Duke Energy

W. R. McCollum, Jr.
Vice President

Duke Energy Corporation
Oconee Nuclear Station
7800 Rochester Highway
Seneca, SC 29672
(864) 885-3107 OFFICE
(864) 885-3564 FAX

May 4, 2000

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

Subject: Oconee Nuclear Site
Docket Nos. 50-269, 50-270 and 50-287
Annual Radiological Environmental Operating Report

Dear Sir:

Pursuant to Oconee Nuclear Station Technical Specification 5.6.2, please find enclosed the Oconee Nuclear Site Annual Radiological Environmental Operating Report for 1999.

Very truly yours,

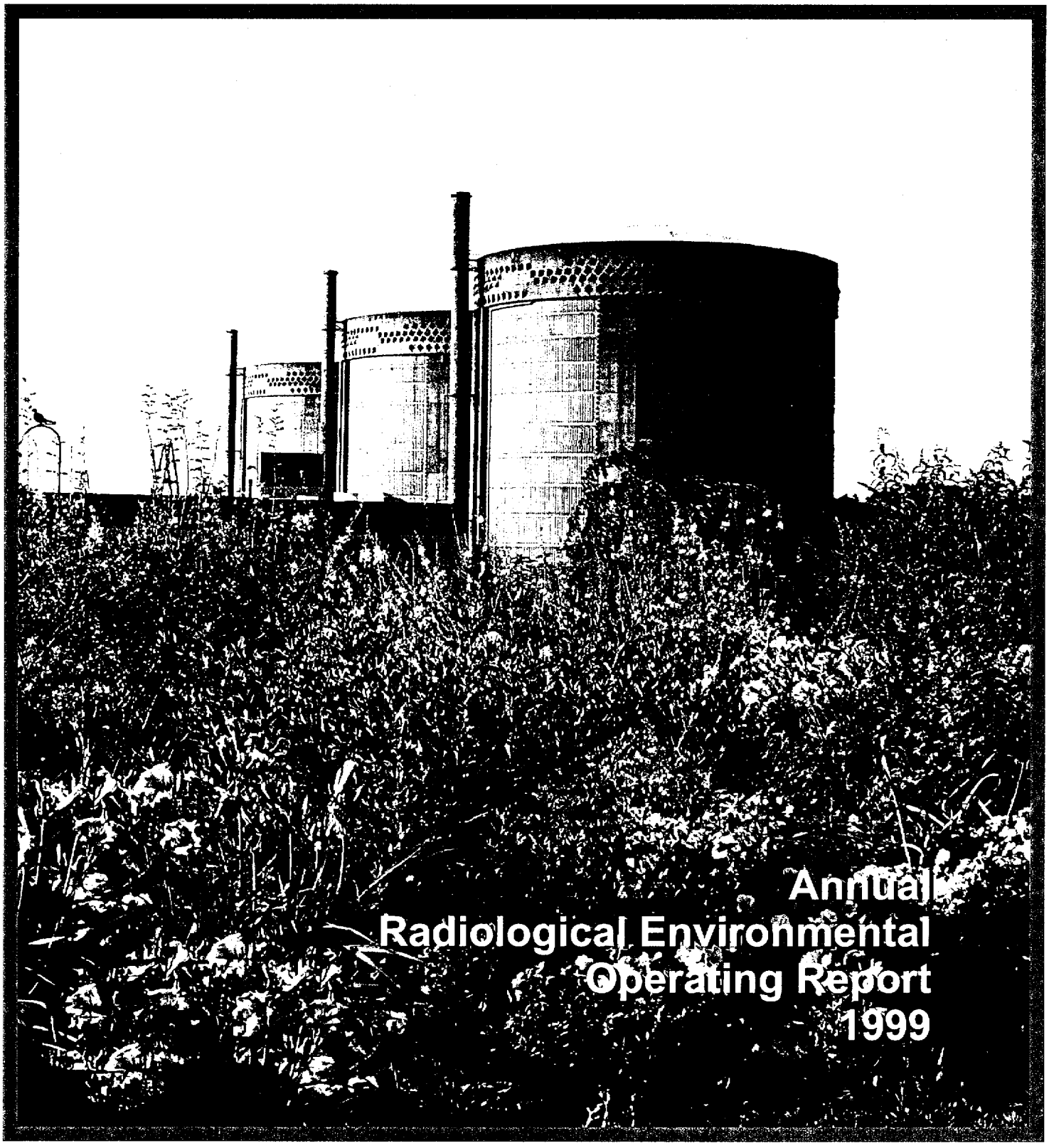
W. R. McCollum, Jr.
Site Vice President
Oconee Nuclear Station

Attachment

C001

Duke Power SM
A Duke Energy Company

Oconee Nuclear Station
Units 1, 2 and 3



Duke Energy SM

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

DUKE POWER COMPANY
OCONEE NUCLEAR STATION
Units 1, 2, and 3

1999

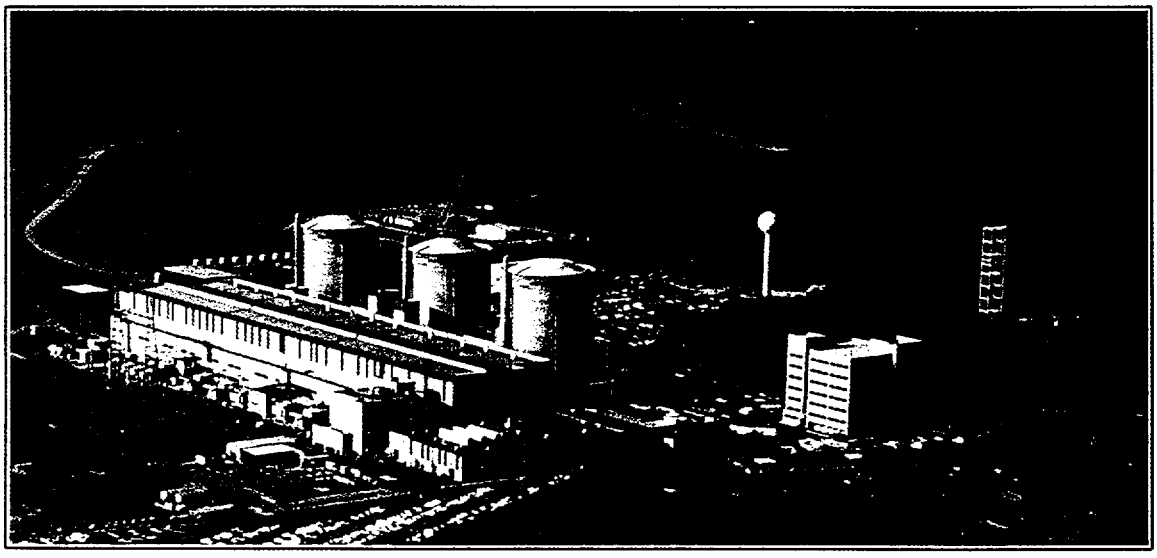


TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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

BW	BiWeekly
C	Control
CL	Critical Level
DEHNR	Department of Environmental Health and Natural Resources
DHEC	Department of Health and Environmental Control
EPA	Environmental Protection Agency
GI-LLI	Gastrointestinal – Lower Large Intestine
LLD	Lower Limit of Detection
M	Monthly
MDA	Minimum Detectable Activity
mrem	Millirem
NIST	National Institute of Standards and Technology
NRC	Nuclear Regulatory Commission
ODCM	Offsite Dose Calculation Manual
pCi/kg	picocurie per kilogram
pCi/l	picocurie per liter
pCi/m3	picocurie per cubic meter
Q	Quarterly
REMP	Radiological Environmental Monitoring Program
SA	Semiannually
SLCs	Selected Licensee Commitments
SM	Semimonthly
TECH SPECs	Technical Specifications
TLD	Thermoluminescent Dosimeter
µCi/ml	microcurie per milliliter
UFSAR	Updated Final Safety Analysis Report
W	Weekly

1.0 EXECUTIVE SUMMARY

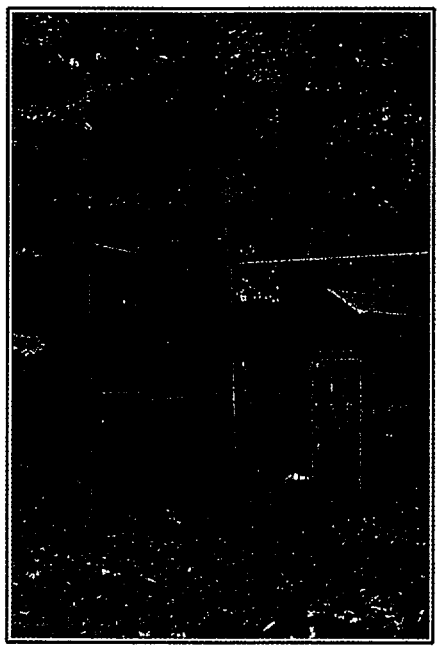
This Annual Radiological Environmental Operating Report describes the Oconee Nuclear Station Radiological Environmental Monitoring Program (REMP), and the program results for the calendar year 1999.

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

Sampling activities were conducted as prescribed by Selected Licensee Commitments (SLC's). Required analyses were performed and detection capabilities were met for all collected samples as required by SLC's. One-thousand fifty samples were analyzed comprising 1206 test results in order to compile data for the 1999 report. Based on the annual land use census, the current number of sampling sites for Oconee Nuclear Station is sufficient.

Concentrations observed in the environment in 1999 for station related radionuclides were within the ranges of concentrations observed in the past. Inspection of data showed that radioactivity concentrations in surface water, shoreline sediment, and fish are higher than the activities reported for samples collected prior to the operation of the station. All positively identified measurements were within limits as specified in SLC's.

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 7.74E-01 mrem for 1999. It is therefore concluded that station operations has had no significant radiological impact on the health and safety of the public or the environment.



Air Sampling at
Oconee Nuclear Station

2.0 INTRODUCTION

2.1 SITE DESCRIPTION AND SAMPLE LOCATIONS

Oconee Nuclear Station (ONS) is located in Oconee County, South Carolina, approximately 8 miles northeast of Seneca, South Carolina, on the shore of Lake Keowee. This lake was formed by damming the Keowee and Little Rivers in that location. Immediately to the south is the U.S. Government Hartwell Project. The Keowee Hydroelectric Plant near the station joins Lake Keowee and the upper reaches of Lake Hartwell. To the north, the Jocassee Hydroelectric Plant joins Lake Jocassee and Lake Keowee. Jocassee is a pumped storage plant.

ONS consists of three pressurized water reactors. Each unit has an output of 866 megawatts net. Unit 1 began commercial operation 7/15/1973. Unit 2 began commercial operation 9/09/1974, and Unit 3 on 12/16/1974. An independent spent fuel storage installation is also located at the site.

Site specific locations for the Radiological Environmental Monitoring Program are defined in the Duke Power Company Offsite Dose Calculation Manual (ODCM). Figures 2.1-1 and 2.1-2 are maps depicting the Thermoluminescent Dosimeter (TLD) monitoring locations and the sampling locations. The samples obtained from the locations include Airborne Radioiodine and Particulates, Drinking Water, Surface Water, Milk, Broadleaf Vegetation, Shoreline Sediment and Fish. Table 2.1-A lists the specific samples required for each location. Table 2.1-B lists the locations of all the TLDs.

2.2 SCOPE AND REQUIREMENTS OF THE REMP

An environmental monitoring program has been in effect at Oconee Nuclear Station since 1969, four years prior to operation of Unit 1 in 1973. 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 Oconee 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 radioactivity 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 Radiological Environmental Monitoring Program 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 3.9.

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 Radiological Environmental Monitoring Program. The following equation was used to estimate the mean (reference 6.8):

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

Where:

$\bar{x}$ = estimate of the mean,
i = individual sample,
N = total number of samples with a net activity (or concentration),
x_i = net activity (or concentration) for sample i.

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

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

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

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

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

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

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

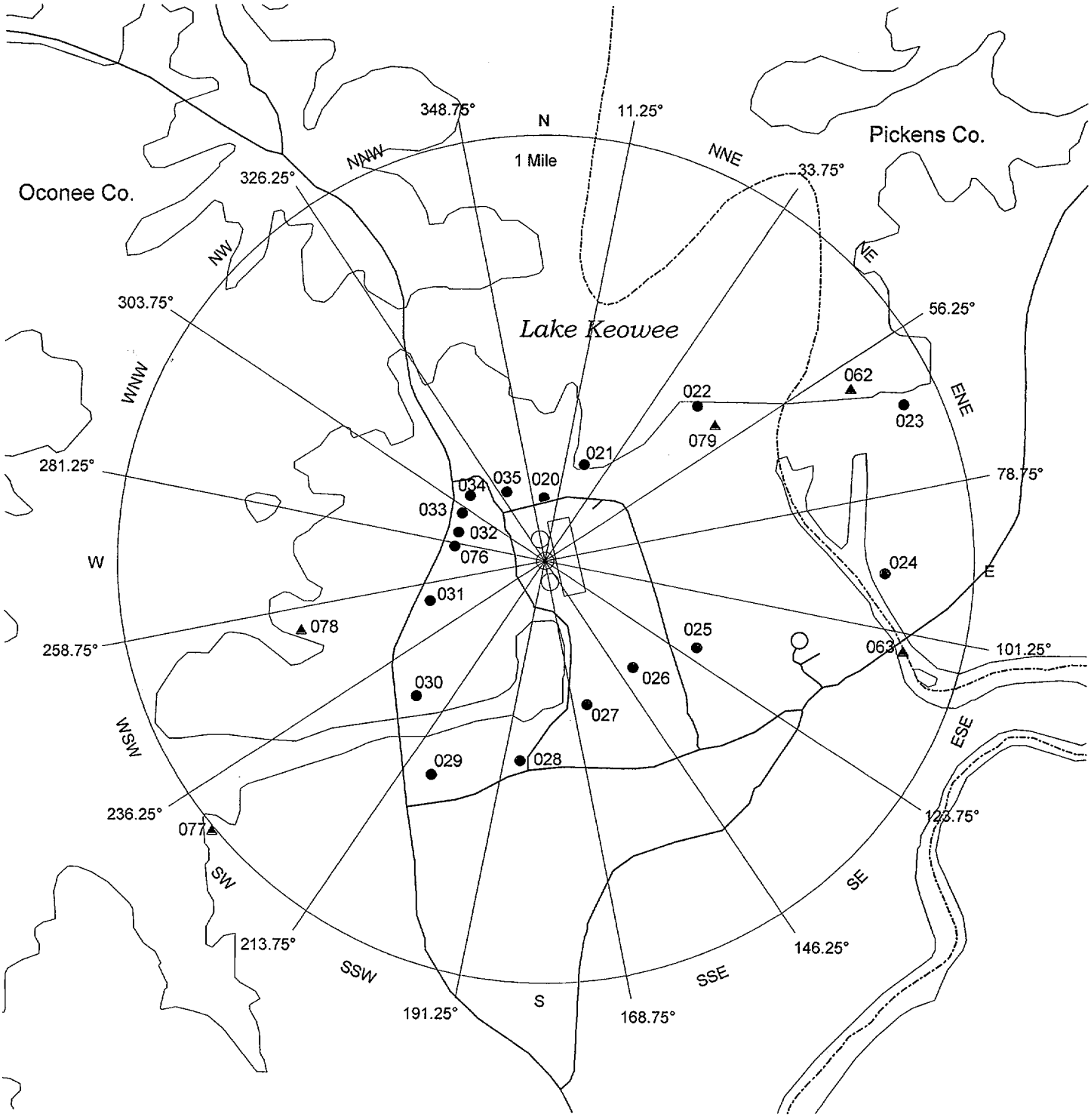
2.3.3 TREND IDENTIFICATION

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

Substantial increases or decreases in the amount of a particular radionuclide's release from the nuclear plant will greatly affect the resulting environmental levels; therefore, a knowledge of the release of a radionuclide from the nuclear plant is necessary to completely interpret the trends, or lack of trends, determined from the environmental data. Some 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.

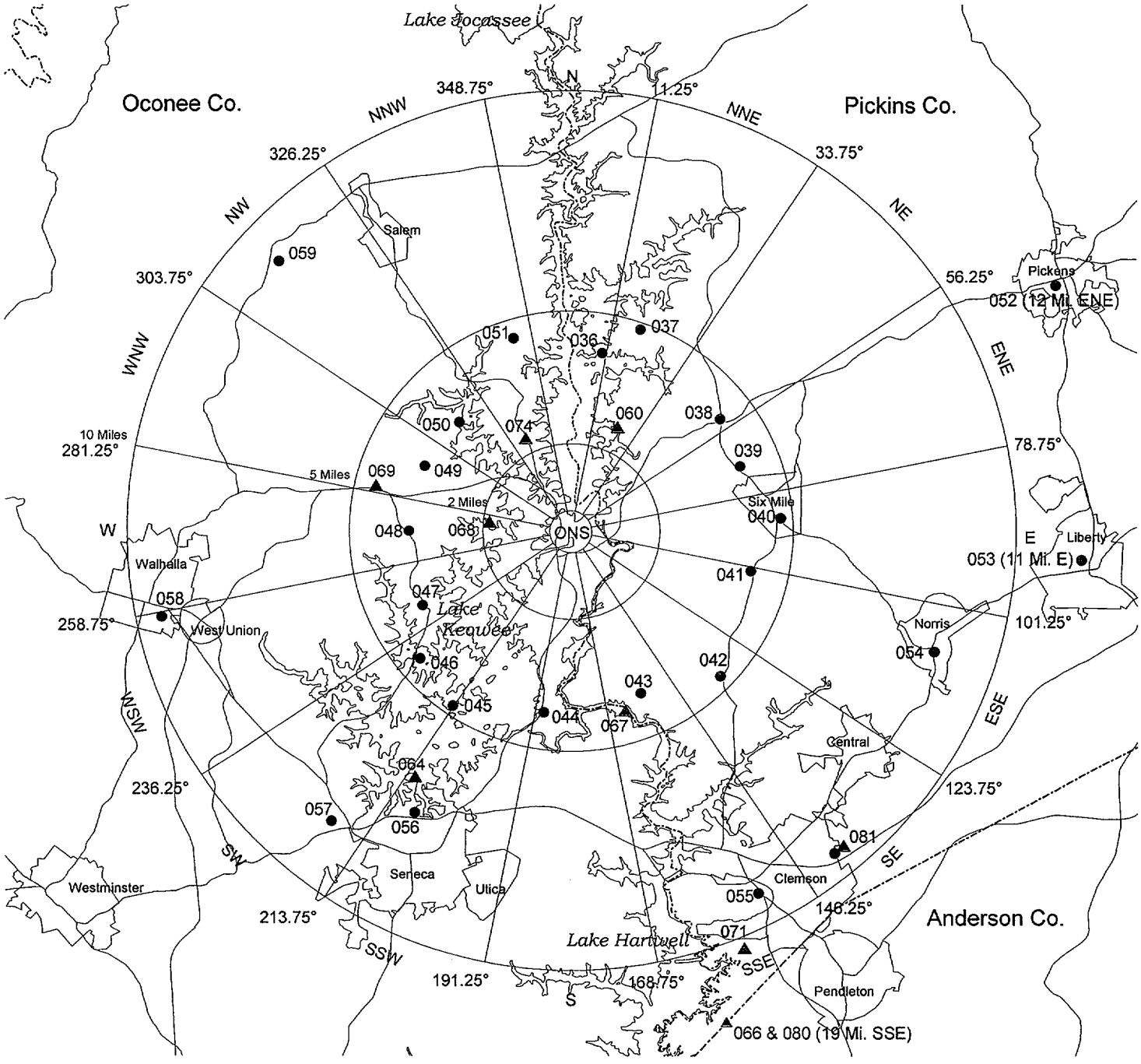
Oconee Nuclear Station
Figure 2.1-1
Sampling Locations Map (Site Boundary)



● TLD Locations

▲ All Other Locations

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



● TLD Locations

▲ All Other Locations

TABLE 2.1-A

OCONEE RADIOLOGICAL MONITORING PROGRAM
SAMPLING LOCATIONS

Table 2.1-A Codes			
W	Weekly	SM	Semimonthly
BW	BiWeekly	Q	Quarterly
M	Monthly	SA	Semiannually
C	Control		

Site #	Location Description	Air Rad. & Particulate	Surface Water	Drinking Water	Shoreline Sediment	Fish	Milk	Broadleaf Vegetation
060 *	Greenville Water Intake Road (2.6 mi NNE)	W		M		SA		M
062 C	Lake Keowee Hydro Intake (0.8 mi ENE)		M					
063	Lake Hartwell Hwy 183 Bridge (0.8 mi ESE) [000.7]		M		SA	SA		
064 C	Seneca (6.7 mi SSW) [004.1]			M				
066	Anderson (19.0 mi SSE) [012]			M				
067	Lawrence Ramsey Bridge Hwy 27 (4.2 mi SSE) [005.2]				SA	SA		
068 C	High Falls County Park (2.0 mi W)				SA			
069	Orr Dairy (4.5 mi WNW) [002.1]						SM	
071	Clemson Dairy (10.3 mi SSE) [006.3]						SM	
081 C	Clemson Operations Center (9.8 mi SE)	W						M
074	Keowee Key Resort (2.3 mi NNW)	W						
077	Skimmer Wall (1.0 mi SW)	W						M
078	Recreation Site (0.6 mi WSW)	W						
079	Keowee Dam (0.5 mi NE)	W						M
080 C	Martin Dairy (19.0 mi SSE)						SM	

* Control for Fish Only
C = Control
[ ] Location Numbers prior to 1984

TABLE 2.1-B

OCONEE RADIOLOCICAL MONITORING PROGRAM
SAMPLING LOCATIONS

(TLD SITES)

Site #	Location Description	Distance	Sector	Site #	Location Description	Distance	Sector
020	SITE BOUNDARY	0.1 miles	N	040	MICROWAVE TOWER, SIX MILE	4.5 miles	E
021	SITE BOUNDARY	0.3 miles	NNE	041	JCT HWY 101 & 133	4.0 miles	ESE
022	SITE BOUNDARY	0.5 miles	NE	042	LAWRENCE CHAPEL CHURCH, HWY 133	5.0 miles	SE
023	SITE BOUNDARY	0.9 miles	ENE	043	HWY 291 AT ISSAQUEENA PARK ENTRANCE	4.0 miles	SSE
024	SITE BOUNDARY	0.8 miles	E	044	HWY 130 AT LITTLE RIVER DAM	4.0 miles	S
025	SITE BOUNDARY	0.4 miles	ESE	045	TERMINUS OF HWY 588 AT CROOKED CREEK	5.0 miles	SSW
026	SITE BOUNDARY	0.3 miles	SE	046	HWY 188 AT CROOKED CREEK BRIDGE	4.5 miles	SW
027	SITE BOUNDARY	0.4 miles	SSE	047	NEW HOPE CHURCH, HWY 188	4.0 miles	WSW
028	SITE BOUNDARY	0.5 miles	S	048	JCT HWY 175 & 188	4.0 miles	W
029	SITE BOUNDARY	0.6 miles	SSW	049	JCT HWY 201 & 92	4.0 miles	WNW
030	SITE BOUNDARY	0.4 miles	SW	050	STAMP CREEK LANDING - END OF HWY 92	4.0 miles	NW
031	SITE BOUNDARY	0.3 miles	WSW	051	HWY 128, 1 MILE N OF HWY 130	4.5 miles	NNW
076	SITE BOUNDARY	0.2 miles	W	052 SI	DPC BRANCH OFFICE SITE - PICKENS	12.0 miles	ENE
032	SITE BOUNDARY	0.2 miles	WNW	053 SI	DPC BRANCH OFFICE SITE – LIBERTY	11.0 miles	E
033	SITE BOUNDARY	0.2 miles	WNW	054 SI	POST OFFICE - HWY 93 NORRIS	9.5 miles	ESE
034	SITE BOUNDARY	0.2 miles	NW	055 SI	CLEMSON METEOROLOGY PLOT	9.5 miles	SSE
035	SITE BOUNDARY	0.2 miles	NNW	056 SI	WATER TOWER - SENECA	8.4 miles	SSW
036	MILE CREEK LANDING	4.0 miles	N	057 SI	OCONEE MEMORIAL HOSPITAL	9.0 miles	SW
037	KEOWEE CHURCH, HWY 327	4.5 miles	NNE	058 C	BRANCH RD SUBSTATION WALHALLA, CONTROL	9.4 miles	WSW
038	DURHAM CONVENIENCE MART, JCT HWY 183 & 133	4.0 miles	NE	059 SI	TAMASSEE DAR SCHOOL	9.2 miles	NW
039	HWY 133, 1 MILE EAST OF JCT HWY 183 & 133	4.0 miles	ENE	081 C	CLEMSON OPERATIONS CENTER	9.8 miles	SE

C = Control
SI = Special 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)	Broadleaf Vegetation (pCi/kg-wet)
H-3	20,000[(a)]				
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[(b)]	1		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) *For drinking water samples only. This is 40CFR Part 141 value.*
(b) *If low-level I-131 analyses are performed.*

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	
	Quarterly Composite	X				
Direct Radiation	Quarterly					X
Surface Water	Monthly	X				
	Quarterly Composite		X			
Drinking Water	Monthly	X		X	X	
	Quarterly Composite		X			
Shoreline Sediment	Semiannually	X				
Milk	Semimonthly	X		X		
Fish	Semiannualy	X				
Broadleaf Vegetation	Monthly	X				

TABLE 2.2-C

MAXIMUM VALUES FOR THE LOWER LIMITS OF DETECTION

Analysis	Water (pCi/liter)	Air Particulates or Gases (pCi/m^3)	Fish (pCi/kg-wet)	Milk (pCi/liter)	Broadleaf Vegetation (pCi/kg-wet)	Sediment (pCi/kg-dry)
Gross Beta	4					
H-3	2000					
Mn-54	15		130			
Fe-59	30		260			
Co-58, 60	15		130			
Zn-65	30		260			
Zr-95	30					
Nb-95	15					
I-131	15[(a)]	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) *LLD for low-level I-131 analyses is 1 pCi/liter*

3.0 INTERPRETATION OF RESULTS

Review of 1999 REMP analysis results was performed to identify changes in environmental levels as a result of station operations. The review is summarized in this section. Data from 1999 was compared to preoperational and historical data. Sample data for some media is not directly comparable to preoperational and earlier operational sample results because of either significant changes in the analysis methods or changes in the reporting of the results.

Evaluation for significant trends was performed for the radionuclides that have required LLDs listed in Selected Licensee Commitment 16.11-6. These radionuclides are collectively referred to as "Selected Licensee Commitments radionuclides" and 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. Drinking water gross beta results are routinely trended. Trending of air particulate gross beta results was initiated in 1996 when the analysis was resumed. Trending is also performed for other radionuclides that are detected and could have been the result of station effluents. Only Selected Licensee Commitment radionuclides were detected in 1999.

Trending was performed by comparing annual mean concentrations of any effluent related detected radionuclide to historical results. Factors evaluated include the frequency of detection and the concentration in terms of the percent of the radionuclide's NRC reporting level (Table 2.2-A). All maximum percent of reporting level values were well below the 100% action level. The highest value reached during 1999 was 9.05% for Cs-137 in a fish sample collected at the discharge Location 063.

Changes in sample location, analytical technique, and presentation of results must be considered when reviewing for trends. Calculation of the annual mean concentrations has been performed differently over the history of the REMP. During 1979-1986, all net results (sample minus background), positive and negative, were included in the calculation of the mean. Only positive net activity results were used to calculate the mean for the other years. A change in gamma spectroscopy analysis systems in 1987 ended a period when many measurements yielded detectable low-level activity for both indicator and control location samples. It is thought that the method the previous system used to estimate net activity may have been vulnerable to false-positive results.

Data presented in Sections 3.1 - 3.8 support the conclusion that there were no significant increases in radionuclides in the environment around ONS due to station operations in 1999. Similarly, there was no significant increase in ambient background radiation levels in the surrounding areas.

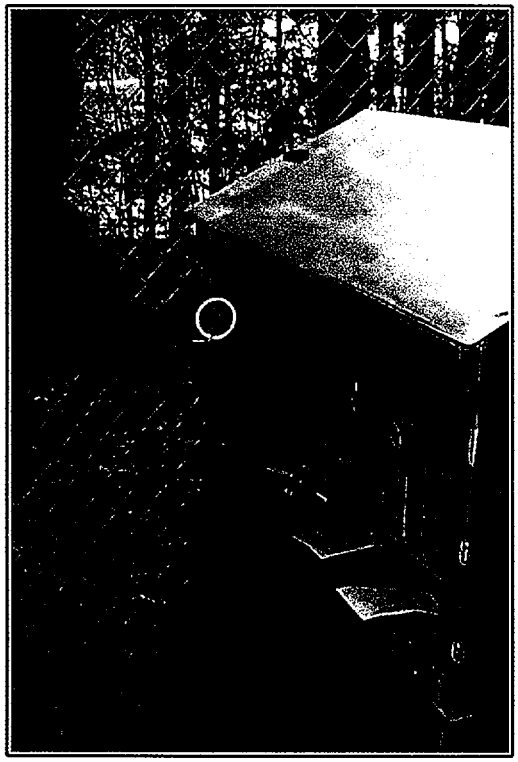
3.1 AIRBORNE RADIOIODINE AND PARTICULATES

In 1999, 312 radioiodine and particulate samples were analyzed, 260 from five indicator locations and 52 from the control location. Radioiodine samples were analyzed by gamma spectroscopy. Particulate samples were analyzed for gross beta. Gamma analysis was performed on 24 composites of particulate samples, 20 at the five indicator locations and four at the control location.

There was no detectable I-131 in air samples in 1999. Table 3.1-A gives the highest indicator location annual mean and control location annual mean for I-131 since the preoperational period. The table shows similar concentrations for both the indicator and control locations and the activities decreasing from early in the operational history of the plant. No I-131 has been detected since 1994.

Cs-137 was detected in one air radioiodine sample in 1999 with the activity being at 0.05% of the reporting level. No Cs-137 was found on the corresponding particulate filter. An investigation performed in 1990 lead to the conclusion that Cs-137 activity detected only on the cartridges was not attributed to station effluents but is an active constituent of the charcoal (reference 6.5).

There were no detectable gamma emitting radionuclides detected in air particulate samples in 1999. No gamma emitting particulates have been detected in indicator location samples since the change in gamma spectroscopy analysis systems in 1987.



Oconee Air Monitoring Station

Beta analysis of particulate filters was initiated in March of 1996 and became required by Selected Licensee Commitments in 1998. Gross beta analysis was performed on particulate filters during the preoperational and early operational history of the plant but had not been required since 1984. Figure 3.1 shows the gross beta results for the indicator location with the highest annual mean and the control location samples. Both the indicator and control location results are similar in concentration and are near the lower range of preoperational gross beta results.

K-40 and Be-7 are the naturally occurring radionuclides that were observed in air samples.

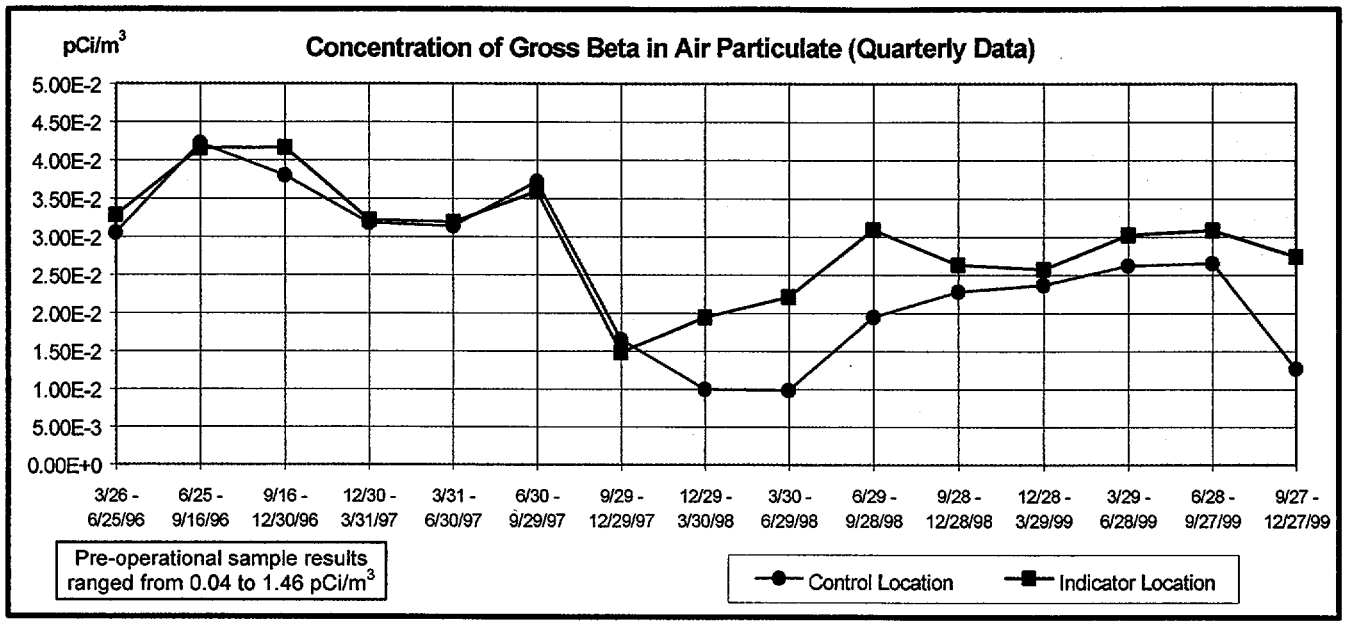
Table 3.1-A Mean Concentration of Air Radioiodine (I-131)

Year	Indicator Location (pCi/m^3)	Control Location (pCi/m^3)
Preoperational 1969-1972	0.00E0	0.00E0
Feb. 1973 - June 1973	0.00E0	0.00E0
July 1973 - Dec. 1973	0.00E0	0.00E0
Jan. 1974 - June 1974	0.00E0	0.00E0
July 1974 - Dec. 1974	2.60E-2	8.00E-3
Jan. 1975 - June 1975	8.65E-2	3.12E-2
July 1975 - Dec. 1975	1.13E-2	9.52E-3
1976	2.76E-2	2.18E-2
1977	3.60E-2	3.60E-2
1978	2.19E-1	1.15E-1
1979	7.54E-3	4.75E-4
1980	3.07E-3	9.67E-4
1981	6.31E-3	5.39E-4
1982	2.87E-3	8.10E-4
1983	1.48E-3	3.05E-4
1984	8.11E-4	-2.30E-5
1985	7.71E-4	4.54E-4
1986	5.02E-3	7.86E-3
1987	4.29E-3	5.19E-3
1988	0.00E0	0.00E0
1989	4.99E-4	0.00E0
1990	0.00E0	0.00E0
1991	0.00E0	0.00E0
1992	0.00E0	0.00E0
1993	0.00E0	0.00E0
1994	1.03E-2	0.00E0
1995	0.00E0	0.00E0
1996	0.00E0	0.00E0
1997	0.00E0	0.00E0
1998	0.00E0	0.00E0
1999	0.00E0	0.00E0

0.00E0 = no detectable measurements

1979 - 1986 mean based on all net activity results

Figure 3.1



There is no reporting level for gross beta in air particulate

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

Monitoring Period	Indicator Location (pCi/m^3)	Control Location (pCi/m^3)
3/26 - 6/25/96	3.28E-2	3.05E-2
6/25 - 9/16/96	4.15E-2	4.22E-2
9/16 - 12/30/96	4.16E-2	3.80E-2
Average (1996)	3.86E-2	3.69E-2
12/30 - 3/31/97	3.22E-2	3.18E-2
3/31 - 6/30/97	3.19E-2	3.14E-2
6/30 - 9/29/97	3.59E-2	3.72E-2
9/29 - 12/29/97	1.48E-2	1.65E-2
Average (1997)	2.87E-2	2.92E-2
12/29 – 3/30/98	1.94E-2	1.00E-2
3/30 – 6/29/98	2.21E-2	9.89E-3
6/29 – 9/28/98	3.09E-2	1.95E-2
9/28 – 12/28/98	2.63E-2	2.28E-2
Average (1998)	2.47E-2	1.56E-2
12/28 – 3/29/99	2.57E-2	2.37E-2
3/29 – 6/28/99	3.02E-2	2.62E-2
6/28 – 9/27/99	3.08E-2	2.65E-2
9/27/ - 12/27/99	2.74E-2	1.27E-2
Average (1999)	2.85E-02	2.23E-02

3.2 DRINKING WATER

Gross beta analysis and gamma spectroscopy were performed on 39 monthly drinking water samples. These samples were composited to form 15 quarterly period samples for Tritium analysis. Two indicator locations and a control location were sampled; however, only one of the indicator locations is downstream of the effluent release point.

Table 3.2 lists the highest indicator location annual mean and control location annual mean for gross beta results since the preoperational period. The indicator location had an average concentration of 1.73 pCi/liter in 1999, and the control location had a similar concentration of 1.49 pCi/liter. The 1998 indicator mean was 2.48 pCi/liter. The table shows that 1999 gross beta levels in drinking water are slightly lower than preopreational concentrations.

Tritium was detected in three of the 15 composite samples during 1999. Tritium was not detected in any of the 15 composite samples during 1998. Low levels of Tritium were detected in three of the five downstream indicator location samples in 1997. The 1999 mean indicator location 066 concentration was 185 pCi/liter, which is 0.93% of the reporting level. Table 3.2 and Figure 3.2 show the highest indicator and control location annual means for Tritium since analysis was initiated early in the operational period. Tritium concentrations have decreased at both the indicator and control locations. The closure of the Clemson water plant in 1989 is one reason for the decrease shown in the table and graph. The Clemson site was typically the high mean location when the plant was in operation. However, Tritium concentrations at the current downstream indicator location, Anderson water plant, have also decreased.

There were no gamma emitting radionuclides identified in drinking water samples in 1999. Gamma spectroscopy analysis has not detected any activity in the water supplies since 1988.

K-40 is the naturally occurring radionuclide that was observed in drinking water samples.

Figure 3.2

Current reporting level implemented 1984

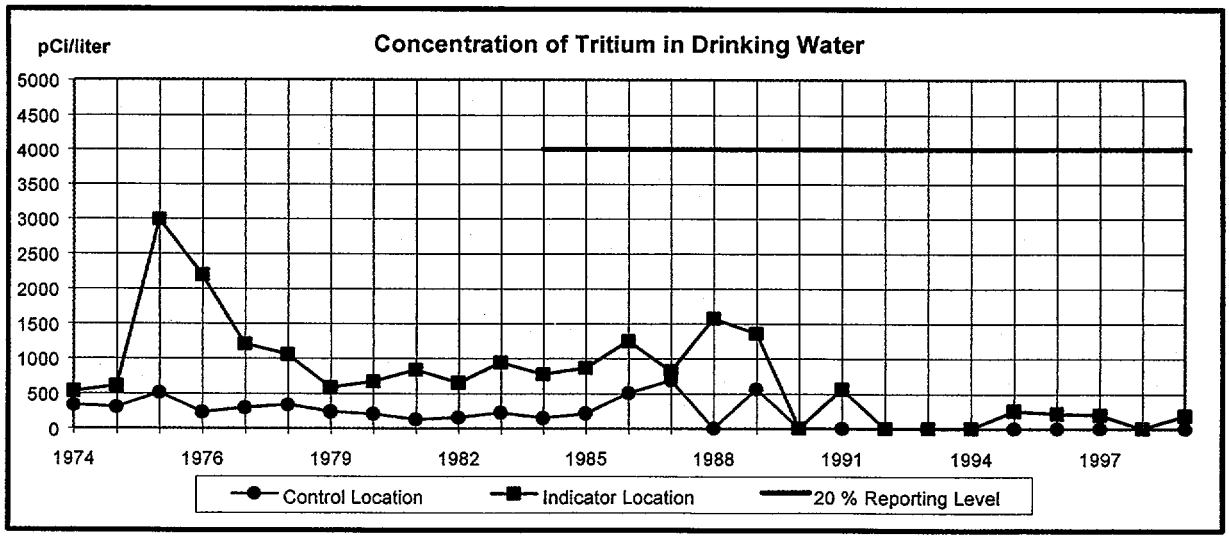


Table 3.2 Mean Concentrations of Radionuclides in Drinking Water

Year	Gross Beta (pCi/l)		Tritium (pCi/l)	
	Indicator Location	Control Location	Indicator Location	Control Location
Preoperational ending Jan. 1971	3.03	5.90	Analysis not required	
Preoperational ending Jan. 1973	3.58	4.94	Analysis not required	
Feb. 1973 - June 1973	Qualitative results reported		Analysis not required	
June 1973 - Dec. 1973	7.15	21.78	Analysis not required	
Jan. 1974 - June 1974	3.13	6.98	Analysis not required	
July 1974 - Dec. 1974	2.24	2.02	525	330
Jan. 1975 - June 1975	1.98	1.59	600	300
July 1975 - Dec. 1975	2.01	1.22	2990	505
1976	2.38	2.00	2196	224
1977	2.70	2.30	1200	290
1978	2.56	2.17	1050	333
1979	1.83	1.36	576	235
1980	1.86	1.63	660	200
1981	1.98	1.88	830	127
1982	2.04	1.45	643	153
1983	1.85	1.54	937	220
1984	1.87	1.08	765	145
1985	2.14	1.16	856	210
1986	1.91	1.04	1240	503
1987	2.00	1.20	815	680
1988	2.00	1.40	1570	0.00
1989	2.30	1.80	1350	559
1990	3.00	2.70	0.00	0.00
1991	1.80	1.40	558	0.00
1992	3.20	1.60	0.00	0.00
1993	2.10	1.90	0.00	0.00
1994	1.90	2.10	0.00	0.00
1995	5.10	2.90	248	0.00
1996	2.07	1.77	214	0.00
1997	2.52	2.23	194	0.00
1998	2.48	1.70	0.00	0.00
1999	1.73	1.49	185	0.00

0.00 = no detectable measurements

1989 - Clemson water plant closes; nearest downstream plant is Anderson.

1979 - 1986 mean based on all net activity results

3.3 SURFACE WATER

Gamma spectroscopy was performed on 26 monthly surface water samples. These samples were composited to form 10 quarterly samples for Tritium analysis. One indicator and one control location were sampled. The indicator location is near the liquid effluent release point.

Tritium was detected in the five indicator location samples. The 1999 average concentration was 11315 pCi/liter. The individual samples ranged from 828 pCi/liter to 44160 pCi/liter. The 1998 mean concentration was 3351 pCi/liter. Tritium was not detected in any control surface water samples.

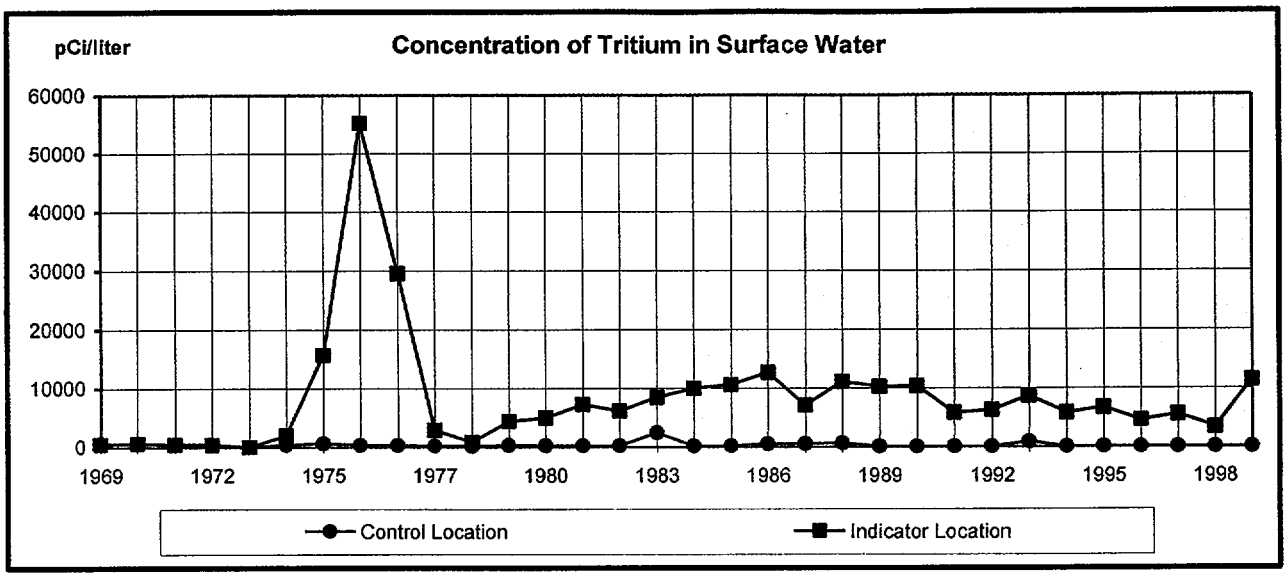
A quarterly Tritium sample from location 063 was analyzed at a concentration of 44,160 pCi/liter. This is higher than what has been observed for this site in recent years. There was no discernible effect on Tritium levels at sample locations monitored downstream. A Problem Investigation Process (PIP) was initiated to investigate the sample results. PIP O-99-04785 documents the review of sample collection and analysis methods, review of effluent releases, results from increased analysis frequency and additional sampling. The additional analyses and sampling demonstrated environmental concentrations are as expected and support the effluent model.

Figure 3.3 shows the indicator and control annual means for Tritium since the preoperational period. Table 3.3 lists the indicator annual means. Tritium concentrations exceed preoperational levels but are not increasing.

Gamma spectroscopy analysis detected Co-58 in one indicator sample at 27.2 pCi/liter, which represents 2.73% of the reporting level. Gamma spectroscopy analysis has not detected any other activity in surface water samples since 1992. Table 3.3 summarizes the indicator annual means of radionuclides detected since the change in the gamma spectroscopy analysis system in 1987. Visual inspection of the tabular data covering the early operational period through 1999 did not reveal any increasing trends.

K-40 is the naturally occurring radionuclide observed in surface water samples in 1999.

Figure 3.3



There is no reporting level for Tritium in surface water

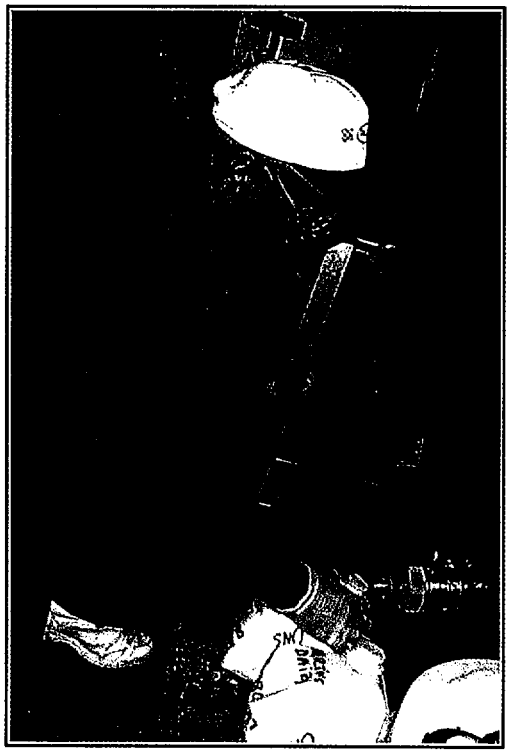
Table 3.3 Mean Concentrations of Radionuclides in Surface Water

Year	Co-58 (pCi/l)	Co-60 (Pci/l)	Nb-95 (pCi/l)	Cs-137 (pCi/l)	H-3 pCi/l)
Preoperational 1969		Qualitative results reported			4.86E2
Preoperational 1970		"			5.94E2
Preoperational 1971		"			4.01E2
Preoperational 1972		"			3.62E2
1973		"			0.00E0
1974	0.00E0	1.32E1	0.00E0	1.60E1	1.99E3
Jan. 1975 – June 1975	0.00E0	0.00E0	0.00E0	0.00E0	1.56E4
July 1975 – Dec. 1975	0.00E0	1.34E1	0.00E0	0.00E0	5.52E4
1976	1.08E2	3.30E1	0.00E0	3.50E1	2.95E4
1977	2.60E1	1.80E1	0.00E0	3.10E1	2.90E3
1978	2.96E2	0.00E0	0.00E0	2.22E1	8.00E2
1979	1.33E0	2.60E0	1.78E0	2.82E0	4.37E3
1980	1.56E0	2.30E0	1.22E0	5.40E0	4.93E3
1981	1.10E0	6.10E-1	1.70E0	3.90E0	7.21E3
1982	6.14E-1	1.99E0	2.29E0	4.85E0	6.13E3
1983	6.99E-1	3.02E0	3.91E-1	6.83E-1	8.40E3
1984	9.40E-1	6.30E-1	7.90E-1	4.83E-1	9.90E3
1985	2.15E-1	6.27E-1	4.95E-1	9.90E-1	1.05E4
1986	3.28E0	1.23E0	1.14E0	3.07E-1	1.26E4
1987	5.10E1	3.40E0	4.00E0	0.00E0	7.08E3
1988	6.20E0	5.00E0	2.50E0	3.50E0	1.10E4
1989	5.30E0	3.00E0	0.00E0	3.40E0	1.02E4
1990	1.70E0	1.60E0	0.00E0	0.00E0	1.03E4
1991	5.40E0	0.00E0	0.00E0	0.00E0	5.76E3
1992	2.50E0	0.00E0	0.00E0	0.00E0	6.22E3
1993	0.00E0	0.00E0	0.00E0	0.00E0	8.62E3
1994	0.00E0	0.00E0	0.00E0	0.00E0	5.75E3
1995	0.00E0	0.00E0	0.00E0	0.00E0	6.65E3
1996	0.00E0	0.00E0	0.00E0	0.00E0	4.54E3
1997	0.00E0	0.00E0	0.00E0	0.00E0	5.50E3
1998	0.00E0	0.00E0	0.00E0	0.00E0	3.35E3
1999	2.73E1	0.00E0	0.00E0	0.00E0	1.13E4

0.00E0 = no detectable measurements
1979-1986 mean based on all net activity results

3.4 MILK

Gamma spectroscopy and low level iodine analysis was performed on 78 milk samples collected in 1999. Two indicator and one control location were sampled.



Milk Sampling

There were no gamma emitting radionuclides identified in indicator or control location samples in 1999. Cs-137 is the only radionuclide, other than naturally occurring, reported in milk samples since 1988. Cs-137 in milk is not unusual. It is a constituent of nuclear weapons test fallout and has been observed in samples from indicator and control locations in previous years.

Table 3.4 lists the highest indicator location annual mean and control location annual mean for Cs-137 since the preoperational period. The table shows similar concentrations for both indicator and control locations.

K-40 is the naturally occurring radionuclide observed in milk samples in 1999.

Table 3.4 Mean Concentration of Radionuclides in Milk

Year	Cs-137 Indicator (pCi/l)	Cs-137 Control (pCi/l)
Preoperational	1.57E1	1.46E1
Feb. 1973 – June 1973	Qualitative results reported	Qualitative results reported
July 1973 - Dec. 1973	5.80E0	"
Jan. 1974 – June 1974	5.30E0	0.00E0
July 1974 - Dec. 1974	1.11E1	0.00E0
Jan. 1975 – June 1975	1.51E1	9.45E0
July 1975 - Dec. 1975	0.00E0	0.00E0
1976	1.80E1	7.47E0
1977	0.00E0	0.00E0
1978	1.33E1	1.33E1
1979	7.25E0	2.52E0
1980	3.58E0	2.63E0
1981	5.52E0	5.51E0
1982	2.71E0	3.25E0
1983	5.04E0	-4.27E-1
1984	2.30E0	2.58E0
1985	2.38E0	1.31E0
1986	2.92E0	2.97E0
1987	4.90E0	4.90E0
1988	3.90E0	3.20E0
1989	4.70E0	2.90E0
1990	6.40E0	0.00E0
1991	5.00E0	0.00E0
1992	6.60E0	0.00E0
1993	0.00E0	0.00E0
1994	0.00E0	1.80E0
1995	2.30E0	2.00E0
1996	0.00E0	4.10E0
1997	0.00E0	0.00E0
1998	0.00E0	0.00E0
1999	0.00E0	0.00E0

0.00E0 = no detectable measurements
1979 - 1986 mean based on all net activity results

3.5 BROADLEAF VEGETATION

Gamma spectroscopy was performed on 48 broadleaf vegetation samples during 1999. Three indicator locations and one control location were sampled. Cs-137 was reported in four indicator samples. Cs-137 was not detected in any control location samples. No other effluent related radionuclide was identified.

Sampling of control location 073 (which has historically had measurable Cs-137 concentrations greater than any indicator location) was discontinued early in 1999 due to construction. The new control location, 081, had no measurable Cs-137 during 1999.

Four of the thirty-six indicator location samples contained Cs-137. The highest concentration was 134 pCi/kg (6.70% of the reporting level). These results are similar to those reported in 1998.

Cs-137 is the only radionuclide, other than naturally occurring, reported in indicator location vegetation samples since the change in gamma spectroscopy analysis systems in 1987.

It is not unusual for Cs-137 to be present in vegetation. It is a constituent of nuclear weapons test fallout and has been observed in samples from indicator and control locations in previous years. Table 3.5 lists the highest indicator location annual mean and control location annual mean for Cs-137 since early in the station's operational history. Visual inspection of the tabular data did not reveal any increasing trends. There is no indication that the Cs-137 is due to ONS operations based on the low concentration observed and the absence of other radionuclides.

K-40 and Be-7 are the naturally occurring radionuclides that were observed in broadleaf vegetation samples in 1999.

Figure 3.5

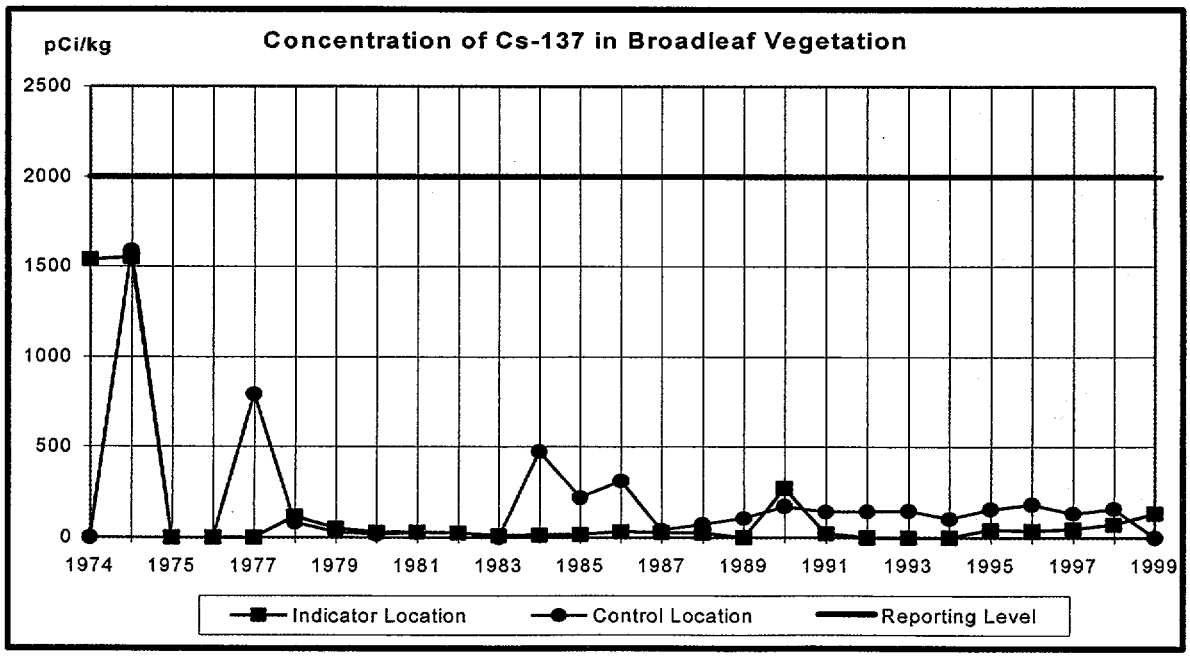


Table 3.5 Mean Concentration of Radionuclides in Vegetation

Year	Cs-137 Indicator (pCi/kg)	Cs-137 Control (pCi/kg)
July 1974 - Dec. 1974	1.54E3	0.00E0
Jan. 1975 - June 1975	1.55E3	1.59E3
July 1975 - Dec. 1975	0.00E0	0.00E0
1976	0.00E0	0.00E0
1977	0.00E0	7.90E2
1978	1.19E2	8.19E1
1979	5.04E1	2.96E1
1980	2.80E1	1.55E1
1981	2.99E1	2.60E1
1982	2.42E1	2.62E1
1983	7.44E0	5.35E-1
1984	1.37E1	4.74E2
1985	1.62E1	2.20E2
1986	3.28E1	3.12E2
1987	2.70E1	4.20E1
1988	2.40E1	7.50E1
1989	0.00E0	1.08E2
1990	2.73E2	1.74E2
1991	2.20E1	1.45E2
1992	0.00E0	1.46E2
1993	0.00E0	1.49E2
1994	0.00E0	1.06E2
1995	4.30E1	1.58E2
1996	3.79E1	1.83E2
1997	4.73E1	1.35E2
1998	7.28E1	1.61E2
1999	1.34E2	0.00E0

0.00E0 = no detectable measurements
Only qualitative results reported prior to 1974
Control location changed to 073 in 1984
Control location 081 added in 1998
Control location 073 was removed in 1999
1979 - 1986 mean based on all net activity results

3.6 FISH

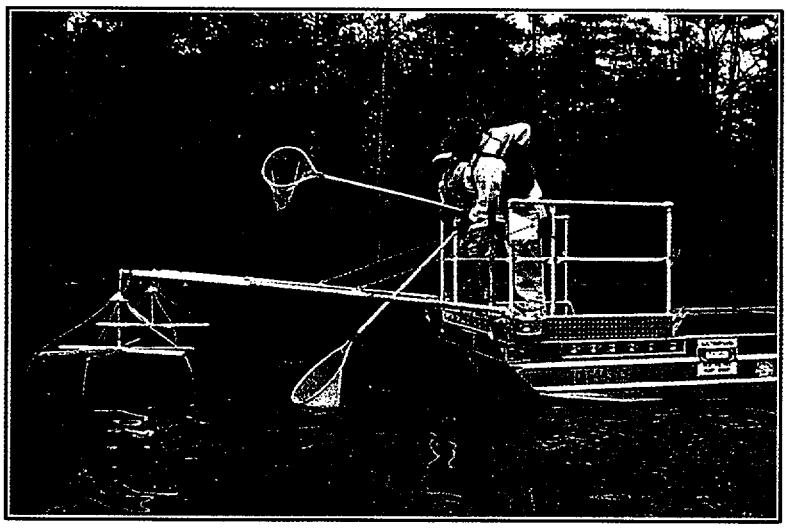
Gamma spectroscopy was performed on 12 fish samples. Two downstream indicator and one control location were sampled. Cs-137 was identified in six of the eight indicator location samples and in one of the four control location samples. No other effluent related radionuclide was identified. The highest average concentration for Cs-137 was 104 pCi/kg (5.2% of reporting level). The highest individual sample concentration for Cs-137 was 181 pCi/kg (9.1% of reporting level). The control Cs-137 average concentration was 20.5 pCi/kg. 1998 Cs-137 sample results for all locations were similar.

Figures 3.6-1 and 3.6-2 are graphs displaying the annual means for Cs-137 and Cs-134. Historically, both are major contributors to the calculated dose from ingestion of fish. Radioactivity concentrations in downstream fish samples are higher than those reported in preoperational fish samples, however, fluctuations in the graphed results are large and no trends are apparent. Based on these graphs, the levels at the two downstream locations do not appear to be increasing.

One factor affecting the trend analysis is a change in sampling locations. In 1984, a second downstream fish location was added. Location 063 is closer to the liquid effluent discharge point and has been the highest mean indicator since it was added.

K-40 was observed in fish samples in addition to the radionuclides discussed above.

Table 3.6 lists the highest indicator location annual means since the preoperational period for radionuclides detected in 1999. Also included in the table are radionuclides that have been identified in this media since the change in analysis systems in 1987. Comparison of data to previous years does not indicate any increases in concentrations.



Fish Sampling

Figure 3.6-1

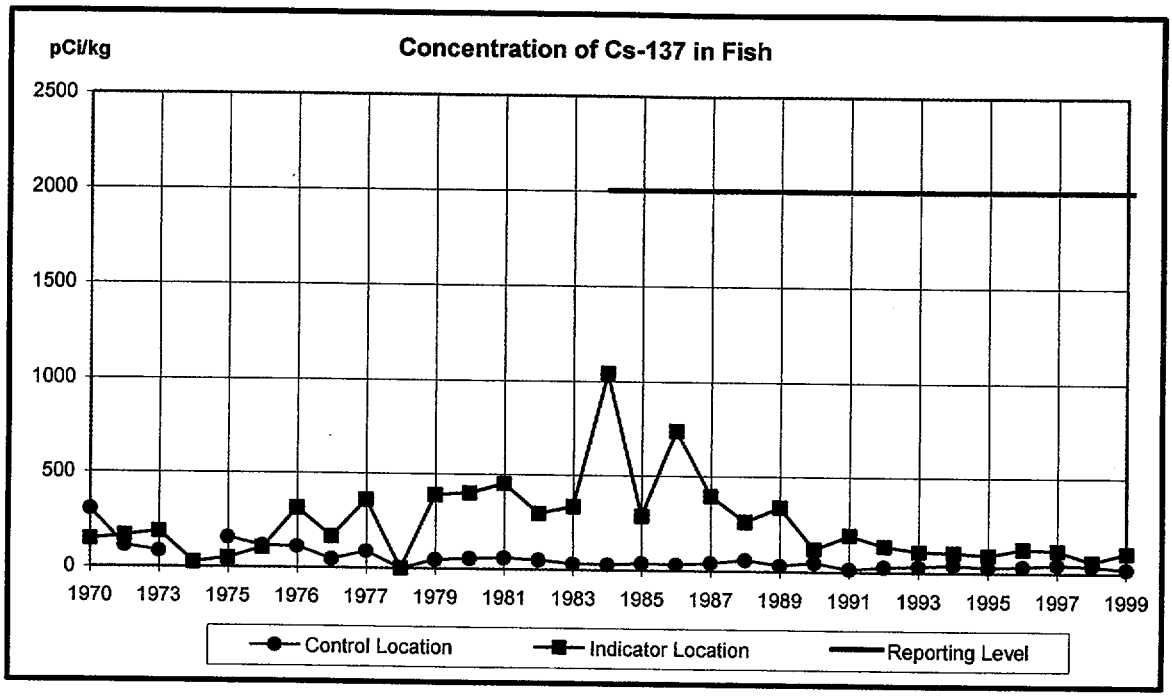
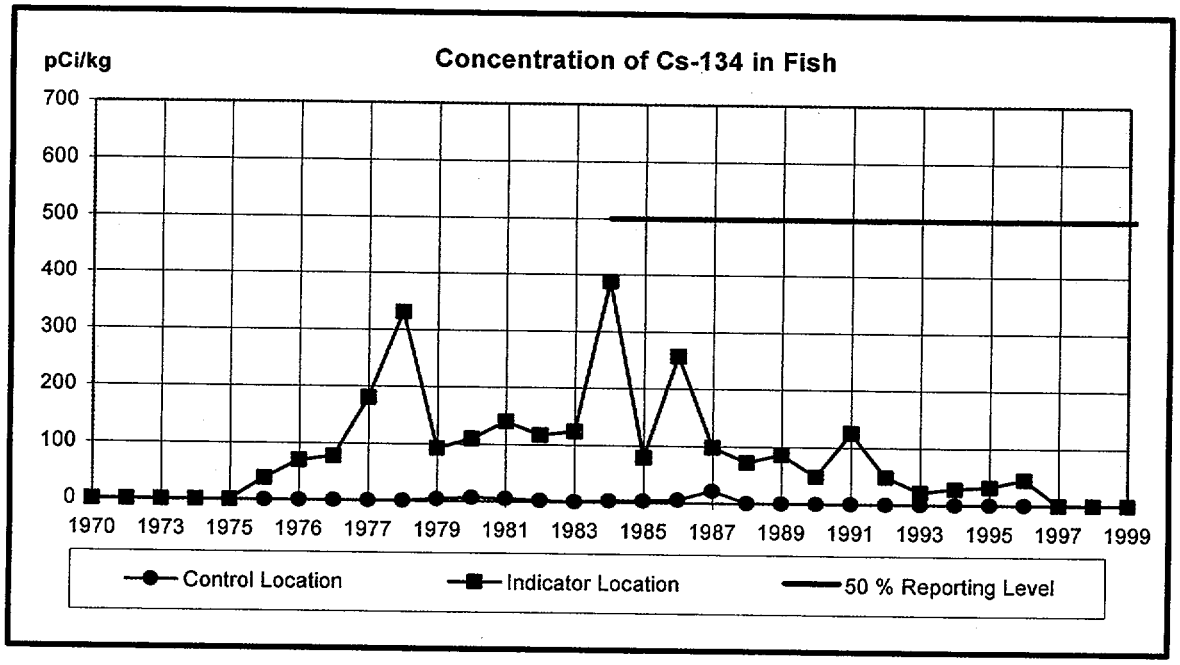


Figure 3.6-2



Current reporting levels implemented 1984

Table 3.6 Mean Concentrations of Radionuclides in Fish

Year	Co-58 (pCi/kg)	Co-60 (pCi/kg)	Cs-134 (pCi/kg)	Cs-137 (pCi/kg)
Preop ending Jan.1971	0.00E0	0.00E0	0.00E0	1.46E2
Preop ending Jan.1973	0.00E0	0.00E0	0.00E0	1.66E2
Feb. 1973 - June 1973	Qualitative results reported-no significant measurements above background			
July 1973 - Dec. 1973	0.00E0	0.00E0	0.00E0	1.89E2
Jan. 1974 - June 1974	0.00E0	0.00E0	0.00E0	2.47E1
July 1974 - Dec. 1974	0.00E0	0.00E0	0.00E0	4.85E1
Jan. 1975 - June 1975	0.00E0	0.00E0	3.81E1	1.05E2
July 1975 - Dec. 1975	8.50E1	0.00E0	7.00E1	3.13E2
1976	5.70E1	1.14E2	7.73E1	1.66E2
1977	0.00E0	0.00E0	1.80E2	3.60E2
1978	3.27E2	0.00E0	3.31E2	0.00E0
1979	1.91E0	1.56E1	9.26E1	3.88E2
1980	1.45E1	1.90E1	1.10E2	3.99E2
1981	2.25E1	1.49E1	1.40E2	4.51E2
1982	9.83E-1	8.03E0	1.17E2	2.94E2
1983	3.35E1	4.53E0	1.24E2	3.32E2
1984	1.21E2	6.23E1	3.87E2	1.04E3
1985	1.62E1	1.10E1	7.93E1	2.85E2
1986	9.56E1	2.59E1	2.57E2	7.36E2
1987	1.63E2	6.30E1	9.80E1	3.93E2
1988	9.60E1	0.00E0	7.20E1	2.60E2
1989	4.30E1	1.50E1	8.60E1	3.36E2
1990	1.50E1	0.00E0	4.80E1	1.19E2
1991	4.59E1	0.00E0	1.25E2	1.94E2
1992	6.10E1	0.00E0	4.80E1	1.36E2
1993	0.00E0	0.00E0	2.10E1	1.10E2
1994	0.00E0	0.00E0	2.80E1	1.05E2
1995	0.00E0	0.00E0	3.10E1	9.20E1
1996	0.00E0	0.00E0	4.49E1	1.25E2
1997	0.00E0	0.00E0	0.00E0	1.18E2
1998	0.00E0	0.00E0	0.00E0	5.79E1
1999	0.00E0	0.00E0	0.00E0	1.04E2

0.00E0 = no detectable measurements

1979 - 1986 mean based on all net activity results

3.7 SHORELINE SEDIMENT

Gamma spectroscopy was performed on six sediment samples. Two downstream indicator locations and one control location were sampled.

Cs-137 was identified in both indicator location samples. Cs-137 was observed in one of the control location samples. The highest 1999 indicator location annual mean was 73.8 pCi/kg. The 1999 control location mean was 16.1 pCi/kg. 1998 Cs-137 sample results for all indicator locations were similar. Table 3.7 lists the highest indicator location annual means since shoreline sediment was initiated in 1984. Included in the table are radionuclides that have been identified in this media since the change in analysis systems in 1987.

Visual inspection of the tabular data did not reveal any trends. Figure 3.7-1 is a graph of the Cs-137 annual means. Figure 3.7-2 is a graph of the Co-60 annual means. Historically, both are major contributors to the calculated dose from shoreline sediment. Fluctuations in the graphed results are large and no trends are apparent.

Previous environmental reports (reference 6.5) have addressed the fluctuations in shoreline sediment sample results. Some of these are attributed to differences in the actual point of sampling due to periods of drought. Samples are collected at the edge of the water. Reduced lake levels caused some samples to be taken at points that are normally submerged and where sediment deposition is expected to be greater.

Mn-54 was detected in two of the four indicator location samples. Mn-54 was not detected in the control location samples. Activity reported as Mn-54 may be contributed by the presence of Ac-228. Ac-228 emits a photon at a similar energy to the single gamma spectroscopy counting line for Mn-54. Mn-54 has been reported in samples from both indicator and control locations in the past. Co-58, Co-60, and Mn-54 are activated corrosion products. Neither Co-58 or Co-60 were detected in any 1999 shoreline sediment samples. It is concluded that Ac-228 is the major contributor to the activity reported as Mn-54 based upon the absence of other corrosion products.

The 1999 doses from shoreline sediments were low and well within all dose limits.

K-40 and Be-7 are the naturally occurring radionuclides observed in shoreline sediment samples in 1999.

Figure 3.7-1

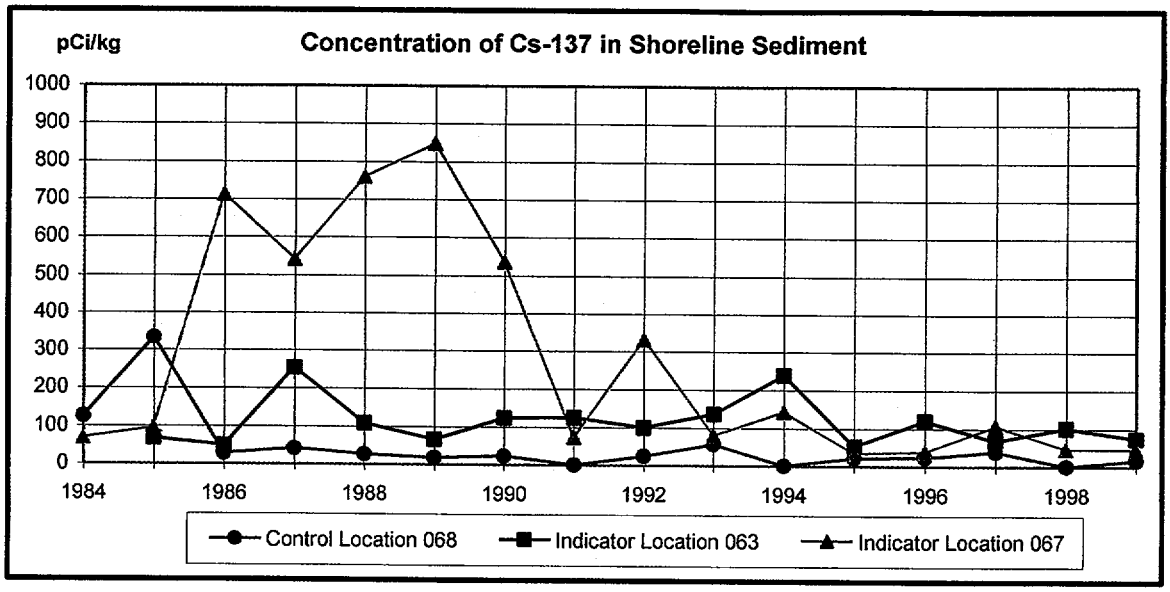
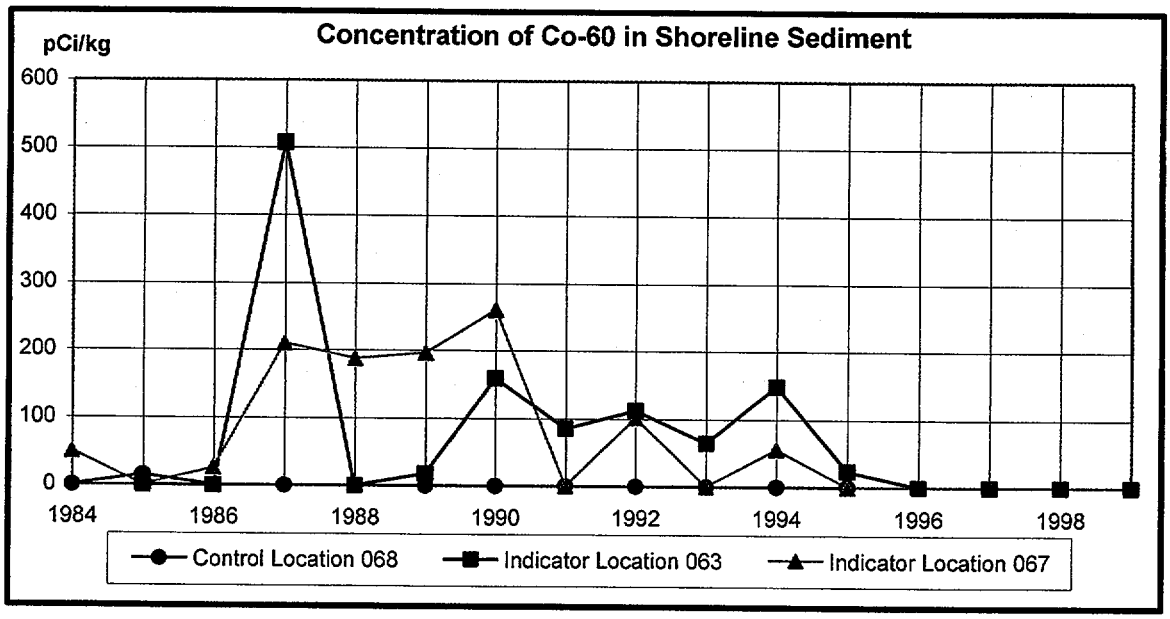


Figure 3.7-2



There are no reporting levels for shoreline sediment

Table 3.7 Mean Concentrations of Radionuclides in Shoreline Sediment (pCi/kg)

Year	Mn-54	Co-58	Co-60	Zn-65	Cs-134	Cs-137	Ag-110m	Sb-125
1984	1.10E1	1.09E1	1.19E1	0.00E0	7.77E1	5.16E1	0.00E0	0.00E0
1985	9.39E0	1.27E0	4.79E0	0.00E0	7.63E1	9.47E1	0.00E0	0.00E0
1986	2.24E1	1.62E1	2.50E1	0.00E0	1.41E2	7.12E2	0.00E0	0.00E0
1987	5.40E1	4.70E2	5.07E2	0.00E0	1.01E2	6.22E2	3.46E2	0.00E0
1988	3.30E1	1.20E2	1.87E2	6.70E1	6.60E1	7.59E2	1.62E2	3.67E2
1989	2.30E1	1.24E2	1.96E2	0.00E0	5.40E1	8.48E2	5.50E1	1.86E2
1990	3.40E1	8.00E1	2.59E2	0.00E0	4.50E1	5.36E2	1.71E2	9.00E1
1991	3.26E1	5.60E1	8.57E1	0.00E0	6.91E1	1.24E2	1.10E2	1.78E2
1992	8.79E1	1.79E2	1.12E2	0.00E0	5.60E1	3.31E2	1.69E2	2.08E2
1993	8.20E1	8.20E1	6.50E1	0.00E0	3.20E1	1.36E2	5.63E1	1.11E2
1994	5.30E1	7.00E1	1.49E2	0.00E0	6.70E1	2.38E2	1.04E2	1.29E2
1995	1.43E2	3.90E1	2.40E1	0.00E0	1.10E1	5.20E1	0.00E0	0.00E0
1996	0.00E0	5.10E1	0.00E0	0.00E0	1.98E1	1.19E2	0.00E0	0.00E0
1997	0.00E0	0.00E0	0.00E0	0.00E0	0.00E0	1.06E2	0.00E0	0.00E0
1998	0.00E0	0.00E0	0.00E0	0.00E0	0.00E0	1.01E2	0.00E0	0.00E0
1999	6.96E1	0.00E0	0.00E0	0.00E0	0.00E0	7.38E1	0.00E0	0.00E0

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

3.8 DIRECT GAMMA RADIATION

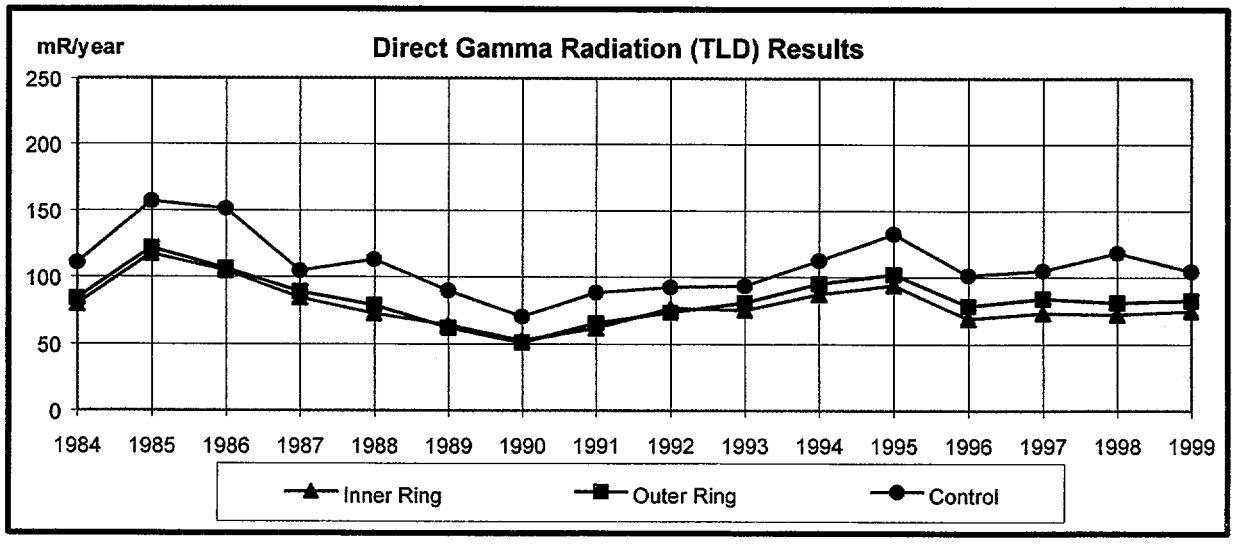
In 1999, 168 Thermoluminescent Dosimeters (TLD) were analyzed, 160 at indicator locations, 8 at the two control locations. TLDs are collected and analyzed quarterly. The highest annual mean exposure for an indicator location was 106.6 milliroentgen. This TLD is located at indicator location 059, 9.2 miles from the station. The annual mean exposure for the control locations was 104 milliroentgen.

Figure 3.8 and Table 3.8 show TLD inner ring (site boundary), outer ring (4-5 miles), and control location annual averages in milliroentgen per year. Data is provided from 1984 when TLD locations were added and arranged in an inner ring and outer ring configuration. Preoperational data is also provided in the table. As shown in the graph, inner and outer ring averages historically compare closely, with control data somewhat higher. Inner and outer ring averages comprise a number of data points with control averages representing only two locations.

In addition, the calculated total body dose (from gaseous effluents) for 1999 was 5.57E-2 mrem, which is 0.07% 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.

The maximum measurement from TLDs at the Independent Spent Fuel Storage Installation (ISFSI) was 481.3 milliroentgen per standard quarter. This is within the range of the measurements observed for this location.

Figure 3.8



There is no reporting level for Direct Radiation (TLD)

Table 3.8 Direct Gamma Radiation (TLD) Results

Year	Inner Ring Average (mR/yr)	Outer Ring Average (mR/yr)	Control (mR/yr)
Preoperational	113.1	123.9	148.9
1984	79.4	83.8	110.3
1985	116.9	121.5	156.6
1986	104.2	106.0	150.9
1987	84.3	88.8	104.3
1988	72.3	78.6	112.6
1989	63.7	61.7	89.4
1990	52.2	50.7	70.1
1991	61.2	65.0	88.0
1992	76.2	73.2	92.0
1993	74.8	80.6	93.0
1994	86.8	94.7	112.0
1995	93.6	101.7	132.0
1996	68.5	78.3	101.0
1997	72.8	83.8	104.5
1998	71.7	80.8	118.0
Average (1989 - 1998)	72.2	77.1	100.0
1999	74.5	82.5	104

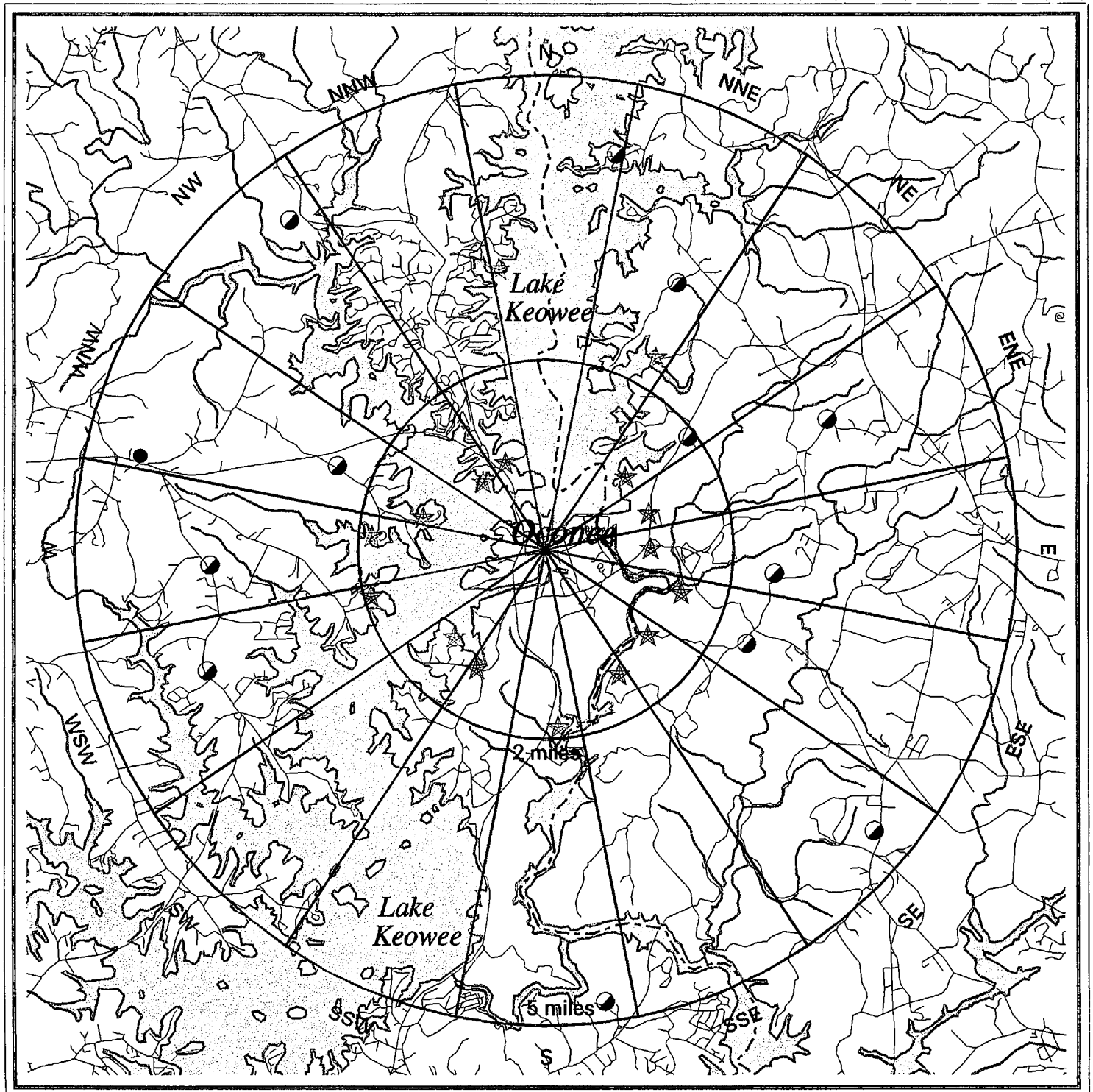
3.9 LAND USE CENSUS

The Land Use Census was conducted during the growing season (9/2 – 9/14/99). The census results are contained in Table 3.9 and Figure 3.9. No program changes were required based on the results of the census.

Table 3.9 Oconee 1999 Land Use Census Results

Sector		Distance (Miles)	Sector		Distance (Miles)
N	Nearest Residence	2.98	S	Nearest Residence	1.85
	Nearest Milk Animal	-		Nearest Milk Animal	-
	Nearest Meat Animal (Cow)	4.10		Nearest Meat Animal (Cow)	4.70
NNE	Nearest Residence	2.39	SSW	Nearest Residence	1.33
	Nearest Milk Animal	-		Nearest Milk Animal	-
	Nearest Meat Animal (Cow)	3.30		Nearest Meat Animal	-
NE	Nearest Residence	1.10	SW	Nearest Residence	1.30
	Nearest Milk Animal	-		Nearest Milk Animal	-
	Nearest Meat Animal (Cow)	1.90		Nearest Meat Animal	-
ENE	Nearest Residence	1.25	WSW	Nearest Residence	1.79
	Nearest Milk Animal	-		Nearest Milk Animal	-
	Nearest Meat Animal (Cow)	3.50		Nearest Meat Animal (Cow)	3.70
E	Nearest Residence	1.16	W	Nearest Residence	1.80
	Nearest Milk Animal	-		Nearest Milk Animal	-
	Nearest Meat Animal (Cow)	2.40		Nearest Meat Animal (Cow)	3.60
ESE	Nearest Residence	1.50	WNW	Nearest Residence	1.33
	Nearest Milk Animal	-		Nearest Milk Animal (Cow)	4.50
	Nearest Meat Animal (Cow)	2.40		Nearest Meat Animal (Cow)	2.40
SE	Nearest Residence	1.45	NW	Nearest Residence	1.00
	Nearest Milk Animal	-		Nearest Milk Animal	-
	Nearest Meat Animal (Cow)	4.60		Nearest Meat Animal (Cow)	4.40
SSE	Nearest Residence	1.55	NNW	Nearest Residence	1.10
	Nearest Milk Animal	-		Nearest Milk Animal	-
	Nearest Meat Animal	-		Nearest Meat Animal	-

"-" indicates no occurrences within the 5 mile radius



Oconee Nuclear Station 1999 Land Use Census Map

- Milk cow
- Beef cow
- Residence

All above locations shown within sectors are approximate.

- Streams and Shorelines
- Roads
- County lines
- Railroads

N
W E
S

0 2 MILES

SCALE: 1:95040

Projection N.C. State Plane

September 1999

bka 11/03/99

4.0 EVALUATION OF DOSE

4.1 DOSE FROM ENVIRONMENTAL MEASUREMENTS

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

Doses based on REMP 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, after subtracting the applicable average background concentration (as measured at the corresponding control location). Regulatory Guide 1.109 consumption rates for the maximum exposed individual were used in the calculations. A dose factor of zero was assumed when the guide listed "NO DATA" as the dose factor for a given radionuclide and organ.

Maximum dose estimates calculated using airborne radioiodine and particulates, drinking water, broadleaf vegetation, fish and shoreline sediment results are reported in Table 4.1-A. The individual critical population and pathway dose calculations are contained in Table 4.1-B.

No radionuclides were detected in milk, airborne radioiodine or airborne particulate samples other than naturally-occurring K-40 and Be-7. Dose estimates were not calculated for surface water samples because surface water is not considered a potable drinking water source. REMP TLD exposure results are discussed in Section 3.8.

The dose contribution from shoreline sediment to each organ, other than the skin, was assumed to equal the total body contribution from shoreline sediment. The maximum total organ dose estimates for the critical age groups have been reported in Table 4.1-A.

4.2 ESTIMATED DOSE FROM RELEASES

Throughout the year, dose estimates were calculated based on actual 1999 liquid and gaseous effluent release data. Effluent-based dose estimates were calculated using the RETDAS computer program which employs methodology and data presented in NRC Regulatory Guide 1.109. The 1999 ONS 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 of 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, milk, inhalation and vegetation pathways.

4.3 COMPARISON OF DOSES

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

In calculations based on liquid release effluent pathways, fish consumption was the predominant dose path based on environmental and effluent samples. The maximum total organ dose based on 1999 environmental sample results was 2.28E-1 mrem to the adult's liver. The fish pathway accounted for 93.8% of the total liver dose. Similarly, the maximum total organ dose of 4.06E-1 mrem for liquid effluent-based estimates was to the teen's liver due to fish consumption. The radionuclide contributing to the majority of both estimates was Cs-137.

For all organs but the thyroid, liquid effluent doses were higher than REMP data doses. The effluent thyroid dose was 71.5% of the REMP-based estimate. Fish was the critical pathway. Fish was also the critical pathway for the thyroid REMP-based estimate with Tritium and Cs-137 as the contributors.

For the gaseous release pathway vegetation ingestion by a child was the critical pathway for environmental dose. A maximum bone dose of 1.14 mrem was calculated with Cs-137 as the major contributor (100%). Vegetation ingestion is the critical path for the effluent-based doses, with the child being the critical age. A maximum thyroid dose of 6.11E-2 mrem was calculated. The major contributors to the effluent vegetation doses are I-131 (7.9% of the dose) and Tritium (90.1% of the dose). Tritium analysis is not performed on gaseous release pathway samples. No I-131 was detected in broadleaf vegetation samples. Noble gas samples are not collected as part of the REMP, preventing an analogous comparison of effluent-based noble gas exposure estimates.

For all organs, REMP data doses exceeded gaseous effluent doses. The REMP data doses are due solely to Cs-137 in vegetation. Vegetation control location 073 (which has historically had measurable Cs-137 concentrations greater than any indicator location) was eliminated due to construction during 1999. The new control location, 081, had no measureable Cs-137 during 1999. This resulted in higher vegetation doses than in past years.

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 ONS are being maintained well within regulatory limits.

TABLE 4.1-A

OCONEE NUCLEAR STATION
1999 ENVIRONMENTAL AND EFFLUENT DOSE COMPARISON

LIQUID RELEASE PATHWAY

Organ	Environmental or Effluent Data	Critical Age	Critical Pathway	Location	Maximum Dose* (mrem)
Skin	Environmental	Teen	Shoreline Sediment	067 (4.2 mi SSE)	2.54E-04
Skin	Effluent	Teen	Shoreline Sediment	0.8 mi ESE	1.22E-02
Bone	Environmental	Child	Fish	063 (0.8 mi ESE)	1.88E-01
Bone	Effluent	Child	Fish	0.8 mi ESE	3.56E-01
Liver	Environmental	Adult	Fish	063 (0.8 mi ESE)	2.28E-01
Liver	Effluent	Teen	Fish	0.8 mi ESE	4.06E-01
T. Body	Environmental	Adult	Fish	063 (0.8 mi ESE)	1.62E-01
T. Body	Effluent	Adult	Fish	0.8 mi ESE	2.63E-01
Thyroid	Environmental	Adult	Fish	063 (0.8 mi ESE)	3.68E-02
Thyroid	Effluent	Adult	Fish	0.8 mi ESE	2.63E-02
Kidney	Environmental	Adult	Fish	063 (0.8 mi ESE)	1.02E-01
Kidney	Effluent	Adult	Fish	0.8 mi ESE	1.54E-01
Lung	Environmental	Adult	Fish	063 (0.8 mi ESE)	5.83E-02
Lung	Effluent	Teen	Fish	0.8 mi ESE	7.55E-02
GI-LLI	Environmental	Adult	Fish	063 (0.8 mi ESE)	4.05E-02
GI-LLI	Effluent	Adult	Fish	0.8 mi ESE	9.61E-02

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

GASEOUS RELEASE PATHWAY

IODINE, PARTICULATE, and TRITIUM

Organ	Environmental or Effluent Data	Critical Age	Critical Pathway	Location	Maximum Dose* (mrem)
Skin	Environmental	-	-	-	0.00E+00
Skin	Effluent	All	Ground/Plane	1.0 mi SW	9.73E-05
Bone	Environmental	Child	Vegetation	060 (2.6 mi NNE)	1.14E+00
Bone	Effluent	Child	Vegetation	1.0 mi SW	2.83E-04
Liver	Environmental	Child	Vegetation	060 (2.6 mi NNE)	1.09E+00
Liver	Effluent	Child	Vegetation	1.0 mi SW	5.59E-02
T. Body	Environmental	Adult	Vegetation	060 (2.6 mi NNE)	6.12E-01
T. Body	Effluent	Child	Vegetation	1.0 mi SW	5.57E-02
Thyroid	Environmental	-	-	-	0.00E+00
Thyroid	Effluent	Child	Vegetation	1.0 mi SW	6.11E-02
Kidney	Environmental	Child	Vegetation	060 (2.6 mi NNE)	3.55E-01
Kidney	Effluent	Child	Vegetation	1.0 mi SW	5.58E-02
Lung	Environmental	Child	Vegetation	060 (2.6 mi NNE)	1.28E-01
Lung	Effluent	Child	Vegetation	1.0 mi SW	5.57E-02
GI-LLI	Environmental	Adult	Vegetation	060 (2.6 mi NNE)	1.81E-02
GI-LLI	Effluent	Child	Vegetation	1.0 mi SW	5.57E-02

* 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	1.0 mi SW	1.10E-03
Gamma	Environmental	N/A	-	-	Not Sampled
Gamma	Effluent	N/A	Noble Gas	1.0 mi SW	9.76E-04

TABLE 4.1-B

Maximum Individual Dose for 1999 based on Environmental Measurements (mrem) for Oconee 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	1.88E-02	1.88E-02	1.88E-02	1.88E-02	1.88E-02	1.88E-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	1.88E-02	1.88E-02	1.88E-02	1.88E-02	1.88E-02	1.88E-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	1.92E-02	1.92E-02	1.92E-02	1.92E-02	1.92E-02	1.92E-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	1.14E+00	1.09E+00	1.61E-01	0.00E+00	3.55E-01	1.28E-01	6.83E-03	0.00E+00
	Fish	1.88E-01	1.95E-01	4.09E-02	1.43E-02	7.30E-02	3.54E-02	1.54E-02	0.00E+00
	Shoreline Sediment	7.24E-05	7.24E-05	7.24E-05	7.24E-05	7.24E-05	7.24E-05	7.24E-05	8.47E-05
	TOTAL	1.33E+00	1.30E+00	2.21E-01	3.36E-02	4.47E-01	1.83E-01	4.15E-02	8.47E-05
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	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-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	6.30E-01	8.39E-01	2.92E-01	0.00E+00	2.85E-01	1.11E-01	1.19E-02	0.00E+00
	Fish	1.50E-01	2.16E-01	8.66E-02	1.73E-02	8.50E-02	4.36E-02	2.01E-02	0.00E+00
	Shoreline Sediment	3.47E-04	3.47E-04	3.47E-04	3.47E-04	3.47E-04	3.47E-04	3.47E-04	4.05E-04
	TOTAL	7.80E-01	1.07E+00	3.89E-01	2.76E-02	3.80E-01	1.65E-01	4.23E-02	4.05E-04
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	1.42E-02	1.42E-02	1.42E-02	1.42E-02	1.42E-02	1.42E-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	6.84E-01	9.35E-01	6.12E-01	0.00E+00	3.17E-01	1.05E-01	1.81E-02	0.00E+00
	Fish	1.40E-01	2.14E-01	1.48E-01	2.25E-02	8.73E-02	4.40E-02	2.62E-02	0.00E+00
	Shoreline Sediment	6.21E-05	6.21E-05	6.21E-05	6.21E-05	6.21E-05	6.21E-05	6.21E-05	7.26E-05
	TOTAL	8.24E-01	1.16E+00	7.74E-01	3.68E-02	4.19E-01	1.63E-01	5.86E-02	7.26E-05

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

Oconee Nuclear Station
Dose from Drinking Water Pathway for 1999 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	066	185.00	0.00E+00	1.88E-02	1.88E-02	1.88E-02	1.88E-02	1.88E-02	1.88E-02
						Dose Commitment (mrem) =				0.00E+00	1.88E-02	1.88E-02	1.88E-02	1.88E-02	1.88E-02	1.88E-02

Oconee Nuclear Station
Dose from Drinking Water Pathway for 1999 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	066	185.00	0.00E+00	1.92E-02	1.92E-02	1.92E-02	1.92E-02	1.92E-02	1.92E-02
						Dose Commitment (mrem) =				0.00E+00	1.92E-02	1.92E-02	1.92E-02	1.92E-02	1.92E-02	1.92E-02

Oconee Nuclear Station

Dose from Broadleaf Vegetation Pathway for 1999 Data

Maximum Exposed Child

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

Usage (intake in one year) = 26 kg

	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	060	134.00	1.14E+00	1.09E+00	1.61E-01	0.00E+00	3.55E-01	1.28E-01	6.83E-03
						Dose Commitment (mrem) =				1.14E+00	1.09E+00	1.61E-01	0.00E+00	3.55E-01	1.28E-01	6.83E-03

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

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

H-3 Concentration in Fish = Surface Water pCi/l x Bioaccumulation Factor 0.9 pCi/kg per pCi/l = 11315 pCi/l x 0.9 = 10184 pCi/kg

Usage (intake in one year) = 6.9 kg

	Ingestion Dose Factor							Highest Annual Net Mean Concentration		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	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
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	063	83.50	1.88E-01	1.80E-01	2.66E-02	0.00E+00	5.88E-02	2.11E-02	1.13E-03
H-3	NO DATA	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	063	10184	0.00E+00	1.43E-02	1.43E-02	1.43E-02	1.43E-02	1.43E-02	1.43E-02
						Dose Commitment (mrem) =				1.88E-01	1.95E-01	4.09E-02	1.43E-02	7.30E-02	3.54E-02	1.54E-02

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

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

Child Dose from Shorline Sediment Pathway (mrem) = Shorline 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	5.81E-09	6.80E-09	067	69.6	4.53E-05	5.30E-05
Co-58	7.00E-09	8.20E-09	ALL	0.00	0.00E+00	0.00E+00
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	063	57.70	2.71E-05	3.17E-05
		Dose Commitment (mrem) =			7.24E-05	8.47E-05

Oconee Nuclear Station
Dose from Drinking Water Pathway for 1999 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	066	185.00	0.00E+00	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02
						Dose Commitment (mrem)=				0.00E+00	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02

Oconee Nuclear Station

Dose from Broadleaf Vegetation Pathway for 1999 Data

Maximum Exposed Teen

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

Usage (intake in one year) = 42 kg

	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	060	134.00	6.30E-01	8.39E-01	2.92E-01	0.00E+00	2.85E-01	1.11E-01	1.19E-02
						Dose Commitment (mrem) =				6.30E-01	8.39E-01	2.92E-01	0.00E+00	2.85E-01	1.11E-01	1.19E-02

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

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

H-3 Concentration in Fish = Surface Water pCi/l x Bioaccumulation Factor 0.9 pCi/kg per pCi/l = 11315 pCi/l x 0.9 = 10184 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	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
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	063	83.50	1.50E-01	1.99E-01	6.93E-02	0.00E+00	6.77E-02	2.63E-02	2.83E-03
H-3	NO DATA	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	063	10184	0.00E+00	1.73E-02	1.73E-02	1.73E-02	1.73E-02	1.73E-02	1.73E-02
						Dose Commitment (mrem) =				1.50E-01	2.16E-01	8.66E-02	1.73E-02	8.50E-02	4.36E-02	2.01E-02

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

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

Teen Dose from Shorline Sediment Pathway (mrem) = Shorline 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	5.81E-09	6.80E-09	067	69.6	2.17E-04	2.54E-04
Co-58	7.00E-09	8.20E-09	ALL	0.00	0.00E+00	0.00E+00
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	063	57.70	1.30E-04	1.52E-04
	Dose Commitment (mrem) =				3.47E-04	4.05E-04

Oconee Nuclear Station
Dose from Drinking Water Pathway for 1999 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

									Highest Annual Net Mean Concentration								
					Ingestion Dose Factor									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	066	185.00	0.00E+00	1.42E-02	1.42E-02	1.42E-02	1.42E-02	1.42E-02	1.42E-02
						Dose Commitment (mrem) =				0.00E+00	1.42E-02	1.42E-02	1.42E-02	1.42E-02	1.42E-02	1.42E-02

Oconee Nuclear Station

Dose from Broadleaf Vegetation Pathway for 1999 Data

Maximum Exposed Adult

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

Usage (intake in one year) = 64 kg

	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	060	134.00	6.84E-01	9.35E-01	6.12E-01	0.00E+00	3.17E-01	1.05E-01	1.81E-02
						Dose Commitment (mrem) =				6.84E-01	9.35E-01	6.12E-01	0.00E+00	3.17E-01	1.05E-01	1.81E-02

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

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

H-3 Concentration in Fish = Surface Water pCi/l x Bioaccumulation Factor 0.9 pCi/kg per pCi/l = 11315 pCi/l x 0.9 = 10184 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	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
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	063	83.50	1.40E-01	1.91E-01	1.25E-01	0.00E+00	6.49E-02	2.16E-02	3.70E-03
H-3	NO DATA	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	063	10184	0.00E+00	2.25E-02	2.25E-02	2.25E-02	2.25E-02	2.25E-02	2.25E-02
								Dose Commitment (mrem) =		1.40E-01	2.14E-01	1.48E-01	2.25E-02	8.73E-02	4.40E-02	2.62E-02

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

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

Adult Dose from Shorline Sediment Pathway (mrem) = Shorline 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)				(mrem)	
Radionuclide	T. Body	Skin	Indicator Location	Sediment (pCi/kg)	T. Body	Skin
Mn-54	5.81E-09	6.80E-09	067	69.6	3.88E-05	4.54E-05
Co-58	7.00E-09	8.20E-09	ALL	0.00	0.00E+00	0.00E+00
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	063	57.70	2.33E-05	2.71E-05
	Dose Commitment (mrem) =				6.21E-05	7.26E-05

5.0 QUALITY ASSURANCE

5.1 SAMPLE COLLECTION

The ONS Chemistry Section performed the environmental sample collections as specified by approved sample collection procedures. The Duke Power Fisheries group assisted in fish sample collection.

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 all tritium analyses.

5.5 DUKE POWER INTERCOMPARISON PROGRAM

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

5.6 DUKE POWER AUDITS

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

5.7 U.S. NUCLEAR REGULATORY COMMISSION INSPECTIONS

The Oconee Nuclear Station Radiological Environmental Monitoring Program was audited by the NRC in March of 1999 (reference 6.13). There were no recommendations as a result of this audit. The inspectors concluded environmental monitors were being maintained in an operational condition to comply with Technical Specification requirements and UFSAR commitments. EnRad Laboratories was not audited by the NRC in 1999.

5.8 STATE OF SOUTH CAROLINA INTERCOMPARISON PROGRAM

Oconee Nuclear Station routinely participates with the Bureau of Radiological Health of the State's Department of Health and Environmental Control (DHEC) in an intercomparison program. Water, milk, vegetation, sediment, and fish samples collected by ONS Chemistry are routinely split with DHEC for intercomparison analysis. DHEC collects air samples near two of the locations sampled for air by ONS. Results of the analyses performed on split and duplicate samples are sent to DHEC.

5.9 TLD INTERCOMPARISON PROGRAM

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

TABLE 5.0

DUKE POWER COMPANY
INTERLABORATORY COMPARISON PROGRAM

1999 CROSS-CHECK RESULTS FOR
ENRAD LABORATORIES

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

Gamma in Water 3.5 liters

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

Gamma in Water 1.0 liter

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

Gamma in Water 0.5 liter

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

Gamma in Water 0.5 liter continued

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

Gamma in Filter

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

Iodine in Water

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

Iodine in Milk

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

Iodine Cartridge

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

Beta in Water

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

Beta Smear

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

Tritium in Water

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

6.0 REFERENCES

6.1 Oconee Selected License Commitments

6.2 Oconee Technical Specifications

6.3 Oconee Updated Final Safety Analysis Report

6.4 Duke Power Company Offsite Dose Calculation Manual

6.5 Oconee Annual Radiological Environmental Operating Report 1969-1998

6.6 Oconee Annual Radioactive Effluent Release Report 1999

6.7 Probability and Statistics in Engineering and Management Science, Hines and Montgomery, 1969, pages 287-293.

6.8 Practical Statistics for the Physical Sciences, Havilcek and Crain, 1988, pages 83-93.

6.9 Nuclear Regulatory Commission Regulatory Guide 1.109, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purposes of Evaluating Compliance with 10CFR50, Appendix I.

6.10 EnRad Laboratories Operating Procedures

6.11 RETDAS, Radiological Effluent Tracking and Dose Assessment Software, Vertechs Version 3.5.0, Duke Power Revision # 3.0

6.12 Oconee Environmental Chemistry Operating Procedures

6.13 NRC Integrated Inspection Report 50-269/99-02, 50-270/99-02, 50-287/99-02

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 Oconee Nuclear Station is 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 ONS Environmental Chemistry, EnRad Laboratories, Dosimetry and Records, and Fisheries.

Section IV of this appendix describes the environmental sampling frequencies and analysis procedures by media type.

I. CHANGE OF SAMPLING PROCEDURES

Changes to the sampling procedure concerning the broadleaf vegetation sampling program were implemented effective 1/5/99. Control location 073 was discontinued effective 1/5/99 due to construction at this location. Broadleaf vegetation control location 081was added to the sampling program effective 8/17/98 and was the control location for the entire 1999 monitoring period.

II. DESCRIPTION OF ANALYSIS PROCEDURES

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

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

Tritium analyses are performed quarterly by using low-level environmental liquid scintillation analysis technique on a Packard 2550 liquid scintillation system. Tritium

samples are batch processed with a tritium spike to verify instrument performance and sample preparation technique are acceptable.

Gross beta analysis is performed by concentrating a designated aliquot of sample precipitate and analyzing by gas-flow proportional counters. Samples are batch processed with a blank to ensure sample contamination has not occurred.

III. CHANGE OF ANALYSIS PROCEDURES

No analysis procedures were changed during 1999.

IV. SAMPLING AND ANALYSIS PROCEDURES

A.1 AIRBORNE PARTICULATE AND RADIOIODINE

Airborne particulate and radioiodine samples at each of seven 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 weekly gamma analysis was performed on each charcoal cartridge and a weekly gross beta analysis was performed on each filter. Filters were segregated by location and a quarterly gamma analysis was performed on the filter composite. The continuous composite samples were collected from the locations listed below.

Location 060	=	New Greenville Water Intake Rd. (2.6 mi. NNE)
Location 074	=	Keowee Key Resort (2.3 mi. NNW)
Location 077	=	Skimmer Wall (1.0 mi. SW)
Location 078	=	Recreation Site (0.6 mi. WSW)
Location 079	=	Keowee Dam (0.5 mi. NE)
Location 081	=	Clemson Operations Center (9.8 mi. SE)

A.2 DRINKING WATER

Monthly composite samplers were operated to collect an aliquot at least every two hours. Low-level Iodine-131, gross beta, and gamma analysis was performed on the monthly composites. Tritium analysis was performed on the quarterly composites. The composites were collected monthly from the locations listed below.

Location 060	=	New Greenville Water Intake Rd. (2.6 mi. NNE)
Location 064	=	Seneca (6.7 mi. SSW)
Location 066	=	Anderson (19.0 mi SSE)

A.3 SURFACE WATER

Monthly composite samplers were operated to collect an aliquot at least every two hours. Gamma analysis was performed on the monthly composites. Tritium analysis was performed on the quarterly composites sample. The composites were collected monthly from the locations listed below.

Location 062	=	Lake Keowee/Hydro Intake (0.8 mi. ENE)
Location 063	=	Lake Hartwell - Hwy 183 Bridge (0.8 mi. ESE)

A.4 MILK

Semimonthly grab samples were collected at each dairy. A gamma and low-level Iodine-131 analysis was performed on each sample. The semimonthly grab samples were collected from the locations listed below.

Location 069	=	Orr's Dairy - (4.5 mi. WNW)
Location 071	=	Clemson Dairy - (10.3 mi. SSE)
Location 080	=	Martin's Dairy - (19.0 mi. SSE)

A.5 BROADLEAF VEGETATION

Monthly samples were collected and a gamma analysis was performed on each sample. The samples were collected from the locations listed below.

Location 060	=	New Greenville Water Intake Rd. (2.6 mi. NNE)
Location 077	=	Skimmer Wall (1.0 mi. SW)
Location 079	=	Keowee Dam (0.5 mi. NE)
Location 081	=	Clemson Operations Center (9.8 mi. SE)

A.6 FISH

Semiannual samples were collected and a gamma analysis was performed on the edible portions of each sample. The samples were collected from the locations listed below.

Location 060	=	New Greenville Water Intake Rd. (2.6 mi. NNE)
Location 063	=	Lake Hartwell - Hwy 183 Bridge (0.8 mi. ESE)
Location 067	=	Lawrence Ramsey Bridge, Hwy 27 (4.2 mi. SSE)

A.7 SHORELINE SEDIMENT

Semiannual samples were collected and 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 063	=	Lake Hartwell - Hwy 183 Bridge (0.8 mi. ESE)
Location 067	=	Lawrence Ramsey Bridge, Hwy 27 (4.2 mi. SSE)
Location 068	=	High Falls County Park (2.0 mi. W)

A.8 DIRECT GAMMA RADIATION (TLD)

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

* An inner ring of 17 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 control locations.

TLD Locations are listed in Table 2.1-B.

A.9 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 following locations in each of the sixteen meteorological sectors:

* The Nearest Residence
* The Nearest Meat Animal
* The Nearest Milk-giving Animal (cow, goat, etc.) where milk is used for human consumption

The census was conducted during the growing season from 9/2 to 9/14/1999. Results are shown in Table 3.9.

APPENDIX B

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

SUMMARY OF RESULTS

1999

Environmental Radiological Monitoring Program Summary

Facility: Oconee Nuclear Station **Docket No. 50-269,270,287**

Location: Oconee County, South Carolina **Report Period: 01-JAN-1999 to 31-DEC-1999**

Medium or Pathway Sampled Unit of Measurement	Type and Total Number of Analyses Performed		Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction Location Code	 Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Air Particulate (pCi/m3)							081 (9.8 mi SE)	
	BETA	312	1.00E-02	2.28E-2 (260/260)	060	2.85E-2 (52/52)	2.23E-2 (52/52)	0
				7.16E-3 - 4.93E-2	(2.6 mi NNE)	1.47E-2 - 4.93E-2	5.56E-3 - 4.74E-2	
	CS-134	24	5.00E-02	0.00 (0/20)		0.00 (0/4)	0.00 (0/4)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137	24	6.00E-02	0.00 (0/20)		0.00 (0/4)	0.00 (0/4)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	I-131	24	7.00E-02	0.00 (0/20)		0.00 (0/4)	0.00 (0/4)	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: Oconee Nuclear Station **Docket No. 50-269,270,287**

Location: Oconee County, South Carolina **Report Period: 01-JAN-1999 to 31-DEC-1999**

Medium or Pathway Sampled Unit of Measurement	Type and Total Number of Analyses Performed		Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction Location Code	 Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Air Radioiodine (pCi/m3)							081 (9.8 mi SE)	
	CS-134	312	5.00E-02	0.00 (0/260)		0.00 (0/52)	0.00 (0/52)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137	312	6.00E-02	9.50E-3 (1/260)	078	9.50E-3 (1/52)	0.00 (0/52)	0
				9.50E-3 - 9.50E-3	(0.6 mi WSW)	9.50E-3 - 9.50E-3	0.00 - 0.00	
	I-131	312	7.00E-02	0.00 (0/260)		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: Oconee Nuclear Station **Docket No. 50-269,270,287**

Location: Oconee County, South Carolina **Report Period: 01-JAN-1999 to 31-DEC-1999**

Medium or Pathway Sampled Unit of Measurement	Type and Total Number of Analyses Performed		Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction Location Code	 Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Drinking Water (pCi/liter)							064 (6.7 mi SSW)	
	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	
	BETA	39	4	1.71 (19/26)	060	1.73 (8/13)	1.49 (8/13)	0
				0.80 - 3.33	(2.60 mi NNE)	0.80 - 3.33	0.74 - 2.66	
	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	15	2000	185 (3/10)	066	185 (3/5)	0.00 (0/5)	0
				163 - 203	(19.0 mi SSE)	163 - 203	0.00 - 0.00	
	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	
	LLI-131	39	1	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	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	

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: Oconee Nuclear Station **Docket No. 50-269,270,287**

Location: Oconee County, South Carolina **Report Period: 01-JAN-1999 to 31-DEC-1999**

Medium or Pathway Sampled	Type and Total Number of	Lower Limit of Detection	All Indicator Locations	Location with Highest Annual Mean Name, Distance, Direction		Control Location	No. of Non-Routine Report Meas.
Unit of Measurement	Analyses Performed	(LLD)	Mean (Fraction) Range	Location Code	Mean (Fraction) Range	Mean (Fraction) Range	
Surface Water (pCi/liter)						062 (0.8 mi ENE)	
BALA-140	26	15	0.00 (0/13)		0.00 (0/13)	0.00 (0/13)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
CO-58	26	15	27.3 (1/13)	063	27.3 (1/13)	0.00 (0/13)	0
			27.3 - 27.3	(0.8 mi ESE)	27.3 - 27.3	0.00 - 0.00	
CO-60	26	15	0.00 (0/13)		0.00 (0/13)	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 (0/13)	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 (0/13)	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 (0/13)	0.00 (0/13)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
H-3	10	2000	11315 (5/5)	063	11315 (5/5)	0.00 (0/5)	0
			828 - 44160	(0.8 mi ESE)	828 - 44160	0.00 - 0.00	
I-131	26	15	0.00 (0/13)		0.00 (0/13)	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 (0/13)	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 (0/13)	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 (0/13)	0.00 (0/13)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
ZR-95	26	30	0.00 (0/13)		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: Oconee Nuclear Station **Docket No. 50-269, 270, 287**

Location: Oconee County, South Carolina **Report Period: 01-JAN-1999 to 31-DEC-1999**

Medium or Pathway Sampled Unit of Measurement	Type and Total Number of Analyses Performed		Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction Location Code	 Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Milk (pCi/liter)							080 (19.0 mi SSE)	
	BALA-140	78	15	0.00 (0/52)		0.00 (0/26)	0.00 (0/26)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-134	78	15	0.00 (0/52)		0.00 (0/26)	0.00 (0/26)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137	78	18	0.00 (0/52)		0.00 (0/26)	0.00 (0/26)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	I-131	78	15	0.00 (0/52)		0.00 (0/26)	0.00 (0/26)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	LLI-131	78	1	0.00 (0/52)		0.00 (0/26)	0.00 (0/26)	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: Oconee Nuclear Station **Docket No. 50-269,270,287**

Location: Oconee County, South Carolina **Report Period: 01-JAN-1999 to 31-DEC-1999**

Medium or Pathway Sampled Unit of Measurement	Type and Total Number of Analyses Performed		Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction Location Code	 Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Broadleaf Vegetation (pCi/kg-wet)							081 (9.8 mi SE)	
	CS-134	48	60	0.00 (0/36)		0.00 (0/12)	0.00 (0/12)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137	48	80	66.8 (4/36)	060	134 (1/12)	0.00 (0/12)	0
				34.2 - 134	(2.6 mi NNE)	134 - 134	0.00 - 0.00	
	I-131	48	60	0.00 (0/36)		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: Oconee Nuclear Station **Docket No. 50-269,270,287**

Location: Oconee County, South Carolina **Report Period: 01-JAN-1999 to 31-DEC-1999**

Medium or Pathway Sampled Unit of Measurement	Type and Total Number of Analyses Performed		Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction Location Code	 Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Fish (pCi/kg-wet)							060 (2.6 mi NNE)	
	CO-58	12	130	0.00 (0/8)		0.00 (0/4)	0.00 (0/4)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CO-60	12	130	0.00 (0/8)		0.00 (0/4)	0.00 (0/4)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-134	12	130	0.00 (0/8)		0.00 (0/4)	0.00 (0/4)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS-137	12	150	80.2 (6/8)	063	104 (3/4)	20.5 (1/4)	0
				41.9 - 181	(0.8 mi ESE)	41.9 - 181	20.5 - 20.5	
	FE-59	12	260	0.00 (0/8)		0.00 (0/4)	0.00 (0/4)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	MN-54	12	130	0.00 (0/8)		0.00 (0/4)	0.00 (0/4)	0
				0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	ZN-65	12	260	0.00 (0/8)		0.00 (0/4)	0.00 (0/4)	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: Oconee Nuclear Station **Docket No. 50-269,270,287**

Location: Oconee County, South Carolina **Report Period: 01-JAN-1999 to 31-DEC-1999**

Medium or Pathway Sampled	Type and Total Number of	Lower Limit of Detection	All Indicator Locations	Location with Highest Annual Mean Name, Distance, Direction		Control Location	No. of Non-Routine Report Meas.
Unit of Measurement	Analyses Performed	(LLD)	Mean (Fraction) Range	Location Code	Mean (Fraction) Range	Mean (Fraction) Range	
Shoreline Sediment (pCi/kg-dry)						068 (2.0 mi W)	
	MN-54 6	0	46.1 (2/4)	067	69.6 (1/2)	0.00 (0/2)	0
			22.6 - 69.6	(4.2 mi SSE)	69.6 - 69.6	0.00 - 0.00	
	CS-134 6	150	0.00 (0/6)		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	59.3 (4/4)	063	73.8 (2/2)	16.1 (1/2)	0
			22.8 - 125	(0.8 mi ESE)	22.8 - 125	16.1 - 16.1	

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: Oconee Nuclear Station **Docket No. 50-269,270,287**

Location: Oconee County, South Carolina **Report Period: 01-JAN-1999 to 31-DEC-1999**

Medium or Pathway Sampled Unit of Measurement	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Annual Mean Name, Distance, Direction Location Code	 Mean (Fraction) Range	Control Location Mean (Fraction) Range	No. of Non-Routine Report Meas.
Direct Radiation TLD (mR/standard quarter)						058 (9.4 mi WSW) 081 (9.8 mi SE)	
	168	0.00E+00	20.1 (160/160)	059	26.7 (4/4)	26.0 (8/8)	0
			7.10 - 29.7	(9.2 mi NW)	24.9 - 28.3	20.1 - 31.7	

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

OCONEE NUCLEAR STATION
SAMPLING DEVIATIONS & UNAVAILABLE ANALYSES

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

C.1 SAMPLING DEVIATIONS

Air Particulate and Air Radioiodines

Location	Scheduled Collection Dates	Actual Collection Dates	Reason Code	Corrective Action
081	6/21 – 6/28/99	6/21 – 6/28/99	PI	Power failure to sampling equipment. Power was restored and normal sampling was resumed.

Surface Water

Location	Scheduled Collection Dates	Actual Collection Dates	Reason Code	Corrective Action
063	11/15 – 12/13/99	11/15 – 12/13/99	OT	Damage to sampling equipment from animal chewing intake water line. Damaged portion of intake water line was replaced. Sampling equipment returned to service and normal sampling resumed.

C.2 UNAVAILABLE ANALYSES

There were no unavailable samples for 1999.

APPENDIX D

ANALYTICAL DEVIATIONS

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

APPENDIX E

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM RESULTS

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