.00E0	2.11E2	2.97E2	0.00E0	0.00E0
1986	1.09E2	3.79E2	2.05E2	0.00E0	3.96E1	6.50E1	1.61E2	0.00E0	0.00E0
1987	8.83E1	4.08E2	1.61E2	4.22E1	0.00E0	6.08E1	1.26E2	0.00E0	0.00E0
1988	1.07E2	3.29E2	2.63E2	2.28E1	7.54E0	2.59E1	1.07E2	7.65E-1	3.68E0
1989	4.58E1	1.94E2	1.21E2	5.02E0	0.00E0	1.65E1	5.77E1	0.00E0	1.57E1
1990	5.39E1	2.08E2	1.77E2	0.00E0	0.00E0	1.66E1	8.18E1	0.00E0	7.15E0
1991	8.50E1	3.70E2	4.19E2	5.30E0	0.00E0	1.82E1	8.33E1	1.20E0	1.50E1
1992	1.17E2	1.13E3	5.80E2	3.50E0	0.00E0	1.69E1	1.07E2	3.00E0	2.70E1
1993	1.33E2	1.07E3	1.04E3	0.00E0	0.00E0	2.80E1	1.26E2	2.47E1	2.16E2
1994	4.93E1	7.98E2	5.73E2	0.00E0	0.00E0	5.67E0	1.07E2	4.38E0	4.60E1
1995	1.02E2	1.33E3	8.65E2	1.13E2	0.00E0	0.00E0	8.50E1	3.69E1	1.49E2
1996	8.73E1	3.39E2	5.81E2	0.00E0	0.00E0	0.00E0	8.30E1	0.00E0	1.96E2
1997	6.96E1	5.90E2	7.64E2	0.00E0	0.00E0	0.00E0	1.43E2	0.00E0	1.76E2
1998	3.07E1	1.88E2	2.30E2	0.00E0	0.00E0	0.00E0	7.11E1	0.00E0	0.00E0
1999	7.28E1	2.29E2	4.39E2	0.00E0	0.00E0	0.00E0	9.42E1	0.00E0	1.40E2

0.00E0 = no detectable measurements
1984 - 1986 mean based on all net activity
Negative values are calculated as zeroes

3.10 BOTTOM SEDIMENT

Bottom sediment samples are not required as a collection media. Samples were first collected during 1986 from three points in the discharge canal (Location 208) following review of shoreline sediment and fish samples collected there. The three points were designated 208-1M, 208-2M and 208-3M (Figure 3.10-1). Bottom sediment control samples have never been collected.

The following radionuclides were identified in bottom sediment samples collected in 1999: Mn-54, Co-58, Co-60, Sb-125, and Cs-137. The majority of samples collected contained these radionuclides, as have samples collected and analyzed since 1986.

Figure 3.10-1

Bottom Sediment Sampling Locations in CNS Discharge Canal

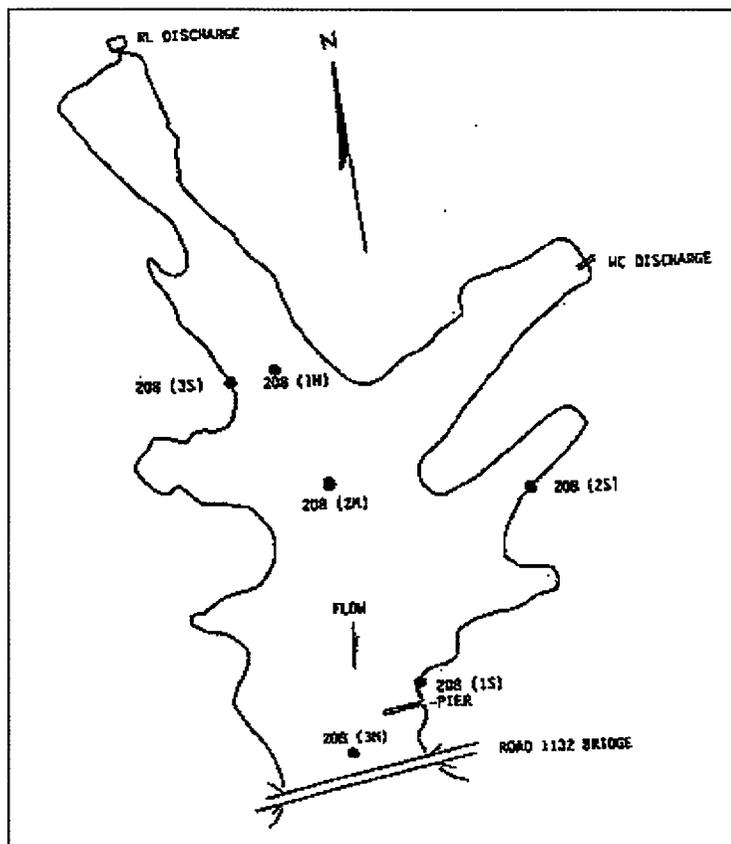


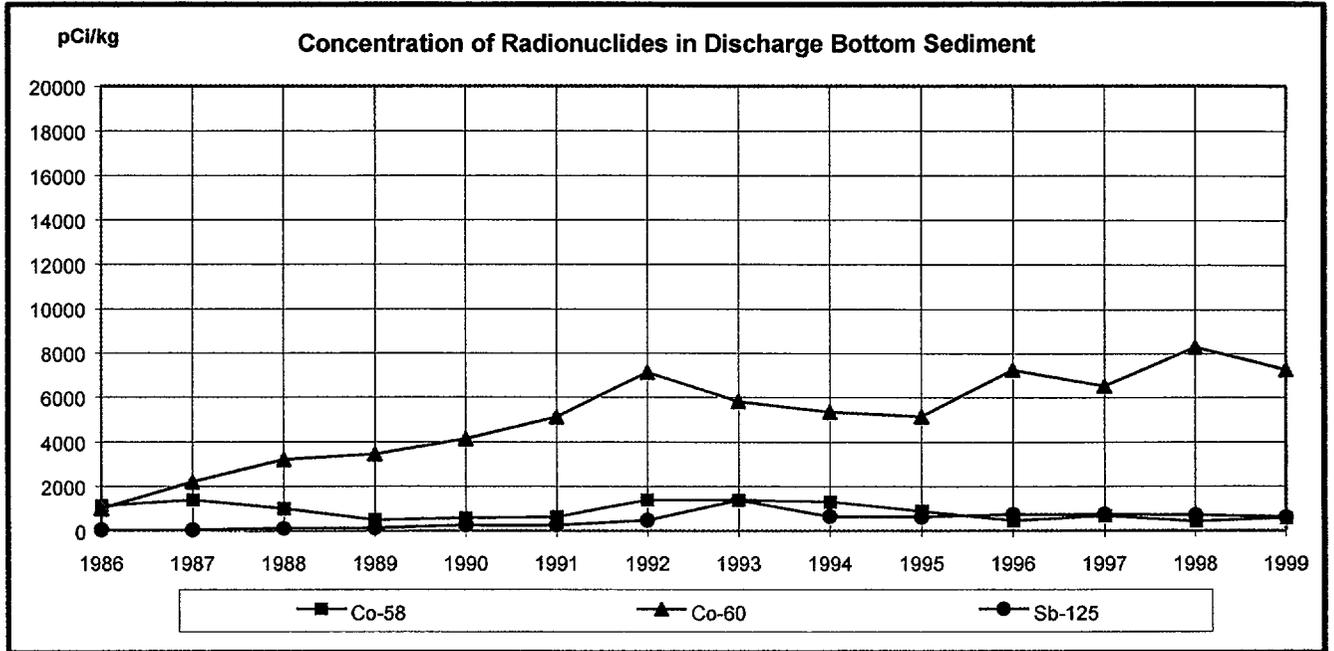
Table 3.10 shows bottom sediment sample annual mean concentrations for the three sample points at indicator Location 208 (CNS discharge canal) for the period 1986 through 1999. Overall detection frequencies were high and relatively stable throughout the period.

From 1986 through 1995, detectable concentrations for bottom sediment correlated well with activities released in liquid effluents. One exception has been Co-60 which has exhibited an increasing trend. Over the period of trending, indications show no significant environmental "removal" processes for Co-60. Considering expected cumulative and decay corrected activities from liquid effluents released since preoperation, one would have expected a decreasing accumulation of the radionuclide.

Figure 3.10-2 shows the major radionuclide contributors identified in bottom sediment from 1986 through 1999. Data shown is annual mean concentrations of Co-58, Co-60, and Sb-125.

Effluent concentrations from liquid releases during 1999 correlate closely with annual mean concentrations of Co-58, Co-60, and Sb-125 detected in bottom sediment. The impact of plant operation on bottom sediment from location 208 was at an expected level when compared to liquid effluent release data for 1999.

Figure 3.10-2



There are no reporting levels for Co-58, Co-60, and Sb-125 in bottom sediment

Table 3.10 Mean Concentrations of Radionuclides in Bottom Sediment (pCi/kg)

Year	Mn-54	Co-58	Co-60	Nb-95	Cs-134	Cs-137	Cr-51	Co-57	Sb-125
1986	3.60E2	1.09E3	9.64E2	6.99E1	1.71E2	3.48E2	0.00E0	0.00E0	0.00E0
1987	5.63E2	1.34E3	2.18E3	6.99E1	1.10E2	4.03E2	0.00E0	0.00E0	0.00E0
1988	5.78E2	9.52E2	3.18E3	1.78E1	1.23E2	5.70E2	0.00E0	5.64E0	6.25E1
1989	3.98E2	4.47E2	3.42E3	4.49E0	1.05E2	5.04E2	0.00E0	4.48E0	8.11E1
1990	3.81E2	5.22E2	4.12E3	7.06E0	9.55E1	5.06E2	0.00E0	4.56E0	2.15E2
1991	4.15E2	5.76E2	5.10E3	1.63E1	8.13E1	5.02E2	7.53E1	8.20E0	2.13E2
1992	5.25E2	1.34E3	7.10E3	7.20E0	4.55E1	4.94E2	2.22E1	1.97E1	4.33E2
1993	3.72E2	1.33E3	5.79E3	0.00E0	7.66E1	5.38E2	0.00E0	1.58E1	1.33E3
1994	2.77E2	1.25E3	5.32E3	0.00E0	0.00E0	4.27E2	0.00E0	1.72E1	5.98E2
1995	1.82E2	8.26E2	5.12E3	1.23E1	6.00E0	4.11E2	0.00E0	1.48E1	5.68E2
1996	1.90E2	4.05E2	7.22E3	0.00E0	0.00E0	4.29E2	0.00E0	4.92E0	6.95E2
1997	1.76E2	6.27E2	6.49E3	4.06E1	0.00E0	3.85E2	0.00E0	0.00E0	6.92E2
1998	1.76E2	3.86E2	8.27E3	0.00E0	0.00E0	4.30E2	0.00E0	2.56E1	6.68E2
1999	1.64E2	5.30E2	7.23E3	0.00E0	0.00E0	3.75E2	0.00E0	0.00E0	5.63E2

0.00E0 = no detectable measurements

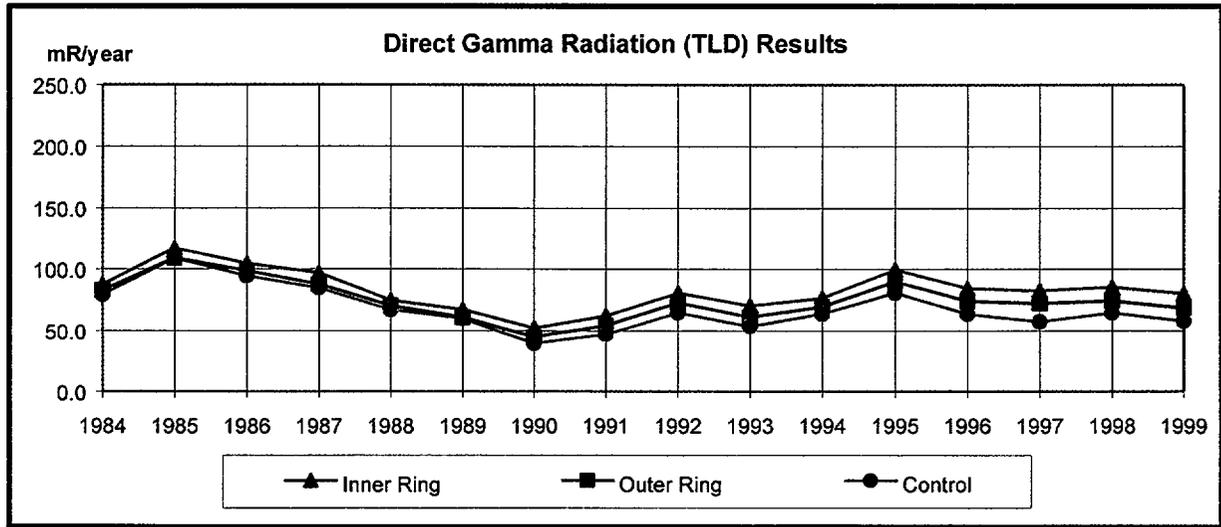
3.11 DIRECT GAMMA RADIATION

In 1999, 158 TLDs were analyzed, 146 at indicator locations and 12 at control locations. TLDs are collected and analyzed quarterly. The highest annual mean exposure for an indicator location was 90.3 milliroentgen. The annual mean exposure for the control locations was 57.8 milliroentgen.

Figure 3.11 and Table 3.11 show TLD inner ring (site boundary), outer ring (4-5 miles), and control location annual averages in milliroentgen per year. Preoperational data and rolling ten year operational data averages are also given. As shown in the graph, inner and outer ring averages historically compare closely, with control data somewhat higher. Inner and outer ring averages comprise a number of data points with control averages representing only three locations.

The calculated total body dose (from gaseous effluents) for 1999 was 1.04 mrem, which is 1.4% of the average inner ring TLD values. Therefore, it can be concluded that discharges from the plant had very little impact upon the measured TLD values.

Figure 3.11



There is no reporting level for Direct Radiation (TLD)

Table 3.11 Direct Gamma Radiation (TLD) Results

Year	Inner Ring Average (mR/yr)	Outer Ring Average (mR/yr)	Control Average (mR/yr)
1984*	87.5	82.6	79.3
1985	116.9	108.7	108.9
1986	104.3	98.5	94.4
1987	97.0	87.4	84.7
1988	74.6	70.3	67.1
1989	67.1	60.8	60.0
1990	52.0	44.5	39.1
1991	62.0	54.1	46.7
1992	80.4	72.5	64.5
1993	70.3	60.9	53.6
1994	76.3	69.3	63.9
1995	99.6	89.7	80.8
1996	84.3	73.9	63.6
1997	82.4	71.9	57.4
1998	85.3	74.2	64.6
Average (1989 – 1998)	76.0	67.2	59.4
1999	80.0	68.1	57.8

* Preoperational Data

3.12 LAND USE CENSUS

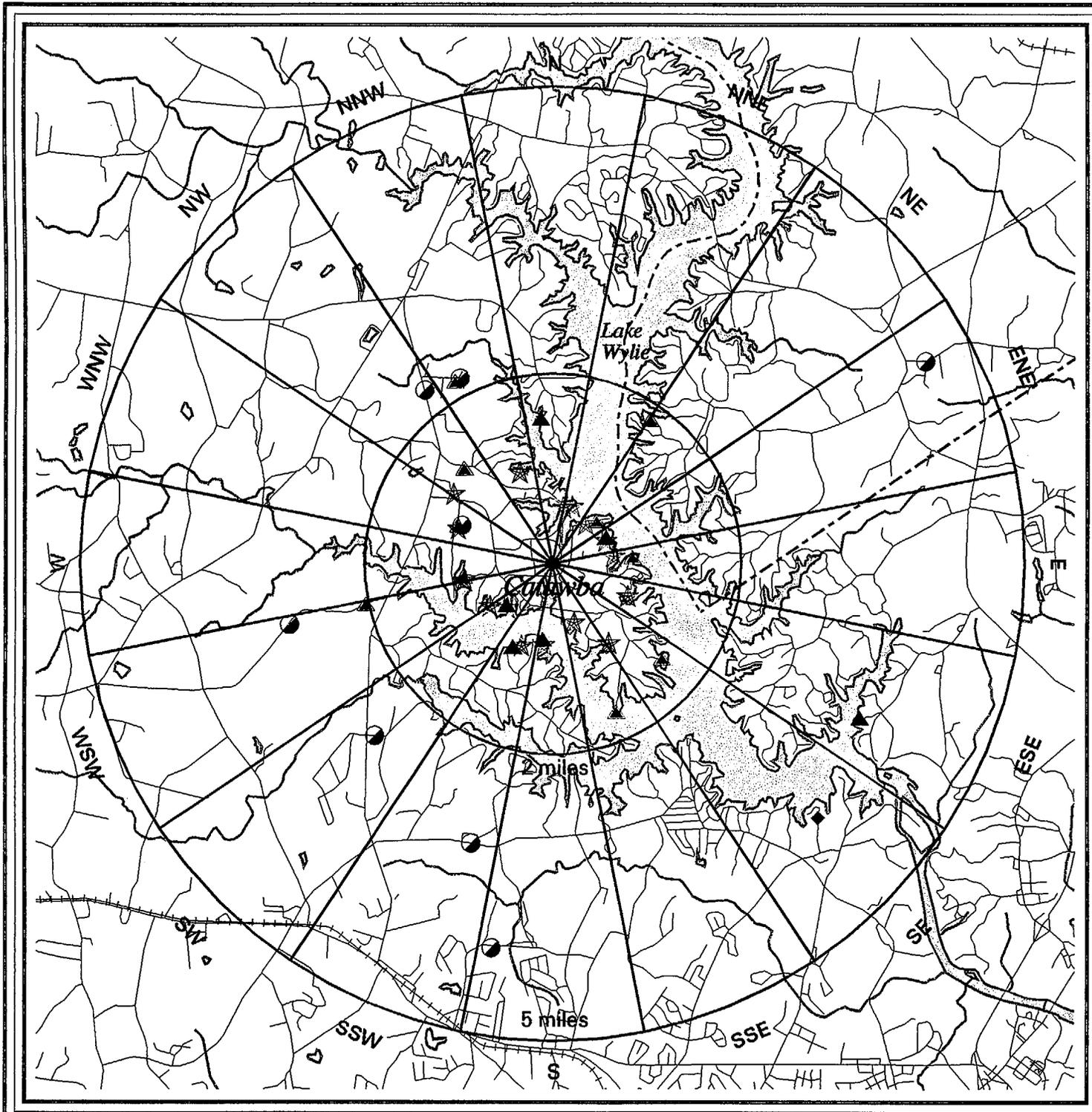
The 1999 Annual Land Use Census was conducted July 14 - July 16, 1999 as required by SLCs 16.11-14. Table 3.12 summarizes census results. Figure 3.12 contains a map showing identified locations. Sectors shown in Table 3.12 that have no values listed had no corresponding location identified in that sector.

Based upon 1999 Annual Land Use Census results for nearest residences and gardens, dose evaluations were performed to ensure current air and broadleaf vegetation sampling locations complied with requirements of SLCs. No changes to the locations were necessary. The evaluations showed that all existing air and broadleaf vegetation sampling locations complied with SLCs requirements. No changes or additions to the locations were required or made as a result of the 1999 census.

Table 3.12 Catawba 1999 Land Use Census Results

Sector		Distance (Miles)	Sector		Distance (Miles)
N	Nearest Residence	0.64	S	Nearest Residence	0.83
	Nearest Garden	1.54		Nearest Garden	0.79
	Nearest Milk Animal	-		Nearest Milk Animal	-
	Nearest Meat Animal (Cow)	4.87		Nearest Meat Animal (Cow)	4.05
NNE	Nearest Residence	0.66	SSW	Nearest Residence	0.89
	Nearest Garden	1.85		Nearest Garden	0.96
	Nearest Milk Animal	-		Nearest Milk Animal	-
	Nearest Meat Animal	-		Nearest Meat Animal (Cow)	3.04
NE	Nearest Residence	0.57	SW	Nearest Residence	0.65
	Nearest Garden	0.66		Nearest Garden	0.65
	Nearest Milk Animal	-		Nearest Milk Animal	-
	Nearest Meat Animal	-		Nearest Meat Animal (Cow)	2.59
ENE	Nearest Residence	0.62	WSW	Nearest Residence	0.79
	Nearest Garden	0.60		Nearest Garden	2.04
	Nearest Milk Animal	-		Nearest Milk Animal	-
	Nearest Meat Animal (Cow)	4.49		Nearest Meat Animal (Cow)	2.87
E	Nearest Residence	0.65	W	Nearest Residence	0.96
	Nearest Garden	0.85		Nearest Garden	0.95
	Nearest Milk Animal	-		Nearest Milk Animal	-
	Nearest Meat Animal	-		Nearest Meat Animal	-
ESE	Nearest Residence	0.84	WNW	Nearest Residence	1.10
	Nearest Garden	3.63		Nearest Garden	1.11
	Nearest Milk Animal	-		Nearest Milk Animal	-
	Nearest Meat Animal	-		Nearest Meat Animal (Cow)	1.10
SE	Nearest Residence	0.99	NW	Nearest Residence	1.31
	Nearest Garden	1.52		Nearest Garden	1.39
	Nearest Milk Animal	-		Nearest Milk Animal	-
	Nearest Meat Animal	-		Nearest Meat Animal (Cow)	2.30
SSE	Nearest Residence	0.62	NNW	Nearest Residence	1.06
	Nearest Garden	1.70		Nearest Garden	2.19
	Nearest Milk Animal	-		Nearest Milk Animal	-
	Nearest Meat Animal	-		Nearest Meat Animal (Cow)	2.21

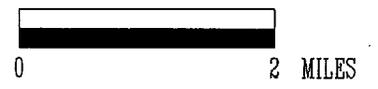
“-“ indicates no occurrences within the 5 mile radius



**Catawba Nuclear
Station 1999 Land
Use Census Map**

- Milk cow
- ▲ Irrigated garden
- △ Non-irrigated Garden
- ★ Residence
- ◐ Beef cow
- Streams and Shorelines
- Roads
- - - County lines
- ⊢ Railroads

1999 data in red



SCALE: 1:95040
Projection N.C. State Plane

July 1999

4.0 EVALUATION OF DOSE

4.1 DOSE FROM ENVIRONMENTAL MEASUREMENTS

Annual doses to maximum exposed individuals were estimated based on measured concentrations of radionuclides in 1999 CNS REMP samples. The primary purpose of estimating doses based on sample results was to allow comparison to effluent program dose estimates. Doses based on sample results were conservatively calculated in a manner as equivalent as possible to effluent-based dose estimates.

Doses based on sample results were calculated using the methodology and data presented in NRC Regulatory Guide 1.109. Measured radionuclide concentrations, averaged over the entire year for a specific radionuclide, indicator location and sample type, were used to calculate REMP-based doses. Where applicable, average background concentration at the corresponding control location was subtracted. Regulatory Guide 1.109 consumption rates for the maximum exposed individual were used in the calculations. When the guide listed "NO DATA" as the dose factor for a given radionuclide and organ, a dose factor of zero was assumed.

Maximum dose estimates (Highest Annual Mean Concentration) based on drinking water, broadleaf vegetation, fish, and shoreline sediment sample results are reported in Table 4.1-A.

REMP-based dose estimates were not reported for airborne radioiodine, airborne particulate, milk, or ground water sample types because no radionuclides other than naturally occurring K-40 and Be-7 were detected in the samples. Dose estimates were not reported for surface water or bottom sediment sample types because sampled surface water is not considered to be a potable drinking water source and sample bottom sediment is permanently submerged. Exposure estimates based upon REMP TLD results are discussed in Section 3.11.

The maximum dose to each organ from any single sample type other than direct radiation from gaseous effluents was determined and reported in Table 4.1-B. The maximum environmental organ dose estimate for any single sample type (other than direct radiation from gaseous effluents) collected during 1999 was 9.18E-1 mrem to the maximum exposed child's bone from consuming broadleaf vegetation.

4.2 ESTIMATED DOSE FROM RELEASES

Throughout the year, dose estimates were calculated based on actual 1999 liquid and gaseous effluent release data. Effluent-based dose estimates were calculated using the RETDAS computer program which employs methodology and data presented in NRC Regulatory Guide 1.109. The 1999 CNS Annual Radioactive Effluent Release

Report (reference 6.6) included calendar year dose estimates for the location with the highest individual organ dose from liquid and gaseous effluent releases. These reported doses are shown in Table 4.1-A along with the corresponding REMP-based dose estimates.

The effluent-based liquid release doses are summations of the dose contributions from the drinking water, fish, and shoreline pathways. The effluent-based gaseous release doses report noble gas exposure separately from iodine, particulate, and tritium exposure. For noble gas exposure there is no critical age group; as the maximum exposed individuals are assumed to receive the same doses, regardless of their age group. For iodine, particulate, and tritium exposure the effluent-based gaseous release doses are summations of the dose contributors from ground/plane, inhalation and vegetation pathways.

4.3 COMPARISON OF DOSES

The environmental and release data doses given in Table 4.1-A agree reasonably well. The similarity of the doses indicate that the radioactivity levels in the environment do not differ significantly from those expected based on effluent measurements and modeling of the environmental exposure pathways. This indicates that effluent program dose estimates are both valid and reasonably conservative.

In calculations based on liquid release pathways, fish and drinking water consumption were the predominant dose pathways based on environmental and effluent samples. The maximum total organ dose based on 1999 environmental sample results was $8.01E-2$ mrem to the adult GI-LLI. The maximum total organ dose of $1.22E-1$ mrem for liquid effluent-based estimates was to the adult GI-LLI. For all organs, liquid effluent doses were higher than REMP data doses.

In calculations based on gaseous release pathways, vegetation was the predominant dose pathway for effluent samples. The maximum total organ dose for gaseous effluent estimates was $1.04E0$ mrem to the child's liver, total body, thyroid, kidney, lung, and GI-LLI. Vegetation was the predominant dose pathway for environmental samples. The maximum total organ dose for gaseous environmental estimates was $9.18E-1$ mrem to the child bone.

Noble gas samples are not collected as part of the REMP, preventing an analogous comparison of effluent-based noble gas exposure estimates. The doses calculated do not exceed the 40CFR190 dose commitment limits for members of the public. Doses to members of the public attributable to the operation of CNS are being maintained well within regulatory limits.

TABLE 4.1-A

**CATAWBA NUCLEAR STATION
1999 ENVIRONMENTAL AND EFFLUENT DOSE COMPARISON**

LIQUID RELEASE PATHWAY

Organ	Environmental or Effluent Data	Critical Age	Critical Pathway	Location	Maximum Dose* (mrem)
Skin	Environmental	Teen	Shoreline Sediment	208 (0.5 mi S)	6.49E-03
Skin	Effluent	Teen	Shoreline Sediment	0.5 mi S	1.36E-02
Bone	Environmental	Teen	Shoreline Sediment	208 (0.5 mi S)	5.53E-03
Bone	Effluent	Child	Fish	0.5 mi S	4.48E-02
Liver	Environmental	Child	Drinking Water	214 (7.3 mi SE)	5.40E-02
Liver	Effluent	Adult	Fish	0.5 mi S	9.86E-02
T. Body	Environmental	Child	Drinking Water	214 (7.3 mi SE)	5.67E-02
T. Body	Effluent	Adult	Fish	0.5 mi S	8.68E-02
Thyroid	Environmental	Child	Drinking Water	214 (7.3 mi SE)	5.26E-02
Thyroid	Effluent	Child	Drinking Water	7.3 mi SE	5.56E-02
Kidney	Environmental	Child	Drinking Water	214 (7.3 mi SE)	5.26E-02
Kidney	Effluent	Adult	Fish	0.5 mi S	7.09E-02
Lung	Environmental	Child	Drinking Water	214 (7.3 mi SE)	5.26E-02
Lung	Effluent	Child	Drinking Water	7.3 mi SE	6.06E-02
GI-LLI	Environmental	Adult	Fish	208 (0.5 mi S)	8.01E-02
GI-LLI	Effluent	Adult	Fish	0.5 mi S	1.22E-01

* Maximum dose is a summation of the fish, drinking water and shoreline sediment pathways.

GASEOUS RELEASE PATHWAY

IODINE, PARTICULATE, and TRITIUM

Organ	Environmental or Effluent Data	Critical Age	Critical Pathway	Location	Maximum Dose* (mrem)
Skin	Environmental	-	-	-	0.00E+00
Skin	Effluent	-	-	-	0.00E+00
Bone	Environmental	Child	Vegetation	201 (0.5 mi NE)	9.18E-01
Bone	Effluent	-	-	-	0.00E+00
Liver	Environmental	Child	Vegetation	201 (0.5 mi NE)	8.79E-01
Liver	Effluent	Child	Vegetation	0.5 mi NE	1.04E+00
T. Body	Environmental	Adult	Vegetation	201 (0.5 mi NE)	4.94E-01
T. Body	Effluent	Child	Vegetation	0.5 mi NE	1.04E+00
Thyroid	Environmental	-	-	-	0.00E+00
Thyroid	Effluent	Child	Vegetation	0.5 mi NE	1.04E+00
Kidney	Environmental	Child	Vegetation	201 (0.5 mi NE)	2.86E-01
Kidney	Effluent	Child	Vegetation	0.5 mi NE	1.04E+00
Lung	Environmental	Child	Vegetation	201 (0.5 mi NE)	1.03E-01
Lung	Effluent	Child	Vegetation	0.5 mi NE	1.04E+00
GI-LLI	Environmental	Adult	Vegetation	201 (0.5 mi NE)	1.46E-02
GI-LLI	Effluent	Child	Vegetation	0.5 mi NE	1.04E+00

* Maximum dose is a summation of the ground/plane, inhalation, milk and vegetation pathways.

NOBLE GAS

Air Dose	Environmental or Effluent Data	Critical Age	Critical Pathway	Location	Maximum Dose (mrad)
Beta	Environmental	-	-	-	Not Sampled
Beta	Effluent	N/A	Noble Gas	0.5 mi NNE	8.06E-02
Gamma	Environmental	-	-	-	Not Sampled
Gamma	Effluent	N/A	Noble Gas	0.5 mi NNE	3.33E-02

TABLE 4.1-B

Maximum Individual Dose for 1999 based on Environmental Measurements (mrem) for Catawba Nuclear Station

Age	Sample Medium	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Skin
Infant	Airborne	0.00E+00							
	Drinking Water	0.00E+00	4.08E-02	4.08E-02	4.08E-02	4.08E-02	4.08E-02	4.08E-02	0.00E+00
	Milk	0.00E+00							
	<u>TOTAL</u>	0.00E+00	4.08E-02	4.08E-02	4.08E-02	4.08E-02	4.08E-02	4.08E-02	0.00E+00
Child	Airborne	0.00E+00							
	Drinking Water	0.00E+00	4.15E-02	4.15E-02	4.15E-02	4.15E-02	4.15E-02	4.15E-02	0.00E+00
	Milk	0.00E+00							
	Broadleaf Vegetation	9.18E-01	8.79E-01	1.30E-01	0.00E+00	2.86E-01	1.03E-01	5.50E-03	0.00E+00
	Fish	0.00E+00	1.13E-02	1.40E-02	9.94E-03	9.94E-03	9.94E-03	1.77E-02	0.00E+00
	Shoreline Sediment	1.16E-03	1.36E-03						
	<u>TOTAL</u>	9.19E-01	9.33E-01	1.87E-01	5.26E-02	3.39E-01	1.56E-01	6.59E-02	1.36E-03
Teen	Airborne	0.00E+00							
	Drinking Water	0.00E+00	2.17E-02	2.17E-02	2.17E-02	2.17E-02	2.17E-02	2.17E-02	0.00E+00
	Milk	0.00E+00							
	Broadleaf Vegetation	5.08E-01	6.76E-01	2.35E-01	0.00E+00	2.30E-01	8.94E-02	9.62E-03	0.00E+00
	Fish	0.00E+00	1.37E-02	1.59E-02	1.20E-02	1.20E-02	1.20E-02	3.46E-02	0.00E+00
	Shoreline Sediment	5.53E-03	6.49E-03						
	<u>TOTAL</u>	5.14E-01	7.17E-01	2.78E-01	3.92E-02	2.69E-01	1.29E-01	7.15E-02	6.49E-03
Adult	Airborne	0.00E+00							
	Drinking Water	0.00E+00	3.07E-02	3.07E-02	3.07E-02	3.07E-02	3.07E-02	3.07E-02	0.00E+00
	Milk	0.00E+00							
	Broadleaf Vegetation	5.51E-01	7.53E-01	4.94E-01	0.00E+00	2.56E-01	8.50E-02	1.46E-02	0.00E+00
	Fish	0.00E+00	1.74E-02	1.94E-02	1.57E-02	1.57E-02	1.57E-02	4.84E-02	0.00E+00
	Shoreline Sediment	9.91E-04	1.16E-03						
	<u>TOTAL</u>	5.52E-01	8.02E-01	5.45E-01	4.74E-02	3.03E-01	1.32E-01	9.47E-02	1.16E-03

Note: Dose tables are provided for sample media displaying positive nuclide occurrence.

Catawba Nuclear Station
Dose from Broadleaf Vegetation Pathway for 1999 Data
Maximum Exposed Child

Child Dose from Vegetation Pathway (mrem) = Usage (kg) x Dose Factor (mrem/pCi ingested) x Concentration (pCi/kg)

Usage (intake in one year) = 26 kg

Radionuclide	<u>Ingestion Dose Factor</u>							<u>Highest Annual Net Mean Concentration</u>		<u>Dose (mrem)</u>						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Indicator Location	Food (pCi/kg)	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
I-131	1.72E-05	1.73E-05	9.83E-06	5.72E-03	2.84E-05	NO DATA	1.54E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	2.34E-04	3.84E-04	8.10E-05	NO DATA	1.19E-04	4.27E-05	2.07E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	3.27E-04	3.13E-04	4.62E-05	NO DATA	1.02E-04	3.67E-05	1.96E-06	201	108.00	9.18E-01	8.79E-01	1.30E-01	0.00E+00	2.86E-01	1.03E-01	5.50E-03
Dose Commitment (mrem) =										9.18E-01	8.79E-01	1.30E-01	0.00E+00	2.86E-01	1.03E-01	5.50E-03

*Catawba Nuclear Station
Dose from Fish Pathway for 1999 Data
Maximum Exposed Child*

Child Dose from Fish Pathway (mrem) = Usage (kg) x Dose Factor (mrem/pCi ingested) x Concentration (pCi/kg)

H-3 Concentration in Fish = Surface Water pCi/l x Bioaccumulation Factor 0.9 pCi/kg per pCi/l = 7887 pCi/l x 0.9 = 7098 pCi/kg

Usage (intake in one year) = 6.9 kg

Radionuclide	<u>Ingestion Dose Factor</u>							<u>Highest Annual Net Mean Concentration</u>		<u>Dose (mrem)</u>						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Indicator Location	Fish (pCi/kg)	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	1.07E-05	2.85E-06	NO DATA	3.00E-06	NO DATA	8.98E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	1.80E-06	5.51E-06	NO DATA	NO DATA	NO DATA	1.05E-05	208	31.20	0.00E+00	3.88E-04	1.19E-03	0.00E+00	0.00E+00	0.00E+00	2.26E-03
Fe-59	1.65E-05	2.67E-05	1.33E-05	NO DATA	NO DATA	7.74E-06	2.78E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C0-60	NO DATA	5.29E-06	1.56E-05	NO DATA	NO DATA	NO DATA	2.93E-05	208	27.10	0.00E+00	9.89E-04	2.92E-03	0.00E+00	0.00E+00	0.00E+00	5.48E-03
Zn-65	1.37E-05	3.65E-05	2.27E-05	NO DATA	2.30E-05	NO DATA	6.41E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	2.34E-04	3.84E-04	8.10E-05	NO DATA	1.19E-04	4.27E-05	2.07E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	3.27E-04	3.13E-04	4.62E-05	NO DATA	1.02E-04	3.67E-05	1.96E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	NO DATA	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	208	7098.00	0.00E+00	9.94E-03	9.94E-03	9.94E-03	9.94E-03	9.94E-03	9.94E-03
Dose Commitment (mrem) =										0.00E+00	1.13E-02	1.40E-02	9.94E-03	9.94E-03	9.94E-03	1.77E-02

Catawba Nuclear Station
Dose from Shoreline Sediment Pathway for 1999 Data
Maximum Exposed Child

Shoreline Recreation = 14 hr (in one year)
 Shore Width Factor = 0.2
 Sediment Surface Mass = 40 kg/m²

Child Dose from Shoreline Sediment Pathway (mrem) = Shoreline Recreation (hr) x External Dose Factor (mrem/hr per pCi/m²) x Shore Width Factor x Sediment Surface Mass (kg/m²) x Sediment Concentration (pCi/kg)

Radionuclide	External Dose Factor Standing on Contaminated Ground (mrem/hr per pCi/m ²)		Indicator Location	Sediment Concentration (pCi/kg)	Highest Annual Net Mean Concentration Dose (mrem)	
	T. Body	Skin			T. Body	Skin
Mn-54	5.80E-09	6.80E-09	208	72.80	4.73E-05	5.54E-05
Co-58	7.00E-09	8.20E-09	208	229.00	1.80E-04	2.10E-04
Co-60	1.70E-08	2.00E-08	208	439.00	8.36E-04	9.83E-04
Cs-134	1.20E-08	1.40E-08	ALL	0.00	0.00E+00	0.00E+00
Cs-137	4.20E-09	4.90E-09	208	94.20	4.43E-05	5.17E-05
*Sb-125	3.10E-09	3.50E-09	208	140.00	4.86E-05	5.49E-05
Dose Commitment (mrem) =					1.16E-03	1.36E-03

* Dose Factor from Reference 6.11

*Catawba Nuclear Station
Dose from Broadleaf Vegetation Pathway for 1999 Data
Maximum Exposed Teen*

Teen Dose from Vegetation Pathway (mrem) = Usage (kg) x Dose Factor (mrem/pCi ingested) x Concentration (pCi/kg)

Usage (intake in one year) = 42 kg

Radionuclide	<u>Ingestion Dose Factor</u>							<u>Highest Annual Net Mean Concentration</u>		<u>Dose (mrem)</u>						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Indicator Location	Food (pCi/kg)	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
I-131	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	NO DATA	1.62E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	8.37E-05	1.97E-04	9.14E-05	NO DATA	6.26E-05	2.39E-05	2.45E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	1.12E-04	1.49E-04	5.19E-05	NO DATA	5.07E-05	1.97E-05	2.12E-06	201	108.00	5.08E-01	6.76E-01	2.35E-01	0.00E+00	2.30E-01	8.94E-02	9.62E-03
Dose Commitment (mrem) =										5.08E-01	6.76E-01	2.35E-01	0.00E+00	2.30E-01	8.94E-02	9.62E-03

Catawba Nuclear Station
Dose from Fish Pathway for 1999 Data
Maximum Exposed Teen

Teen Dose from Fish Pathway (mrem) = Usage (kg) x Dose Factor (mrem/pCi ingested) x Concentration (pCi/kg)

H-3 Concentration in Fish = Surface Water pCi/l x Bioaccumulation Factor 0.9 pCi/kg per pCi/l = 7887 pCi/l x 0.9 = 7098 pCi/kg

Usage (intake in one year) = 16 kg

Radionuclide	<u>Ingestion Dose Factor</u>							<u>Highest Annual Net Mean Concentration</u>		<u>Dose (mrem)</u>						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Location	(pCi/kg)	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	5.90E-06	1.17E-06	NO DATA	1.76E-06	NO DATA	1.21E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	9.72E-07	2.24E-06	NO DATA	NO DATA	NO DATA	1.34E-05	208	31.20	0.00E+00	4.85E-04	1.12E-03	0.00E+00	0.00E+00	0.00E+00	6.69E-03
Fe-59	5.87E-06	1.37E-05	5.29E-06	NO DATA	NO DATA	4.32E-06	3.24E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	2.81E-06	6.33E-06	NO DATA	NO DATA	NO DATA	3.66E-05	208	27.10	0.00E+00	1.22E-03	2.74E-03	0.00E+00	0.00E+00	0.00E+00	1.59E-02
Zn-65	5.76E-06	2.00E-05	9.33E-06	NO DATA	1.28E-05	NO DATA	8.47E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	8.37E-05	1.97E-04	9.14E-05	NO DATA	6.26E-05	2.39E-05	2.45E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	1.12E-04	1.49E-04	5.19E-05	NO DATA	5.07E-05	1.97E-05	2.12E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	NO DATA	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	208	7098.00	0.00E+00	1.20E-02	1.20E-02	1.20E-02	1.20E-02	1.20E-02	1.20E-02
Dose Commitment (mrem) =										0.00E+00	1.37E-02	1.59E-02	1.20E-02	1.20E-02	1.20E-02	3.46E-02

Catawba Nuclear Station
Dose from Shoreline Sediment Pathway for 1999 Data
Maximum Exposed Teen

Shoreline Recreation = 67 hr (in one year)
 Shore Width Factor = 0.2
 Sediment Surface Mass = 40 kg/m²

Teen Dose from Shoreline Sediment Pathway (mrem) = Shoreline Recreation (hr) x External Dose Factor (mrem/hr per pCi/m²) x Shore Width Factor x Sediment Surface Mass (kg/m²) x Sediment Concentration (pCi/kg)

Radionuclide	External Dose Factor Standing on Contaminated Ground (mrem/hr per pCi/m ²)		Indicator Location	Sediment (pCi/kg)	Highest Annual Net Mean Concentration Dose (mrem)	
	T. Body	Skin			T. Body	Skin
Mn-54	5.80E-09	6.80E-09	208	72.80	2.26E-04	2.65E-04
Co-58	7.00E-09	8.20E-09	208	229.00	8.59E-04	1.01E-03
Co-60	1.70E-08	2.00E-08	208	439.00	4.00E-03	4.71E-03
Cs-134	1.20E-08	1.40E-08	ALL	0.00	0.00E+00	0.00E+00
Cs-137	4.20E-09	4.90E-09	208	94.20	2.12E-04	2.47E-04
*Sb-125	3.10E-09	3.50E-09	208	140.00	2.33E-04	2.63E-04
Dose Commitment (mrem) =					5.53E-03	6.49E-03

* Dose Factor from Reference 6.11

*Catawba Nuclear Station
Dose from Broadleaf Vegetation Pathway for 1999 Data
Maximum Exposed Adult*

Adult Dose from Vegetation (mrem) = Usage (kg) x Dose Factor (mrem/pCi ingested) x Concentration (pCi/kg)

Usage (intake in one year) = 64 kg

Radionuclide	<u>Ingestion Dose Factor</u>							<u>Highest Annual Net Mean Concentration</u>		<u>Dose (mrem)</u>						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Indicator Location	Food (pCi/kg)	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
I-131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	NO DATA	1.57E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	6.22E-05	1.48E-04	1.21E-04	NO DATA	4.79E-05	1.59E-05	2.59E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	7.97E-05	1.09E-04	7.14E-05	NO DATA	3.70E-05	1.23E-05	2.11E-06	201	108.00	5.51E-01	7.53E-01	4.94E-01	0.00E+00	2.56E-01	8.50E-02	1.46E-02
Dose Commitment (mrem) =										5.51E-01	7.53E-01	4.94E-01	0.00E+00	2.56E-01	8.50E-02	1.46E-02

Catawba Nuclear Station
Dose from Fish Pathway for 1999 Data
Maximum Exposed Adult

Adult Dose from Fish Pathway (mrem) = Usage (kg) x Dose Factor (mrem/pCi ingested) x Concentration (pCi/kg)

H-3 Concentration in Fish = Surface Water pCi/l x Bioaccumulation Factor 0.9 pCi/kg per pCi/l = 7887 pCi/l x 0.9 = 7098 pCi/kg

Usage (intake in one year) = 21 kg

Radionuclide	<u>Ingestion Dose Factor</u>							<u>Highest Annual Net Mean Concentration</u>		<u>Dose (mrem)</u>						
	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Location	(pCi/kg)	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	4.57E-06	8.72E-07	NO DATA	1.36E-06	NO DATA	1.40E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	7.45E-07	1.67E-06	NO DATA	NO DATA	NO DATA	1.51E-05	208	31.20	0.00E+00	4.88E-04	1.09E-03	0.00E+00	0.00E+00	0.00E+00	9.89E-03
Fe-59	4.34E-06	1.02E-05	3.91E-06	NO DATA	NO DATA	2.85E-06	3.40E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	2.14E-06	4.72E-06	NO DATA	NO DATA	NO DATA	4.02E-05	208	27.10	0.00E+00	1.22E-03	2.69E-03	0.00E+00	0.00E+00	0.00E+00	2.29E-02
Zn-65	4.84E-06	1.54E-05	6.96E-06	NO DATA	1.03E-05	NO DATA	9.70E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	6.22E-05	1.48E-04	1.21E-04	NO DATA	4.79E-05	1.59E-05	2.59E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	7.97E-05	1.09E-04	7.14E-05	NO DATA	3.70E-05	1.23E-05	2.11E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	NO DATA	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	208	7098.00	0.00E+00	1.57E-02	1.57E-02	1.57E-02	1.57E-02	1.57E-02	1.57E-02
Dose Commitment (mrem) =										0.00E+00	1.74E-02	1.94E-02	1.57E-02	1.57E-02	1.57E-02	4.84E-02

Catawba Nuclear Station
Dose from Shoreline Sediment Pathway for 1999 Data
Maximum Exposed Adult

Shoreline Recreation = 12 hr (in one year)
 Shore Width Factor = 0.2
 Sediment Surface Mass = 40 kg/m²

Adult Dose from Shoreline Sediment Pathway (mrem) = Shoreline Recreation (hr) x External Dose Factor (mrem/hr per pCi/m²) x Shore Width Factor x Sediment Surface Mass (kg/m²) x Sediment Concentration (pCi/kg)

Radionuclide	External Dose Factor Standing on Contaminated Ground (mrem/hr per pCi/m ²)		Indicator Location	Highest Annual Net Mean Concentration Sediment (pCi/kg)	Dose (mrem)	
	T. Body	Skin			T. Body	Skin
Mn-54	5.80E-09	6.80E-09	208	72.80	4.05E-05	4.75E-05
Co-58	7.00E-09	8.20E-09	208	229.00	1.54E-04	1.80E-04
Co-60	1.70E-08	2.00E-08	208	439.00	7.16E-04	8.43E-04
Cs-134	1.20E-08	1.40E-08	ALL	0.00	0.00E+00	0.00E+00
Cs-137	4.20E-09	4.90E-09	208	94.20	3.80E-05	4.43E-05
*Sb-125	3.10E-09	3.50E-09	208	140.00	4.17E-05	4.70E-05
Dose Commitment (mrem) =					9.91E-04	1.16E-03

* Dose Factor from Reference 6.11

5.0 QUALITY ASSURANCE

5.1 SAMPLE COLLECTION

EnRad Laboratories, Fisheries, and Aquatic Ecology performed the environmental sample collections as specified by approved sample collection procedures.

5.2 SAMPLE ANALYSIS

EnRad Laboratories performed the environmental sample analyses as specified by approved analysis procedures. EnRad Laboratories is located in Huntersville, North Carolina, at Duke Power Company's Environmental Center.



Duke Power Company's
Environmental Center

5.3 DOSIMETRY ANALYSIS

The Radiation Dosimetry and Records group performed environmental dosimetry measurements as specified by approved dosimetry analysis procedures.

5.4 LABORATORY EQUIPMENT QUALITY ASSURANCE

5.4.1 DAILY QUALITY CONTROL

EnRad Laboratories has an internal quality assurance program which monitors each type of instrumentation for reliability and accuracy. Daily quality control checks ensure that instruments are in proper working order and these checks are used to monitor instrument performance.

5.4.2 CALIBRATION VERIFICATION

National Institute of Standards and Technology (NIST) standards that represent counting geometries are analyzed as unknowns at various frequencies ranging from weekly to annually to verify that efficiency calibrations are valid. The frequency is dependent upon instrument use and performance. Investigations are performed and documented should calibration verification data fall out of limits.

5.4.3 BATCH PROCESSING

Method quality control samples are analyzed with sample analyses that are processed in batches. These include gross beta in drinking water and tritium analyses.

5.5 DUKE POWER INTERCOMPARISON PROGRAM

EnRad Laboratories participated in the Duke Power Nuclear Generation Department Intercomparison Program during 1999. Interlaboratory cross-check standards, including, Marinelli beakers, air filters, air cartridges, gross beta on smears, and tritium in water samples were analyzed at various times of the year by the four counting laboratories in Duke Power Company for this program. A summary of these Intercomparison Reports for 1999 is documented in Table 5.0.

5.6 DUKE POWER AUDITS

EnRad Laboratories participated in a laboratory assessment conducted by the Duke Power Corporate Radiation Protection in April, 1999. Laboratory practices and procedures were reviewed. No significant problems were identified as a result of this assessment.

5.7 U.S. NUCLEAR REGULATORY COMMISSION INSPECTIONS

The Catawba Nuclear Station Radiological Environmental Monitoring Program was audited by the NRC January 24 – March 13, 1999. There were no findings from this audit. EnRad Laboratories was not audited by the NRC in 1999.

5.8 STATE OF SOUTH CAROLINA INTERCOMPARISON PROGRAM

EnRad Laboratories routinely participates with the Bureau of Radiological Health of the State's Department of Health and Environmental Control (DHEC) in an intercomparison program. EnRad Laboratories sends air, water, milk, vegetation, sediment, and fish samples which have been collected to the State of South Carolina DHEC Laboratory for intercomparison analysis.

5.9 TLD INTERCOMPARISON PROGRAM

Radiation Dosimetry and Records normally participates in a TLD intercomparison program with the State of North Carolina Radiation Protection section. This intercomparison was not performed during 1999. A new program with an outside laboratory was established beginning in 2000.

TABLE 5.0
DUKE POWER COMPANY
INTERLABORATORY COMPARISON PROGRAM
1999 CROSS-CHECK RESULTS FOR
ENRAD LABORATORIES

Cross-Check samples are normally analyzed a minimum of three times. A status of "3 Pass" indicates that all three analyses yielded results within the designated acceptance range. A status of "1 Pass" indicates that one analysis of the cross-check was performed.

Gamma in Water 3.5 liters

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/l	Reference Value pCi/l	Mean Reported Value pCi/l	Cross Check Status
3/3/99	Q991GWSL	Cr-51	1.13 - 2.00 E5	1.51 E5	1.49 E5	3 Pass
		Mn-54	3.07 - 5.45 E4	4.09 E4	4.24 E4	3 Pass
		Fe-59	1.94 - 3.44 E4	2.59 E4	2.75 E4	3 Pass
		Co-60	3.55 - 6.30 E4	4.74 E4	4.77 E4	3 Pass
		Zn-65	3.97 - 7.04 E4	5.29 E4	5.54 E4	3 Pass
		Cs-134	2.25 - 3.98 E4	2.99 E4	2.70 E4	3 Pass
		Cs-137	4.68 - 8.29 E4	6.23 E4	5.97 E4	3 Pass
		Ce-141	4.76 - 8.45 E4	6.35 E4	6.37 E4	3 Pass
6/2/99	Q992GWR	Cr-51	2.09 - 6.73 E2	3.74 E2	4.31 E2	3 Pass
		Mn-54	0.61 - 1.08 E3	8.10 E2	8.67 E2	3 Pass
		Fe-59	0.96 - 2.44 E2	1.52 E2	1.88 E2	3 Pass
		Co-60	0.83 - 1.48 E3	1.11 E3	1.17 E3	3 Pass
		Zn-65	0.74 - 1.32 E3	9.89 E2	1.04 E3	3 Pass
		Cs-134	5.00 - 8.86 E2	6.66 E2	6.34 E2	3 Pass
		Cs-137	1.12 - 1.99 E3	1.50 E3	1.47 E3	3 Pass
		Ce-141	1.65 - 2.93 E2	2.21 E2	2.20 E2	3 Pass
8/20/99	Q993GWSL	Cr-51	0.63 - 1.11 E5	8.35 E4	8.48 E4	3 Pass
		Mn-54	3.29 - 5.84 E4	4.39 E4	4.60 E4	3 Pass
		Fe-59	2.33 - 4.13 E4	3.11 E4	3.26 E4	3 Pass
		Co-60	2.35 - 4.16 E4	3.13 E4	3.20 E4	3 Pass
		Zn-65	3.24 - 5.75 E4	4.32 E4	4.49 E4	3 Pass
		Cs-134	1.79 - 3.17 E4	2.38 E4	2.24 E4	3 Pass
		Cs-137	3.92 - 6.94 E4	5.22 E4	5.19 E4	3 Pass
		Ce-141	0.73 - 1.30 E5	9.78 E4	9.91 E4	3 Pass
12/3/99	Q994GWR	Cr-51	3.18 - 5.64 E2	4.24 E2	4.83 E2	3 Pass
		Mn-54	1.83 - 3.25 E3	2.44 E3	2.68 E3	3 Pass
		Fe-59	3.21 - 5.68 E2	4.27 E2	4.81 E2	3 Pass
		Co-60	1.59 - 2.81 E3	2.12 E3	2.23 E3	3 Pass
		Zn-65	1.69 - 3.00 E3	2.25 E3	2.42 E3	3 Pass
		Cs-134	1.14 - 2.02 E3	1.52 E3	1.41 E3	3 Pass
		Cs-137	2.73 - 4.85 E3	3.64 E3	3.69 E3	3 Pass
		Ce-141	5.49 - 9.73 E2	7.32 E2	7.64 E2	3 Pass

Gamma in Water 1.0 liter

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/l	Reference Value pCi/l	Mean Reported Value pCi/l	Cross Check Status
3/3/99	Q991GWSL	Cr-51	1.13 - 2.00 E5	1.51 E5	1.52 E5	3 Pass
		Mn-54	3.07 - 5.45 E4	4.09 E4	4.27 E4	3 Pass
		Fe-59	1.94 - 3.44 E4	2.59 E4	2.76 E4	3 Pass
		Co-60	3.55 - 6.30 E4	4.74 E4	4.81 E4	3 Pass
		Zn-65	3.97 - 7.04 E4	5.29 E4	5.58 E4	3 Pass
		Cs-134	2.25 - 3.98 E4	2.99 E4	2.72 E4	3 Pass
		Cs-137	4.68 - 8.29 E4	6.23 E4	6.01 E4	3 Pass
		Ce-141	4.76 - 8.45 E4	6.35 E4	6.47 E4	3 Pass
6/2/99	Q992GWR	Cr-51	2.09 - 6.73 E2	3.74 E2	5.12 E2	3 Pass
		Mn-54	0.61 - 1.08 E3	8.10 E2	8.62 E2	3 Pass
		Fe-59	0.96 - 2.44 E2	1.52 E2	1.85 E2	3 Pass
		Co-60	0.83 - 1.48 E3	1.11 E3	1.20 E3	3 Pass
		Zn-65	0.74 - 1.32 E3	9.89 E2	1.09 E3	3 Pass
		Cs-134	5.00 - 8.86 E2	6.66 E2	6.09 E2	3 Pass
		Cs-137	1.12 - 1.99 E3	1.50 E3	1.49 E3	3 Pass
		Ce-141	1.65 - 2.93 E2	2.21 E2	2.28 E2	3 Pass
8/20/99	Q993GWSL	Cr-51	0.63 - 1.11 E5	8.35 E4	8.50 E4	3 Pass
		Mn-54	3.29 - 5.84 E4	4.39 E4	4.59 E4	3 Pass
		Fe-59	2.33 - 4.13 E4	3.11 E4	3.33 E4	3 Pass
		Co-60	2.35 - 4.16 E4	3.13 E4	3.22 E4	3 Pass
		Zn-65	3.24 - 5.75 E4	4.32 E4	4.54 E4	3 Pass
		Cs-134	1.79 - 3.17 E4	2.38 E4	2.12 E4	3 Pass
		Cs-137	3.92 - 6.94 E4	5.22 E4	5.07 E4	3 Pass
		Ce-141	0.73 - 1.30 E5	9.78 E4	9.80 E4	3 Pass
12/3/99	Q994GWR	Cr-51	2.12 - 8.48 E2	4.24 E2	6.16 E2	3 Pass
		Mn-54	1.83 - 3.25 E3	2.44 E3	2.59 E3	3 Pass
		Fe-59	3.21 - 5.68 E2	4.27 E2	4.47 E2	3 Pass
		Co-60	1.59 - 2.81 E3	2.12 E3	2.18 E3	3 Pass
		Zn-65	1.69 - 3.00 E3	2.25 E3	2.44 E3	3 Pass
		Cs-134	1.14 - 2.02 E3	1.52 E3	1.35 E3	3 Pass
		Cs-137	2.73 - 4.85 E3	3.64 E3	3.60 E3	3 Pass
		Ce-141	5.49 - 9.73 E2	7.32 E2	7.26 E2	3 Pass

Gamma in Water 0.5 liter

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/l	Reference Value pCi/l	Mean Reported Value pCi/l	Cross Check Status
3/3/99	Q991GWSL	Cr-51	1.13 - 2.00 E5	1.51 E5	1.46 E5	3 Pass
		Mn-54	3.07 - 5.45 E4	4.09 E4	4.29 E4	3 Pass
		Fe-59	1.94 - 3.44 E4	2.59 E4	2.79 E4	3 Pass
		Co-60	3.55 - 6.30 E4	4.74 E4	4.76 E4	3 Pass
		Zn-65	3.97 - 7.04 E4	5.29 E4	5.68 E4	3 Pass
		Cs-134	2.25 - 3.98 E4	2.99 E4	2.60 E4	3 Pass
		Cs-137	4.68 - 8.29 E4	6.23 E4	5.94 E4	3 Pass
		Ce-141	4.76 - 8.45 E4	6.35 E4	6.29 E4	3 Pass

Gamma in Water 0.5 liter continued

6/2/99	Q992GWR	Cr-51	2.09 - 6.73 E2	3.74 E2	5.23 E2	3 Pass
		Mn-54	0.61 - 1.08 E3	8.10 E2	8.66 E2	3 Pass
		Fe-59	0.96 - 2.44 E2	1.52 E2	1.74 E2	3 Pass
		Co-60	0.83 - 1.48 E3	1.11 E3	1.16 E3	3 Pass
		Zn-65	0.74 - 1.32 E3	9.89 E2	1.06 E3	3 Pass
		Cs-134	5.00 - 8.86 E2	6.66 E2	5.71 E2	3 Pass
		Cs-137	1.12 - 1.99 E3	1.50 E3	1.43 E3	3 Pass
		Ce-141	1.65 - 2.93 E2	2.21 E2	2.47 E2	3 Pass
8/20/99	Q993GWSL	Cr-51	0.63 - 1.11 E5	8.35 E4	8.42 E4	3 Pass
		Mn-54	3.29 - 5.84 E4	4.39 E4	4.59 E4	3 Pass
		Fe-59	2.33 - 4.13 E4	3.11 E4	3.32 E4	3 Pass
		Co-60	2.35 - 4.16 E4	3.13 E4	3.21 E4	3 Pass
		Zn-65	3.24 - 5.75 E4	4.32 E4	4.61 E4	3 Pass
		Cs-134	1.79 - 3.17 E4	2.38 E4	2.09 E4	3 Pass
		Cs-137	3.92 - 6.94 E4	5.22 E4	5.05 E4	3 Pass
		Ce-141	0.73 - 1.30 E5	9.78 E4	9.73 E4	3 Pass
12/3/99	Q994GWR	Cr-51	3.18 - 5.64 E2	4.24 E2	4.36 E2	3 Pass
		Mn-54	1.83 - 3.25 E3	2.44 E3	2.55 E3	3 Pass
		Fe-59	3.21 - 5.68 E2	4.27 E2	4.82 E2	3 Pass
		Co-60	1.59 - 2.81 E3	2.12 E3	2.13 E3	3 Pass
		Zn-65	1.69 - 3.00 E3	2.25 E3	2.38 E3	3 Pass
		Cs-134	1.14 - 2.02 E3	1.52 E3	1.36 E3	3 Pass
		Cs-137	2.73 - 4.85 E3	3.64 E3	3.54 E3	3 Pass
		Ce-141	5.49 - 9.73 E2	7.32 E2	7.24 E2	3 Pass

Gamma in Filter

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/total	Reference Value pCi/total	Mean Reported Value pCi/total	Cross Check Status
6/24/99	E1802-37	Cr-51	1.91 - 3.39 E2	2.55 E2	2.47 E2	3 Pass
		Mn-54	0.75 - 1.33 E2	1.00 E2	1.15 E2	3 Pass
		Fe-59	4.28 - 7.58 E1	5.70 E1	7.73 E1	2/3 High
		Co-60	1.90 - 3.36 E2	2.53 E2	2.76 E2	3 Pass
		Zn-65	1.09 - 1.93 E2	1.45 E2	1.72 E2	3 Pass
		Cs-134	1.02 - 1.81 E2	1.36 E2	1.21 E2	3 Pass
		Cs-137	1.67 - 2.97 E2	2.23 E2	2.30 E2	3 Pass
		Ce-141	1.49 - 2.65 E2	1.99 E2	2.04 E2	3 Pass

Iodine in Water

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/l	Reference Value pCi/l	Mean Reported Value pCi/l	Cross Check Status
1/29/99	Q991LIW1	I-131	1.71 - 3.04 E1	2.28 E1	2.36 E1	3 Pass
1/29/99	Q991LIW2	I-131	0.69 - 1.22 E1	9.17 E0	9.49 E0	3 Pass
1/29/99	Q991LIW3	I-131	0.60 - 1.06 E2	7.95 E1	8.52 E1	3 Pass

Iodine in Milk

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/l	Reference Value pCi/l	Mean Reported Value pCi/l	Cross Check Status
3/15/99	Q991LIM1	I-131	2.17 - 3.84 E1	2.89 E1	3.05 E1	3 Pass
3/15/99	Q991LIM2	I-131	0.00 - 0.00 E0	0.00 E0	0.00 E0	3 Pass
3/15/99	Q991LIM3	I-131	0.65 - 1.15 E2	8.63 E1	8.40 E1	3 Pass
6/10/99	Q992LIM-1	I-131	0.00 - 0.00 E0	0.00 E0	0.00 E0	3 Pass
6/10/99	Q992LIM-2	I-131	0.72 - 1.27 E3	9.53 E2	9.17 E2	3 Pass
6/10/99	Q992LIM-3	I-131	0.80 - 3.19 E0	1.60 E0	2.15 E0	3 Pass
8/31/99	Q993LIM-1	I-131	0.00 - 0.00 E0	0.00 E0	0.00 E0	3 Pass
8/31/99	Q993LIM-2	I-131	1.88 - 3.33 E1	2.50 E1	2.35 E1	3 Pass
8/31/99	Q993LIM-3	I-131	5.41 - 9.59 E1	7.21 E1	7.03 E1	3 Pass

Iodine Cartridge

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/total	Reference Value pCi/total	Mean Reported Value pCi/total	Cross Check Status
6/24/99	E1803-37	I-131	0.57 - 1.01 E2	7.60 E1	7.79 E1	3 Pass

Beta in Water

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/l	Reference Value pCi/l	Mean Reported Value pCi/l	Cross Check Status
3/18/99	E1676-37	Beta	1.51 - 2.67 E2	2.01 E2	1.88 E2	1 Pass
9/23/99	E1879-37	Beta	2.03 - 3.60 E2	2.71 E2	1.98 E2	2/3 Low

Beta Smear

Reference Date	Sample I.D.	Nuclide	Acceptance Range uCi/total	Reference Value uCi/total	Mean Reported Value uCi/total	Cross Check Status
5/14/99	A12034-37	Beta	4.58 - 8.11 E-3	6.10 E-3	5.99 E-3	3 Pass
5/14/99	A12043-04	Beta	4.02 - 7.13 E-3	5.36 E-3	5.50 E-3	4 Pass

Tritium in Water

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/l	Reference Value pCi/l	Mean Reported Value pCi/l	Cross Check Status
3/3/99	Q991TWSL	H-3	3.99 - 7.08 E4	5.32 E4	5.42 E4	3 Pass
6/2/99	Q992TWR-1	H-3	2.63 - 4.66 E2	3.50 E2	4.02 E2	3 Pass
6/2/99	Q992TWR-2	H-3	4.42 - 7.83 E3	5.89 E3	5.68 E3	3 Pass
6/2/99	Q992TWR-3	H-3	0.75 - 1.33 E3	9.96 E2	9.48 E2	3 Pass
8/20/99	Q993TWSL	H-3	0.69 - 1.22 E5	9.17 E4	8.40 E4	3 Pass
12/1/99	Q994TWR1	H-3	0.63 - 1.11 E4	8.34 E3	7.63 E3	3 Pass
12/1/99	Q994TWR2	H-3	0.96 - 1.70 E3	1.28 E3	1.52 E3	3 Pass
12/1/99	Q994TWR3	H-3	2.63 - 4.66 E2	3.50 E2	3.95 E2	3 Pass

6.0 REFERENCES

- 6.1 Catawba Selected License Commitments
- 6.2 Catawba Technical Specifications
- 6.3 Catawba Updated Final Safety Analysis Review
- 6.4 Catawba Offsite Dose Calculation Manual
- 6.5 Catawba Annual Environmental Operating Report 1985 - 1998
- 6.6 Catawba Annual Effluent Report 1985 - 1999
- 6.7 Probability and Statistics in Engineering and Management Science, Hines and Montgomery, 1969, pages 287-293.
- 6.8 Practical Statistics for the Physical Sciences, Havilcek and Crain, 1988, pages 83-93.
- 6.9 Nuclear Regulatory Commission Regulatory Guide 1.109, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purposes of Evaluating Compliance with 10CFR50, Appendix I.
- 6.10 EnRad Laboratories Operating Procedures
- 6.11 RETDAS, Radiological Effluent Tracking and Dose Assessment Software, Vertechs Version 3.5.0, Duke Power Revision # 3.0

APPENDIX A

ENVIRONMENTAL SAMPLING
&
ANALYSIS PROCEDURES

APPENDIX A

ENVIRONMENTAL SAMPLING AND ANALYSIS PROCEDURES

Adherence to established procedures for sampling and analysis of all environmental media at Catawba Nuclear Station was required to ensure compliance with Station Selected Licensee Commitments. Analytical procedures were employed to ensure that Selected Licensee Commitments detection capabilities were achieved.

Environmental sampling and analyses were performed by EnRad Laboratories, Dosimetry and Records, Fisheries and Aquatic Ecology.

This appendix describes the environmental sampling frequencies and analysis procedures by media type.

I. CHANGE OF SAMPLING PROCEDURES

No sampling changes were made to the sampling procedure during 1999.

II. DESCRIPTION OF ANALYSIS PROCEDURES

Gamma spectroscopy analyses are performed using high purity germanium gamma detectors and Canberra analytical software. Designated sample volumes are transferred to appropriate counting geometries and analyzed by gamma spectroscopy. Perishable samples such as fish and broadleaf vegetation are ground to achieve a homogeneous mixture. Soils and sediments are dried, sifted to remove foreign objects (rocks, clams, glass, etc.) then transferred to appropriate counting geometry. Ten percent of samples receiving gamma analysis are analyzed as duplicate analyses.

Low-level iodine analyses are performed by passing a designated sample aliquot through an ion exchange resin to remove and concentrate any iodine in the aqueous sample (milk). The resin is then dried and transferred to appropriate counting geometry and analyzed by gamma spectroscopy.

Tritium analyses are performed quarterly by using low-level environmental liquid scintillation analysis technique on a Packard 2550 liquid scintillation system. Tritium samples are batch processed with a tritium spike to verify instrument performance and sample preparation technique are acceptable.

Gross beta analysis is performed by concentrating a designated aliquot of sample precipitate and analyzing by gas-flow proportional counters. Samples are batch

processed with a spike sample to verify instrument performance and a blank to ensure sample contamination has not occurred.

III. CHANGE OF ANALYSIS PROCEDURES

No analysis procedures were changed during 1999.

IV. SAMPLING AND ANALYSIS PROCEDURES

A.1 AIRBORNE PARTICULATE AND RADIOIODINE

Airborne particulate and radioiodine samples at each of five locations were composited continuously by means of continuous air samplers. Air particulates were collected on a particulate filter and radioiodines were collected in a charcoal cartridge situated behind the filter in the sampler. The samplers are designed to operate at a constant flow rate (in order to compensate for any filter loading) and are set to sample approximately 2 cubic feet per minute. Filters and cartridges were collected weekly. A weekly gross beta analysis was performed on each filter and a weekly gamma analysis was performed on each charcoal cartridge. Filters were segregated by location and a quarterly gamma analysis was performed on the filter composite. The filter and charcoal cartridge were analyzed independently. The continuous composite samples were collected from the locations listed below.

Location 200	=	Site Boundary (0.6 mi. NNE)
Location 201	=	Site Boundary (0.5 mi. NE)
Location 205	=	Site Boundary (0.3 mi. SW)
Location 212	=	Tega Cay, SC (3.3 mi. E)
Location 217	=	Rock Hill Substation (10.3 mi. SSE)

A.2 DRINKING WATER

Biweekly composite drinking water samples were collected at each of two locations. A gross beta and gamma analysis was performed on monthly composites. Tritium analysis was performed on the quarterly composites. The composites were collected biweekly from the locations listed below.

Location 214	=	Rock Hill Water Supply (7.3 mi. SE)
Location 218	=	Belmont Water Supply (13.4 mi. NNE)

A.3 SURFACE WATER

Biweekly composite samples were collected at each of three locations. A gamma analysis was performed on the monthly composites. Tritium analysis

was performed on the quarterly composites. The composites were collected biweekly from the locations listed below.

Location 208 = Discharge Canal (0.5 mi. S)
Location 211 = Wylie Dam (4.0 mi. ESE)
Location 215 = River Pointe - Hwy 49 (4.2 mi. NNE)

A.4 GROUND WATER

Grab samples were collected quarterly from residential wells at each of two locations. A gamma analysis and tritium analysis were performed on each sample. The samples were collected from the locations listed below.

Location 252 = Residence (0.7 mi. SW)
Location 254 = Residence (0.8 mi. N)

A.5 MILK

Biweekly grab samples were collected at each of three locations. A gamma and low-level Iodine-131 analysis was performed on each sample. The biweekly grab samples were collected from the locations listed below.

Location 209 = Wood Dairy - (6.0 mi. SSW)
Location 219 = Pursley Dairy - (5.7 mi. SW)
Location 221 = Oates Dairy - (14.5 mi. NW)

A.6 BROADLEAF VEGETATION

Monthly samples were collected as available at each of five locations. A gamma analysis was performed on each sample. The samples were collected from the locations listed below.

Location 200 = Site Boundary (0.6 mi. NNE)
Location 201 = Site Boundary (0.5 mi. NE)
Location 217 = Rock Hill Substation (10.3 mi. SSE)
Location 222 = Site Boundary (0.7 mi N)
Location 226 = Site Boundary (0.5 mi. S)

A.7 FOOD PRODUCTS

Monthly samples were collected when available during the harvest season at one location. A gamma analysis was performed on each sample. The samples were collected from the location listed below.

Location 253 = Cloninger Irrigated Garden (1.93 mi. SSE)

A.8 FISH

Semiannual samples were collected at each of two locations. A gamma analysis was performed on the edible portions of each sample. Boney fish (i.e. Sunfish) were prepared whole minus the head and tail portions. The samples were collected from the locations listed below.

Location 208 = Discharge Canal (0.5 mi. S)
Location 216 = Hwy 49 Bridge (4.0 mi. NNE)

A.9 SHORELINE SEDIMENT

Semiannual samples were collected at each of three locations. A gamma analysis was performed on each sample following the drying and removal of rocks and clams. The samples were collected from the locations listed below.

Location 208 = Discharge Canal (0.5 mi. S)
Location 210 = Ebenezer Access (2.3 mi. SE)
Location 215 = River Pointe - Hwy 49 (4.2 mi. NNE)

A.10 BOTTOM SEDIMENT

Quarterly samples were collected at each of three locations. A gamma analysis was performed on each sample following the druning and removal of rocks and clams. The samples were collected from the locations listed below.

Location 208-1M = Closest to RL Discharge
Location 208-2M = Approximate midpoint of Discharge Canal
Location 208-3M = Site 208 Surface Water sampling pier vicinity

A.11 DIRECT GAMMA RADIATION (TLD)

Thermoluminescent dosimeters (TLD) were collected quarterly at forty locations. A gamma exposure rate was determined for each TLD. TLD locations are listed in Table 2.1-A. The TLDs were placed as indicated below.

- * An inner ring of 16 TLDs, one in each meteorological sector in the general area of the site boundary.
- * An outer ring of 16 TLDs, one in each meteorological sector in the 6 to 8 kilometer range.
- * The remaining TLDs were placed in special interest areas such as population centers, residential areas, schools, and at three control locations.

A.12 ANNUAL LAND USE CENSUS

An Annual Land Use Census was conducted to identify within a distance of 8 kilometers (5.0 miles) from the station, the nearest location from the site boundary in each of the sixteen meteorological sectors, the following:

- * The Nearest Residence
- * The Nearest Meat Animal
- * The Nearest Garden greater than 50 square meters or 500 square feet
- * The Nearest Milk-giving Animal (cow, goat, etc.)

This census was initiated on July 14, 1999 and completed on July 16, 1999.

Results are shown in Table 3.12.

V. PROGRAM IMPROVEMENTS

Trending of air sampler and water sampler site locations is performed for continuous identification of problems impacting deviation rate of the Radiological Environmental Monitoring Program. A continued program of preventive maintenance, improved equipment quality and trending have proven to be extremely beneficial.

APPENDIX B

**RADIOLOGICAL
ENVIRONMENTAL MONITORING
PROGRAM**

SUMMARY OF RESULTS

1999

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station

Docket No. 50-413,414

Location: York County, South Carolina

Report Period: 01-JAN-1999 to 31-DEC-1999

Medium or Pathway Sampled	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction		Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
				Location Code	Mean (Fraction) Range		
Air Particulate (pCi/m ³)						217 (10.3 mi SSE)	
BETA	260	1.00E-02	2.30E-2 (208/208) 3.41E-3 - 6.19E-2	212 (3.3 mi E)	2.53E-2 (52/52) 3.41E-3 - 6.19E-2	2.04E-2 (52/52) 1.03E-2 - 3.53E-2	0
CS-134	20	5.00E-02	0.00 (0/16) 0.00 - 0.00		0.00 (0/4) 0.00 - 0.00	0.00 (0/4) 0.00 - 0.00	0
CS-137	20	6.00E-02	0.00 (0/16) 0.00 - 0.00		0.00 (0/4) 0.00 - 0.00	0.00 (0/4) 0.00 - 0.00	0
I-131	20	7.00E-02	0.00 (0/16) 0.00 - 0.00		0.00 (0/4) 0.00 - 0.00	0.00 (0/4) 0.00 - 0.00	0

Mean and range based upon detectable measurements only

Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)

Zero range indicates no detectable activity measurements

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station

Docket No. 50-413,414

Location: York County, South Carolina

Report Period: 01-JAN-1999 to 31-DEC-1999

Medium or Pathway Sampled	Type and Total Number of	Lower Limit of Detection	All Indicator Locations	Location with Highest Annual Mean		Control Location	No. of Non-Routine Report Meas.
				Name, Distance, Direction	Mean (Fraction)		
Unit of Measurement	Analyses Performed	(LLD)	Mean (Fraction) Range	Location Code	Mean (Fraction) Range	Mean (Fraction) Range	
Air Radioiodine (pCi/m ³)						217 (10.3 mi SSE)	
	CS-134 260	5.00E-02	0.00 (0/208) 0.00 - 0.00		0.00 (0/52) 0.00 - 0.00	0.00 (0/52) 0.00 - 0.00	0
	CS-137 260	6.00E-02	8.27E-3 (2/208) 6.67E-3 - 9.87E-3	201 (0.5 mi NE)	9.87E-3 (1/52) 9.87E-3 - 9.87E-3	0.00 (0/52) 0.00 - 0.00	0
	I-131 260	7.00E-02	0.00 (0/208) 0.00 - 0.00		0.00 (0/52) 0.00 - 0.00	0.00 (0/52) 0.00 - 0.00	0

Mean and range based upon detectable measurements only

Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)

Zero range indicates no detectable activity measurements

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station

Docket No. 50-413,414

Location: York County, South Carolina

Report Period: 01-JAN-1999 to 31-DEC-1999

Medium or Pathway Sampled	Type and Total Number of	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction		Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
				Location Code	Mean (Fraction) Range		
Drinking Water (pCi/liter)						218 (13.4 mi NNE)	
BALA-140	26	15	0.00 (0/13) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
BETA	26	4	3.55 (12/13) 2.82 - 4.70	214 (7.3 mi SE)	3.55 (12/13) 2.82 - 4.70	2.48 (12/13) 1.17 - 3.87	0
CO-58	26	15	0.00 (0/13) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
CO-60	26	15	0.00 (0/13) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
CS-134	26	15	0.00 (0/13) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
CS-137	26	18	0.00 (0/13) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
FE-59	26	30	0.00 (0/13) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
H-3	8	2000	671 (4/4) 473 - 801	214 (7.3 mi SE)	671 (4/4) 473 - 801	270 (4/4) 232 - 308	0
I-131	26	15	0.00 (0/13) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
MN-54	26	15	0.00 (0/13) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
NB-95	26	15	0.00 (0/13) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
ZN-65	26	30	0.00 (0/13) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
ZR-95	26	15	0.00 (0/13) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0

Mean and range based upon detectable measurements only

Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)

Zero range indicates no detectable activity measurements

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station

Docket No. 50-413,414

Location: York County, South Carolina

Report Period: 01-JAN-1999 to 31-DEC-1999

Medium or Pathway Sampled Unit of Measurement	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction		Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
				Location Code	Mean (Fraction) Range		
Surface Water (pCi/liter)						215 (4.2 mi NNE)	
BALA-140	39	15	0.00 (0/26) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
CO-58	39	15	0.00 (0/26) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
CO-60	39	15	0.00 (0/26) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
CS-134	39	15	0.00 (0/26) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
CS-137	39	18	0.00 (0/26) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
FE-59	39	30	0.00 (0/26) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
H-3	12	2000	4387 (8/8) 416 - 9925	208 (0.5 mi S)	8128 (4/4) 6880 - 9925	241 (4/4) 181 - 347	0
I-131	39	15	0.00 (0/26) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
MN-54	39	15	0.00 (0/26) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
NB-95	39	15	0.00 (0/26) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
ZN-65	39	30	0.00 (0/26) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
ZR-95	39	15	0.00 (0/26) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0

Mean and range based upon detectable measurements only

Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)

Zero range indicates no detectable activity measurements

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station

Docket No. 50-413,414

Location: York County, South Carolina

Report Period: 01-JAN-1999 to 31-DEC-1999

Medium or Pathway Sampled	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction		Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
				Location Code	Mean (Fraction) Range		
Surface Water (pCi/liter)						215 (4.2 mi NNE)	
BALA-140	39	15	0.00 (0/26) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
CO-58	39	15	0.00 (0/26) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
CO-60	39	15	0.00 (0/26) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
CS-134	39	15	0.00 (0/26) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
CS-137	39	18	0.00 (0/26) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
FE-59	39	30	0.00 (0/26) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
H-3	12	2000	4387 (8/8) 416 - 9925	208 (0.5 mi S)	8128 (4/4) 6880 - 9925	241 (4/4) 181 - 347	0
I-131	39	15	0.00 (0/26) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
MN-54	39	15	0.00 (0/26) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
NB-95	39	15	0.00 (0/26) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
ZN-65	39	30	0.00 (0/26) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0
ZR-95	39	15	0.00 (0/26) 0.00 - 0.00		0.00 (0/13) 0.00 - 0.00	0.00 (0/13) 0.00 - 0.00	0

Mean and range based upon detectable measurements only

Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)

Zero range indicates no detectable activity measurements

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station

Docket No. 50-413,414

Location: York County, South Carolina

Report Period: 01-JAN-1999 to 31-DEC-1999

Medium or Pathway Sampled	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction		Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
				Location Code	Mean (Fraction) Range		
Ground Water (pCi/liter)				NO CONTROL LOCATION			
	BALA-140	8	15	0.00 (0/8) 0.00 - 0.00	0.00 (0/8) 0.00 - 0.00	0.00 (0/0) 0.00 - 0.00	0
	CO-58	8	15	0.00 (0/8) 0.00 - 0.00	0.00 (0/8) 0.00 - 0.00	0.00 (0/0) 0.00 - 0.00	0
	CO-60	8	15	0.00 (0/8) 0.00 - 0.00	0.00 (0/8) 0.00 - 0.00	0.00 (0/0) 0.00 - 0.00	0
	CS-134	8	15	0.00 (0/8) 0.00 - 0.00	0.00 (0/8) 0.00 - 0.00	0.00 (0/0) 0.00 - 0.00	0
	CS-137	8	18	0.00 (0/8) 0.00 - 0.00	0.00 (0/8) 0.00 - 0.00	0.00 (0/0) 0.00 - 0.00	0
	FE-59	8	30	0.00 (0/8) 0.00 - 0.00	0.00 (0/8) 0.00 - 0.00	0.00 (0/0) 0.00 - 0.00	0
	H-3	8	2000	0.00 (0/8) 0.00 - 0.00	0.00 (0/8) 0.00 - 0.00	0.00 (0/0) 0.00 - 0.00	0
	I-131	8	15	0.00 (0/8) 0.00 - 0.00	0.00 (0/8) 0.00 - 0.00	0.00 (0/0) 0.00 - 0.00	0
	MN-54	8	15	0.00 (0/8) 0.00 - 0.00	0.00 (0/8) 0.00 - 0.00	0.00 (0/0) 0.00 - 0.00	0
	NB-95	8	15	0.00 (0/8) 0.00 - 0.00	0.00 (0/8) 0.00 - 0.00	0.00 (0/0) 0.00 - 0.00	0
	ZN-65	8	30	0.00 (0/8) 0.00 - 0.00	0.00 (0/8) 0.00 - 0.00	0.00 (0/0) 0.00 - 0.00	0
	ZR-95	8	15	0.00 (0/8) 0.00 - 0.00	0.00 (0/8) 0.00 - 0.00	0.00 (0/0) 0.00 - 0.00	0

Mean and range based upon detectable measurements only

Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)

Zero range indicates no detectable activity measurements

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station

Docket No. 50-413,414

Location: York County, South Carolina

Report Period: 01-JAN-1999 to 31-DEC-1999

Medium or Pathway Sampled	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction		Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
				Location Code	Mean (Fraction) Range		
Milk (pCi/liter)						221 (14.5 mi NW)	
	BALA-140 75	15	0.00 (0/50) 0.00 - 0.00		0.00 (0/25) 0.00 - 0.00	0.00 (0/25) 0.00 - 0.00	0
	CS-134 75	15	0.00 (0/50) 0.00 - 0.00		0.00 (0/25) 0.00 - 0.00	0.00 (0/25) 0.00 - 0.00	0
	CS-137 75	18	0.00 (0/50) 0.00 - 0.00		0.00 (0/25) 0.00 - 0.00	0.00 (0/25) 0.00 - 0.00	0
	I-131 75	15	0.00 (0/50) 0.00 - 0.00		0.00 (0/25) 0.00 - 0.00	0.00 (0/25) 0.00 - 0.00	0
	LLI-131 75	1	0.00 (0/50) 0.00 - 0.00		0.00 (0/25) 0.00 - 0.00	0.00 (0/25) 0.00 - 0.00	0

Mean and range based upon detectable measurements only

Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)

Zero range indicates no detectable activity measurements

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station

Docket No. 50-413,414

Location: York County, South Carolina

Report Period: 01-JAN-1999 to 31-DEC-1999

Medium or Pathway Sampled	Type and Total Number of	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction		Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
				Location Code	Mean (Fraction) Range		
Broadleaf Vegetation (pCi/kg-wet)						217 (10.3 mi SSE)	
	CS-134	35	60	0.00 (0/28) 0.00 - 0.00		0.00 (0/7) 0.00 - 0.00	0
	CS-137	35	80	108 (5/28) 21.8 - 270	201 (0.5 mi NE)	108 (5/7) 21.8 - 270	0
	I-131	35	60	0.00 (0/28) 0.00 - 0.00		0.00 (0/7) 0.00 - 0.00	0

Mean and range based upon detectable measurements only

Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)

Zero range indicates no detectable activity measurements

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station

Docket No. 50-413,414

Location: York County, South Carolina

Report Period: 01-JAN-1999 to 31-DEC-1999

Medium or Pathway Sampled Unit of Measurement	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction		Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
				Location Code	Mean (Fraction) Range		
Food Products (pCi/kg-wet)						NO CONTROL LOCATION	
CS-134	8	60	0.00 (0/8)		0.00 (0/8)	0.00 (0/0)	0
			0.00 - 0.00		0.00 - 0.00		
CS-137	8	80	0.00 (0/8)		0.00 (0/8)	0.00 (0/0)	0
			0.00 - 0.00		0.00 - 0.00		
I-131	8	60	0.00 (0/8)		0.00 (0/8)	0.00 (0/0)	0
			0.00 - 0.00		0.00 - 0.00		

Mean and range based upon detectable measurements only

Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)

Zero range indicates no detectable activity measurements

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station

Docket No. 50-413,414

Location: York County, South Carolina

Report Period: 01-JAN-1999 to 31-DEC-1999*

Medium or Pathway Sampled	Type and Total Number of	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction		Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
				Location Code	Mean (Fraction) Range		
Fish (pCi/kg-wet)						216 (4.0 mi NNE)	
CO-58	24	130	31.2 (2/12) 27.4 - 35.1	208 (0.5 mi S)	31.2 (2/12) 27.4 - 35.1	0.00 (0/12) 0.00 - 0.00	0
CO-60	24	130	27.1 (1/12) 27.1 - 27.1	208 (0.5 mi S)	27.1 (1/12) 27.1 - 27.1	0.00 (0/12) 0.00 - 0.00	0
CS-134	24	130	0.00 (0/12) 0.00 - 0.00		0.00 (0/12) 0.00 - 0.00	0.00 (0/12) 0.00 - 0.00	0
CS-137	24	150	18.7 (3/12) 8.81 - 35.0	208 (0.5 mi S)	18.7 (3/12) 8.81 - 35.0	19.7 (2/12) 17.0 - 22.4	0
FE-59	24	260	0.00 (0/12) 0.00 - 0.00		0.00 (0/12) 0.00 - 0.00	0.00 (0/12) 0.00 - 0.00	0
MN-54	24	130	0.00 (0/12) 0.00 - 0.00		0.00 (0/12) 0.00 - 0.00	0.00 (0/12) 0.00 - 0.00	0
ZN-65	24	260	0.00 (0/12) 0.00 - 0.00		0.00 (0/12) 0.00 - 0.00	0.00 (0/12) 0.00 - 0.00	0

Mean and range based upon detectable measurements only

Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)

Zero range indicates no detectable activity measurements

* Includes all fish samples collected for period 1/1/1999 - 12/31/1999 (First through fourth quarter sampling)

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station

Docket No. 50-413,414

Location: York County, South Carolina

Report Period: 01-JAN-1999 to 31-DEC-1999*

Medium or Pathway Sampled Unit of Measurement	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction		Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.	
				Location Code	Mean (Fraction) Range			
Shoreline Sediment (pCi/kg-dry)						215 (4.2 mi NNE)		
	CO-58	20	0	145 (11/16) 29.6 - 540	208-3S	229 (4/4) 68.0 - 540	0.00 (0/4) 0.00 - 0.00	0
	CO-60	20	0	312 (8/16) 125 - 1190	208-3S	439 (4/4) 139 - 1190	0.00 (0/4) 0.00 - 0.00	0
	CS-134	20	150	0.00 (0/16) 0.00 - 0.00		0.00 (0/4) 0.00 - 0.00	0.00 (0/4) 0.00 - 0.00	0
	CS-137	20	180	79.2 (5/16) 44.0 - 149	208-3S	94.2 (3/4) 61.4 - 149	0.00 (0/4) 0.00 - 0.00	0
	MN-54	20	0	72.8 (2/16) 41.4 - 104	208-3S	72.8 (2/4) 41.4 - 104	0.00 (0/4) 0.00 - 0.00	0
	SB-125	20	0	140 (2/16) 98.7 - 181	208-3S	140 (2/4) 98.7 - 181	0.00 (0/4) 0.00 - 0.00	0

Mean and range based upon detectable measurements only

Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)

Zero range indicates no detectable activity measurements

If LLD is equal to 0.00, then the LLD is not required by Selected Licensee Commitments

* Includes all shoreline sediment collected for period 1/1/1999 - 12/31/1999 (First through fourth quarter sampling)

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station

Docket No. 50-413,414

Location: York County, South Carolina

Report Period: 01-JAN-1999 to 31-DEC-1999*

Medium or Pathway Sampled Unit of Measurement	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations	Location with Highest Annual Mean Name, Distance, Direction		Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
			Mean (Fraction) Range	Location Code	Mean (Fraction) Range		
Bottom Sediment (pCi/kg-dry)				NO CONTROL LOCATION			
	CO-57	12	0	0.00 (0/12) 0.00 - 0.00		0.00 (0/4) 0.00 - 0.00	0
	CO-58	12	0	530 (6/12) 111 - 1026	208 - 1M	587 (4/4) 254 - 1026	0
	CO-60	12	0	7234 (12/12) 327 - 19760	208 - 2M	14900 (4/4) 10800 - 19800	0
	CS-137	12	0	375 (12/12) 65.2 - 654	208 - 2M	551 (4/4) 503 - 654	0
	MN-54	12	0	164 (7/12) 40.0 - 472	208 - 2M	250 (4/4) 120 - 472	0
	SB-125	12	0	563 (12/12) 107 - 1973	208 - 2M	1230 (4/4) 809 - 1970	0

Mean and range based upon detectable measurements only

Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)

Zero range indicates no detectable activity measurements

If LLD is equal to 0.00, then the LLD is not required by Selected Licensee Commitments

* Includes all bottom sediment collected for period 1/1/1999 - 12/31/1999 (First through fourth quarter sampling)

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station

Docket No. 50-413,414

Location: York County, South Carolina

Report Period: 01-JAN-1999 to 31-DEC-1999

Medium or Pathway Sampled	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction		Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
				Location Code	Mean (Fraction) Range		
Direct Radiation TLD (mR/standard quarter)						217 (10.0 mi SSE)	
						247 (7.5 mi ESE)	
						251 (9.8 mi WNW)	
	158	0.00E+00	18.3 (146/146)	255	22.6 (4/4)	14.5 (12/12)	0
			11.3 - 25.2	(0.6 mi ENE)	21.5 - 23.8	10.6 - 20.8	

Mean and range based upon detectable measurements only

Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)

Zero range indicates no detectable activity measurements

APPENDIX C

**SAMPLING DEVIATIONS
&
UNAVAILABLE ANALYSES**

APPENDIX C

CATAWBA NUCLEAR STATION SAMPLING DEVIATIONS & UNAVAILABLE ANALYSES

DEVIATION & UNAVAILABLE REASON CODES			
BF	Blown Fuse	PO	Power Outage
FZ	Sample Frozen	PS	Pump out of service / Undergoing Repair
IW	Inclement Weather	SL	Sample Loss/Lost due to Lab Accident
LC	Line Clog to Sampler	SM	Motor / Rotor Seized
OT	Other	TF	Torn Filter
PI	Power Interrupt	VN	Vandalism
PM	Preventive Maintenance		

C.1 SAMPLING DEVIATIONS

Air Particulate and Air Radioiodines

Location	Scheduled Collection Dates	Actual Collection Dates	Reason Code	Corrective Action
205	4/19 – 4/26/99	4/19 – 4/25/99	PO	Power to sampling equipment interrupted due to power loss at Catawba motor control center. Work request 98075750 was submitted for power restoration.
205	4/26 – 5/3/99	4/27 – 5/3/99	PO	Power to sampling equipment interrupted due to power loss at Catawba motor control center. Work request 98075750 was completed and power was restored to sampling equipment on 4/27/99 @ 05:00.

Surface Water

Location	Scheduled Collection Dates	Actual Collection Dates	Reason Code	Corrective Action
211	4/5 – 5/3/99	4/5 – 4/22/99	OT	Sampling equipment out of service due to construction at the sampling site. Work request 98079179 was submitted. A temporary ISCO sampler was placed in service.
208	8/23 – 9/20/99	9/7 – 9/20/99	PS	Pump out of service. Work request 98095363 was submitted for repairs. A temporary ISCO sampler was placed in service until repairs were completed.

C.2 UNAVAILABLE ANALYSES

TLD

Location	Scheduled Collection Dates	Reason Code	Corrective Action
241	12/28 – 3/31/99	VN	TLD missing. 2 nd quarter TLD placed in field.
231	3/31 – 6/30/99	OT	TLD missing due to construction at site. 3 rd quarter TLD placed in field.

APPENDIX D

ANALYTICAL DEVIATIONS

No analytical deviations were incurred for the
1999 Radiological Environmental Monitoring Program

APPENDIX E

**RADIOLOGICAL
ENVIRONMENTAL MONITORING
PROGRAM RESULTS**

This appendix includes all of the sample analysis reports generated from each sample medium for 1999. Appendix E is located separately from this report and is permanently archived at Duke Power Company's Environmental Center radiological environmental master file, located at the McGuire Nuclear Station Site in Huntersville, North Carolina.