Duke Power SM
A Duke Energy Company

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

DUKE POWER COMPANY
CATAWBA NUCLEAR STATION
Units 1 and 2

2004

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

BW	BiWeekly
C	Control
CNS	Catawba Nuclear Station
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
GPS	Global Positioning System
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/m3	picocurie per cubic meter
PIP	Problem Investigation Process
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 2004.

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. Eight-hundred eighty-eight samples were analyzed comprising 1,200 test results in order to compile data for the 2004 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 2004 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 2.94E-01 mrem for 2004. 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.

Figures 2.1-1 and 2.1-2 are maps depicting the Thermoluminescent Dosimeter (TLD) monitoring locations and the 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 a one mile radius of CNS. Figure 2.1-2 comprises all sample locations within a 10 mile radius of CNS.

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 3.11.

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):

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

Where:

$\overline{x}$ = estimate of the mean,
i = individual sample,
N = total number of samples with a net activity (or concentration),
χ_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 AND MINIMUM DETECTABLE ACTIVITY

The Lower Level of Detection (LLD), and Minimum Detectable Activity (MDA) 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.

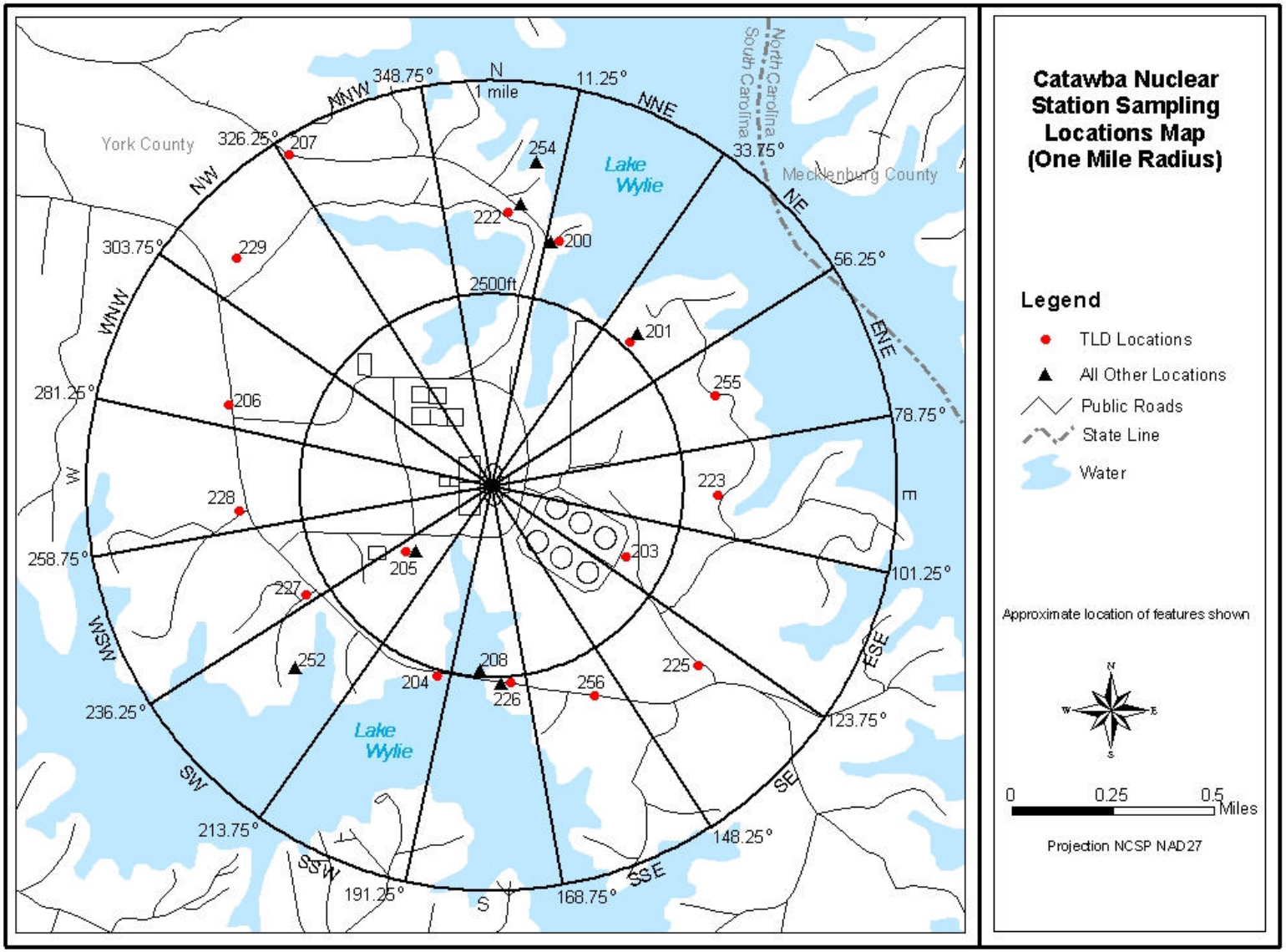
MDA - The MDA may be thought of as an "actual" LLD for a particular sample measurement remembering that the MDA is calculated using a sample background instead of a system background.

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.

Figure 2.1-1


Catawba Nuclear Station Sampling Locations Map (One Mile Radius)
Legend
TLD Locations
All Other Locations
Public Roads
State Line
Water
Approximate location of features shown
0
0.25
0.5
Miles
Projection NCSP NAD27
N
1 mile
2500ft
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
11.25°
33.75°
56.25°
78.75°
101.25°
123.75°
148.25°
168.75°
191.25°
213.75°
236.25°
258.75°
281.25°
303.75°
326.25°
348.75°
York County
Mecklenburg County
North Carolina
South Carolina
Lake Wylie
Lake Wylie
200
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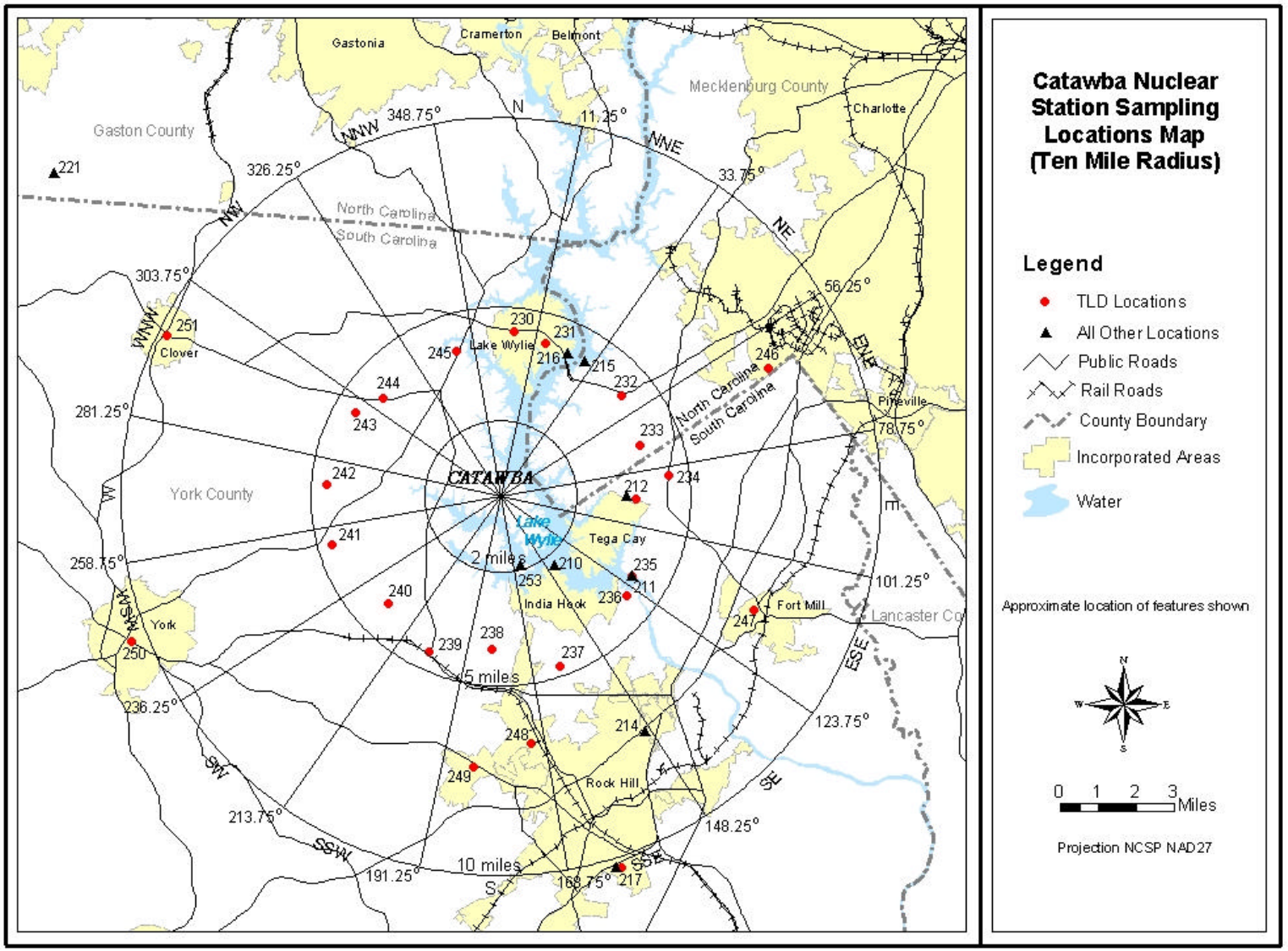
255
256

Figure 2.1-2


Gastonia
Cramerton
Belmont
Mecklenburg County
Charlotte
Gaston County
Clover
York County
York
Lake Wylie
Tega Cay
India Hook
Fort Mill
Lancaster Co
Pineville
Rock Hill
CATAWBA
North Carolina
South Carolina
N
NNW
NNE
NW
NE
WNW
ENE
W
E
WSW
ESE
SW
SE
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348.75°
11.25°
33.75°
56.25°
78.75°
101.25°
123.75°
148.25°
168.75°
191.25°
213.75°
236.25°
258.75°
281.25°
303.75°
326.25°
2 miles
5 miles
10 miles
221
230
231
245
216
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214
248
249
217
Catawba Nuclear Station Sampling Locations Map (Ten Mile Radius)
Legend
TLD Locations
All Other Locations
Public Roads
Rail Roads
County Boundary
Incorporated Areas
Water
Approximate location of features shown
0 1 2 3 Miles
Projection NCSP NAD27

TABLE 2.1-A

CATAWBA RADIOLOGICAL MONITORING PROGRAM
SAMPLING LOCATIONS

Table 2.1-B Codes			
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 (0.63 mi NNE)	W							M	
201	Site Boundary (0.53 mi NE)	W							M	
205	Site Boundary (0.23 mi SW)	W								
208	Discharge Canal (0.45 mi S)		M		SA		SA			
210	Ebenezer Access (2.31 mi SE)				SA					
211	Wylie Dam (4.06 mi ESE)		M							
212	Tega Cay (3.32 mi E)	W								
214	Rock Hill Water Supply (7.30 mi SSE)			M						
215 C	River Pointe - Hwy 49 (4.21 mi NNE)		M		SA					
216 C	Hwy 49 Bridge (4.19 mi NNE)						SA			
217 C	Rock Hill Substation (10.3 mi SSE)	W							M	
218 C	Belmont Water Supply (13.5 mi NNE)			M						
221 C	Dairy (14.5 mi NW)							SM		
222	Site Boundary (0.70 mi N)								M	
226	Site Boundary (0.48 mi S)								M	
252	Residence (0.64 mi SW)									Q
253	Irrigated Gardens (1.90 mi SSE)					M(a)				
254	Residence (0.82 mi N)									Q

(a) During Harvest Season
(b) When Available

* GPS data reflect approximate accuracy to within 2-5 meters. GPS field measurements were taken as close as possible to the item of interest.

TABLE 2.1-B

CATAWBA RADIOLOGICAL MONITORING PROGRAM
SAMPLING LOCATIONS

(TLD SITES)

Site #	Location*	Distance	Sector	Site #	Location*	Distance	Sector
200	SITE BOUNDARY	0.63 miles	NNE	234	HOME FEDERAL BANK	4.50 miles	E
201	SITE BOUNDARY	0.53 miles	NE	235	LAKE WYLIE DAM	4.07 miles	ESE
203	SITE BOUNDARY	0.38 miles	ESE	236	SC WILDLIFE FEDERATION OFFICE	4.25 miles	SE
204	SITE BOUNDARY	0.48 miles	SSW	237	TWIN LAKES ROAD AND HOMESTEAD ROAD	4.75 miles	SSE
205	SITE BOUNDARY	0.23 miles	SW	238	PENNINGTON ROAD AND WEST OAK ROAD	4.02 miles	S
206	SITE BOUNDARY	0.67 miles	WNW	239	CARTER LUMBER COMPANY	4.49 miles	SSW
207	SITE BOUNDARY	0.95 miles	NNW	240	PARAHAM ROAD	4.07 miles	SW
212 SI	TEGA CAY AIR SITE	3.32 miles	E	241	CAMPBELL ROAD	4.58 miles	WSW
217 C	ROCK HILL AIR SITE	10.3 miles	SSE	242	TRANSMISSION TOWER ON PARAHAM ROAD	4.56 miles	W
222	SITE BOUNDARY	0.69 miles	N	243	KINGSBERRY ROAD	4.39 miles	WNW
223	SITE BOUNDARY	0.57 miles	E	244	BETHEL ELEMENTARY SCHOOL	4.02 miles	NW
225	SITE BOUNDARY	0.68 miles	SE	245	CROWDERS CREEK BOAT LANDING	4.01 miles	NNW
226	SITE BOUNDARY	0.48 miles	S	246 SI	CAROWINDS GUARD HOUSE	7.87 miles	ENE
227	SITE BOUNDARY	0.52 miles	WSW	247 C	FORT MILL	7.33 miles	ESE
228	SITE BOUNDARY	0.61 miles	W	248 SI	PIEDMONT MEDICAL CENTER	6.54 miles	S
229	SITE BOUNDARY	0.84 miles	NW	249 SI	YORK COUNTY OPERATIONS CENTER	7.17 miles	S
230	RIVER HILLS COMMUNITY CHURCH	4.37 miles	N	250 SI	YORK DUKE POWER OFFICE	10.4 miles	WSW
231	RIVER HILLS FRONT ENTRANCE	4.21 miles	NNE	251 C	CLOVER	9.72 miles	WNW
232	PLEASANT HILL ROAD	4.18 miles	NE	255	SITE BOUNDARY	0.61 miles	ENE
233	ZOAR ROAD AND THOMAS DRIVE	3.95 miles	ENE	256	SITE BOUNDARY	0.58 miles	SSE

C = Control
SI = Special Interest

* GPS data reflect approximate accuracy to within 2-5 meters. GPS field measurements were taken as close as possible to the item of interest.

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 Particulate	Weekly	X			X	
Direct Radiation	Quarterly					X
Surface Water	Monthly Composite	X				
	Quarterly Composite		X			
Drinking Water	Monthly Composite	X		(a)	X	
	Quarterly Composite		X			
Ground Water	Quarterly	X	X			
Shoreline Sediment	Semiannually	X				
Milk	Semimonthly	X		X		
Fish	Semiannually	X				
Broadleaf Vegetation	Monthly[b]	X				
Food Products	Monthly[b]	X				

(a) Low-level I-131 analysis will be performed if the dose calculated for the consumption of drinking water is > 1 mrem per year. An LLD of 1 pCi/liter will be required for this analysis.
(b) 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

Review of all 2004 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 2004 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 2004. Summary tables containing 2004 information required by Technical Specification Administrative Control 5.6.2 are located in Appendix B.

Evaluation for significant trends was performed for radionuclides that are listed as required within Selected Licensee Commitments 16.11-13. 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 SLC reporting levels (Table 2.2-A) were used as criteria for trending conclusions. All 2004 maximum percentages of reporting levels were well below the 100% action level. The highest value noted during 2004 was 4.34% for tritium in drinking water collected at the Rock Hill Water Supply, Location 214.

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 2004 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.

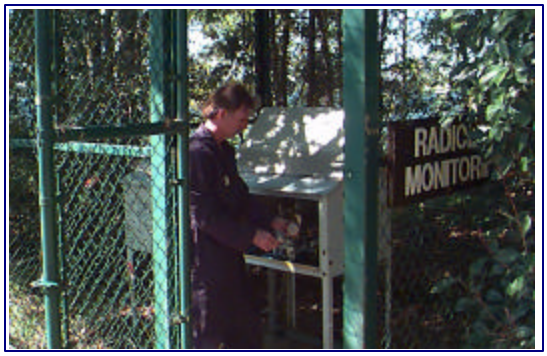
Review of all 2004 data presented in this section supports the conclusion that there were no significant changes in environmental sample radionuclide concentrations of samples collected and analyzed from CNS site and surrounding areas that were attributable to plant operations.

3.1 AIRBORNE RADIOIODINE AND PARTICULATES

In 2004, 260 radioiodine and particulate samples were analyzed, 208 from four indicator locations and 52 at the control location. Particulate samples were analyzed weekly for gamma and gross beta. Radioiodine samples received a weekly gamma analysis.

Figure 3.1 shows individual sample gross beta results for the indicator location with highest annual mean and the control location samples during 2004. 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 2004. Table 3.1-A shows the highest indicator annual mean and control location annual mean for gross beta in air particulate.



There was no detectable I-131 in air radioiodine samples analyzed in 2004. 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 not detected on any cartridges in 2004. Cs-137 detection on the charcoal cartridge was determined in 1990 to be an active constituent of the charcoal. A similar study was performed in 2001 again yielding this conclusion. Therefore, any Cs-137 activities were not used in any dose calculations in Section 4.0 of this report.

There is no reporting level for gross beta in air

Figure 3.1

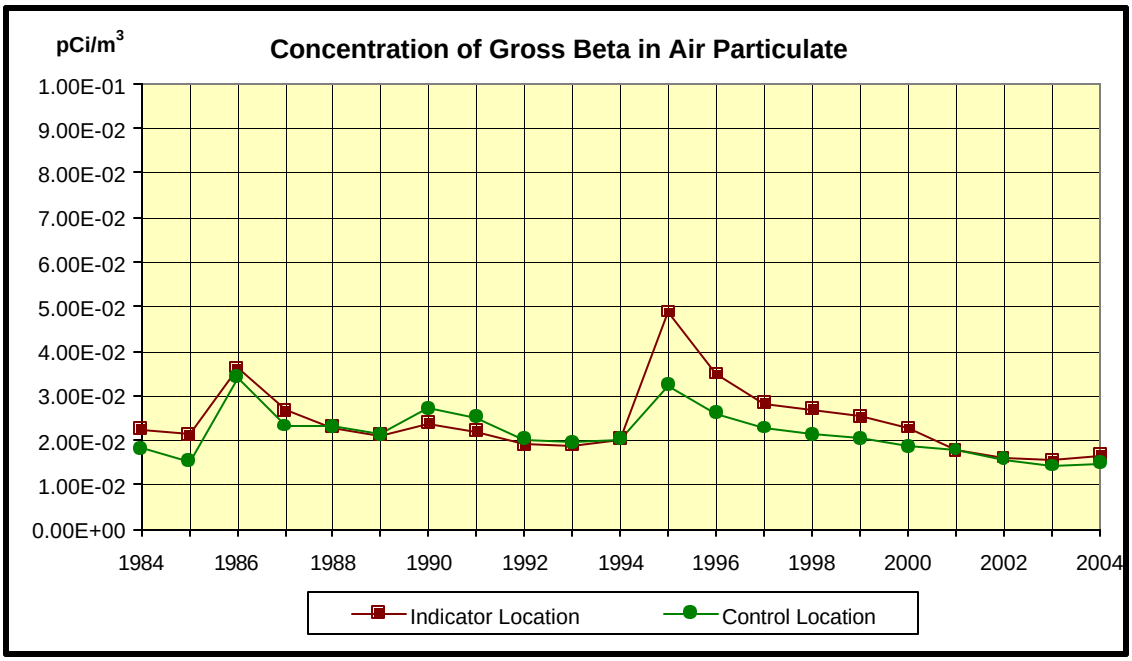


Table 3.1-A Mean Concentration of Gross Beta in Air Particulate

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
1999	2.53E-2	2.04E-2
2000	2.28E-2	1.86E-2
2001	1.76E-2	1.78E-2
2002	1.60E-2	1.57E-2
2003	1.54E-2	1.42E-2
Average (1994 - 2003)	2.56E-2	2.09E-2
2004	1.65E-2	1.49E-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
2000	0.00E0	0.00E0
2001	0.00E0	0.00E0
2002	0.00E0	0.00E0
2003	0.00E0	0.00E0
2004	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 the four indicator samples and the four control samples during 2004. The mean indicator tritium concentration for 2004 was 547 pCi/l, 2.74% of reporting level. The mean control tritium concentration for 2004 was 254 pCi/l, 1.27% of reporting level. Figure 3.2 and Table 3.2 display the highest indicator and control location annual mean concentrations for tritium since 1984.

The dose for consumption of water was less than one mrem per year, historically and for 2004; therefore low-level iodine analysis is not required.

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 1.88 pCi/l in 2004 and the control location concentration was 1.69 pCi/l. The 2003 indicator mean was 2.27 pCi/l. The table shows that current gross beta levels are not statistically different from preoperational concentrations.

No gamma emitting radionuclides were identified in 2004 drinking water samples. There have been no gamma emitting radionuclides identified in drinking water samples since 1988.

The region experienced a severe drought over a four year period (1999 to 2002). Rainfall in the area was substantially below normal (approximately 40 inches below normal) for this four year period. The reduced rainfall resulted in reduced flow in the Catawba River. The increase in drinking water tritium up to 2002 is considered to be a result of the decreased river flow.

Figure 3.2

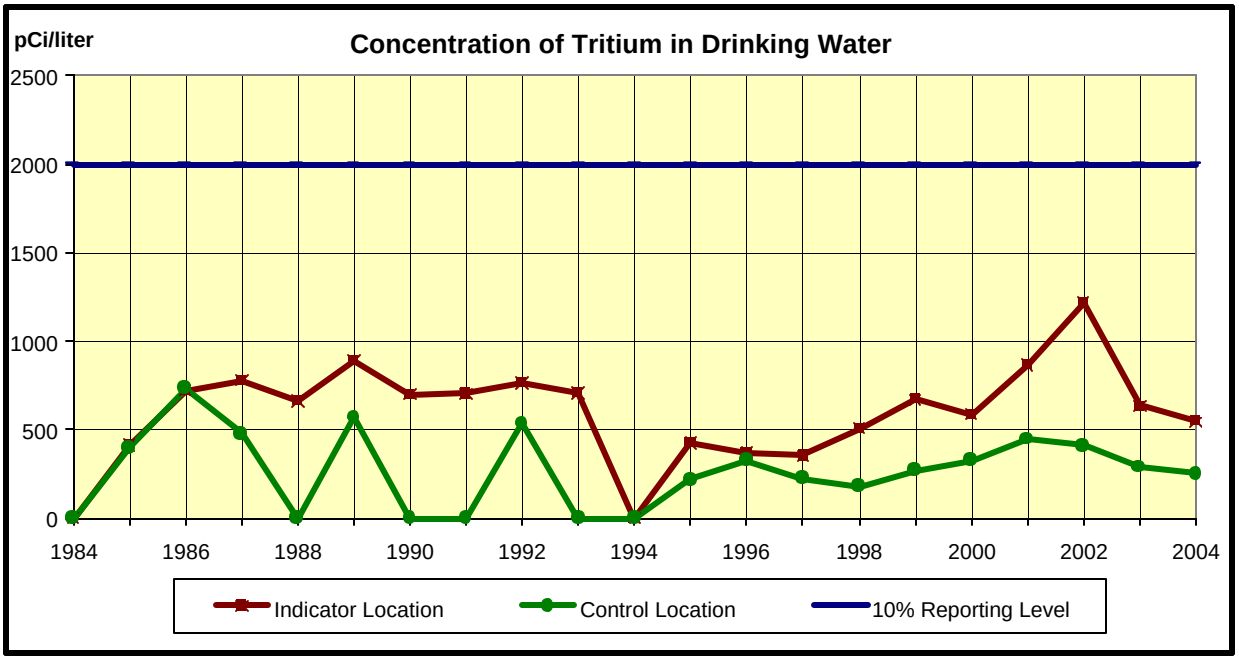


Table 3.2 Mean Concentration of Radionuclides in Drinking Water

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
2000	3.04	2.27	5.87E2	3.26E2
2001	3.49	2.30	8.66E2	4.50E2
2002	3.44	2.36	1.22E3	4.11E2
2003	2.27	2.02	6.36E2	2.88E2
2004	1.88	1.69	5.47E2	2.54E2

0.00E0 = no detectable measurements
1984 - 1986 mean based on all net activity

3.3 SURFACE WATER

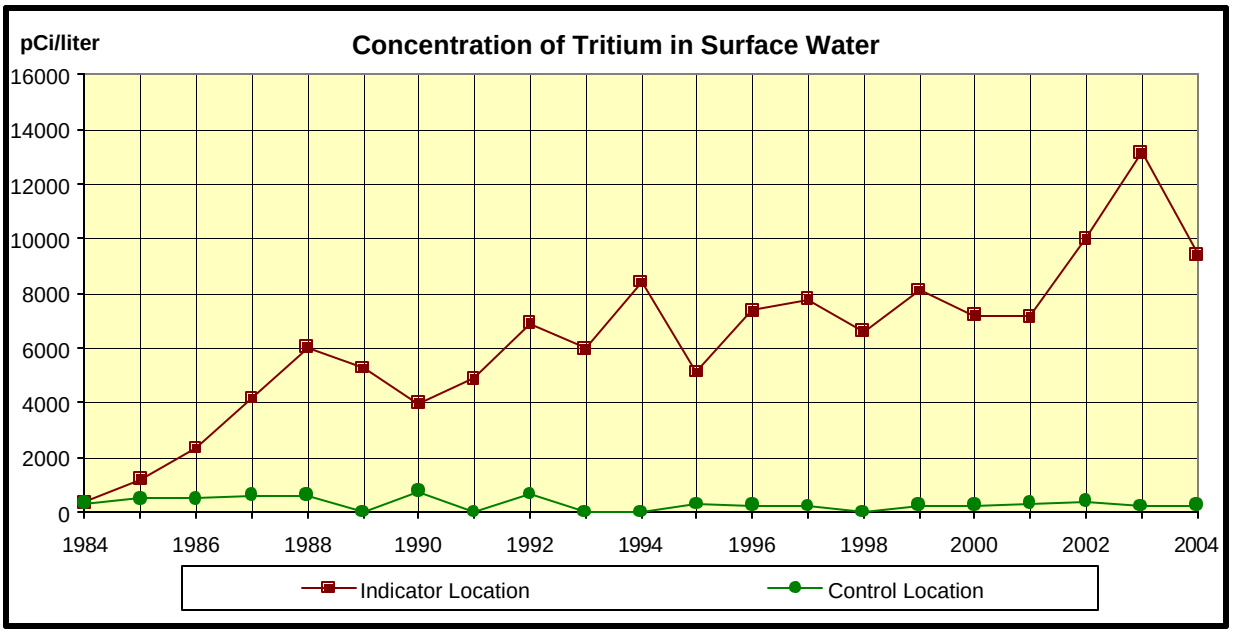
A total of 39 monthly surface water samples was analyzed for gamma emitting radionuclides. The samples were composited to create 12 quarterly samples for tritium analysis. Two indicator locations and one control location were sampled. One indicator location (208) is located near the liquid effluent discharge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

Tritium was the only radionuclide identified in surface water samples collected during 2004. All indicator location samples contained tritium with an average concentration of 4985 pCi/l. Indicator Location 208 (Discharge Canal) showed a range of activities from 3870 to 14200 pCi/l which had the highest mean concentration of 9430 pCi/l. Tritium was detected in three of the four control samples during 2004 with an average concentration of 260 pCi/l.

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

Tritium in surface water in 2003 was higher than usual due to the one-time draining of approximately 40,000 gallons of water on 9/8 and 9/9/03 from the Recycle Holdup Tanks following the Unit 1 outage. The Recycle Holdup Tanks contain evaporator distillate water containing tritium. Other surface water samples during the year were normal and did not indicate a trend. The release of the Recycle Holdup Tanks is documented in PIP C-03-5726.

Figure 3.3



There is no reporting level for tritium in surface water, however, if no drinking water pathway exists, a value of 30,000 pCi/l may be used. A drinking water pathway exists for Catawba Nuclear Station, so this limit does not apply for surface water. See section 3.2 for drinking water results.

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
2000	0.00E0	0.00E0	0.00E0	0.00E0	7.19E3	2.56E2
2001	0.00E0	0.00E0	0.00E0	0.00E0	7.13E3	3.28E2
2002	0.00E0	0.00E0	0.00E0	0.00E0	1.00E4	3.80E2
2003	0.00E0	0.00E0	0.00E0	0.00E0	1.31E4	2.37E2
2004	0.00E0	0.00E0	0.00E0	0.00E0	9.43E3	2.60E2

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 2004.

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 26 milk samples was analyzed by gamma spectroscopy and low level iodine during 2004. There was one control location sampled. Two indicator dairies ceased operation in December, 2003 leaving the one control location. No indicator dairies were identified by the 2004 land use census.

There were no gamma emitting radionuclides identified in milk during 2004. Airborne Cs-137 has not been released from the plant since 1992.

Cs-137 was last detected in an indicator sample during 1996. 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
2000	0.00E0	0.00E0
2001	0.00E0	0.00E0
2002	0.00E0	0.00E0
2003	0.00E0	0.00E0
2004	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 60 broadleaf vegetation samples during 2004. Four indicator locations and one control location were sampled.

Two of the forty-eight samples collected at indicator locations contained detectable Cs-137 activity. Cs-137 was detected in one of the twelve samples collected at Location 201. The highest concentration detected at Location 201 was 54.5 pCi/kg which is 2.73% of the reporting level. Cs-137 was not detected in any of the twelve control location samples.

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 2004 show a stable trend for Cs-137 in vegetation.

No airborne Cs-137 has been released from the plant since 1992. Cs-137 attributable to past nuclear weapons testing is known to exist in many environmental media at low and highly variable levels.

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

Figure 3.6

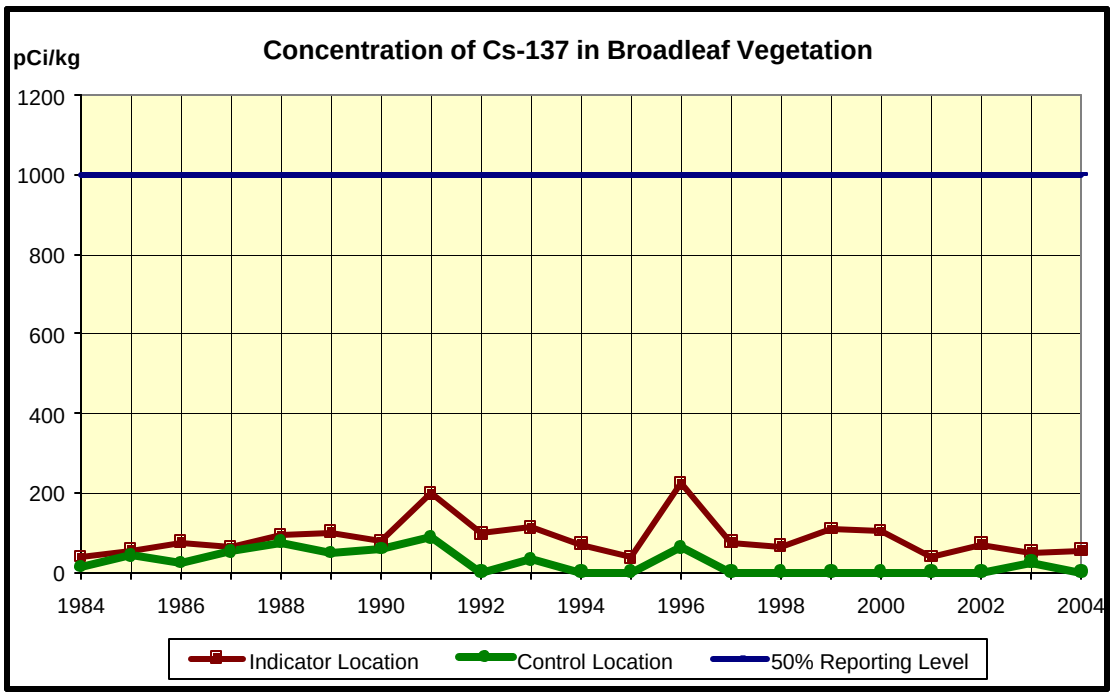


Table 3.6 Mean Concentration of Radionuclides in Broadleaf Vegetation

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
2000	1.04E2	0.00E0
2001	3.76E1	0.00E0
2002	7.02E1	0.00E0
2003	4.96E1	2.40E1
2004	5.45E1	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 2004 growing season, six 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
2000	0.00E0
2001	0.00E0
2002	0.00E0
2003	0.00E0
2004	0.00E0

0.00E0 = no detectable measurements

3.8 FISH

Gamma spectroscopy was performed on 12 fish samples collected during 2004. One downstream indicator location and one control location were sampled.

Co-58, Co-60, and Cs-137 area normally the predominant radionuclides identified in fish samples. One of the six indicator location samples contained Co-58. Co-60 and Cs-137 were not detected in any indicator samples. One of the six indicator location samples contained Mn-54. Co-58, Co-60, and Cs-137 were not detected in any control location samples.

The highest average concentration for Co-58 in indicator location samples was 18.1 pCi/kg which represents 0.06% of the reporting level. The highest average concentration for Mn-54 in indicator location samples was 49.2 pCi/kg which represents 0.16% of the 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 slightly higher for forager fish than for predator and bottom feeding fish. Similar results have been noted from 1990 through 2003.

Figures 3.8-1 and 3.8-2 are graphs displaying annual mean concentrations for Co-58 and Co-60. 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.

K-40 was observed in fish samples collected during 2004.

Figure 3.8-1

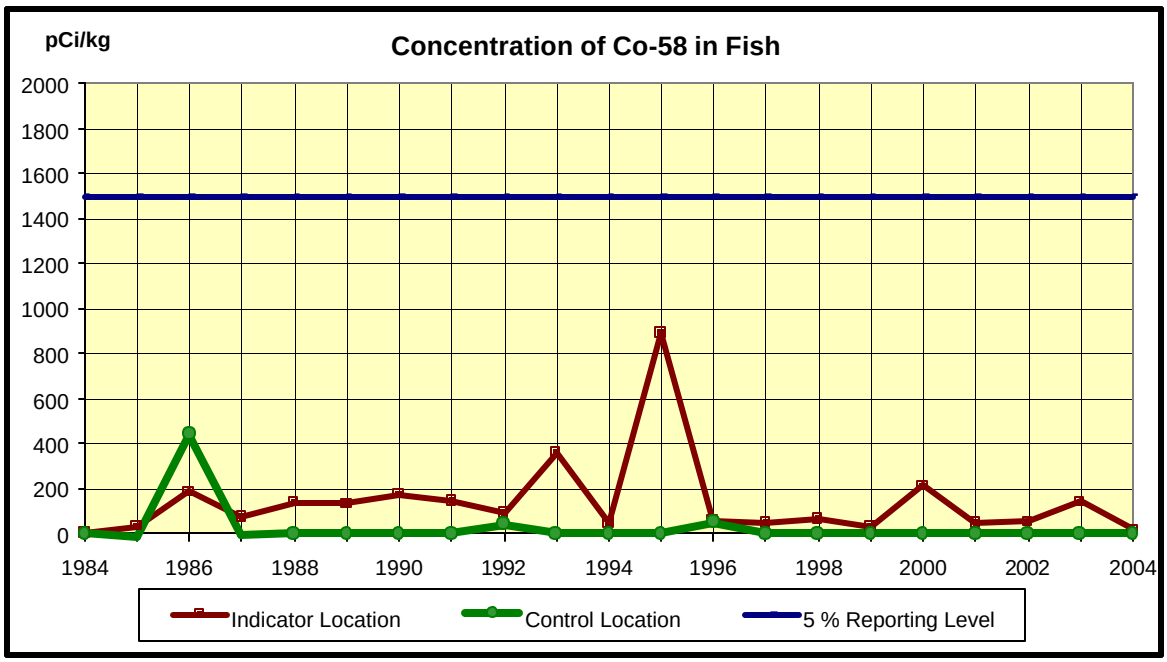


Figure 3.8-2

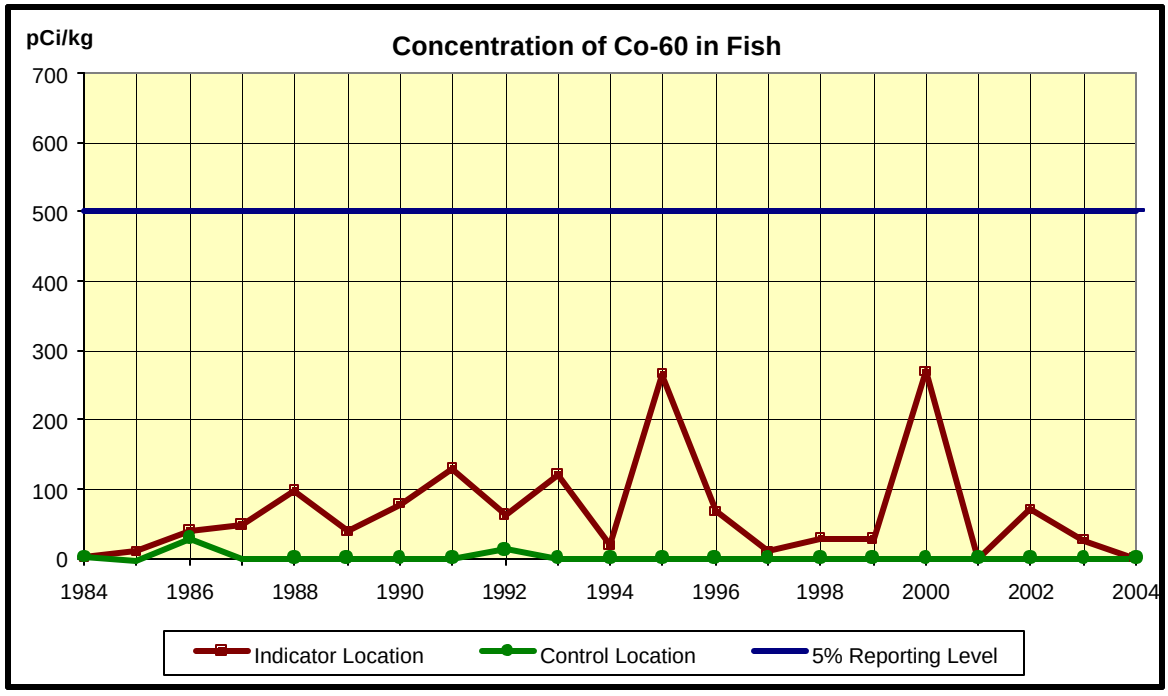


Table 3.8 Mean Concentrations of Radionuclides in Fish (pCi/kg)

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
2000	0.00E0	2.13E2	2.69E2	0.00E0	1.52E1	0.00E0	0.00E0	0.00E0	0.00E0
2001	0.00E0	4.66E1	0.00E0	0.00E0	2.08E1	0.00E0	0.00E0	0.00E0	0.00E0
2002	0.00E0	5.23E1	7.00E1	0.00E0	1.73E1	0.00E0	0.00E0	0.00E0	0.00E0
2003	0.00E0	1.43E2	2.61E1	0.00E0	1.19E1	0.00E0	0.00E0	0.00E0	0.00E0
2004	4.92E1	1.81E1	0.00E0	0.00E0	0.00E0	0.00E0	0.00E0	0.00E0	0.00E0

0.00E0 = no detectable measurements

3.9 SHORELINE SEDIMENT

During 2004, a total of 6 shoreline sediment samples was analyzed, four from two indicator locations and two from the control location.

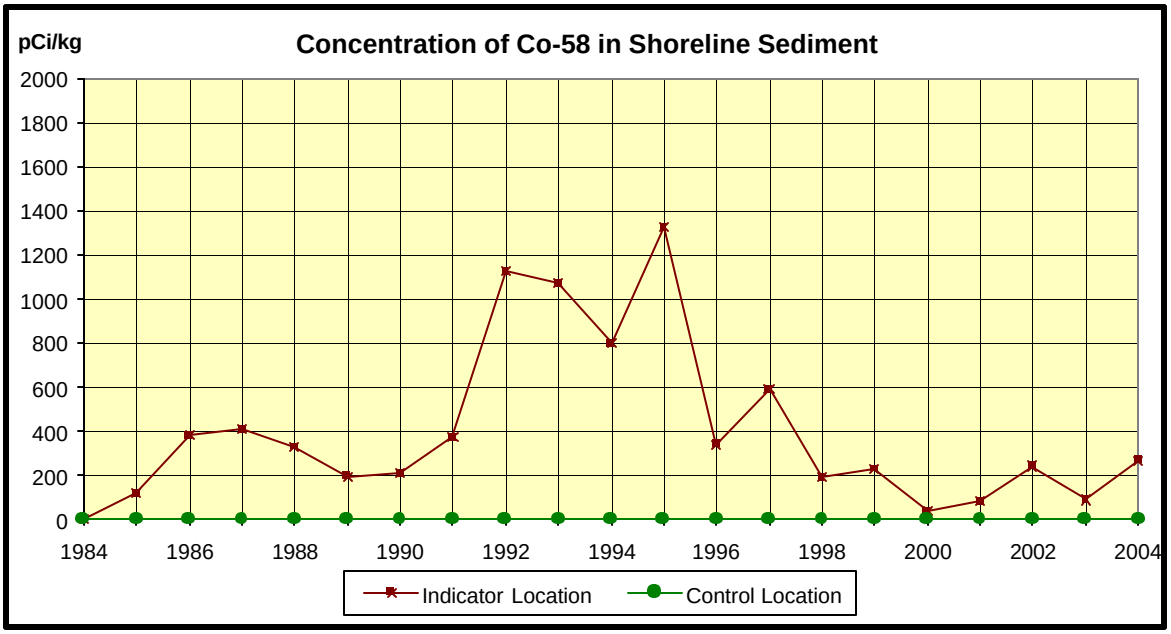
Mn-54, Co-58, Co-60, and Cs-137 were identified in samples collected from indicator location 208-1S, which is closest to the plant's liquid effluent release point. Naturally occurring K-40 was identified in many of the indicator and control locations. Activity released in plant effluents has decreased since 1996 and as a result decreased activity has been measured in the environment.

The shoreline sediment location with the highest annual mean for all detectable radionuclides was location 208-1S. Cs-137 was identified at location 208-1S with an annual mean concentration of 37.9 pCi/kg. Other radionuclides identified during 2004 at shoreline sediment location 208-1S included Mn-54 with an annual mean of 66.0 pCi/kg, Co-58 with an annual mean of 267 pCi/kg, and Co-60 with an annual mean of 383 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.

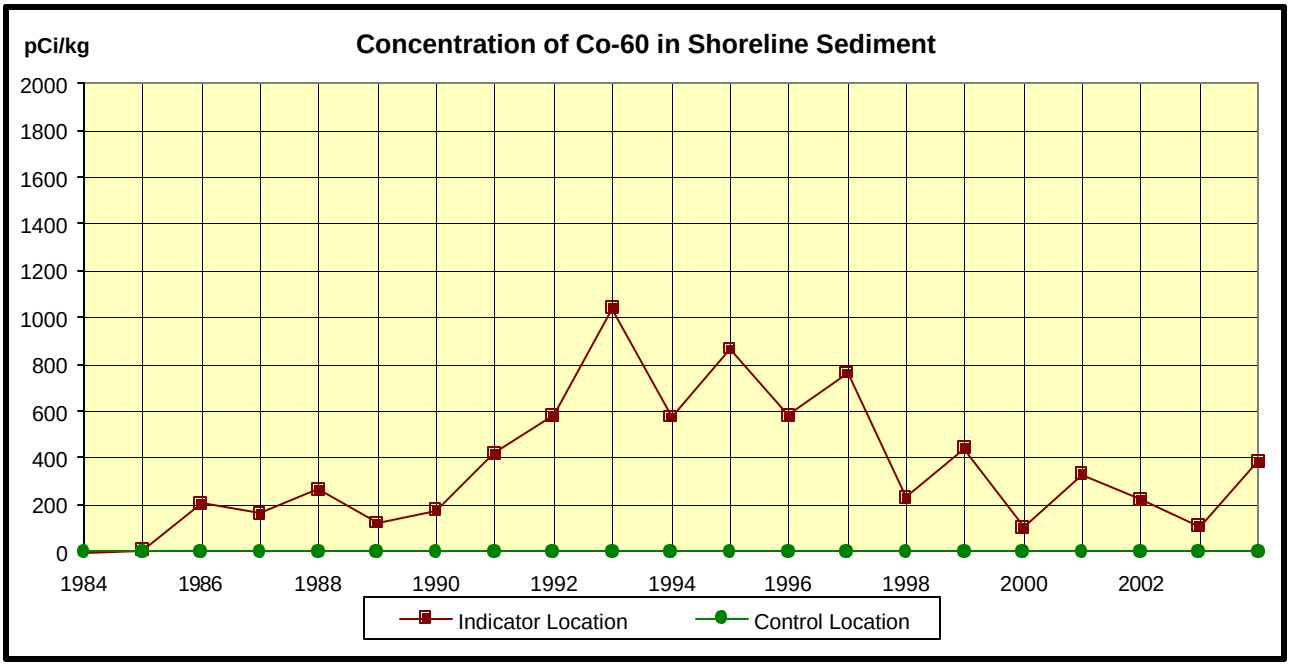
Figure 3.9-1 graphically depicts Co-58 annual mean concentrations. Figure 3.9-2 depicts Co-60 annual mean concentrations.

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
2000	0.00E0	3.90E1	1.03E2	0.00E0	0.00E0	0.00E0	4.96E1	0.00E0	0.00E0
2001	3.86E1	8.27E1	3.29E2	0.00E0	0.00E0	0.00E0	5.58E1	0.00E0	0.00E0
2002	3.51E1	2.41E2	2.22E2	0.00E0	0.00E0	0.00E0	8.83E1	0.00E0	0.00E0
2003	2.17E1	8.75E1	1.08E2	0.00E0	0.00E0	0.00E0	2.69E1	0.00E0	0.00E0
2004	6.60E1	2.67E2	3.83E2	0.00E0	0.00E0	0.00E0	3.79E1	0.00E0	0.00E0

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

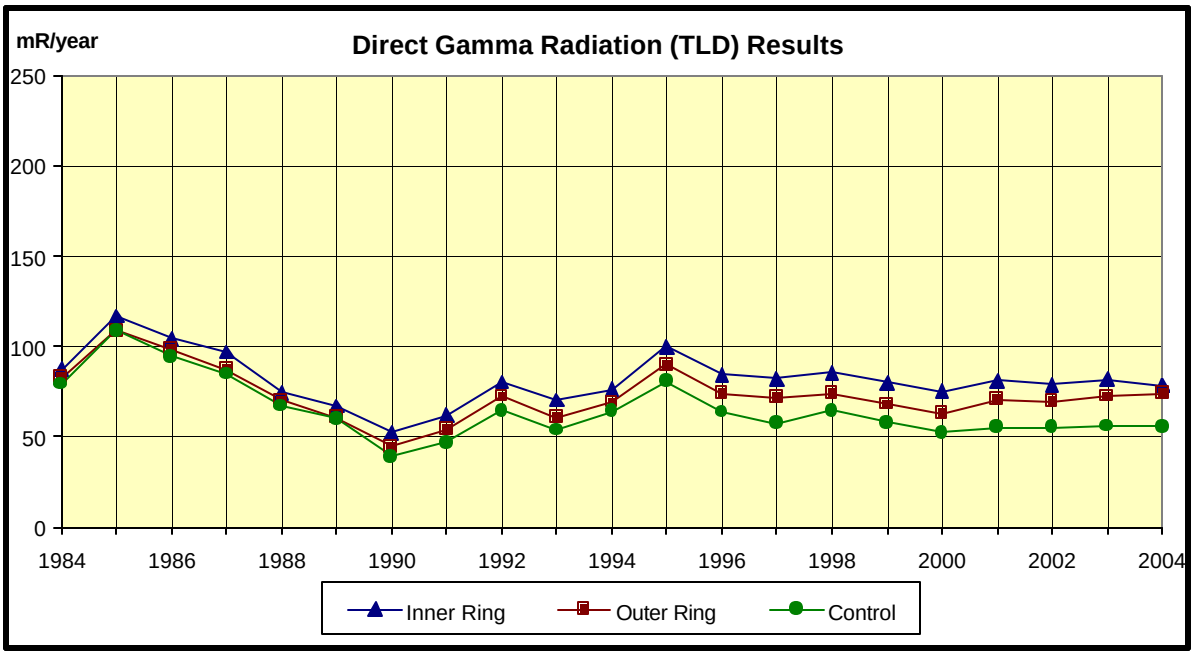
3.10 DIRECT GAMMA RADIATION

In 2004, 157 TLDs were analyzed, 145 at indicator locations and 12 at control locations. TLDs are collected and analyzed quarterly. The highest annual mean exposure for an indicator location was 99.6 milliroentgen. The annual mean exposure for the control locations was 55.6 milliroentgen.

Figure 3.10 and Table 3.10 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 ring, outer ring, and control data averages historically compare closely. 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 2004 was 0.83 mrem, which is 1.06% 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 3.10



There is no reporting level for Direct Radiation (TLD)

Table 3.10 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
1999	80.0	68.1	57.8
2000	75.0	63.0	52.4
2001	81.0	70.5	55.2
2002	78.8	69.5	55.2
2003	81.7	72.6	56.0
Average (1994 – 2003)	82.4	72.3	60.7
2004	78.6	73.8	55.6

* Preoperational Data

3.11 LAND USE CENSUS

The 2004 Annual Land Use Census was conducted July 12 and July 14, 2004 as required by SLC 16.11-14. Table 3.11 summarizes census results. A map indicating identified locations is shown in Figure 3.11.

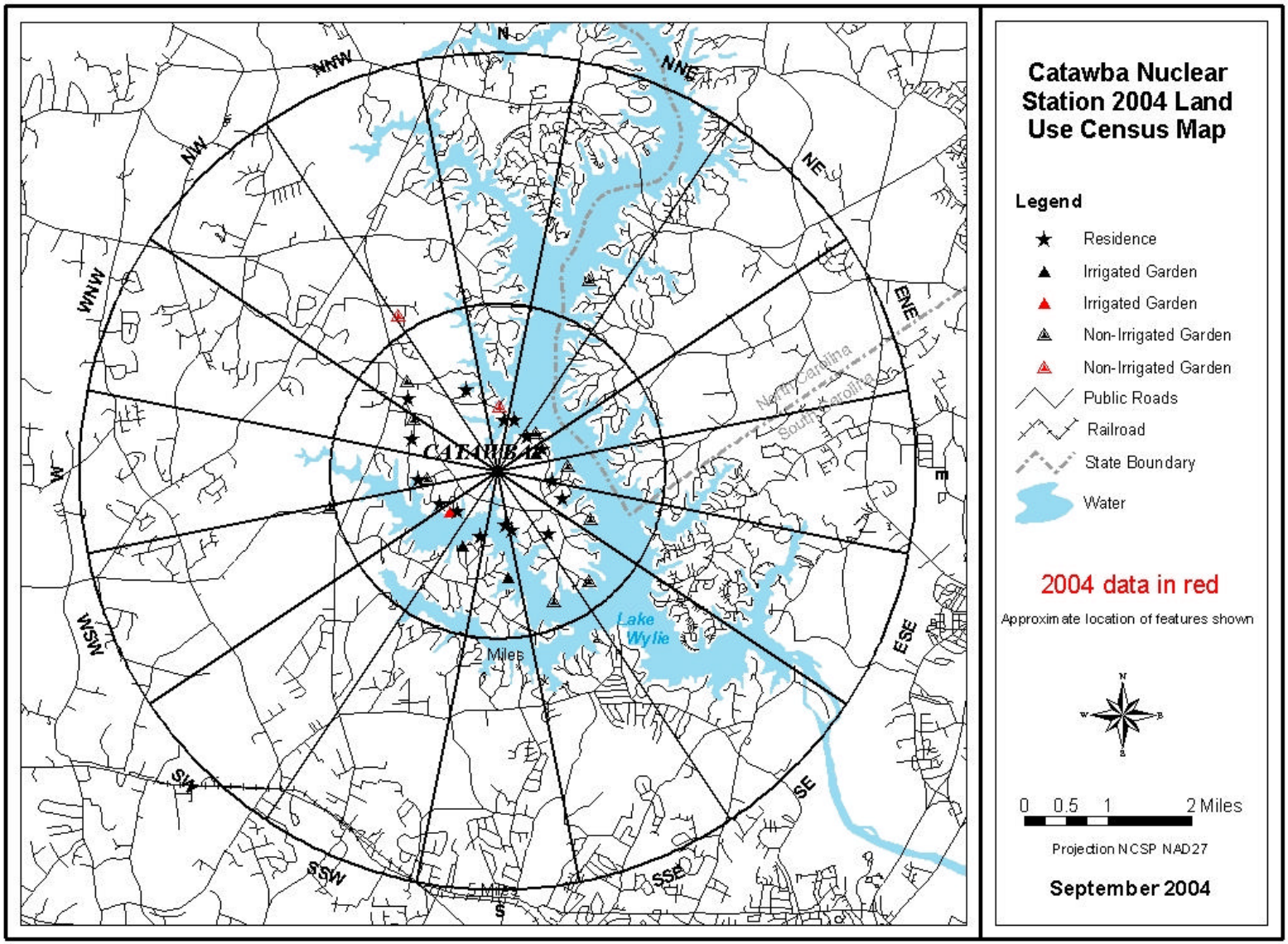
During the 2004 census, no new or closer irrigated gardens were identified. The nearest residence is located in the NE sector at 0.56 miles. No program changes were required as a result of the 2004 land use census.

Table 3.11 Catawba 2004 Land Use Census Results

Sector		Distance (Miles)	Sector		Distance (Miles)
N	Nearest Residence	0.63	S	Nearest Residence	0.63
	Nearest Garden	0.78		Nearest Garden (irrigated)	1.26
	Nearest Milk Animal	-		Nearest Milk Animal	-
NNE	Nearest Residence	0.66	SSW	Nearest Residence	0.81
	Nearest Garden	2.53		Nearest Garden (irrigated)	0.96
	Nearest Milk Animal	-		Nearest Milk Animal	-
NE	Nearest Residence	0.56	SW	Nearest Residence	0.66
	Nearest Garden	0.65		Nearest Garden (irrigated)	0.66
	Nearest Milk Animal	-		Nearest Milk Animal	-
ENE	Nearest Residence	0.61	WSW	Nearest Residence	0.78
	Nearest Garden (irrigated)	0.61		Nearest Garden	2.04
	Nearest Milk Animal	-		Nearest Milk Animal	-
E	Nearest Residence	0.65	W	Nearest Residence	0.97
	Nearest Garden	0.84		Nearest Garden	0.96
	Nearest Milk Animal	-		Nearest Milk Animal	-
ESE	Nearest Residence	0.84	WNW	Nearest Residence	1.10
	Nearest Garden	1.23		Nearest Garden	1.19
	Nearest Milk Animal	-		Nearest Milk Animal	-
SE	Nearest Residence	0.97	NW	Nearest Residence	1.39
	Nearest Garden	1.70		Nearest Garden	1.54
	Nearest Milk Animal	-		Nearest Milk Animal	-
SSE	Nearest Residence	0.74	NNW	Nearest Residence	1.06
	Nearest Garden	1.69		Nearest Garden	2.21
	Nearest Milk Animal	-		Nearest Milk Animal	-

"-" indicates no occurrences within the 5 mile radius

Figure 3.11


Catawba Nuclear Station 2004 Land Use Census Map
Legend
Residence
Irrigated Garden
Irrigated Garden
Non-Irrigated Garden
Non-Irrigated Garden
Public Roads
Railroad
State Boundary
Water
2004 data in red
Approximate location of features shown
0 0.5 1 2 Miles
Projection NCSP NAD27
September 2004
CATAWBA
Lake Wylie
North Carolina
South Carolina
2 Miles
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW

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 2004 CNS REMP samples. The primary purpose of estimating doses based on sample results is to allow comparison to effluent program 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. The individual critical population and pathway dose calculations are reported in Table 4.1-B.

REMP-based dose estimates are 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 are not reported for surface water because sampled surface water is not considered to be a potable drinking water source. Exposure estimates based upon REMP TLD results are discussed in Section 3.10.

The maximum environmental organ dose estimate for any single sample type (other than direct radiation from gaseous effluents) collected during 2004 was 4.63E-1 mrem to the maximum exposed child bone from consuming broadleaf vegetation.

4.2 ESTIMATED DOSE FROM RELEASES

Throughout the year, dose estimates were calculated based on actual 2004 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 2004 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, milk and vegetation pathways.

4.3 COMPARISON OF DOSES

The gaseous environmental and effluent dose estimates given in Table 4.1-A agree reasonably well. The calculated environmental doses for liquid pathways are slightly lower than liquid effluent doses. Effluent models are based on historical averages. The region experienced a severe drought from 1999 to 2002 which has resulted in differences in the actual river flow versus the historical values used in the model. Drought conditions lessened during 2003 and continued to improve during 2004.

There are some differences in how effluent and environmental doses are calculated that affect the comparison. Doses calculated from environmental data are conservative because they are based on a mean that includes only samples with a net positive activity versus a mean that includes all sample results (i.e. zero results are not included in the mean). Also, airborne tritium is not measured in environmental samples but is used to calculate effluent doses.

In calculations based on liquid release pathways, fish, drinking water, and shoreline sediment were the predominant dose pathways based on environmental and effluent data. The maximum total organ dose based on 2004 environmental sample results was 6.09E-2 mrem to the adult GI-LLI. The maximum total organ dose of 9.65E-2 mrem for liquid effluent-based estimates was to the adult GI-LLI.

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 8.30E-1 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 4.63E-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
2004 ENVIRONMENTAL AND EFFLUENT DOSE COMPARISON

LIQUID RELEASE PATHWAY

Organ	Environmental or Effluent Data	Critical Age (1)	Critical Pathway (2)	Location	Maximum Dose (3) (mrem)
Skin	Environmental	Teen	Shoreline Sediment	208 (0.45 mi. S)	5.62E-03
Skin	Effluent	Teen	Shoreline Sediment	0.5 mi. S	1.06E-02
Bone	Environmental	-	-	-	0.00E+00
Bone	Effluent	Teen	Shoreline Sediment	0.5 mi. S	1.58E-02
Liver	Environmental	Child	Drinking Water	214 (7.30 mi. SSE)	4.57E-02
Liver	Effluent	Child	Drinking Water	0.5 mi. S	7.92E-02
T. Body	Environmental	Child	Drinking Water	214 (7.30 mi. SSE)	4.45E-02
T. Body	Effluent	Child	Drinking Water	0.5 mi. S	7.19E-02
Thyroid	Environmental	Child	Drinking Water	214 (7.30 mi. SSE)	4.19E-02
Thyroid	Effluent	Child	Drinking Water	0.5 mi. S	6.90E-02
Kidney	Environmental	Child	Drinking Water	214 (7.30 mi. SSE)	4.29E-02
Kidney	Effluent	Child	Drinking Water	0.5 mi. S	7.21E-02
Lung	Environmental	Child	Drinking Water	214 (7.30 mi. SSE)	4.19E-02
Lung	Effluent	Child	Drinking Water	0.5 mi. S	7.00E-02
GI-LLI	Environmental	Adult	Fish	208 (0.45 mi. S)	6.09E-02
GI-LLI	Effluent	Adult	Fish	0.5 mi. S	9.65E-02

(1) Critical Age is the highest total dose (all pathways) to an age group.

(2) Critial Pathway is the highest individual dose within the identified Critical Age group.

(3) 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 (1)	Critical Pathway (2)	Location	Maximum Dose (3) (mrem)
Skin	Environmental	-	-	-	0.00E+00
Skin	Effluent	-	-	0.5 mi. N	-
Bone	Environmental	Child	Vegetation	201 (0.53 mi. NE)	4.63E-01
Bone	Effluent	-	-	0.5 mi. N	-
Liver	Environmental	Child	Vegetation	201 (0.53 mi. NE)	4.44E-01
Liver	Effluent	Child	Vegetation	0.5 mi. N	8.30E-01
T. Body	Environmental	Adult	Vegetation	201 (0.53 mi. NE)	2.49E-01
T. Body	Effluent	Child	Vegetation	0.5 mi. N	8.30E-01
Thyroid	Environmental	-	-	-	0.00E+00
Thyroid	Effluent	Child	Vegetation	0.5 mi. N	8.30E-01
Kidney	Environmental	Child	Vegetation	201 (0.53 mi. NE)	1.45E-01
Kidney	Effluent	Child	Vegetation	0.5 mi. N	8.30E-01
Lung	Environmental	Child	Vegetation	201 (0.53 mi. NE)	5.20E-02
Lung	Effluent	Child	Vegetation	0.5 mi. N	8.30E-01
GI-LLI	Environmental	Adult	Vegetation	201 (0.53 mi. NE)	7.36E-03
GI-LLI	Effluent	Child	Vegetation	0.5 mi. N	8.30E-01

(1) Critical Age is the highest total dose (all pathways) to an age group.

(2) Critial Pathway is the highest individual dose within the identified Critical Age group.

(3) 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	1.20E-02
Gamma	Environmental	-	-	-	Not Sampled
Gamma	Effluent	N/A	Noble Gas	0.5 mi. NNE	2.30E-02

TABLE 4.1-B

Maximum Individual Dose for 2004 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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Drinking Water	0.00E+00	2.98E-02	2.98E-02	2.98E-02	2.98E-02	2.98E-02	2.98E-02	0.00E+00
	Milk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	TOTAL	0.00E+00	2.98E-02	2.98E-02	2.98E-02	2.98E-02	2.98E-02	2.98E-02	0.00E+00
Child	Airborne	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Drinking Water	0.00E+00	3.03E-02	3.03E-02	3.03E-02	3.03E-02	3.03E-02	3.03E-02	0.00E+00
	Milk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Broadleaf Vegetation	4.63E-01	4.44E-01	6.55E-02	0.00E+00	1.45E-01	5.20E-02	2.78E-03	0.00E+00
	Fish	0.00E+00	1.54E-02	1.32E-02	1.16E-02	1.26E-02	1.16E-02	1.59E-02	0.00E+00
	Shoreline Sediment	0.00E+00	0.00E+00	9.99E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-03
	TOTAL	4.63E-01	4.90E-01	1.10E-01	4.19E-02	1.88E-01	9.39E-02	4.90E-02	1.17E-03
Teen	Airborne	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Drinking Water	0.00E+00	1.58E-02	1.58E-02	1.58E-02	1.58E-02	1.58E-02	1.58E-02	0.00E+00
	Milk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Broadleaf Vegetation	2.56E-01	3.41E-01	1.19E-01	0.00E+00	1.16E-01	4.51E-02	4.85E-03	0.00E+00
	Fish	0.00E+00	1.89E-02	1.56E-02	1.40E-02	1.54E-02	1.40E-02	2.74E-02	0.00E+00
	Shoreline Sediment	0.00E+00	0.00E+00	4.78E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.62E-03
	TOTAL	2.56E-01	3.76E-01	1.55E-01	2.98E-02	1.47E-01	7.49E-02	4.81E-02	5.62E-03
Adult	Airborne	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Drinking Water	0.00E+00	2.25E-02	2.25E-02	2.25E-02	2.25E-02	2.25E-02	2.25E-02	0.00E+00
	Milk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Broadleaf Vegetation	2.78E-01	3.80E-01	2.49E-01	0.00E+00	1.29E-01	4.29E-02	7.36E-03	0.00E+00
	Fish	0.00E+00	2.32E-02	1.97E-02	1.82E-02	1.96E-02	1.82E-02	3.84E-02	0.00E+00
	Shoreline Sediment	0.00E+00	0.00E+00	8.57E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.01E-03
	TOTAL	2.78E-01	4.26E-01	2.92E-01	4.07E-02	1.71E-01	8.36E-02	6.83E-02	1.01E-03

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

Catawba Nuclear Station
Dose from Drinking Water Pathway for 2004 Data
Maximum Exposed Infant

Infant Dose from Drinking Water Pathway (mrem) = Usage (l) x Dose Factor (mrem/pCi ingested) x Concentration (pCi/l)

Usage (intake in one year) = 330 l

	Ingestion Dose Factor							Highest Annual Net Mean Concentration		Dose (mrem)						
Radionuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Indicator Location	Water (pCi/l)	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	1.99E-05	4.51E-06	NO DATA	4.41E-06	NO DATA	7.31E-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	3.60E-06	8.98E-06	NO DATA	NO DATA	NO DATA	8.97E-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
Fe-59	3.08E-05	5.38E-05	2.12E-05	NO DATA	NO DATA	1.59E-05	2.57E-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	1.08E-05	2.55E-05	NO DATA	NO DATA	NO DATA	2.57E-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
Zn-65	1.84E-05	6.31E-05	2.91E-05	NO DATA	3.06E-05	NO DATA	5.33E-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
Nb-95	4.20E-08	1.73E-08	1.00E-08	NO DATA	1.24E-08	NO DATA	1.46E-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
Zr-95	2.06E-07	5.02E-08	3.56E-08	NO DATA	5.41E-08	NO DATA	2.50E-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
I-131	3.59E-05	4.23E-05	1.86E-05	1.39E-02	4.94E-05	NO DATA	1.51E-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	3.77E-04	7.03E-04	7.10E-05	NO DATA	1.81E-04	7.42E-05	1.91E-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	5.22E-04	6.11E-04	4.33E-05	NO DATA	1.64E-04	6.64E-05	1.91E-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
BaLa-140	1.71E-04	1.71E-07	8.81E-06	NO DATA	4.06E-08	1.05E-07	4.20E-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
H-3	NO DATA	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07	214	293	0.00E+00	2.98E-02	2.98E-02	2.98E-02	2.98E-02	2.98E-02	2.98E-02
						Dose Commitment (mrem) =				0.00E+00	2.98E-02	2.98E-02	2.98E-02	2.98E-02	2.98E-02	2.98E-02

Catawba Nuclear Station
Dose from Drinking Water Pathway for 2004 Data
Maximum Exposed Child

Child Dose from Drinking Water Pathway (mrem) = Usage (l) x Dose Factor (mrem/pCi ingested) x Concentration (pCi/l)

Usage (intake in one year) = 510 l

	Ingestion Dose Factor							Highest Annual Net Mean Concentration		Dose (mrem)						
Radionuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Indicator Location	Water (pCi/l)	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	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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
Nb-95	2.25E-08	8.76E-09	6.26E-09	NO DATA	8.23E-09	NO DATA	1.62E-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
Zr-95	1.16E-07	2.55E-08	2.27E-08	NO DATA	3.65E-08	NO DATA	2.66E-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
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	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BaLa-140	8.31E-05	7.28E-08	4.85E-06	NO DATA	2.37E-08	4.34E-08	4.21E-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
H-3	NO DATA	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	214	293	0.00E+00	3.03E-02	3.03E-02	3.03E-02	3.03E-02	3.03E-02	3.03E-02
						Dose Commitment (mrem) =				0.00E+00	3.03E-02	3.03E-02	3.03E-02	3.03E-02	3.03E-02	3.03E-02

Catawba Nuclear Station
Dose from Broadleaf Vegetation Pathway for 2004 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

	Ingestion Dose Factor							Highest Annual Net Mean Concentration		Dose (mrem)						
Radionuclide	**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**	**54.5**	**4.63E-01**	**4.44E-01**	**6.55E-02**	**0.00E+00**	**1.45E-01**	**5.20E-02**	**2.78E-03**
						Dose Commitment (mrem) =				**4.63E-01**	**4.44E-01**	**6.55E-02**	**0.00E+00**	**1.45E-01**	**5.20E-02**	**2.78E-03**

Catawba Nuclear Station
Dose from Fish Pathway for 2004 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 = 9170 pCi/l x 0.9 = 8253 pCi/kg

Usage (intake in one year) = 6.9 kg

								Highest Annual Net Mean Concentration								
				Ingestion Dose Factor						Dose (mrem)						
Radionuclide	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	208	49.2	0.00E+00	3.63E-03	9.68E-04	0.00E+00	1.02E-03	0.00E+00	3.05E-03
Co-58	NO DATA	1.80E-06	5.51E-06	NO DATA	NO DATA	NO DATA	1.05E-05	208	18.1	0.00E+00	2.25E-04	6.88E-04	0.00E+00	0.00E+00	0.00E+00	1.31E-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	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	8253	0.00E+00	1.16E-02	1.16E-02	1.16E-02	1.16E-02	1.16E-02	1.16E-02
						Dose Commitment (mrem) =				0.00E+00	1.54E-02	1.32E-02	1.16E-02	1.26E-02	1.16E-02	1.59E-02

Catawba Nuclear Station
Dose from Shoreline Sediment Pathway for 2004 Data
Maximum Exposed Child

Shoreline Recreation = **14** **hr (in one year)**
Shore Width Factor = **0.2**
Sediment Surface Mass = **40** **kg/m^2**

Child Dose from Shoreline Sediment Pathway (mrem) = Shoreline Recreation (hr) x External Dose Factor (mrem/hr per pCi/m^2) x Shore Width Factor x Sediment Surface Mass (kg/m^2) x Sediment Concentration (pCi/kg)

	External Dose Factor Standing on Contaminated Ground		**Highest Annual Net Mean Concentration**		**Dose**	
	(mrem/hr per pCi/m^2)		**Indicator**	**Sediment**	**(mrem)**	
Radionuclide	**T. Body**	**Skin**	**Location**	**(pCi/kg)**	**T. Body**	**Skin**
Mn-54	**5.80E-09**	**6.80E-09**	**208-1S**	**66.0**	**4.29E-05**	**5.03E-05**
Co-58	**7.00E-09**	**8.20E-09**	**208-1S**	**267**	**2.09E-04**	**2.45E-04**
Co-60	**1.70E-08**	**2.00E-08**	**208-1S**	**383**	**7.29E-04**	**8.58E-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**	**208-1S**	**37.9**	**1.78E-05**	**2.08E-05**
		Dose Commitment (mrem) =			**9.99E-04**	**1.17E-03**

Catawba Nuclear Station
Dose from Drinking Water Pathway for 2004 Data
Maximum Exposed Teen

Teen Dose from Drinking Water Pathway (mrem) = Usage (l) x Dose Factor (mrem/pCi ingested) x Concentration (pCi/l)

Usage (intake in one year) = 510 l

				Ingestion Dose Factor				Highest Annual Net Mean Concentration		Dose (mrem)						
Radionuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Indicator Location	Water (pCi/l)	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	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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
Nb-95	8.22E-09	4.56E-09	2.51E-09	NO DATA	4.42E-09	NO DATA	1.95E-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
Zr-95	4.12E-08	1.30E-08	8.94E-09	NO DATA	1.91E-08	NO DATA	3.00E-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
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	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BaLa-140	2.84E-05	3.48E-08	1.83E-06	NO DATA	1.18E-08	2.34E-08	4.38E-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
H-3	NO DATA	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	214	293	0.00E+00	1.58E-02	1.58E-02	1.58E-02	1.58E-02	1.58E-02	1.58E-02
						Dose Commitment (mrem)=				0.00E+00	1.58E-02	1.58E-02	1.58E-02	1.58E-02	1.58E-02	1.58E-02

Catawba Nuclear Station
Dose from Broadleaf Vegetation Pathway for 2004 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

	Ingestion Dose Factor							Highest Annual Net Mean Concentration		Dose (mrem)						
Radionuclide	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	54.5	2.56E-01	3.41E-01	1.19E-01	0.00E+00	1.16E-01	4.51E-02	4.85E-03
						Dose Commitment (mrem) =				2.56E-01	3.41E-01	1.19E-01	0.00E+00	1.16E-01	4.51E-02	4.85E-03

Catawba Nuclear Station
Dose from Fish Pathway for 2004 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 = 9170 pCi/l x 0.9 = 8253 pCi/kg

Usage (intake in one year) = 16 kg

	Ingestion Dose Factor							Highest Annual Net Mean Concentration		Dose (mrem)						
Radionuclide	**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	208	49.2	0.00E+00	4.64E-03	9.21E-04	0.00E+00	1.39E-03	0.00E+00	9.53E-03
Co-58	NO DATA	9.72E-07	2.24E-06	NO DATA	NO DATA	NO DATA	1.34E-05	208	18.1	0.00E+00	2.81E-04	6.49E-04	0.00E+00	0.00E+00	0.00E+00	3.88E-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	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	8253	0.00E+00	1.40E-02	1.40E-02	1.40E-02	1.40E-02	1.40E-02	1.40E-02
						Dose Commitment (mrem) =				0.00E+00	1.89E-02	1.56E-02	1.40E-02	1.54E-02	1.40E-02	2.74E-02

Catawba Nuclear Station
Dose from Shoreline Sediment Pathway for 2004 Data
Maximum Exposed Teen

Shoreline Recreation = 67 hr (in one year)
Shore Width Factor = 0.2
Sediment Surface Mass = 40 kg/m^2

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/m^2) x Sediment Concentration (pCi/kg)

	External Dose Factor Standing on Contaminated Ground (mrem/hr per pCi/m^2)		Highest Annual Net Mean Concentration		Dose (mrem)	
Radionuclide	T. Body	Skin	Indicator Location	Sediment (pCi/kg)	T. Body	Skin
Mn-54	5.80E-09	6.80E-09	208-1S	66.0	2.05E-04	2.41E-04
Co-58	7.00E-09	8.20E-09	208-1S	267	1.00E-03	1.17E-03
Co-60	1.70E-08	2.00E-08	208-1S	383	3.49E-03	4.11E-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	208-1S	37.9	8.53E-05	9.95E-05
Dose Commitment (mrem) =					4.78E-03	5.62E-03

Catawba Nuclear Station
Dose from Drinking Water Pathway for 2004 Data
Maximum Exposed Adult

Adult Dose from Drinking Water Pathway (mrem) = Usage (l) x Dose Factor (mrem/pCi ingested) x Concentration (pCi/l)

Usage (intake in one year) = 730 l

	Ingestion Dose Factor							Highest Annual Net Mean Concentration		Dose (mrem)						
Radionuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Indicator Location	Water (pCi/l)	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	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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
Nb-95	6.22E-09	3.46E-09	1.86E-09	NO DATA	3.42E-09	NO DATA	2.10E-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
Zr-95	3.04E-08	9.75E-09	6.60E-09	NO DATA	1.53E-08	NO DATA	3.09E-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
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	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BaLa-140	2.03E-05	2.55E-08	1.33E-06	NO DATA	8.67E-09	1.46E-08	4.18E-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
H-3	NO DATA	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	214	293	0.00E+00	2.25E-02	2.25E-02	2.25E-02	2.25E-02	2.25E-02	2.25E-02
						Dose Commitment (mrem) =				0.00E+00	2.25E-02	2.25E-02	2.25E-02	2.25E-02	2.25E-02	2.25E-02

Catawba Nuclear Station
Dose from Broadleaf Vegetation Pathway for 2004 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

	Ingestion Dose Factor							Highest Annual Net Mean Concentration		Dose (mrem)						
Radionuclide	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	54.5	2.78E-01	3.80E-01	2.49E-01	0.00E+00	1.29E-01	4.29E-02	7.36E-03
						Dose Commitment (mrem) =				2.78E-01	3.80E-01	2.49E-01	0.00E+00	1.29E-01	4.29E-02	7.36E-03

Catawba Nuclear Station
Dose from Fish Pathway for 2004 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 = 9170 pCi/l x 0.9 = 8253 pCi/kg

Usage (intake in one year) = 21 kg

	Ingestion Dose Factor							Highest Annual Net Mean Concentration		Dose (mrem)						
Radionuclide	**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	208	49.2	0.00E+00	4.72E-03	9.01E-04	0.00E+00	1.41E-03	0.00E+00	1.45E-02
Co-58	NO DATA	7.45E-07	1.67E-06	NO DATA	NO DATA	NO DATA	1.51E-05	208	18.1	0.00E+00	2.83E-04	6.35E-04	0.00E+00	0.00E+00	0.00E+00	5.74E-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	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	8253	0.00E+00	1.82E-02	1.82E-02	1.82E-02	1.82E-02	1.82E-02	1.82E-02
						Dose Commitment (mrem) =				0.00E+00	2.32E-02	1.97E-02	1.82E-02	1.96E-02	1.82E-02	3.84E-02

Catawba Nuclear Station
Dose from Shoreline Sediment Pathway for 2004 Data
Maximum Exposed Adult

Shoreline Recreation = 12 hr (in one year)
Shore Width Factor = 0.2
Sediment Surface Mass = 40 kg/m^2

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/m^2) x Sediment Concentration (pCi/kg)

	External Dose Factor Standing on Contaminated Ground (mrem/hr per pCi/m^2)		Highest Annual Net Mean Concentration		Dose (mrem)	
Radionuclide	T. Body	Skin	Indicator Location	Sediment (pCi/kg)	T. Body	Skin
Mn-54	5.80E-09	6.80E-09	208-1S	66.0	3.67E-05	4.31E-05
Co-58	7.00E-09	8.20E-09	208-1S	267	1.79E-04	2.10E-04
Co-60	1.70E-08	2.00E-08	208-1S	383	6.25E-04	7.35E-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	208-1S	37.9	1.53E-05	1.78E-05
Dose Commitment (mrem) =					8.57E-04	1.01E-03

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 2004. 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 2004 is documented in Table 5.0-A.

5.6 DUKE POWER AUDITS

The Catawba Radiation Protection Section was audited by the Quality Assurance Group in February, 2004. There were no findings as a result of this audit.

EnRad Laboratories was audited by the Quality Assurance Group in March, 2004. Laboratory practices and procedures were reviewed. One example of insufficient documentation for a cross-check which yielded data outside of acceptance limits was identified and is described in PIP G-04-00140. Several areas for improvement were identified and are described in PIP G-04-00142. There were no significant findings as a result of this audit.

5.7 U.S. NUCLEAR REGULATORY COMMISSION INSPECTIONS

The Catawba Nuclear Station Radiological Environmental Monitoring Program was not audited by the NRC in 2004. The program was audited by the NRC in June 2003 (Reference 6.12). There were no findings or issues identified by the audit.

EnRad Laboratories was not audited by the NRC in 2004.

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

5.9.1 NUCLEAR TECHNOLOGY SERVICES INTERCOMPARISON PROGRAM

Radiation Dosimetry and Records participates in a quarterly TLD intercomparison program administered by Nuclear Technology Services, Inc. of Roswell, GA. Nuclear Technology Services irradiates environmental dosimeters quarterly and sends them to the Radiation Dosimetry and Records group for analysis of the unknown estimated delivered exposure. A summary of the Nuclear Technology Services Intercomparison Report is documented in Table 5.0-B.

5.9.2 STATE OF NORTH CAROLINA INTERCOMPARISON PROGRAM

Radiation Dosimetry and Records routinely participates in a TLD intercomparison program. The State of North Carolina Radiation Protection Section irradiates environmental dosimeters and sends them to the Radiation Dosimetry and Records group for analysis of the unknown estimated delivered exposure. A summary of the State of North Carolina Environmental Dosimetry Intercomparison Report for 2004 is documented in Table 5.0-B.

5.9.3 INTERNAL CROSSCHECK (DUKE POWER)

Radiation Dosimetry and Records participates in a quarterly TLD intracomparison program administered internally by the Dosimetry Lab. The Dosimetry Lab Staff irradiates environmental dosimeters quarterly and submits them for analysis of the unknown estimated delivered exposure. A summary of the Internal Cross Check (Duke Power) Result is documented in Table 5.0-B.

TABLE 5.0-A

DUKE POWER COMPANY
INTERLABORATORY COMPARISON PROGRAM

2004 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.

Footnote explanations are included following this data table.

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
3/17/2004	Q041GWSL	Cr-51	1.06 - 1.88 E3	1.41 E3	1.41 E3	3 Pass
		Mn-54	2.63 - 4.67 E4	3.51 E4	3.73 E4	3 Pass
		Co-57	0.00 - 0.00 E3	0.00E+00	1.00 E3	3 Pass(1)
		Co-58	7.07 - 12.53 E3	9.42 E3	9.40 E3	3 Pass
		Fe-59	2.01 - 3.56 E3	2.67 E3	2.80 E3	3 Pass
		Co-60	4.86 - 8.62 E4	6.48 E4	6.85 E4	3 Pass
		Zn-65	4.42 - 7.84 E4	5.90 E4	6.21 E4	3 Pass
		Cs-134	4.26 - 7.56 E4	5.68 E4	5.22 E4	3 Pass
		Cs-137	3.67 - 6.51 E4	4.90 E4	4.80 E4	3 Pass
		Ce-139	0.00 - 0.00 E2	0.00E+00	6.10 E2	3 Pass(1)
		Ce-141	0.76 - 1.35 E3	1.01E+03	1.01 E3	3 Pass
6/28/2004	Q042GWR	Cr-51	3.52 - 6.25 E3	4.70 E3	4.56 E3	3 Pass
		Co-57	1.46 - 2.58 E2	1.94 E2	1.86 E2	3 Pass
		Co-60	0.81 - 1.44 E3	1.08 E3	1.06 E3	3 Pass
		Sr-85	7.47 - 13.25 E2	9.96 E2	9.64 E2	3 Pass
		Y-88	1.33 - 2.37 E3	1.78 E3	1.76 E3	3 Pass
		Cd-109	3.83 - 6.79 E3	5.11 E3	5.43 E3	3 Pass
		Sn-113	6.53 - 11.58 E2	8.71 E2	8.78 E2	3 Pass
		Te-123m	1.79 - 3.17 E2	2.38 E2	2.36 E2	3 Pass
		Cs-137	6.24 - 11.06 E2	8.32 E2	7.96 E2	3 Pass
9/8/2004	Q043GWSL	Cr-51	3.84 - 6.82 E5	5.13 E5	4.96 E5	3 Pass
		Co-57	1.03 - 1.82 E4	1.37 E4	1.39 E4	3 Pass
		Co-60	5.07 - 8.99 E4	6.76 E4	6.45 E4	3 Pass
		Sr-85	6.40 - 11.35 E4	8.53 E4	8.10 E4	3 Pass
		Y-88	1.01 - 1.80 E5	1.35 E5	1.30 E5	3 Pass
		Cd-109	2.64 - 4.69 E5	3.52 E5	3.51 E5	3 Pass
		Sn-113	4.89 - 8.67 E4	6.52 E4	6.31 E4	3 Pass
		Te-123m	1.29 - 2.28 E4	1.71 E4	1.68 E4	3 Pass
		Cs-137	4.21 - 7.46 E4	5.61 E4	5.25 E4	3 Pass

Gamma in Water 3.5 liters, continued

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/l	Reference Value pCi/l	Mean Reported Value pCi/l	Cross Check Status
12/3/2004	Q044GWR	Cr-51	0.97 - 1.72 E5	1.29 E5	1.27 E5	3 Pass
		Co-57	2.32 - 4.12 E3	3.10 E3	3.18 E3	3 Pass
		Co-60	1.18 - 2.09 E4	1.57 E4	1.52 E4	3 Pass
		Sr-85	1.58 - 2.81 E4	2.11 E4	2.01 E4	3 Pass
		Y-88	2.35 - 4.17 E4	3.14 E4	3.07 E4	3 Pass
		Cd-109	5.91 - 10.48 E4	7.88 E4	7.95 E4	3 Pass
		Sn-113	1.12 - 1.98 E4	1.49 E4	1.47 E4	3 Pass
		Te-123m	2.94 - 5.21 E3	3.92 E3	3.83 E3	3 Pass
		Cs-137	0.98 - 1.74 E4	1.31 E4	1.24 E4	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
3/17/2004	Q041GWSL	Cr-51	1.06 - 1.88 E3	1.41 E3	1.55 E3	3 Pass
		Mn-54	2.63 - 4.67 E4	3.51 E4	3.73 E4	3 Pass
		Co-57	0.00 - 0.00 E3	0.00E+00	1.02 E3	3 Pass(1)
		Co-58	7.07 - 12.53 E3	9.42 E3	9.37 E3	3 Pass
		Fe-59	2.01 - 3.56 E3	2.67 E3	2.85 E3	3 Pass
		Co-60	4.86 - 8.62 E4	6.48 E4	6.86 E4	3 Pass
		Zn-65	4.42 - 7.84 E4	5.90 E4	6.30 E4	3 Pass
		Cs-134	4.26 - 7.56 E4	5.68 E4	5.07 E4	3 Pass
		Cs-137	3.67 - 6.51 E4	4.90 E4	4.77 E4	3 Pass
		Ce-139	0.00 - 0.00 E2	0.00E+00	5.81 E2	3 Pass(1)
		Ce-141	0.76 - 1.35 E3	1.01E+03	1.00 E3	3 Pass
6/28/2004	Q042GWR	Cr-51	3.52 - 6.25 E3	4.70 E3	4.52 E3	3 Pass
		Co-57	1.46 - 2.58 E2	1.94 E2	2.00 E2	3 Pass
		Co-60	0.81 - 1.44 E3	1.08 E3	1.06 E3	3 Pass
		Sr-85	7.47 - 13.25 E2	9.96 E2	9.23 E2	3 Pass
		Y-88	1.33 - 2.37 E3	1.78 E3	1.73 E3	3 Pass
		Cd-109	3.83 - 6.79 E3	5.11 E3	5.04 E3	3 Pass
		Sn-113	6.53 - 11.58 E2	8.71 E2	8.15 E2	3 Pass
		Te-123m	1.79 - 3.17 E2	2.38 E2	2.39 E2	3 Pass
		Cs-137	6.24 - 11.06 E2	8.32 E2	7.89 E2	3 Pass
9/8/2004	Q043GWSL	Cr-51	3.84 - 6.82 E5	5.13 E5	4.94 E5	3 Pass
		Co-57	1.03 - 1.82 E4	1.37 E4	1.39 E4	3 Pass
		Co-60	5.07 - 8.99 E4	6.76 E4	6.56 E4	3 Pass
		Sr-85	6.40 - 11.35 E4	8.53 E4	7.93 E4	3 Pass
		Y-88	1.01 - 1.80 E5	1.35 E5	1.31 E5	3 Pass
		Cd-109	2.64 - 4.69 E5	3.52 E5	3.43 E5	3 Pass
		Sn-113	4.89 - 8.67 E4	6.52 E4	6.25 E4	3 Pass
		Te-123m	1.29 - 2.28 E4	1.71 E4	1.67 E4	3 Pass
		Cs-137	4.21 - 7.46 E4	5.61 E4	5.19 E4	3 Pass

Gamma in Water 1.0 liter, continued

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/l	Reference Value pCi/l	Mean Reported Value pCi/l	Cross Check Status
12/3/2004	Q044GWR	Cr-51	0.97 - 1.72 E5	1.29 E5	1.25 E5	3 Pass
		Co-57	2.32 - 4.12 E3	3.10 E3	3.07 E3	3 Pass
		Co-60	1.18 - 2.09 E4	1.57 E4	1.54 E4	3 Pass
		Sr-85	1.58 - 2.81 E4	2.11 E4	1.97 E4	3 Pass
		Y-88	2.35 - 4.17 E4	3.14 E4	3.06 E4	3 Pass
		Cd-109	5.91 - 10.48 E4	7.88 E4	7.72 E4	3 Pass
		Sn-113	1.12 - 1.98 E4	1.49 E4	1.43 E4	3 Pass
		Te-123m	2.94 - 5.21 E3	3.92 E3	3.77 E3	3 Pass
		Cs-137	0.98 - 1.74 E4	1.31 E4	1.21 E4	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
3/17/2004	Q041GWSL	Cr-51	1.06 - 1.88 E3	1.41 E3	1.58 E3	3 Pass
		Mn-54	2.63 - 4.67 E4	3.51 E4	3.77 E4	3 Pass
		Co-57	0.00 - 0.00 E3	0.00E+00	1.01 E3	3 Pass(1)
		Co-58	7.07 - 12.53 E3	9.42 E3	9.35 E3	3 Pass
		Fe-59	2.01 - 3.56 E3	2.67 E3	2.83 E3	3 Pass
		Co-60	4.86 - 8.62 E4	6.48 E4	6.89 E4	3 Pass
		Zn-65	4.42 - 7.84 E4	5.90 E4	6.45 E4	3 Pass
		Cs-134	4.26 - 7.56 E4	5.68 E4	4.87 E4	3 Pass
		Cs-137	3.67 - 6.51 E4	4.90 E4	4.78 E4	3 Pass
		Ce-139	0.00 - 0.00 E2	0.00E+00	5.89 E2	3 Pass(1)
		Ce-141	0.76 - 1.35 E3	1.01E+03	1.05 E3	3 Pass
6/28/2004	Q042GWR	Cr-51	3.52 - 6.25 E3	4.70 E3	4.53 E3	3 Pass
		Co-57	1.46 - 2.58 E2	1.94 E2	1.91 E2	3 Pass
		Co-60	0.81 - 1.44 E3	1.08 E3	1.08 E3	3 Pass
		Sr-85	7.47 - 13.25 E2	9.96 E2	9.42 E2	3 Pass
		Y-88	1.33 - 2.37 E3	1.78 E3	1.76 E3	3 Pass
		Cd-109	3.83 - 6.79 E3	5.11 E3	4.83 E3	3 Pass
		Sn-113	6.53 - 11.58 E2	8.71 E2	8.36 E2	3 Pass
		Te-123m	1.79 - 3.17 E2	2.38 E2	2.51 E2	3 Pass
		Cs-137	6.24 - 11.06 E2	8.32 E2	7.92 E2	3 Pass
9/8/2004	Q043GWSL	Cr-51	3.84 - 6.82 E5	5.13 E5	4.95 E5	3 Pass
		Co-57	1.03 - 1.82 E4	1.37 E4	1.38 E4	3 Pass
		Co-60	5.07 - 8.99 E4	6.76 E4	6.63 E4	3 Pass
		Sr-85	6.40 - 11.35 E4	8.53 E4	8.08 E4	3 Pass
		Y-88	1.01 - 1.80 E5	1.35 E5	1.32 E5	3 Pass
		Cd-109	2.64 - 4.69 E5	3.52 E5	3.48 E5	3 Pass
		Sn-113	4.89 - 8.67 E4	6.52 E4	6.25 E4	3 Pass
		Te-123m	1.29 - 2.28 E4	1.71 E4	1.66 E4	3 Pass
		Cs-137	4.21 - 7.46 E4	5.61 E4	5.32 E4	3 Pass

Gamma in Water 0.5 liter, continued

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/l	Reference Value pCi/l	Mean Reported Value pCi/l	Cross Check Status
12/3/2004	Q044GWR	Cr-51	0.97 - 1.72 E5	1.29 E5	1.22 E5	3 Pass
		Co-57	2.32 - 4.12 E3	3.10 E3	3.09 E3	3 Pass
		Co-60	1.18 - 2.09 E4	1.57 E4	1.53 E4	3 Pass
		Sr-85	1.58 - 2.81 E4	2.11 E4	1.98 E4	3 Pass
		Y-88	2.35 - 4.17 E4	3.14 E4	3.01 E4	3 Pass
		Cd-109	5.91 - 10.48 E4	7.88 E4	7.55 E4	3 Pass
		Sn-113	1.12 - 1.98 E4	1.49 E4	1.42 E4	3 Pass
		Te-123m	2.94 - 5.21 E3	3.92 E3	3.79 E3	3 Pass
		Cs-137	0.98 - 1.74 E4	1.31 E4	1.21 E4	3 Pass

Gamma in Water 0.25 liter

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/l	Reference Value pCi/l	Mean Reported Value pCi/l	Cross Check Status
3/17/2004	Q041GWSL	Cr-51	1.06 - 1.88 E3	1.41 E3	1.52 E3	3 Pass
		Mn-54	2.63 - 4.67 E4	3.51 E4	3.84 E4	3 Pass
		Co-57	0.00 - 0.00 E3	0.00E+00	1.02 E3	3 Pass(1)
		Co-58	7.07 - 12.53 E3	9.42 E3	9.54 E3	3 Pass
		Fe-59	2.01 - 3.56 E3	2.67 E3	2.97 E3	3 Pass
		Co-60	4.86 - 8.62 E4	6.48 E4	7.04 E4	3 Pass
		Zn-65	4.42 - 7.84 E4	5.90 E4	6.54 E4	3 Pass
		Cs-134	4.26 - 7.56 E4	5.68 E4	5.00 E4	3 Pass
		Cs-137	3.67 - 6.51 E4	4.90 E4	4.87 E4	3 Pass
		Ce-139	0.00 - 0.00 E2	0.00E+00	5.85 E2	3 Pass(1)
		Ce-141	0.76 - 1.35 E3	1.01E+03	1.05 E3	3 Pass
6/28/2004	Q042GWR	Cr-51	3.52 - 6.25 E3	4.70 E3	4.45 E3	3 Pass
		Co-57	1.34 - 2.81 E2	1.94 E2	1.73 E2	3 Pass
		Co-60	0.81 - 1.44 E3	1.08 E3	1.07 E3	3 Pass
		Sr-85	7.47 - 13.25 E2	9.96 E2	9.15 E2	3 Pass
		Y-88	1.33 - 2.37 E3	1.78 E3	1.67 E3	3 Pass
		Cd-109	3.58 - 7.30 E3	5.11 E3	4.85 E3	3 Pass
		Sn-113	6.53 - 11.58 E2	8.71 E2	8.40 E2	3 Pass
		Te-123m	1.79 - 3.17 E2	2.38 E2	2.40 E2	3 Pass
		Cs-137	6.24 - 11.06 E2	8.32 E2	7.72 E2	3 Pass
9/8/2004	Q043GWSL	Cr-51	3.84 - 6.82 E5	5.13 E5	5.03 E5	3 Pass
		Co-57	1.03 - 1.82 E4	1.37 E4	1.40 E4	3 Pass
		Co-60	5.07 - 8.99 E4	6.76 E4	6.74 E4	3 Pass
		Sr-85	6.40 - 11.35 E4	8.53 E4	8.18 E4	3 Pass
		Y-88	1.01 - 1.80 E5	1.35 E5	1.33 E5	3 Pass
		Cd-109	2.64 - 4.69 E5	3.52 E5	3.55 E5	3 Pass
		Sn-113	4.89 - 8.67 E4	6.52 E4	6.41 E4	3 Pass
		Te-123m	1.29 - 2.28 E4	1.71 E4	1.71 E4	3 Pass
		Cs-137	4.21 - 7.46 E4	5.61 E4	5.39 E4	3 Pass

Gamma in Water 0.25 liter, continued

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/l	Reference Value pCi/l	Mean Reported Value pCi/l	Cross Check Status
12/3/2004	Q044GWR	Cr-51	0.97 - 1.72 E5	1.29 E5	1.25 E5	3 Pass
		Co-57	2.32 - 4.12 E3	3.10 E3	3.18 E3	3 Pass
		Co-60	1.18 - 2.09 E4	1.57 E4	1.55 E4	3 Pass
		Sr-85	1.58 - 2.81 E4	2.11 E4	1.97 E4	3 Pass
		Y-88	2.35 - 4.17 E4	3.14 E4	3.05 E4	3 Pass
		Cd-109	5.91 - 10.48 E4	7.88 E4	7.88 E4	3 Pass
		Sn-113	1.12 - 1.98 E4	1.49 E4	1.45 E4	3 Pass
		Te-123m	2.94 - 5.21 E3	3.92 E3	3.83 E3	3 Pass
		Cs-137	0.98 - 1.74 E4	1.31 E4	1.21 E4	3 Pass

Gamma in Filter

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi	Reference Value pCi	Mean Reported Value pCi	Cross Check Status
6/15/2004	1066324	Cr-51	0.97 - 1.94 E2	1.37 E2	1.52 E2	3 Pass
		Co-57	2.55 - 7.09 E0	4.25 E0	5.32 E0	3 Pass
		Co-60	1.66 - 3.20 E1	2.30 E1	2.32 E1	3 Pass
		Sr-85	1.82 - 3.22 E1	2.42 E1	2.54 E1	3 Pass
		Y-88	3.07 - 5.45 E1	4.10 E1	4.23 E1	3 Pass
		Cd-109	0.68 - 1.78 E2	1.10 E2	1.32 E2	3 Pass
		Sn-113	1.40 - 2.85 E1	1.99 E1	1.89 E1	3 Pass
		Te-123m	4.08 - 7.23 E0	5.44 E0	5.72 E0	3 Pass
		Cs-137	1.23 - 2.52 E1	1.76 E1	1.72 E1	3 Pass
12/9/2004	E4348-37	Cr-51	1.82 - 3.23 E2	2.43 E2	2.38 E2	3 Pass
		Mn-54	6.53 - 11.57 E1	8.70 E1	9.11 E1	3 Pass
		Co-57	0.00 - 0.00 E0	0.00E+00	4.06 E0	3 Pass[(2)]
		Co-58	7.05 - 12.50 E1	9.40 E1	9.11 E1	3 Pass
		Fe-59	5.85 - 10.37 E1	7.80 E1	8.25 E1	3 Pass
		Co-60	0.84 - 1.49 E2	1.12 E2	1.09 E2	3 Pass
		Zn-65	0.95 - 1.68 E2	1.26 E2	1.23 E2	3 Pass
		Cs-134	0.82 - 1.45 E2	1.09 E2	0.98 E2	3 Pass
		Cs-137	6.08 - 10.77 E1	8.10 E1	7.80 E1	3 Pass
		Ce-141	0.77 - 1.37 E2	1.03 E2	1.00 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
1/2/2004	Q041LIW1	I-131	6.00 - 10.64 E2	8.00 E2	7.94 E2	3 Pass
1/2/2004	Q041LIW2	I-131	6.38 - 11.32 E1	8.51 E1	9.12 E1	3 Pass
1/2/2004	Q041LIW3	I-131	N/A	0.00E+00	0.00E+00	3 Pass

Iodine in Water, continued

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi/l	Reference Value pCi/l	Mean Reported Value pCi/l	Cross Check Status
7/14/2004	Q043LIW1	I-131	7.16 - 12.69 E2	9.54 E2	6.91 E2	3/3 Low[3]
7/14/2004	Q043LIW2	I-131	2.56 - 4.54 E2	3.41 E2	2.53 E2	2/3 Low[4]
7/14/2004	Q043LIW3	I-131	1.61 - 10.04 E0	4.02 E0	2.61 E0	3 Pass
12/2/2004	Q044LIW1	I-131	2.36 - 4.18 E1	3.15 E1	3.02 E1	3 Pass
12/2/2004	Q044LIW2	I-131	0.92 - 1.62 E2	1.22 E2	1.15 E2	3 Pass
12/2/2004	Q044LIW3	I-131	N/A	0.00E+00	0.00E+00	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
6/22/2004	Q042LIM1	Co-58	0.00 - 0.00 E0	0.00E+00	3.47 E0	3/3 High[5]
		I-131	N/A	0.00E+00	0.00E+00	3 Pass
6/22/2004	Q042LIM2	I-131	0.82 - 1.45 E3	1.09 E3	0.91 E3	3 Pass
6/22/2004	Q042LIM3	I-131	1.87 - 3.31 E1	2.49 E1	2.09 E1	3 Pass

Iodine on Cartridge

Reference Date	Sample I.D.	Nuclide	Acceptance Range pCi	Reference Value pCi	Mean Reported Value pCi	Cross Check Status
6/15/2004	1066-32-3	I-131	4.13 - 7.33 E6	5.51 E6	4.91 E6	3 Pass
12/9/2004	E4349-37	I-131	6.64 - 11.77 E1	8.85 E1	10.63 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
3/25/2004	E4056-37	Cs-137	2.07 - 3.67 E2	2.76 E2	2.60 E2	3 Pass
9/16/2004	E4233-37	Cs-137	1.69 - 2.99 E2	2.25 E2	2.34 E2	3 Pass

Beta Smear

Reference Date	Sample I.D.	Nuclide	Acceptance Range dpm	Reference Value dpm	Mean Reported Value dpm	Cross Check Status
5/14/2004	A18024-37	Am-241	N/A	Interference	4.71 E3	3 Pass
		Cs-137	1.01 - 1.80 E4	1.35 E4	1.35 E4	3 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
3/17/2004	Q041TWSL1	H-3	2.70 - 4.79 E4	3.60 E4	3.17 E4	3 Pass
3/17/2004	Q041TWSL2	H-3	N/A	0.00E+00	0.00E+00	3 Pass
6/28/2004	Q042TWR1	H-3	5.24 - 9.29 E2	6.99 E2	7.33 E2	3 Pass
6/28/2004	Q042TWR2	H-3	2.29 - 5.59 E2	3.58 E2	4.12 E2	3 Pass
6/28/2004	Q042TWR3	H-3	N/A	0.00E+00	0.00E+00	3 Pass
9/8/2004	Q043TWSL1	H-3	N/A	0.00E+00	0.00E+00	3 Pass
9/8/2004	Q043TWSL2	H-3	6.18 - 10.96 E4	8.24 E4	7.94 E4	3 Pass
12/3/2004	Q044TWR1	H-3	N/A	0.00E+00	0.00E+00	3 Pass
12/3/2004	Q044TWR2	H-3	4.43 - 8.07 E2	5.98 E2	5.77 E2	3 Pass
12/3/2004	Q044TWR3	H-3	1.52 - 2.70 E3	2.03 E3	2.04 E3	3 Pass

Table 5.0-A Footnote Explanations

(1) Gamma in Water, Sample ID Q041GWSL, Reference Date 3/17/2004: 3.5 L Marinelli, 1.0 L Marinelli, 0.5 L Marinelli, 0.25 L Marinelli

Co-57 and Ce-139 were observed in cross-checks and attributed to a contaminant arriving with the source. The nuclides were determined to be present, but there was no reference activity applicable to the results.

(2) Gamma in Filter, Sample ID E4348-37, Reference Date 12/9/2004

Co-57 was observed in cross-check and attributed to a contaminant arriving with the source. The nuclide was determined to be present, but there was no reference activity applicable to the results.

(3) Iodine in Water, Sample ID Q043LIW1, Reference Date 7/14/2004

Three results for low-level I-131 [364.48 keV] analysis were reported, with all three being below acceptance limit. General Office PIP G-04-00280 was written to record investigative actions.

(4) Iodine in Water, Sample ID Q043LIW2, Reference Date 7/14/2004

Three results for low-level I-131 [364.48 keV] analysis were reported, with two of the three being below acceptance limit. General Office PIP G-04-00280 was written to record investigative actions.

(5) Iodine in Milk, Sample ID Q042LIM1, Reference Date 6/22/2004

Three results for low-level I-131 [364.48 keV] analysis were reported and were within acceptance limits. Co-58 was observed in all three analyses and was attributed to an unintended contaminant. General Office PIP G-04-00248 was written to record investigative actions.

TABLE 5.0-B
2004 ENVIRONMENTAL DOSIMETER CROSS-CHECK RESULTS

Nuclear Technology Services

1st Quarter 2004

TLD Number	Delivered (mrem)	Reported (mrem)	Bias (% diff)	Pass/Fail Criteria	Pass/Fail
101150	90.5	98.5	8.84	<+/-15%	Pass
101147	90.5	96.6	6.74	<+/-15%	Pass
101175	90.5	95.4	5.41	<+/-15%	Pass
101173	90.5	96.0	6.08	<+/-15%	Pass
101374	90.5	95.3	5.30	<+/-15%	Pass
		Average Bias (B)	6.48		
		Standard Deviation (S)	1.44		
		Measure Performance |B|+S	7.92	<15%	Pass

2nd Quarter 2004

TLD Number	Delivered (mrem)	Reported (mrem)	Bias (% diff)	Pass/Fail Criteria	Pass/Fail
100380	65.5	66.6	1.68	<+/-15%	Pass
100215	65.5	66.1	0.92	<+/-15%	Pass
100240	65.5	66.9	2.14	<+/-15%	Pass
100045	65.5	66.9	2.14	<+/-15%	Pass
100040	65.5	63.0	-3.82	<+/-15%	Pass
		Average Bias (B)	0.61		
		Standard Deviation (S)	2.52		
		Measure Performance |B|+S	3.14	<15%	Pass

3rd Quarter 2004

TLD Number	Delivered (mrem)	Reported (mrem)	Bias (% diff)	Pass/Fail Criteria	Pass/Fail
100178	94.0	100.2	6.60	<+/-15%	Pass
100700	94.0	97.8	4.04	<+/-15%	Pass
100821	94.0	99.3	5.64	<+/-15%	Pass
101179	94.0	101.3	7.77	<+/-15%	Pass
101376	94.0	97.5	3.72	<+/-15%	Pass
		Average Bias (B)	5.55		
		Standard Deviation (S)	1.70		
		Measure Performance |B|+S	7.26	<15%	Pass

4th Quarter 2004

TLD Number	Delivered (mrem)	Reported (mrem)	Bias (% diff)	Pass/Fail Criteria	Pass/Fail
101290	71.7	67.8	-5.44	<+/-15%	Pass
101322	71.7	69.9	-2.51	<+/-15%	Pass
101370	71.7	70.7	-1.39	<+/-15%	Pass
101373	71.7	69.5	-3.07	<+/-15%	Pass
101418	71.7	70.1	-2.23	<+/-15%	Pass
		Average Bias (B)	-2.93		
		Standard Deviation (S)	1.53		
		Measure Performance |B|+S	4.46	<15%	Pass

State of North Carolina, Division of Radiation Protection

Spring 2004

TLD Number	Delivered (mrem)	Reported (mrem)	Bias (% diff)	Pass/Fail Criteria	Pass/Fail
101213	54.0	59.9	10.93	<+/-15%	Pass
101145	54.0	57.4	6.30	<+/-15%	Pass
101370	54.0	58.9	9.07	<+/-15%	Pass
101322	54.0	58.7	8.70	<+/-15%	Pass
101290	54.0	56.7	5.00	<+/-15%	Pass
101339	54.0	57.8	7.04	<+/-15%	Pass
101265	54.0	56.7	5.00	<+/-15%	Pass
101418	54.0	57.8	7.04	<+/-15%	Pass
		Average Bias (B)	7.38		
		Standard Deviation (S)	2.07		
		Measure Performance |B|+S	9.45	<15%	Pass

Fall 2004

TLD Number	Delivered (mrem)	Reported (mrem)	Bias (% diff)	Pass/Fail Criteria	Pass/Fail
100958	46.5	51.7	11.15	<+/-15%	Pass
100526	46.5	49.9	7.33	<+/-15%	Pass
100121	46.5	52.6	13.12	<+/-15%	Pass
100109	46.5	49.9	7.25	<+/-15%	Pass
100723	46.5	48.3	3.94	<+/-15%	Pass
100267	46.5	51.4	10.63	<+/-15%	Pass
100660	46.5	50.2	8.03	<+/-15%	Pass
100921	46.5	50.9	9.51	<+/-15%	Pass
		Average Bias (B)	8.87		
		Standard Deviation (S)	2.85		
		Measure Performance |B|+S	11.71	<15%	Pass

Internal Crosscheck (Duke Power)

1st Quarter 2004

TLD Number	Delivered (mrem)	Reported (mrem)	Bias (% diff)	Pass/Fail Criteria	Pass/Fail
100103	26.0	24.1	-7.31	<+/-15%	Pass
100794	26.0	24.6	-5.38	<+/-15%	Pass
100964	26.0	24.4	-6.15	<+/-15%	Pass
100940	26.0	25.4	-2.31	<+/-15%	Pass
100747	26.0	24.6	-5.38	<+/-15%	Pass
101020	26.0	24.3	-6.54	<+/-15%	Pass
100080	26.0	24.5	-5.77	<+/-15%	Pass
100818	26.0	24.8	-4.62	<+/-15%	Pass
101122	26.0	24.1	-7.31	<+/-15%	Pass
100727	26.0	25.5	-1.92	<+/-15%	Pass
		Average Bias (B)	-5.27		
		Standard Deviation (S)	1.87		
		Measure Performance |B|+S	7.14	<15%	Pass

2nd Quarter 2004

TLD Number	Delivered (mrem)	Reported (mrem)	Bias (% diff)	Pass/Fail Criteria	Pass/Fail
100080	19.0	19.0	0.19	<+/-15%	Pass
100727	19.0	19.4	1.94	<+/-15%	Pass
100964	19.0	19.1	0.44	<+/-15%	Pass
101020	19.0	18.6	-1.93	<+/-15%	Pass
100103	19.0	18.8	-0.99	<+/-15%	Pass
100794	19.0	18.7	-1.46	<+/-15%	Pass
101036	19.0	19.6	2.98	<+/-15%	Pass
100176	19.0	19.7	3.62	<+/-15%	Pass
100770	19.0	18.5	-2.42	<+/-15%	Pass
101035	19.0	18.3	-3.44	<+/-15%	Pass
		Average Bias (B)	-0.11		
		Standard Deviation (S)	2.37		
		Measure Performance |B|+S	2.47	<15%	Pass

3rd Quarter 2004

TLD Number	Delivered (mrem)	Reported (mrem)	Bias (% diff)	Pass/Fail Criteria	Pass/Fail
100813	38.0	36.7	-3.43	<+/-15%	Pass
100068	38.0	40.2	5.78	<+/-15%	Pass
100940	38.0	39.4	3.74	<+/-15%	Pass
100953	38.0	38.4	1.18	<+/-15%	Pass
100251	38.0	39.4	3.80	<+/-15%	Pass
100506	38.0	39.8	4.73	<+/-15%	Pass
100654	38.0	40.6	6.74	<+/-15%	Pass
101017	38.0	38.4	1.11	<+/-15%	Pass
100252	38.0	38.5	1.42	<+/-15%	Pass
100150	38.0	39.2	3.22	<+/-15%	Pass
		Average Bias (B)	2.83		
		Standard Deviation (S)	2.91		
		Measure Performance |B|+S	5.74	<15%	Pass

4th Quarter 2004

TLD Number	Delivered (mrem)	Reported (mrem)	Bias (% diff)	Pass/Fail Criteria	Pass/Fail
100079	63.0	61.0	-3.16	<+/-15%	Pass
100106	63.0	62.5	-0.72	<+/-15%	Pass
100148	63.0	62.0	-1.55	<+/-15%	Pass
100268	63.0	60.2	-4.46	<+/-15%	Pass
100110	63.0	61.8	-1.96	<+/-15%	Pass
100830	63.0	60.8	-3.54	<+/-15%	Pass
100801	63.0	61.9	-1.72	<+/-15%	Pass
100826	63.0	62.9	-0.19	<+/-15%	Pass
100439	63.0	64.5	2.34	<+/-15%	Pass
100953	63.0	61.3	-2.75	<+/-15%	Pass
		Average Bias (B)	-1.77		
		Standard Deviation (S)	1.94		
		Measure Performance |B|+S	3.71	<15%	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 - 2003

6.6 Catawba Annual Effluent Report 1985 - 2004

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, Canberra Version 3.5.1, DPC Revision #4.0

6.12 NRC Integrated Inspection Report 03-03

6.13 Duke Power Company EnRad Laboratory Charcoal Cartridge Study, performed 2001

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 changes were made to the sampling procedure during 2004.

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.

Low-level iodine analyses are performed by passing a designated sample aliquot through a pre-weighed amount of ion exchange resin to remove and concentrate any iodine in the aqueous sample (milk). The resin is then dried, mixed thoroughly, and a net resin weight determined before being 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 blank to ensure sample contamination has not occurred.

III. CHANGE OF ANALYSIS PROCEDURES

No analysis procedures were changed during 2004.

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 positioned 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 separate weekly gamma analysis was performed on each charcoal cartridge and air particulate. A weekly gross beta analysis was performed on each filter. The continuous composite samples were collected from the locations listed below.

Location 200	=	Site Boundary (0.63 mi. NNE)
Location 201	=	Site Boundary (0.53 mi. NE)
Location 205	=	Site Boundary (0.23 mi. SW)
Location 212	=	Tega Cay (3.32 mi. E)
Location 217	=	Rock Hill Substation (10.3 mi. SSE)

A.2 DRINKING WATER

Monthly 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 (7.30 mi. SSE)
Location 218	=	Belmont Water Supply (13.5 mi. NNE)

A.3 SURFACE WATER

Monthly 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 (0.45 mi. S)
Location 211	=	Wylie Dam (4.06 mi. ESE)
Location 215	=	River Pointe - Hwy 49 (4.21 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 (0.64 mi. SW)
Location 254	=	Residence (0.82 mi. N)

A.5 MILK

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

Location 221	=	Dairy (14.5 mi. NW)

A.6 BROADLEAF VEGETATION

Monthly samples were collected 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 (0.63 mi. NNE)
Location 201	=	Site Boundary (0.53 mi. NE)
Location 217	=	Rock Hill Substation (10.3 mi. SSE)
Location 222	=	Site Boundary (0.70 mi. N)
Location 226	=	Site Boundary (0.48 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	=	Irrigated Gardens (1.90 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 (0.45 mi. S)
Location 216	=	Hwy 49 Bridge (4.19 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 (0.45 mi. S)
Location 210	=	Ebenezer Access (2.31 mi. SE)
Location 215	=	River Pointe - Hwy 49 (4.21 mi. NNE)

A.10 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-B. 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.11 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 Garden greater than 50 square meters or 500 square feet

* The Nearest Milk-giving Animal (cow, goat, etc.)

The census was conducted during the growing season on 7/12 and 7/14/2004. Results are shown in Table 3.11. No changes were made to the sampling procedures during 2004 as a result of the 2004 census.

V. GLOBAL POSITIONING SYSTEM (GPS) ANALYSIS

The Catawba site centerline used for GPS measurements was referenced from the Catawba Nuclear Station Updated Final Safety Analysis Report (UFSAR), section 2.1.1.1, Specification of Location. Waypoint coordinates used for CNS GPS measurements were latitude 35°-3'-5"N and longitude 81°-4'-10"W. Maps and tables were generated using North American Datum (NAD) 27. Data normally reflect accuracy to within 2 to 5 meters from point of measurement. All GPS field measurements were taken as close as possible to the item of interest. Distances for the locations are displayed using three significant figures.

APPENDIX B

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

SUMMARY OF RESULTS

2004

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station **Docket No. 50-413,414**

Location: York County, South Carolina **Report Period: 01-JAN-2004 to 31-DEC-2004**

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 Location Code	 Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Air Particulate (pCi/m3)							217 (10.3 mi SSE)	
	BETA	260	1.00E-02	1.54E-2 (208/208)	205	1.65E-2 (52/52)	1.49E-2 (52/52)	0
				4.09E-3 - 2.64E-2	(0.23 mi SW)	9.02E-3 - 2.53E-2	5.30E-3 - 2.39E-2	
	CS-134	260	5.00E-02	0.00 (0/208)		0.00 (0/52)	0.00 (0/52)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137	260	6.00E-02	0.00 (0/208)		0.00 (0/52)	0.00 (0/52)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	I-131	260	7.00E-02	0.00 (0/208)		0.00 (0/52)	0.00 (0/52)	0
				0.00 - 0.00		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-2004 to 31-DEC-2004**

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 Location Code	 Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Air Radioiodine (pCi/m3)						217 (10.3 mi SSE)	
CS-134	260	5.00E-02	0.00 (0/208)		0.00 (0/52)	0.00 (0/52)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
CS-137	260	6.00E-02	0.00 (0/208)		0.00 (0/52)	0.00 (0/52)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
I-131	260	7.00E-02	0.00 (0/208)		0.00 (0/52)	0.00 (0/52)	0
			0.00 - 0.00		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-2004 to 31-DEC-2004**

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 Location Code	 Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Drinking Water (pCi/liter)						218 (13.5 mi NNE)	
	BALA-140 26	15	0.00 (0/13)		0.00 (0/14)	0.00 (0/13)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	BETA 26	4	1.88 (13/13)	214	1.88 (13/13)	1.69 (13/13)	0
			1.15 - 2.72	(7.30 mi SSE)	1.15 - 2.72	1.10 - 2.33	
	CO-58 26	15	0.00 (0/13)		0.00 (0/14)	0.00 (0/13)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CO-60 26	15	0.00 (0/13)		0.00 (0/14)	0.00 (0/13)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-134 26	15	0.00 (0/13)		0.00 (0/14)	0.00 (0/13)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137 26	18	0.00 (0/13)		0.00 (0/14)	0.00 (0/13)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	FE-59 26	30	0.00 (0/13)		0.00 (0/14)	0.00 (0/13)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	H-3 8	2000	547 (4/4)	214	547 (4/4)	254 (4/4)	0
			310 - 867	(7.30 mi SSE)	310 - 867	193 - 316	
	I-131 26	15	0.00 (0/13)		0.00 (0/14)	0.00 (0/13)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	MN-54 26	15	0.00 (0/13)		0.00 (0/14)	0.00 (0/13)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	NB-95 26	15	0.00 (0/13)		0.00 (0/14)	0.00 (0/13)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	ZN-65 26	30	0.00 (0/13)		0.00 (0/14)	0.00 (0/13)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	ZR-95 26	15	0.00 (0/13)		0.00 (0/14)	0.00 (0/13)	0
			0.00 - 0.00		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-2004 to 31-DEC-2004**

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 Location Code	 Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Surface Water (pCi/liter)							215 (4.21 mi NNE)	
	BALA-140	39	15	0.00 (0/26)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CO-58	39	15	0.00 (0/26)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CO-60	39	15	0.00 (0/26)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-134	39	15	0.00 (0/26)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137	39	18	0.00 (0/26)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	FE-59	39	30	0.00 (0/26)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	H-3	12	2000	4985 (8/8)	208	9430 (4/4)	260 (3/4)	0
				404 - 14200	(0.45 mi S)	3870 - 14200	176 - 310	
	I-131	39	15	0.00 (0/26)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	MN-54	39	15	0.00 (0/26)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	NB-95	39	15	0.00 (0/26)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	ZN-65	39	30	0.00 (0/26)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	ZR-95	39	15	0.00 (0/26)		0.00 (0/13)	0.00 (0/13)	0
				0.00 - 0.00		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-2004 to 31-DEC-2004**

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 Location Code	 Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Ground Water (pCi/liter)						NO CONTROL LOCATION	
	BALA-140 8	15	0.00 (0/8)		0.00 (0/8)	0.00 (0/0)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CO-58 8	15	0.00 (0/8)		0.00 (0/8)	0.00 (0/0)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CO-60 8	15	0.00 (0/8)		0.00 (0/8)	0.00 (0/0)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-134 8	15	0.00 (0/8)		0.00 (0/8)	0.00 (0/0)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137 8	18	0.00 (0/8)		0.00 (0/8)	0.00 (0/0)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	FE-59 8	30	0.00 (0/8)		0.00 (0/8)	0.00 (0/0)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	H-3 8	2000	0.00 (0/8)		0.00 (0/8)	0.00 (0/0)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	I-131 8	15	0.00 (0/8)		0.00 (0/8)	0.00 (0/0)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	MN-54 8	15	0.00 (0/8)		0.00 (0/8)	0.00 (0/0)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	NB-95 8	15	0.00 (0/8)		0.00 (0/8)	0.00 (0/0)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	ZN-65 8	30	0.00 (0/8)		0.00 (0/8)	0.00 (0/0)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	ZR-95 8	15	0.00 (0/8)		0.00 (0/8)	0.00 (0/0)	0
			0.00 - 0.00		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-2004 to 31-DEC-2004**

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 Location Code	 Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Milk (pCi/liter)			NO INDICATOR LOCATION			221 (14.5 mi NW)	
	BALA-140 26	15	0.00 (0/0)		0.00 (0/0)	0.00 (0/26)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-134 26	15	0.00 (0/0)		0.00 (0/0)	0.00 (0/26)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137 26	18	0.00 (0/0)		0.00 (0/0)	0.00 (0/26)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	I-131 26	15	0.00 (0/0)		0.00 (0/0)	0.00 (0/26)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	LLI-131 26	1	0.00 (0/0)		0.00 (0/0)	0.00 (0/26)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	

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Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
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Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station **Docket No. 50-413,414**

Location: York County, South Carolina **Report Period: 01-JAN-2004 to 31-DEC-2004**

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 Location Code	 Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Broadleaf Vegetation (pCi/kg-wet)							217 (10.3 mi SSE)	
	CS-134	60	60	0.00 (0/48)		0.00 (0/12)	0.00 (0/12)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137	60	80	39.8 (2/48)	201	54.5 (1/12)	0.00 (0/12)	0
				25.2 - 54.5	(0.53 mi NE)	54.5 - 54.5	0.00 - 0.00	
	I-131	60	60	0.00 (0/48)		0.00 (0/12)	0.00 (0/12)	0
				0.00 - 0.00		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-2004 to 31-DEC-2004**

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 Location Code	 Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Food Products (pCi/kg-wet)							NO CONTROL LOCATION	
	CS-134	6	60	0.00 (0/6)		0.00 (0/6)	0.00 (0/0)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137	6	80	0.00 (0/6)		0.00 (0/6)	0.00 (0/0)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	I-131	6	60	0.00 (0/6)		0.00 (0/6)	0.00 (0/0)	0
				0.00 - 0.00		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

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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 Location Code	 Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Fish (pCi/kg-wet)							216 (4.19 mi NNE)	
	CO-58	12	130	18.1 (1/6)	208	18.1 (1/6)	0.00 (0/6)	0
				18.1 - 18.1	(0.45 mi S)	18.1 - 18.1	0.00 - 0.00	
	CO-60	12	130	0.00 (0/6)		0.00 - 0.00	0.00 (0/6)	0
				0.00 - 0.00		0.00 (0/6)	0.00 - 0.00	
	CS-134	12	130	0.00 (0/6)		0.00 (0/6)	0.00 (0/6)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137	12	150	0.00 (0/6)		0.00 - 0.00	0.00 (0/6)	0
				0.00 - 0.00		0.00 (0/6)	0.00 - 0.00	
	FE-59	12	260	0.00 (0/6)		0.00 (0/6)	0.00 (0/6)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	MN-54	12	130	49.2 (1/6)	208	49.2 (1/6)	0.00 (0/6)	0
				49.2 - 49.2	(0.45 mi S)	49.2 - 49.2	0.00 - 0.00	
	ZN-65	12	260	0.00 (0/6)		0.00 (0/6)	0.00 (0/6)	0
				0.00 - 0.00		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-2004 to 31-DEC-2004**

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 Location Code	 Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Shoreline Sediment (pCi/kg-dry)							215 (4.21 mi NNE)	
	MN-54	6	0	66.0 (2/4)	208-1S	66.0 (2/2)	0.00 (0/2)	
				43.5 - 88.4	(0.45 mi S)	43.5 - 88.4	0.00 - 0.00	
	CO-58	6	0	267 (2/4)	208-1S	267 (2/2)	0.00 (0/2)	0
				131 - 403	(0.45 mi S)	131 - 403	0.00 - 0.00	
	CO-60	6	0	383 (2/4)	208-1S	383 (2/2)	0.00 (0/2)	0
				338 - 428	(0.45 mi S)	338 - 428	0.00 - 0.00	
	CS-134	6	150	0.00 (0/4)		0.00 (0/2)	0.00 (0/2)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137	6	180	37.9 (1/4)	208-1S	37.9 (1/2)	0.00 (0/2)	0
				37.9 - 37.9	(0.45 mi S)	37.9 - 37.9	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
If LLD is equal to 0.00, then the LLD is not required by Selected Licensee Commitments

Environmental Radiological Monitoring Program Summary

Facility: Catawba Nuclear Station **Docket No. 50-413,414**

Location: York County, South Carolina **Report Period: 01-JAN-2004 to 31-DEC-2004**

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 Location Code	 Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Direct Radiation TLD (mR/standard quarter)						217 (10.3 mi SSE) 247 (7.33 mi ESE) 251 (9.72 mi WNW)	
	157	0.00E+00	18.7 (145/145) 10.7 - 27.8	235 (4.07 mi ESE)	24.9 (4/4) 20.9 - 27.6	13.9 (12/12) 10.4 - 19.9	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

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	CN	Construction

C.1 SAMPLING DEVIATIONS

Air Particulate and Air Radioiodines

Location	Scheduled Collection Dates	Actual Collection Dates	Reason Code	Corrective Action
217	1/20-1/27/2004	1/20-1/22/2004	BF	The two air samplers at this site were found inoperative at time of collection due to blown fuses in both air samplers. The cause of the blown fuses in both air samplers could not be determined. The fuses were determined to have blown at approximately 1/22/2004 00:55. The samplers operated for about 38.4 hours. Fuses were replaced in both air samplers and air monitoring equipment was returned to normal operation.

Surface Water

Location	Scheduled Collection Dates	Actual Collection Dates	Reason Code	Corrective Action
208	9/28-10/26/2004	9/28-10/26/2004	PS	A loss of water flow to the sample house was observed during the 10/26/2004 collection. Sufficient sample volume was available at time of collection for required analyses and detection limits. Catawba work request #98328800 and PIP C-04-05820 were written for repair and problem documentation. Temporary ISCO sampling equipment was placed into operation on the site pier until normal sampling was resumed.

C.2 UNAVAILABLE ANALYSES

TLD

Location	Scheduled Collection Dates	Reason Code	Corrective Action
231	12/17/2003 - 3/17/2004	VN	TLD missing. 2nd quarter 2004 TLD placed in field.
234	9/15/2004 - 12/15/2004	VN	TLD missing. 1st quarter 2005 TLD placed in field.
246	9/15/2004 - 12/15/2004	VN	TLD missing. 1st quarter 2005 TLD placed in field.

APPENDIX D

ANALYTICAL DEVIATIONS

No Analytical deviations were incurred for the
2004 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 2004. 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.