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DUKE POWER

April 23, 1997

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

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Pursuant to Oconee Nuclear Station Technical Specification 6.6.1.5, please find enclosed the Oconee Nuclear Site Annual Radiological Environmental Operating Report for 1996.

Very truly yours,

J. W. Hampton

1/1
C001

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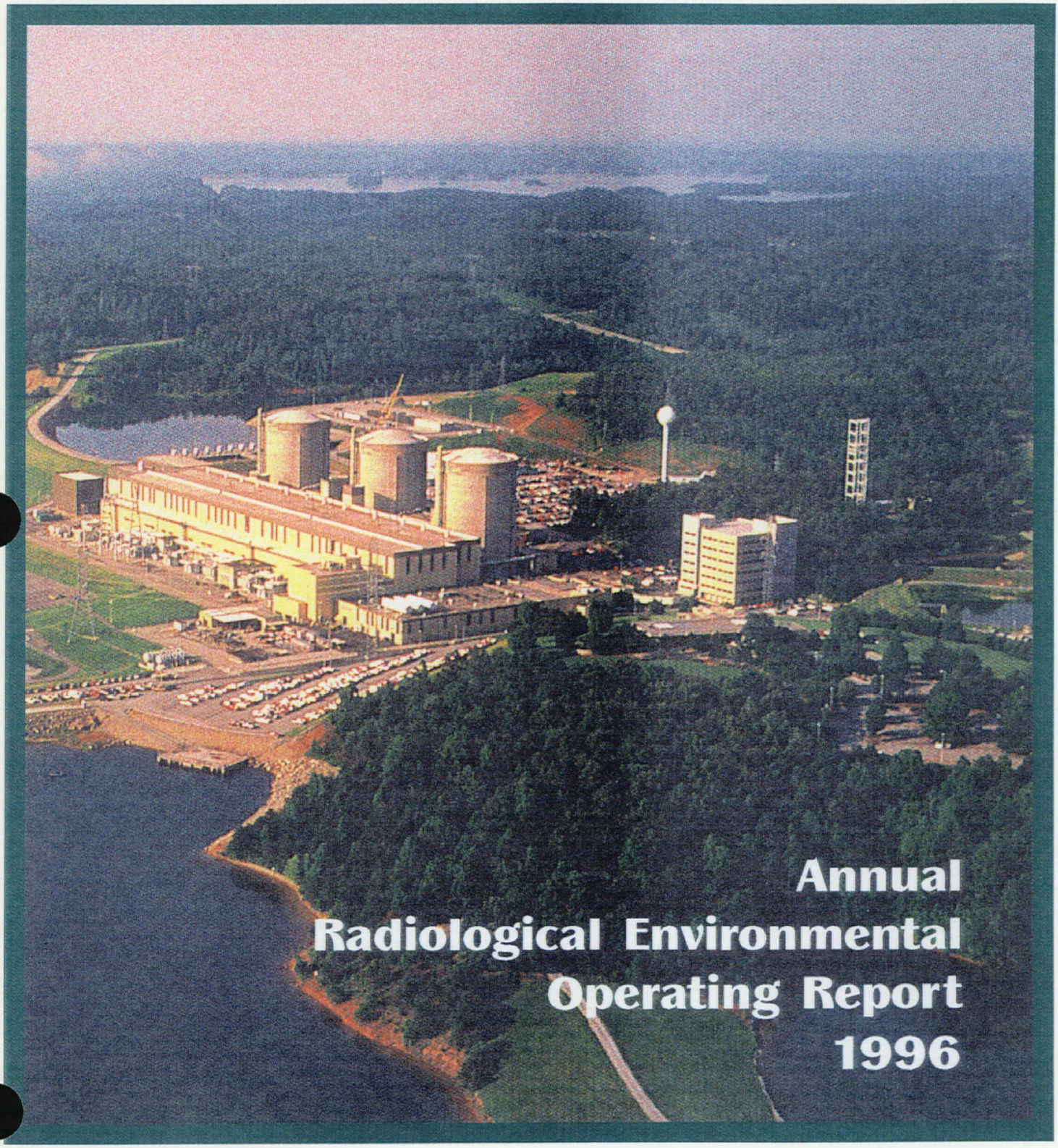


Annual Radiological Environmental Operating Report 1996

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

for

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

January 1 - December 31

1996

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

Acronyms and their interpretations used in this report (displayed alphabetically)

ACRONYM	DEFINITION
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
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 1996.

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

Sampling activities were conducted as prescribed by Selected Licensee Commitments (SLC's). Required analyses were performed and detection capabilities were met for all samples as required by SLC's. Supplemental analyses were performed for some media for additional information. One-thousand forty samples were analyzed comprising 3825 test results in order to compile data for the 1996 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 1996 for station related radionuclides were within the ranges of concentrations observed in the past. Inspection of data showed that radioactivity concentrations in surface water, drinking water, shoreline sediment, and fish are higher than the activities reported for samples collected prior to the operation of the station. Measured concentrations were not higher than expected, and all positively identified measurements were within limits as specified in 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 2.78E-01 mrem for 1996. It is therefore concluded that station operations has had no significant radiological impact on the health and safety of the public or the environment.

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 7/15/73. Unit 2 began commercial operation 9/09/74, and Unit 3 on 12/16/74.

Site specific locations for the Radiological Environmental Monitoring Program are defined in the Duke Power Company Offsite Dose Calculation Manual (ODCM). Figure 2.1-1 is a map depicting the Thermoluminescent Dosimeter (TLD) monitoring locations and the sampling locations within a one mile radius of the site. 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. Figure 2.1-2 is a map showing the TLD locations and sampling locations within a 10 mile radius of the site. Table 2.1-B lists the locations of all the TLDs.

2.2 SCOPE AND REQUIREMENTS OF ENVIRONMENTAL MONITORING PROGRAM

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.

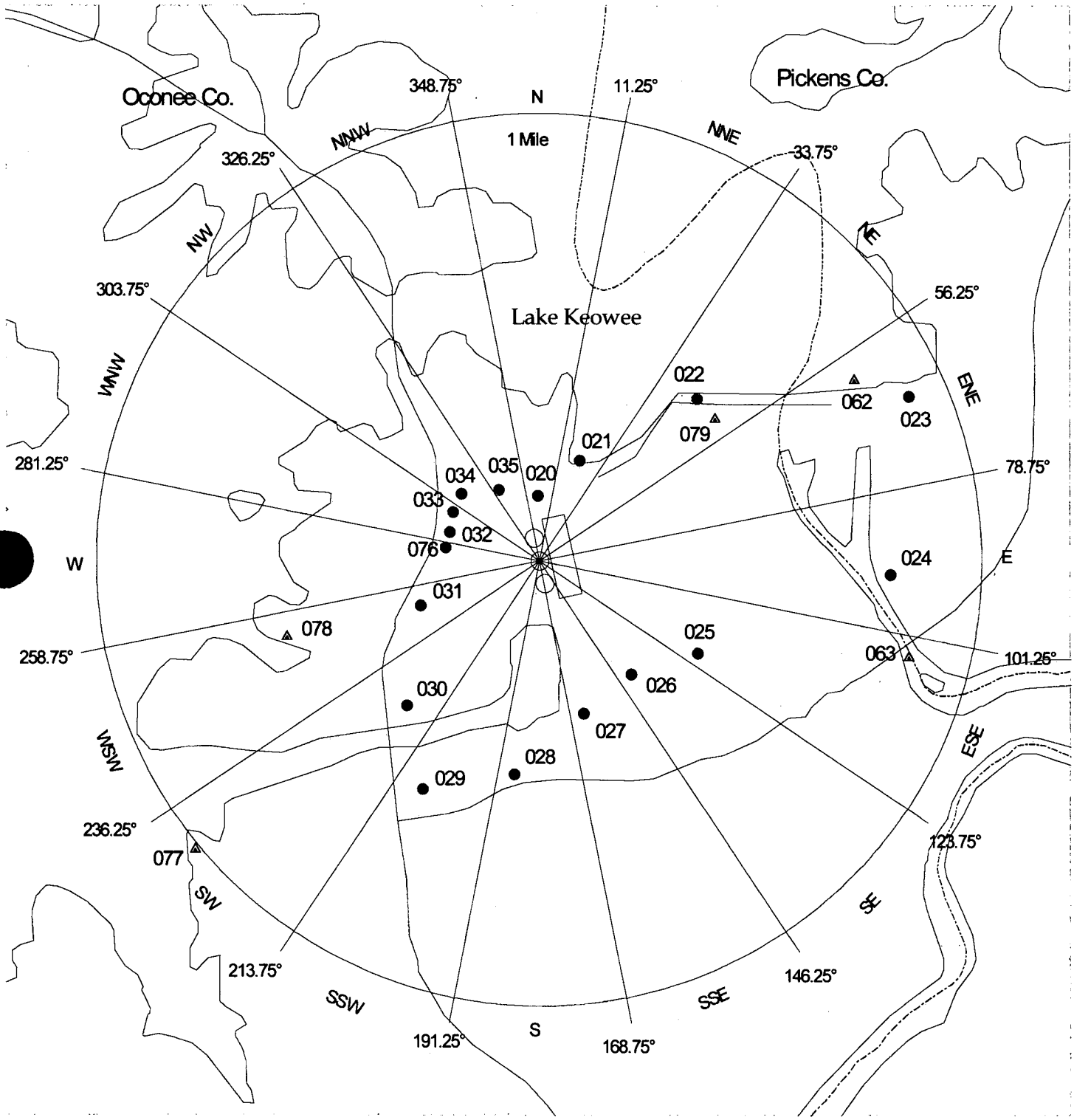
CL - The CL is defined as the net count rate which must be exceeded before a sample is considered to contain any measurable activity above the background.

2.3.3 TREND IDENTIFICATION

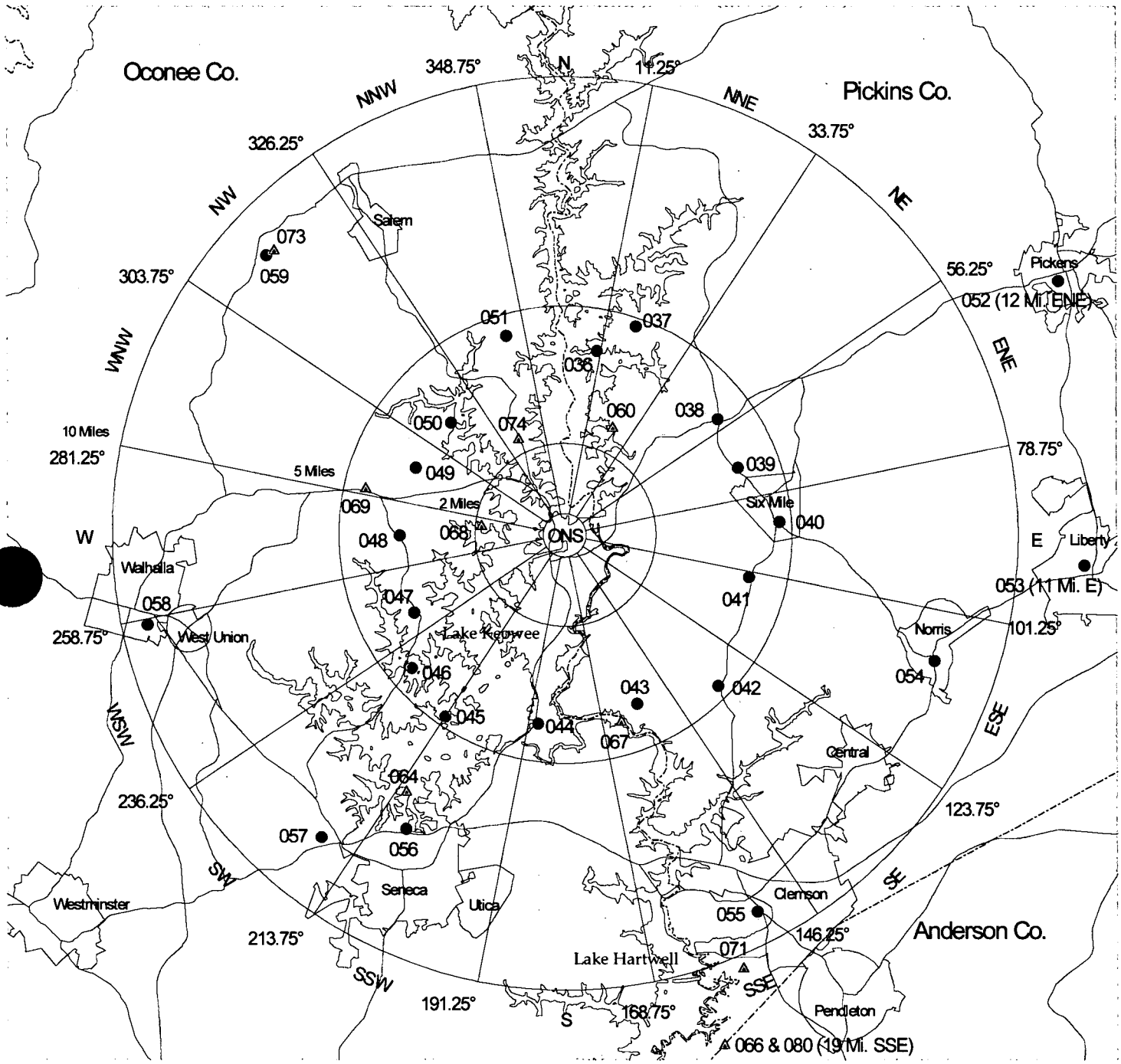
One of the purposes of an environmental monitoring program is to determine if there is a buildup of radionuclides in the environment due to the operation of the nuclear station. Visual inspection of tabular or graphical presentations of data (including preoperational) is used to determine if a trend exists. Since nuclear reactor operations do not remove radioactivity from the surrounding environment, 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)



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 2.1-1 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
028	Site Boundary (0.5 mi S)							M(a)
060	Greenville Water Intake Road (2.6 mi NNE)*	W		M		SA		M(a)
062 C	Lake Keowee Hydro Intake (0.8 mi ENE)		M					
	Lake Hartwell Hwy 183 Bridge (0.8 mi ESE) [000.7]		M		SA	SA		
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	
073 C	Tamassee DAR School (9.2 mi NW)	W						M(a)
074	Keowee Key Resort (2.3 mi NNW)	W						
077	Skimmer Wall (1.0 mi SW)	W						M(a)
078	Recreation Site (0.6 mi WSW)	W						
079	Keowee Dam (0.5 mi NE)	W						M(a)
080C	Martin Dairy (19.0 mi SSE)						SM	

(a) When Available
* Control for Fish Only
[ ] Location Numbers prior to 1984

TABLE 2.1-B

OCONEE RADIOLOCICAL MONITORING PROGRAM
SAMPLING LOCATIONS

(TLD SITES)

Site #	Location Description		Site #:	Location Description	
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
[illegible]	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	DPC BRANCH OFFICE - PICKENS	12.0 miles ENE
032	SITE BOUNDARY	0.2 miles WNW	053	DPC BRANCH OFFICE - LIBERTY	11.0 miles E
033	SITE BOUNDARY	0.2 miles WNW	054	POST OFFICE - HWY 93 NORRIS	9.5 miles ESE
034	SITE BOUNDARY	0.2 miles NW	055	CLEMSON METEOROLOGY PLOT	9.5 miles SSE
035	SITE BOUNDARY	0.2 miles NNW	056	WATER TOWER - SENECA	8.4 miles SSW
036	MILE CREEK LANDING	4.0 miles N	057C	OCONEE MEMORIAL HOSPITAL	9.0 miles SW
037	KEOWEE CHURCH, HWY 327	4.5 miles NNE	058	BRANCH RD SUBSTATION WALHALLA, CONTROL	9.4 miles WSW
038	DURHAM CONVENIENCE MART, JCT HWY 183 & 133	4.0 miles NE	059	TAMASSEE DAR SCHOOL	9.2 miles NW
039	HWY 133, 1 MILE EAST OF JCT HWY 183 & 133	4.0 miles ENE			

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)
H3	20,000[a]				
Mn54	1,000		30,000		
Fe59	400		10,000		
Co58	1,000		30,000		
Co60	300		10,000		
Zn65	300		20,000		
Zr-Nb-95	400				
I131	2[b]	1		3	100
Cs134	30	10	1,000	60	1,000
Cs137	50	20	2,000	70	2,000
Ba-La-140	200			300	

(a) *For drinking water samples. 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 and Particulates	Weekly	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				
dleaf Vegetation	Monthly (when available)	X				

TABLE 2.2-C

LOWER LIMIT OF DETECTION (LLD)
CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS

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					
H3	2000					
Mn54	15		130			
Fe59	30		260			
Co58, 60	15		130			
Zn65	30		260			
Zr95	30					
Nb95	15					
I131	15[(a)]	0.07		1	60	
Cs134	15	0.05	130	15	60	150
Cs137	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 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM-DISCUSSION, INTERPRETATION AND TRENDING OF RESULTS

Review of 1996 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 1996 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 1996.

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 1996 was 57%, for surface water tritium collected during the third quarter 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 1996. Similarly, there was no significant increase in ambient background radiation levels in the surrounding areas.

3.1 AIRBORNE RADIOIODINE AND PARTICULATES

Gamma spectroscopy was performed on 311 fiber filters and charcoal cartridges collected during 1996. Five indicator locations and one control location were sampled.

There was no detectable I-131 in air samples in 1996. Table 3.1 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.

Table 3.1 Air Radioiodine Annual Mean Concentrations

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

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

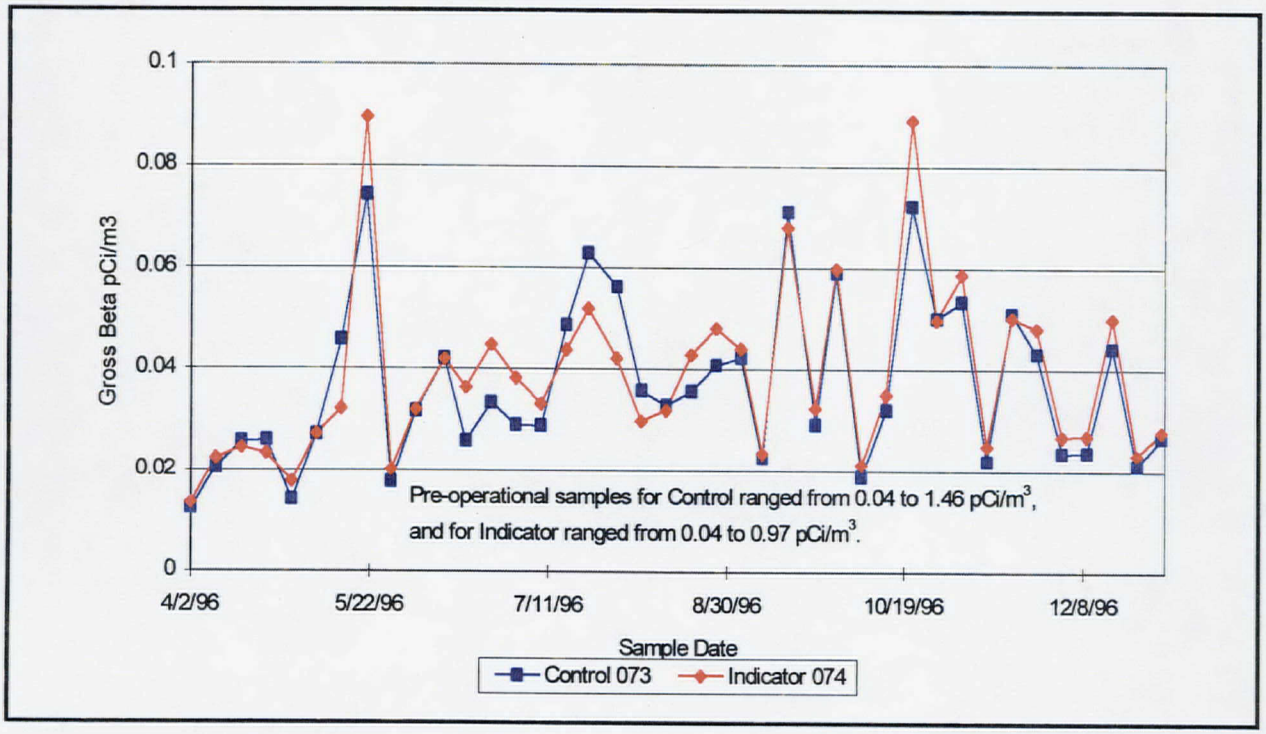
Cs-137 was detected in one indicator location cartridge sample at a concentration that was 0.08% of the reporting level. However, no Cs-137 was found on the corresponding particulate filter. This has occurred in the past. An investigation, performed in 1990, lead to

the conclusion that Cs-137 activity detected only on the cartridges was not attributed by station effluents but is an active constituent of the charcoal (reference 6.5). Therefore, the Cs-137 activity was not used in calculating the doses in Section 4.0. In 1995, Cs-137 was detected in two indicator and two control location cartridges with activities ranging 0.01% to 0.05% of the reporting level.

There were no detectable gamma emitting radionuclides detected in air particulate samples in 1996. No gamma emitting particulates have been detected in indicator location samples since the change in gamma spectroscopy analysis systems in 1987.

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

Figure 3.1 Air Particulate Gross Beta Concentrations



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

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 2.07 pCi/liter in 1996, and the control location had a similar concentration of 1.77 pCi/liter. The 1995 indicator mean was 5.1 pCi/liter. The table shows that 1996 gross beta levels in drinking water are slightly lower than preopreational concentrations.

Table 3.2 Drinking Water Annual Mean Concentrations

Year	Gross Beta pCi/liter		Tritium pCi/liter	
	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

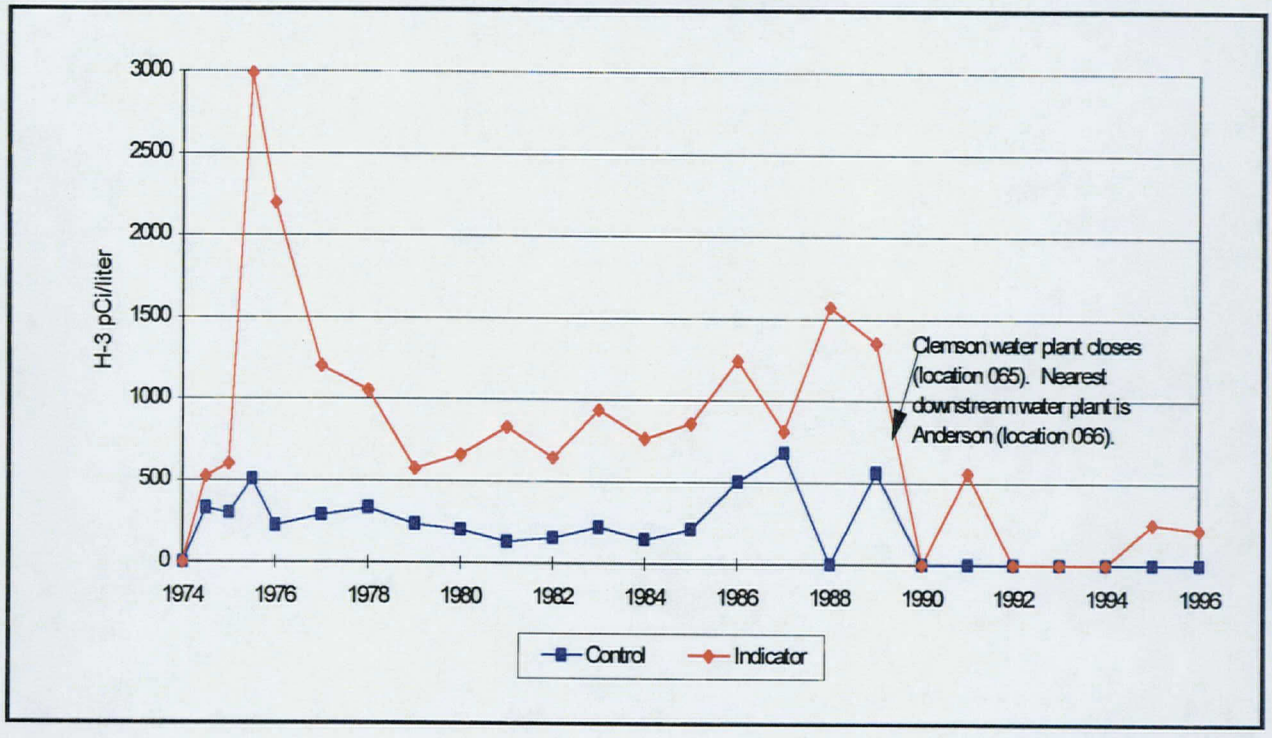
0.00 = no detectable measurements

1979 - 1986 mean based on all net activity results

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

Low levels of Tritium were detected in three of the five downstream indicator location samples in 1996. The mean concentration was 214 pCi/liter, which is 1.07% of the reporting level. No Tritium was detected in drinking water samples from other locations. In 1995, the majority of the samples from the downstream location contained Tritium with a mean concentration of 248 pCi/liter. 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.

Figure 3.2 Drinking Water Tritium Concentrations



There were no gamma emitting radionuclides identified in drinking water samples in 1996. 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.

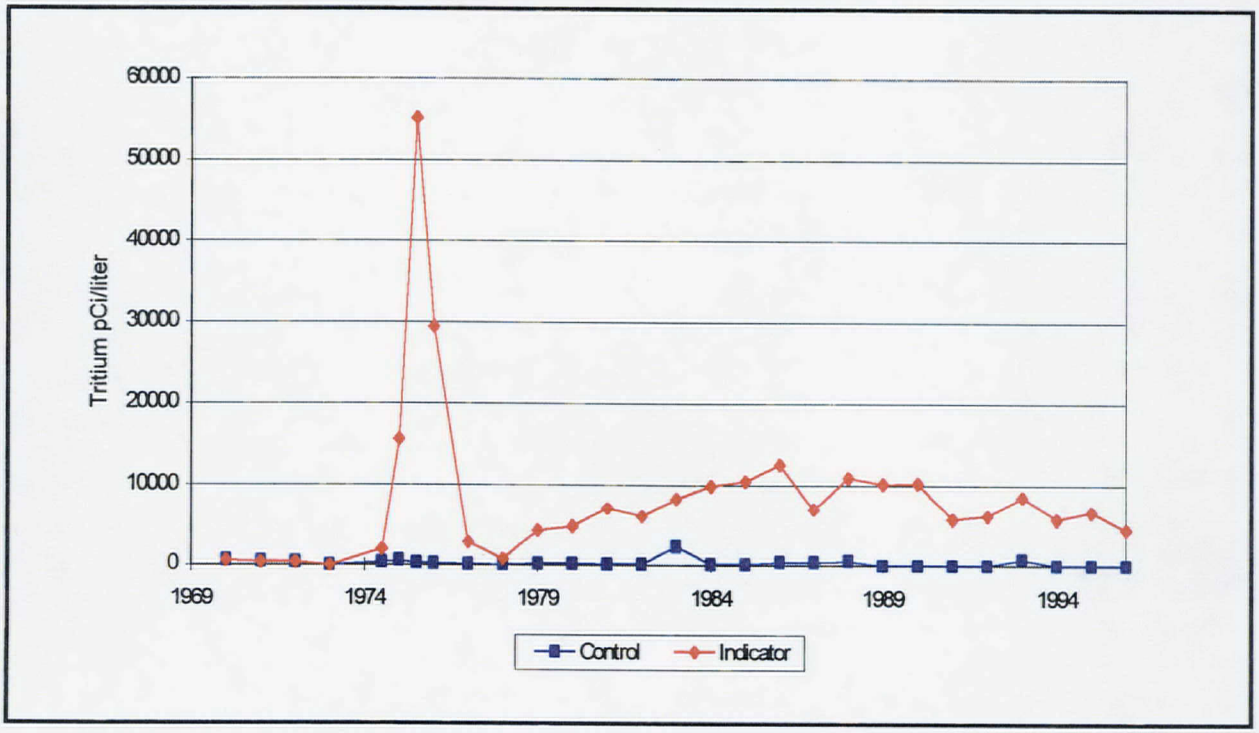
3.3 SURFACE WATER

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.

Only Tritium was detected in the samples. All five indicator location samples contained Tritium. The 1996 average concentration was 4535 pCi/liter. This is 23% of the reporting level for Tritium in drinking water. The individual samples ranged from 3.6% to 57% of the reporting level. The 1995 mean concentration was 6650 pCi/liter. Tritium was not detected in any control samples.

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 are not increasing.

Figure 3.3 Surface Water Tritium Concentrations



Gamma spectroscopy analysis has not detected any 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 1996 did not reveal any increasing trends.

K-40 is the naturally occurring radionuclide observed in surface water samples in 1996.

Table 3.3 Surface Water Annual Mean Concentrations

Year	Co-58 pCi/liter	Co-60 pCi/liter	Nb-95 pCi/liter	Cs-137 pCi/liter	H-3 pCi/liter
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

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 1996. Two indicator and one control location were sampled.

There were no gamma emitting radionuclides identified in indicator location samples in 1996. Cs-137 was detected in one of the control location samples at a concentration of 4.1 pCi/liter (6% of the reporting level). 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. In 1995, one indicator and one control sample contained Cs-137 with the maximum result being 2.3 pCi/liter.

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. Cs-137 is the only radionuclide, other than naturally occurring K-40, reported in milk samples since 1988.

TABLE 3.4 Milk Annual Mean Concentrations

Year	Indicator Location Cs-137 pCi/liter	Control Location Cs-137 pCi/liter
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

0.00E0 = no detectable measurements

1979 - 1986 mean based on all net activity results

3.5 BROADLEAF VEGETATION

Gamma spectroscopy was performed on 70 broadleaf vegetation samples during 1996. Four indicator locations and one control were sampled. Cs-137 was reported in indicator and control location samples. No other effluent related radionuclide was identified.

Cs-137 was detected more often and in higher concentrations for control Location 073 samples. The majority of control location samples contained Cs-137 with an annual mean of 183 pCi/kg (9% of reporting level). The highest concentration identified was 409 pCi/kg. Four of the fifty-six indicator location samples contained Cs-137. The highest concentration was 63.3 pCi/kg (3% of the reporting level). These results are similar to those reported in 1995.

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. Their 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.

Table 3.5 Vegetation Annual Mean Concentrations

Year	Indicator Location Cs-137 pCi/kg	Control Location Cs-137 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

Only qualitative results reported prior to 1974
Control location changed to 073 in 1984
1979 - 1986 mean based on all net activity results

3.6 SHORELINE SEDIMENT

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

Co-58 and Cs-134 were detected in samples from the indicator location closest to the effluent release point. Cs-137 was identified in both indicator and control location samples. The 1996 control location result for Cs-137 was 23.2 pCi/kg. Table 3.6 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.

Table 3.6 Shoreline Sediment Annual Mean Concentrations, 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

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

Visual inspection of the tabular data did not reveal any trends. Figure 3.6-1 is a graph of the Cs-137 annual means. Figure 3.6-2 is a graph of the Co-60 annual means. 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.

The 1996 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.

Figure 3.6-1 Shoreline Sediment Cs-137 Concentrations

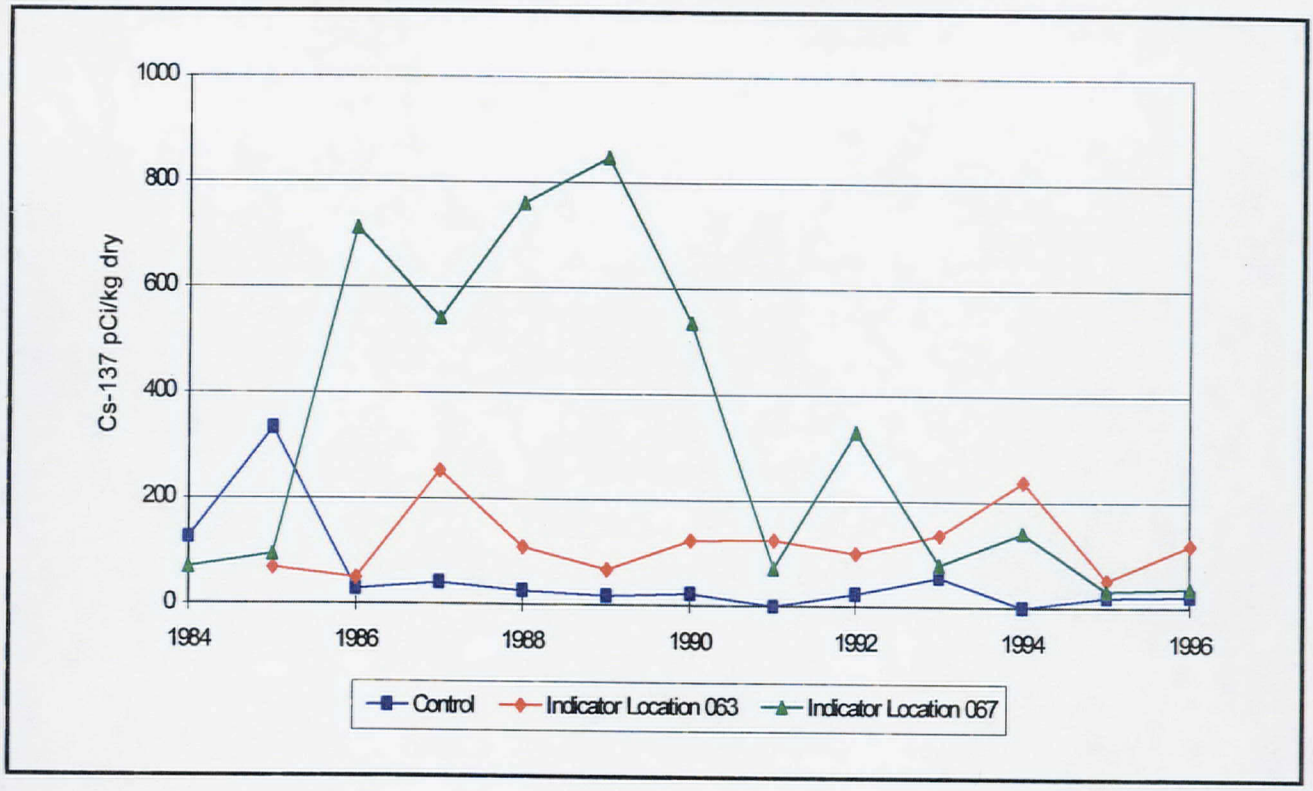
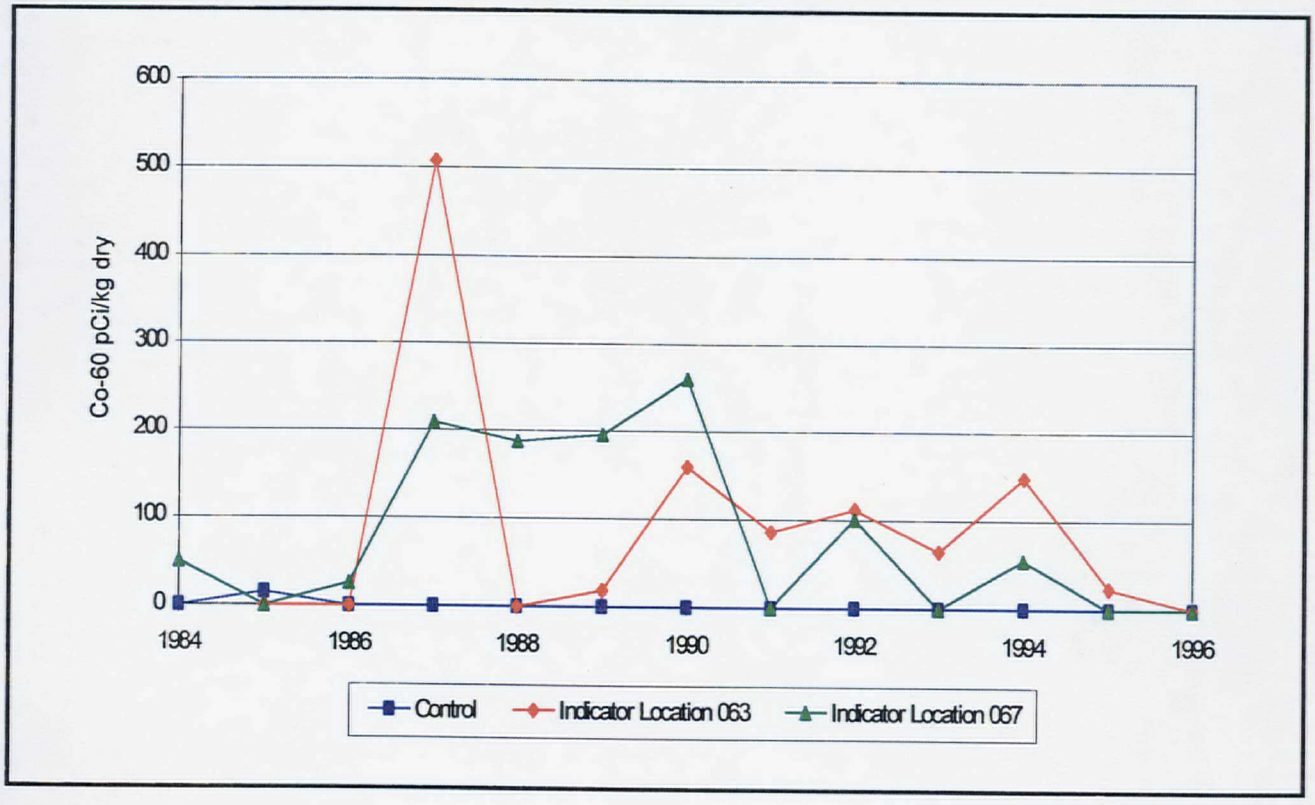


Figure 3.6-2 Shoreline Sediment Co-60 Concentrations



3.7 FISH

Gamma spectroscopy was performed on 12 fish samples. Two downstream indicator and one control location were sampled. Cs-137 was identified in all the indicator location samples and half of the control location samples. Cs-134 was the only other effluent related radionuclide identified. Cs-134 was found in 40% of the indicator samples. The highest average concentration for Cs-134 was 44.9 pCi/kg (4.5% of reporting level) and for Cs-137 was 125 pCi/kg (6.3% of reporting level). The highest individual sample concentration for Cs-137 was 245 pCi/kg (12.3 % of reporting level). The control Cs-137 concentration was 32.6 pCi/kg. 1995 sample results for all locations are essentially the same.

Table 3.7 lists the highest indicator location annual means since the preoperational period for radionuclides detected in 1996. 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.

Table 3.7 Fish Annual Mean Concentrations pCi/kg

Year	Co-58	Co-60	Cs-134	Cs-137
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

0.00E0 = no detectable measurements

1979 - 1986 mean based on all net activity results

Figures 3.7-1 and 3.7-2 are graphs displaying the annual means for Cs-137 and Cs-134. 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.

Figure 3.7-1 Fish Cs-137 Concentrations

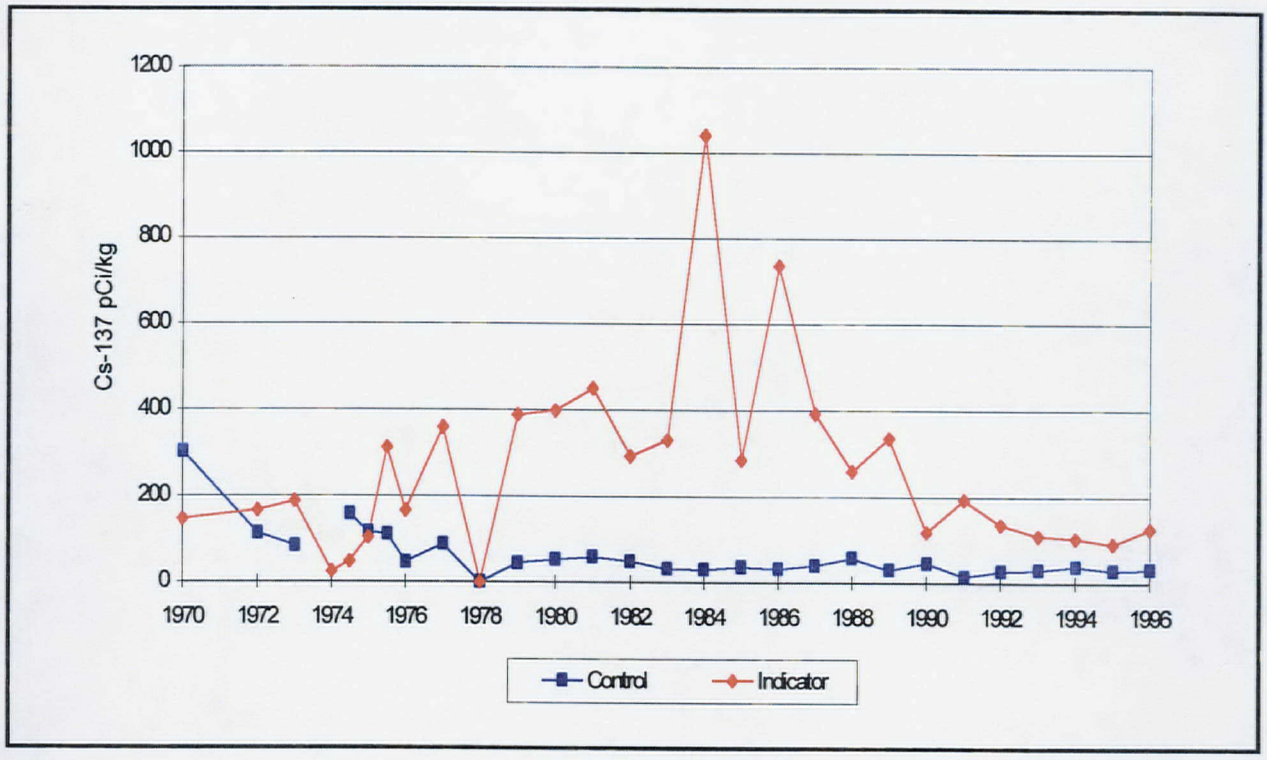
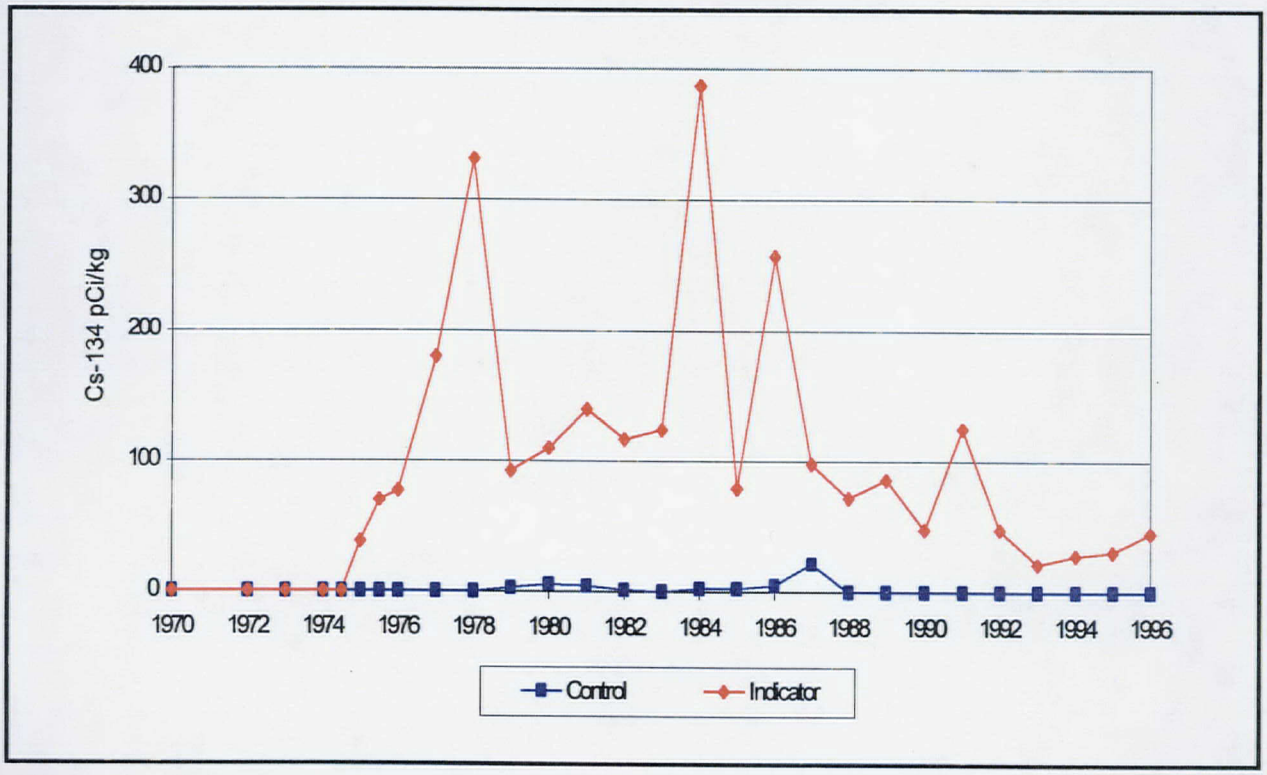


Figure 3.7-2 Fish Cs-134 Concentrations

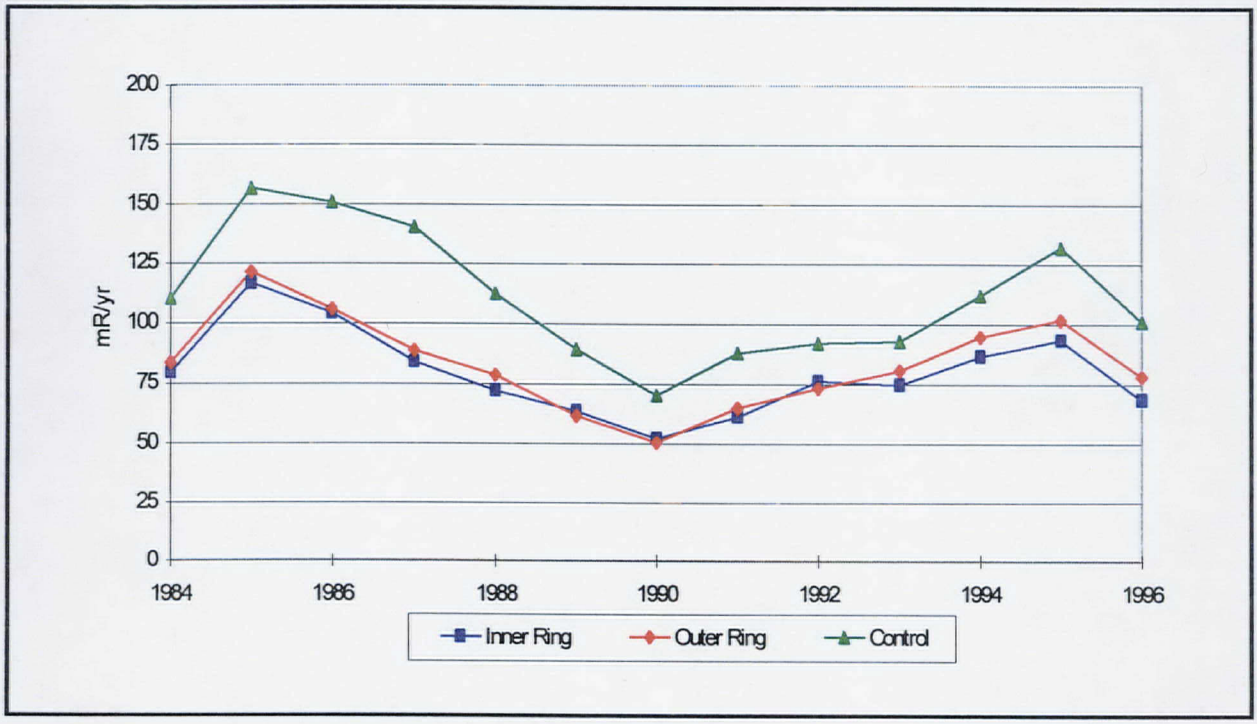


3.8 DIRECT GAMMA RADIATION

Thermoluminescent Dosimeter (TLD) measurements for direct gamma radiation were made each quarter at forty-one locations. Many of the TLDs are placed at the same site used by the NRC in their TLD Direct Radiation Monitoring Network. All but two of the TLDs placed in the field were recovered and processed. The highest annual mean exposure for an indicator location was 110 milliroentgen. This TLD is located at indicator location 052, 12 miles from the station. The annual mean exposure for the control location was also 101 milliroentgen.

Figure 3.8 and Table 3.8 show TLD inner ring, outer ring, and control locaiton 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 one location.

Figure 3.8 Direct Gamma Radiation (TLD) Results



In addition, the calculated total body dose (from gaseous effluents) for 1996 was 1.66E-3 mrem. This is <0.01% of the measured TLD values. It can be concluded that discharges from ONS had very little impact upon the measured TLD values.

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

3.9 LAND USE CENSUS

The Land Use Census was conducted during August in 1996. The census results are contained in Table 3.9. No program changes were required based on the results of the census.

TABLE 3.9 LAND USE CENSUS RESULTS

Dates(s) Performed: 8-14-96, 8-15-96

Sector		Distance (Miles)	Sector		Distance (Miles)
	Nearest Residence	2.98		Nearest Residence	1.85
	Nearest Beef Cow	-		Nearest Beef Cow	-
N			S		
	Nearest Milk Cow	-		Nearest Milk Cow	-
	Nearest Milk Goat	-		Nearest Milk Goat	-
	Nearest Residence	2.39		Nearest Residence	1.33
	Nearest Beef Cow	3.50		Nearest Beef Cow	-
NNE			SSW		
	Nearest Milk Cow	-		Nearest Milk Cow	-
	Nearest Milk Goat	-		Nearest Milk Goat	-
	Nearest Residence	1.44		Nearest Residence	1.50
	Nearest Beef Cow	4.25		Nearest Beef Cow	1.50
NE			SW		
	Nearest Milk Cow	-		Nearest Milk Cow	-
	Nearest Milk Goat	-		Nearest Milk Goat	-
	Nearest Residence	1.25		Nearest Residence	1.79
	Nearest Beef Cow	3.25		Nearest Beef Cow	1.80
ENE			WSW		
	Nearest Milk Cow	-		Nearest Milk Cow	-
	Nearest Milk Goat	-		Nearest Milk Goat	-
	Nearest Residence	1.16		Nearest Residence	2.31
	Nearest Beef Cow	2.00		Nearest Beef Cow	-
E			W		
	Nearest Milk Cow	-		Nearest Milk Cow	-
	Nearest Milk Goat	-		Nearest Milk Goat	-
	Nearest Residence	1.67		Nearest Residence	1.33
	Nearest Beef Cow	1.90		Nearest Beef Cow	4.00
ESE			WNW		
	Nearest Milk Cow	-		Nearest Milk Cow	4.50
	Nearest Milk Goat	-		Nearest Milk Goat	-
	Nearest Residence	1.45		Nearest Residence	1.0
	Nearest Beef Cow	4.50		Nearest Beef Cow	-
SE			NW		
	Nearest Milk Cow	-		Nearest Milk Cow	-
	Nearest Milk Goat	-		Nearest Milk Goat	-
	Nearest Residence	1.55		Nearest Residence	1.56
	Nearest Beef Cow	4.80		Nearest Beef Cow	-
SSE			NNW		
	Nearest Milk Cow	-		Nearest Milk Cow	-
	Nearest Milk Goat	-		Nearest Milk Goat	-

4.0 EVALUATION OF DOSE FROM ENVIRONMENTAL MEASUREMENTS VERSUS ESTIMATED DOSE FROM RELEASES

4.1 DOSE FROM ENVIRONMENTAL MEASUREMENTS

Annual doses to maximum exposed individuals were estimated based on measured concentrations of radionuclides in 1996 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 calcualted using airborne radioiodine and particulates, drinking water, milk, 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.

REMP-based dose estimates of zero were reported for gaseous release pathway sample types. No radionuclides were detected in airborne radioiodine or particulate samples other than naturally-occurring K-40 and Be-7 or the Cs-137 from charcoal in the cartridges (Section 3.1). Similarly, no effluent related radionuclides were detected in milk or broadleaf vegetation samples in excess of that was detected in control location samples. Dose estimates were not calculated for surface water samples because surface water is not considered a potable drinking water source. Exposure based on REMP TLD results is discussed in Section 3.8.

Maximum 1996 REMP-based dose estimates for drinking water, fish and shoreline sediment sample results were summed to determine the maximum total dose for the liquid effluent release pathways. 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 1996 liquid and gaseous effluent release data. Effluent-based dose estimates were calculated using the LADTAP and GASPAR computer programs which employ methodology and data presented in NRC Regulatory Guide 1.109. The 1996 ONS Annual Radioactive Effluent Release Report (reference 6.6) included calendar year dose estimates for the maximum exposed individual from liquid and gaseous effluent releases. These reported doses are shown in Table 4.1-A along with the corresponding REMP-based dose estimates.

The effluent-based liquid release doses are summations of the dose contributions from the drinking water, fish and shoreline sediment 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 1996 ONS Annual Radioactive Effluent Release Report lists the maximum total organ dose for the highest dose location, but only for the maximum organ for the critical age group. The child's thyroid was the maximum organ in 1996. Effluent-based dose estimates for organs other than the thyroid are not reported in the iodine, particulate, and tritium exposure summary.

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 is the predominant dose path based on environmental and effluent samples. The maximum total organ dose based on 1996 sample results was 3.81E-1 mrem to the teen's liver. The fish pathway accounted for 97% of the total liver dose. Similarly, the maximum total organ dose for liquid effluent-based estimates was slightly higher at 4.75E-1

mrem, also to the teen's liver due to fish consumption. The radionuclides contributing the majority of both estimates are Cs-134 and Cs-137.

For most organs, liquid effluent doses are higher than REMP data doses. The REMP-based lung and thyroid doses exceed the effluent-based doses, however the dose estimates and their differences are small. The lung effluent lung dose was 98% of the REMP-based estimate. The effluent thyroid dose was 22% of the REMP-based estimate. The major contributors to the effluent thyroid dose due to fish consumption were I-131, H-3, Co-60 and Sb-125. These were not detected in any actual fish samples. Iodine was also not detected in any drinking water samples leaving Tritium as the contributor to the REMP-based drinking water dose.

A zero dose value is given for gaseous release pathway doses based on environmental results due to the absence of activity in the pathway samples that could be attributed to station operations. Vegetation ingestion is the critical path for the effluent-based doses, with the child being the critical age. The major contributors to the effluent vegetation doses are I-131 (57.4% of the dose) and Tritium (39.6% of the dose). No I-131 was detected in broadleaf vegetation samples or any other gaseous release pathway samples. Tritium analysis is not performed on gaseous release pathway samples. Noble gas samples are not collected as part of the REMP, preventing an analogous comparison of effluent-based noble gas exposure estimates.

Doses from all sampled paths were summed. 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 guidelines.

TABLE 4.1-A

1996 ENVIRONMENTAL AND EFFLUENT DOSE COMPARISON FOR LIQUID AND GASEOUS WASTE RELEASE PATHWAYS

LIQUID RELEASE PATHWAY

Organ	Environmental or Effluent Data	Critical Age	Critical Pathway	Maximum Dose* (mrem)
Skin	Environmental	Teen	Shoreline Sediment	6.24E-04
Skin	Effluent	Teen	Shoreline Sediment	1.91E-03
Bone	Environmental	Child	Fish	2.81E-01
Bone	Effluent	Child	Fish	3.88E-01
Liver	Environmental	Teen	Fish	3.81E-01
Liver	Effluent	Teen	Fish	4.75E-01
T. Body	Environmental	Adult	Fish	2.78E-01
T. Body	Effluent	Adult	Fish	3.23E-01
Thyroid	Environmental	Child	Drinking Water	2.80E-02
Thyroid	Effluent	Teen	Fish	6.07E-03
Kidney	Environmental	Adult	Fish	1.42E-01
Kidney	Effluent	Teen	Fish	1.61E-01
Lung	Environmental	Teen	Fish	6.53E-02
Lung	Effluent	Teen	Fish	6.39E-02
GI-LLI	Environmental	Adult	Drinking Water	3.20E-02
GI-LLI	Effluent	Adult	Fish	9.21E-02

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

GASEOUS RELEASE PATHWAY

Organ	Environmental or Effluent Data	Critical Age	Critical Pathway	Maximum Dose (mrem)
		NOBLE GAS EXPOSURE		
Skin	Environmental	-	-	Not Sampled
Skin	Effluent	N/A	Noble Gas	4.61E-03
T. Body	Environmental	-	-	Not Sampled
T. Body	Effluent	N/A	Noble Gas	1.66E-03

Organ	Environmental or Effluent Data	Critical Age	Critical Pathway	Maximum Dose* (mrem)
		IODINE, PARTICULATE, and TRITIUM		
Bone	Environmental	-	-	0.00E+00
Liver	Environmental	-	-	0.00E+00
T. Body	Environmental	-	-	0.00E+00
Thyroid	Environmental	-	-	0.00E+00
Thyroid	Effluent	Child	Vegetation	6.44E-02
Kidney	Environmental	-	-	0.00E+00
Lung	Environmental	-	-	0.00E+00
GI-LLI	Environmental	-	-	0.00E+00

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

TABLE 4.1-B

Maximum Individual Dose for 1996 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	2.18E-02	2.18E-02	2.18E-02	2.18E-02	2.18E-02	2.18E-02	0.00E+00
	Milk	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	TOTAL	0.00E+00	2.18E-02	2.18E-02	2.18E-02	2.18E-02	2.18E-02	2.18E-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	2.22E-02	2.22E-02	2.22E-02	2.22E-02	2.22E-02	2.22E-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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Fish	2.81E-01	3.24E-01	6.03E-02	5.72E-03	1.08E-01	4.23E-02	7.61E-03	0.00E+00
	Shoreline Sediment	1.12E-04	1.12E-04	1.12E-04	1.12E-04	1.12E-04	1.12E-04	1.12E-04	1.30E-04
	TOTAL	2.81E-01	3.46E-01	8.26E-02	2.80E-02	1.30E-01	6.46E-02	2.99E-02	1.30E-04
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	1.16E-02	1.16E-02	1.16E-02	1.16E-02	1.16E-02	1.16E-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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Fish	2.26E-01	3.69E-01	1.49E-01	6.92E-03	1.27E-01	5.32E-02	1.18E-02	0.00E+00
	Shoreline Sediment	5.34E-04	5.34E-04	5.34E-04	5.34E-04	5.34E-04	5.34E-04	5.34E-04	6.24E-04
	TOTAL	2.27E-01	3.81E-01	1.61E-01	1.91E-02	1.39E-01	6.53E-02	2.39E-02	6.24E-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	1.64E-02	1.64E-02	1.64E-02	1.64E-02	1.64E-02	1.64E-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	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Fish	2.13E-01	3.60E-01	2.62E-01	9.00E-03	1.26E-01	4.79E-02	1.55E-02	0.00E+00
	Shoreline Sediment	9.57E-05	9.57E-05	9.57E-05	9.57E-05	9.57E-05	9.57E-05	9.57E-05	1.12E-04
	TOTAL	2.13E-01	3.76E-01	2.78E-01	2.55E-02	1.42E-01	6.44E-02	3.20E-02	1.12E-04

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

Dose from Drinking Water Pathway for 1996 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	214.00	0.00E+00	2.18E-02	2.18E-02	2.18E-02	2.18E-02	2.18E-02	2.18E-02
						Dose Commitment (mrem) =				0.00E+00	2.18E-02	2.18E-02	2.18E-02	2.18E-02	2.18E-02	2.18E-02

Dose from Drinking Water Pathway for 1996 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	214.00	0.00E+00	2.22E-02	2.22E-02	2.22E-02	2.22E-02	2.22E-02	2.22E-02
						Dose Commitment (mrem) =				0.00E+00	2.22E-02	2.22E-02	2.22E-02	2.22E-02	2.22E-02	2.22E-02

Dose from Fish Pathway for 1996 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/l = 4535 pCi/l x 0.9 = 4082 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	067	44.90	7.25E-02	1.19E-01	2.51E-02	0.00E+00	3.69E-02	1.32E-02	6.41E-04
Cs-137	3.27E-04	3.13E-04	4.62E-05	NO DATA	1.02E-04	3.67E-05	1.96E-06	063	92.40	2.08E-01	2.00E-01	2.95E-02	0.00E+00	6.50E-02	2.34E-02	1.25E-03
H-3	NO DATA	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	063	4082.00	0.00E+00	5.72E-03	5.72E-03	5.72E-03	5.72E-03	5.72E-03	5.72E-03
								Dose Commitment (mrem) =		2.81E-01	3.24E-01	6.03E-02	5.72E-03	1.08E-01	4.23E-02	7.61E-03

Dose from Shoreline Sediment Pathway for 1996 Data
Maximum Exposed Child

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

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

	External Dose Factor Standing on Contaminated Ground		Highest Annual Net Mean Concentration		Dose	
	(mrem/hr per pCi/m2)				(mrem)	
Radionuclide	T. Body	Skin	Indicator Location	Sediment (pCi/kg)	T. Body	Skin
Co-58	7.00E-09	8.20E-09	063	51.00	4.00E-05	4.68E-05
Cs-134	1.20E-08	1.40E-08	063	19.80	2.66E-05	3.10E-05
Cs-137	4.20E-09	4.90E-09	063	95.80	4.51E-05	5.26E-05
		Dose Commitment (mrem) =			1.12E-04	1.30E-04

Dose from Drinking Water Pathway for 1996 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	214.00	0.00E+00	1.16E-02	1.16E-02	1.16E-02	1.16E-02	1.16E-02	1.16E-02
						Dose Commitment (mrem)=				0.00E+00	1.16E-02	1.16E-02	1.16E-02	1.16E-02	1.16E-02	1.16E-02

Dose from Fish Pathway for 1996 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/l = 4535 pCi/l x 0.9 = 4082 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	067	44.90	6.01E-02	1.42E-01	6.57E-02	0.00E+00	4.50E-02	1.72E-02	1.76E-03
Cs-137	1.12E-04	1.49E-04	5.19E-05	NO DATA	5.07E-05	1.97E-05	2.12E-06	063	92.40	1.66E-01	2.20E-01	7.67E-02	0.00E+00	7.50E-02	2.91E-02	3.13E-03
H-3	NO DATA	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	063	4082.00	0.00E+00	6.92E-03	6.92E-03	6.92E-03	6.92E-03	6.92E-03	6.92E-03
						Dose Commitment (mrem) =				2.26E-01	3.69E-01	1.49E-01	6.92E-03	1.27E-01	5.32E-02	1.18E-02

Dose from Shoreline Sediment Pathway for 1996 Data
Maximum Exposed Teen

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

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

	External Dose Factor Standing on Contaminated Ground (mrem/hr per pCi/m2)		Highest Annual Net Mean Concentration		Dose (mrem)	
Radionuclide	T. Body	Skin	Indicator Location	Sediment (pCi/kg)	T. Body	Skin
Co-58	7.00E-09	8.20E-09	063	51.00	1.91E-04	2.24E-04
Cs-134	1.20E-08	1.40E-08	063	19.80	1.27E-04	1.49E-04
Cs-137	4.20E-09	4.90E-09	063	95.80	2.16E-04	2.52E-04
	Dose Commitment (mrem) =				5.34E-04	6.24E-04

Dose from Drinking Water Pathway for 1996 Data
Maximum Exposed Adult

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

Usage (intake in one year) = 730 l

	Ingestion Dose Factor							Highest Annual Net Mean Concentration		Dose (mrem)						
Radionuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Indicator Location	Water (pCi/l)	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	4.57E-06	8.72E-07	NO DATA	1.36E-06	NO DATA	1.40E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	7.45E-07	1.67E-06	NO DATA	NO DATA	NO DATA	1.51E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	4.34E-06	1.02E-05	3.91E-06	NO DATA	NO DATA	2.85E-06	3.40E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	2.14E-06	4.72E-06	NO DATA	NO DATA	NO DATA	4.02E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	4.84E-06	1.54E-05	6.96E-06	NO DATA	1.03E-05	NO DATA	9.70E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	6.22E-09	3.46E-09	1.86E-09	NO DATA	3.42E-09	NO DATA	2.10E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	3.04E-08	9.75E-09	6.60E-09	NO DATA	1.53E-08	NO DATA	3.09E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	NO DATA	1.57E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	6.22E-05	1.48E-04	1.21E-04	NO DATA	4.79E-05	1.59E-05	2.59E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	7.97E-05	1.09E-04	7.14E-05	NO DATA	3.70E-05	1.23E-05	2.11E-06	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BaLa-140	2.03E-05	2.55E-08	1.33E-06	NO DATA	8.67E-09	1.46E-08	4.18E-05	ALL	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	NO DATA	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	066	214.00	0.00E+00	1.64E-02	1.64E-02	1.64E-02	1.64E-02	1.64E-02	1.64E-02
						Dose Commitment (mrem) =				0.00E+00	1.64E-02	1.64E-02	1.64E-02	1.64E-02	1.64E-02	1.64E-02

Dose from Fish Pathway for 1996 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/l = 4535 pCi/l x 0.9 = 4082 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	067	44.90	5.86E-02	1.40E-01	1.14E-01	0.00E+00	4.52E-02	1.50E-02	2.44E-03
Cs-137	7.97E-05	1.09E-04	7.14E-05	NO DATA	3.70E-05	1.23E-05	2.11E-06	063	92.40	1.55E-01	2.12E-01	1.39E-01	0.00E+00	7.18E-02	2.39E-02	4.09E-03
H-3	NO DATA	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	063	4082.00	0.00E+00	9.00E-03	9.00E-03	9.00E-03	9.00E-03	9.00E-03	9.00E-03
						Dose Commitment (mrem) =				2.13E-01	3.60E-01	2.62E-01	9.00E-03	1.26E-01	4.79E-02	1.55E-02

Dose from Shoreline Sediment Pathway for 1996 Data
Maximum Exposed Adult

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

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

	External Dose Factor Standing on Contaminated Ground (mrem/hr per pCi/m2)		Highest Annual Net Mean Concentration		Dose (mrem)	
Radionuclide	T. Body	Skin	Indicator Location	Sediment (pCi/kg)	T. Body	Skin
Co-58	7.00E-09	8.20E-09	063	51.00	3.43E-05	4.01E-05
Cs-134	1.20E-08	1.40E-08	063	19.80	2.28E-05	2.66E-05
Cs-137	4.20E-09	4.90E-09	063	95.80	3.86E-05	4.51E-05
Dose Commitment (mrem) =					9.57E-05	1.12E-04

5.0 QUALITY ASSURANCE

5.1 DUKE POWER COMPANY'S RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

5.1.1 SAMPLE COLLECTION

The ONS Chemistry Section performed the environmental sample collections as specified by approved sample collection procedures.

5.1.2 SAMPLE ANALYSIS

The Radiological and Environmental Services Group performed the environmental sample analyses as specified by approved analysis procedures.

5.1.3 DOSIMETRY ANALYSIS

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

5.1.4 INTRALABORATORY QUALITY ASSURANCE

Radiological and Environmental Services 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.

Additionally, 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.

Radiological and Environmental Services (R&ES) did not participate in the Environmental Protection Agency (EPA) cross check program during 1996 due to the EPA power plant cross-check program being discontinued by EPA. R&ES contracted a similar cross-check program using North American Scientific as the supplier of the cross-checks. Results of these cross-checks are displayed in Table 5.0-A.

5.1.5 INTERLABORATORY QUALITY ASSURANCE

5.1.5.1 DUKE POWER'S AUDIT DIVISION

The Oconee Nuclear Station Radiation Protection Section participated in a Quality Assurance audit in November 1995. This audit was conducted by the Nuclear Assessment and Issues Division, Regulatory Audit Group. No recommendations pertaining to the Oconee Radiological Environmental Monitoring Program were identified in the audit. No audit was conducted in 1996.

5.1.5.2 DUKE POWER'S INTERCOMPARISON PROGRAM

The Radiological and Environmental Services group participated in the Duke Power Nuclear Generation Department Intercomparison Program during 1996. Interlaboratory cross-check standards, including marinelli beakers, air filters, air cartridges, gross alpha/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 1996 is documented in Table 5.0-A.

5.1.5.3 U.S. NUCLEAR REGULATORY COMMISSION INSPECTIONS

The Oconee Nuclear Station Radiological Environmental Monitoring Program was audited by the NRC in March/April 1996. There were no recommendations as a result of this audit and it was noted that an effective radiological environmental monitoring program had been implemented. Radiological and Environmental Services was not audited by the NRC in 1996.

5.1.5.4 NRC/STATE OF S.C. SAMPLING 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 from two of the locations sampled for air by ONS. Results of the analyses performed on split and duplicate samples are sent to DHEC for use in their report to the NRC.

5.1.5.5 STATE OF N.C. TLD INTERCOMPARISON PROGRAM

Radiation Dosimetry and Records routinely participates in a TLD intercomparison program. Every six to eight months, the State of North Carolina Radiation Protection Section irradiates environmental dosimeters and sends them to the Radiation Dosimetry and Records group for analysis of the unknown estimated delivered exposure. A summary of the State of North Carolina Environmental Dosimetry Intercomparison Report for 1996 is documented in Table 5.0-B.

5.2 CONTRACTOR LABORATORIES

No contractor laboratories were used during 1996.

TABLE 5.0-A

DUKE POWER COMPANY
INTERLABORATORY COMPARISON PROGRAM

1996 CROSS-CHECK RESULTS FOR THE RADIOLOGICAL & ENVIRONMENTAL SERVICES LABORATORY

Gamma in Charcoal Cartridge:

Collection Date	Geometry	Nuclide	Acceptance Range (pCi/total)	Reference Value (pCi/total)	Reported Value (pCi/total)
4/9/96	Cartridge	Co-57	1.30E-02 - 2.30E-2	1.73E-02	1.93E-02
		Co-60	2.65E-02 - 4.69E-02	3.53E-02	3.87E-02
		Y-88	5.60E-02 - 9.94E-02	7.47E-02	8.93E-02
		Cd-109	5.36E-01 - 9.51E-01	7.15E-01	7.57E-01
		Sn-113	3.41E-02 - 6.05E-02	4.55E-02	4.92E-02
		Cs-137	1.64E-02 - 2.91E-02	2.19E-02	2.30E-02
6/1/96	Cartridge	Ba-133	1.94E+04 - 3.48E+04	2.62E+04	2.45E+04

Gamma in Marinelli Beaker:

Collection Date	Geometry	Nuclide	Acceptance Range (pCi/total)	Reference Value (pCi/total)	Reported Value (pCi/total)
6/1/96	3.5 liter	Cr-51	1.34E+04 - 2.38E+04	1.79E+04	1.88E+04
		Co-57	8.9E+02 - 1.58E+03	1.19E+03	1.32E+03
		Co-60	2.06E+03 - 3.64E+03	2.74E+03	2.94E+03
		Y-88	7.87E+03 - 1.40E+04	1.05E+04	1.07E+04
		Sn-113	3.73E+03 - 6.61E+03	4.97E+03	5.15E+03
		Te-123m	7.83E+02 - 1.39E+03	1.04E+03	1.01E+03
12/17/96	3.5 liter	Cr-51	2.00E+05 - 3.54E+05	2.66E+05	2.43E+05
		Co-60	4.83E+04 - 8.57E+04	6.44E+04	6.24E+04
		I-131	5.02E+04 - 8.90E+04	6.69E+04	6.35E+04
		Cs-134	7.14E+04 - 1.27E+05	9.52E+04	8.03E+04
		Cs-137	9.00E+03 - 1.60E+04	1.20E+04	1.06E+04

Collection Date	Geometry	Nuclide	Acceptance Range (pCi/total)	Reference Value (pCi/total)	Reported Value (pCi/total)
6/1/96	1.0 liter	Cr-51	3.59+04 - 6.37E+04	4.79E+04	4.71E+04
		Co-57	2.39E+03 - 4.23E+03	3.18E+03	3.18E+03
		Co-60	5.50E+03 - 9.75E+03	7.33E+03	7.50E+03
		Y-88	2.11E+04 - 3.74E+04	2.81E+04	2.68E+04
		Sn-113	9.98E+03 - 1.77E+04	1.33E+04	1.31E+04
		Te-123m	2.10E+03 - 3.72E+03	2.80E+03	2.58E+03
		Cs-137	1.04E+04 - 1.84E+04	1.38E+04	1.30E+04
12/17/96	1.0 liter	Cr-51	2.00E+05 - 3.54E+05	2.66E+05	2.58E+05
		Co-60	4.83E+04 - 8.57E+04	6.44E+04	6.45E+04
		I-131	5.02E+04 - 8.90E+04	6.69E+04	6.68E+04
		Cs-134	7.14E+04 - 1.27E+05	9.52E+04	8.69E+04
		Cs-137	9.00E+03 - 1.60E+04	1.20E+04	1.18E+04
12/17/96	0.5 liter	Cr-51	2.00E+05 - 3.54E+05	2.66E+05	2.43E+05
		Co-60	4.83E+04 - 8.57E+04	6.44E+04	6.24E+04
		I-131	5.02E+04 - 8.90E+04	6.69E+04	6.35E+04
		Cs-134	7.14E+04 - 1.27E+05	9.52E+04	8.03E+04
		Cs-137	9.00E+03 - 1.60E+04	1.20E+04	1.06E+04
7/11/96	Gamma in Water	Cs-137	1.25E+02 - 2.22E+02	1.67E+02	1.47E+02
7/11/96	Gamma in Milk	Cs-137	1.71E+02 - 3.03E+02	2.28E+02	1.96E+02
12/17/96	Iodine in Water	I-131	1.24E+01 - 2.19E+01	1.65E+01	1.80E+01

Gross Beta in Air Particulate:

Collection Date	Geometry	Nuclide	Acceptance Range (DPM)	Reference Value (DPM)	Reported Value (DPM)
4/9/96	Gross Beta in Air Filter	Cs-137	1.55E+04 - 2.74E+04	2.06E+04	2.05E+04
6/1/96	Gross Beta in Air Filter	Cs-137	5.84E+04 - 1.04E+05	7.79E+04	7.21E+04

Tritium:

Collection Date	Geometry	Nuclide	Acceptance Range (pCi/liter)	Reference Value (pCi/liter)	Reported Value (pCi/liter)
3/25/96	Tritium in Water	H-3	1.31E+05 - 2.33E+05	1.75E+05	2.23E+05
7/9/96	Tritium Water	H-3	3.03E+06 - 5.37E+06	4.04E+06	4.33E+06
		H-3	5.92E+03 - 1.05E+04	7.89E+03	8.22E+03

TABLE 5.0-B

STATE OF NORTH CAROLINA DEPARTMENT OF ENVIRONMENTAL HEALTH AND NATURAL RESOURCES

1996 ENVIRONMENTAL DOSIMETER CROSS-CHECK RESULTS

Cross-Check Date	State of N.C. Delivered Value (mR)	Radiation Dosimetry & Records Reported Value (mR)	Acceptance Criteria +/- 10 %
Jun-96	55	51.6	Pass
Dec-96	40	38.4	Pass

6.0 REFERENCES

6.1 Oconee Selected License Commitments

6.2 Oconee Technical Specifications

6.3 Oconee Final Safety Analysis Review

6.4 Oconee Offsite Dose Calculation Manual

6.5 Oconee Annual Environmental Operating Report 1969-1995

6.6 Oconee Annual Effluent Report 1996

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 Radiological and Environmental Services Operating Procedures

6.11 NUREG/CR-1276, Users Manual for LADTAP II - A Computer Program for Calculating Radiation Exposure to Man from Routine Release of Nuclear Reactor Liquid Effluents.

6.12 Oconee Environmental Chemistry Operating Procedures

APPENDIX A

ENVIRONMENTAL SAMPLING AND 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, Radiological and Environmental Services, Dosimetry and Records, and Fisheries and Aquatic Ecology.

Section A.1 of this appendix describes the environmental sampling frequencies and analysis procedures by media type.

I. CHANGE OF SAMPLING PROCEDURES

No sampling changes were made to the sampling procedure methods during 1996.

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

III. CHANGE OF ANALYSIS PROCEDURES

No analysis procedures were changed during 1996.

IV. SAMPLING AND ANALYSIS PROCEDURES

A.1 AIRBORNE PARTICULATE AND RADIOIODINE

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

Location 060	=	New Greenville Water Intake Rd. (2.6 mi. NNE)
Location 073	=	Tamassee Dar School (9.2 mi. NW)
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)

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 028	=	Site Boundary (0.5 mi. S)
Location 060	=	New Greenville Water Intake Rd. (2.6 mi. NNE)
Location 073	=	Tamassee Dar School (9.2 mi. NW)
Location 077	=	Skimmer Wall (1.0 mi. SW)
Location 079	=	Keowee Dam (0.5 mi. NE)

A.6 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.7 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.8 DIRECT GAMMA RADIATION (TLD)

Thermoluminescent dosimeters (TLD) were collected quarterly at forty-one 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 nearest location from the site boundary in each of the sixteen meteorological sectors, the following:

* 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 August 1996 (8/14 - 8/15/96) and results are shown in Table 3.9.

APPENDIX B

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

SUMMARY OF RESULTS 1996

Environmental Radiological Monitoring Program Summary

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

Location: Oconee County, South Carolina **Report Period: 01-JAN-1996 to 31-DEC-1996**

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	Location with Highest Annual Mean Name, Distance, Direction Mean Range	Control Location Mean Range	No. of Non-Routine Report Meas.
Air Particulate (pCi/m3)						073 (9.2 mi NW)	
BETA	199	1.00E-02	(199/199)	074	3.87E-02 (40/40)	3.69E-02 (40/40)	0
			8.80E-03 - 8.96E-02	(2.3 mi NNW)	1.36E-02 - 8.96E-02	1.25E-02 - 7.44E-02	
CS134	311	5.00E-02	0.00 (0/259)		0.00 (0/52)	0.00 (0/52)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
CS137	311	6.00E-02	0.00 (0/259)		0.00 (0/52)	0.00 (0/52)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
I131	311	7.00E-02	0.00 (0/259)		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
If LLD is equal to 0.00, then the LLD is not required by Selected Licensee Commitments

Environmental Radiological Monitoring Program Summary

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

Location: Oconee County, South Carolina **Report Period: 01-JAN-1996 to 31-DEC-1996**

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	Location with Highest Annual Mean Name, Distance, Direction: Mean Range	Control Location Mean Range	No. of Non Routine Report Meas.
Air Radioiodine (pCi/m3)						073 (9.2 mi NW)	
CS134	311	5.00E-02	0.00 (0/259)		0.00 (0/52)	0.00 (0/52)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
CS137	311	6.00E-02	1.29E-02 (2/259)	060	1.68E-02 (1/52)	0.00 (0/52)	0
			8.97E-03 - 1.68E-02	(2.6 mi NNE)	1.68E-02 - 1.68E-02	0.00 - 0.00	
I131	311	7.00E-02	0.00 (0/259)		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
If LLD is equal to 0.00, then the LLD is not required by Selected Licensee Commitments

Environmental Radiological Monitoring Program Summary

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

Location: Oconee County, South Carolina **Report Period: 01-JAN-1996 to 31-DEC-1996**

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	Location with Highest Annual Mean Name, Distance, Direction Mean Range	Control Location Mean Range	No. of Non-Routine Report Meas.
Broadleaf Vegetation (pCi/kg-wet)						073 (9.2 mi NW)	
	CS134 70	60	0.00 (0/56)		0.00 (0/14)	0.00 (0/14)	0
			0.00 - 0.00		0.00 - 0.00	0.00 - 0.00	
	CS137 70	80	42.6 (4/56)	060	37.9 (3/14)	183 (12/14)	0
			14.8 - 63.3	(2.6 mi NNE)	14.8 - 63.3	53.1 - 409	
	I131 70	60	0.00 (0/56)		0.00 (0/14)	0.00 (0/14)	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
If LLD is equal to 0.00, then the LLD is not required by Selected Licensee Commitments

Environmental Radiological Monitoring Program Summary

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

Location: Oconee County, South Carolina **Report Period: 01-JAN-1996 to 31-DEC-1996**

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 Range	Control Location Mean Range	No. of Non-Routine Report Meas.
Drinking Water (pCi/liter)						064 (6.7 mi SSW)	
BALA140	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	1.78 (23/26)	066	2.07 (12/13)	1.77 (9/13)	0
			0.46 - 6.09	(19.0 mi SSE)	0.83 - 6.09	0.73 - 3.87	
CO58	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	
CO60	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	
CS134	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	
CS137	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	
FE59	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	
H3	15	2000	214 (3/10)	066	214 (3/5)	0.00 (0/5)	0
			179 - 281	(19.0 mi SSE)	179 - 281	0.00 - 0.00	
I131	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	
LLI131	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	
MN54	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	
NB95	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	
ZN65	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	
ZR95	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 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-1996 to 31-DEC-1996**

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 Range	Control Location Mean Range	No. of Non-Routine Report Meas.
Fish (pCi/kg-wet)						060 (2.6 mi NNE)	
C058	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	
CO60	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	
CS134	12	130	42.1 (3/8)	067	44.9 (2/4)	0.00 (0/4)	0
			13.5 - 76.2	(4.2 mi SSE)	13.5 - 76.2	0.00 - 0.00	
CS137	12	150	123 (8/8)	063	125 (4/4)	32.6 (2/4)	0
			56.4 - 245	(0.8 mi ESE)	56.4 - 245	32.1 - 33.1	
FE59	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	
MN54	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	
ZN65	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
If LLD is equal to 0.00, then the LLD is not required by Selected Licensee Commitments

Environmental Radiological Monitoring Program Summary

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

Location: Oconee County, South Carolina **Report Period: 01-JAN-1996 to 31-DEC-1996**

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 Range	Control Location Mean Range	No. of Non-Routine Report Meas.
Milk (pCi/liter)						080 (19.0 mi SSE)	
BALA140	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	
CS134	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	
CS137	78	18	0.00 (0/52)		0.00 (0/26)	4.1 (1/26)	0
			0.00 - 0.00		0.00 - 0.00	4.1 - 4.1	
I131	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	
LLI131	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
If LLD is equal to 0.00, then the LLD is not required by Selected Licensee Commitments

Environmental Radiological Monitoring Program Summary

F[redacted] Oconee Nuclear Station **Docket No. 50-269,270,287**

Location: Oconee County, South Carolina **Report Period: 01-JAN-1996 to 31-DEC-1996**

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 Range	Control Location Mean Range	No. of Non-Routine Report Meas.
Shoreline Sediment (pCi/kg-dry)						068 (2.0 mi W)	
	CO58	6	0	51.0 (1/4)	063	51.0 (1/2)	0.00 (0/2)	0
				51.0 - 51.0	(0.8 mi ESE)	51.0 - 51.0	0.00 - 0.00	
	CS134	6	150	19.8 (1/4)	063	19.8 (1/2)	0.00 (0/2)	0
				19.8 - 19.8	(0.8 mi ESE)	19.8 - 19.8	0.00 - 0.00	
	CS137	6	180	64.5 (3/4)	063	119 (1/2)	23.2 (1/2)	0
				37.2 - 119	(0.8 mi ESE)	119 - 119	23.2 - 23.2	

Me[redacted]d range based upon detectable measurements only
Fra[redacted]f detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements
If LLD is equal to 0.00, then the LLD is not required by Selected Licensee Commitments

Environmental Radiological Monitoring Program Summary

F[redacted] Oconee Nuclear Station **Docket No. 50-269,270,287**

Location: Oconee County, South Carolina **Report Period: 01-JAN-1996 to 31-DEC-1996**

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 Range	Control Location Mean Range	No. of Non-Routine Report Meas.
Surface Water (pCi/liter)						062 (0.8 mi ENE)	
BALA140	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	
CO58	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	
CO60	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	
CS134	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	
CS137	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	
FE59	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	
H3	10	2000	4535 (5/5)	063	4535 (5/5)	0.00 (0/5)	0
			720 - 11420	(0.8 mi ESE)	720 - 11420	0.00 - 0.00	
I131	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	
MN54	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	
NB95	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	
ZN65	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	
ZR95	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
If LLD is equal to 0.00, then the LLD is not required by Selected Licensee Commitments

Environmental Radiological Monitoring Program Summary

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

Location: Oconee County, South Carolina **Report Period: 01-JAN-1996 to 31-DEC-1996**

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 Range	Mean Range	
Direct Radiation TLD (mR/Quarter)						058 (9.4 mi WSW)	
mR/Qtr	162	0.00E+00	19.8 (158/158)	052	27.4 (4/4)	25.3 (4/4)	0
			8.9 - 31.9	(12.0 mi ENE)	19.8 - 31.9	18.4 - 28.9	

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements
If LLD is equal to 0.00, then the LLD is not required by Selected Licensee Commitments

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 Laboratory 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

There were no sampling deviations for 1996.

C.2 UNAVAILABLE ANALYSES

The following unavailable analyses from sampling requirements occurred during 1996:

Air Particulate and Air Radioiodines

Location	Scheduled Collection Dates	Reason	Corrective Action
060	6/12 - 6/18/96	PI	Lightning strike occurred and damaged air samplers. Back up air sampler placed in service until primary samplers repaired.

TLD

Location	Scheduled Collection Dates	Reason	Corrective Action
030	3/14 - 6/27/96	VN	TLD missing. Replacement TLD was placed a few feet further (approximately 15 feet) northward on a fence post to be less conspicuous to public.
037	3/14 - 6/27/96	OT	TLD missing. Both primary and secondary TLDs were missing due to construction work. Replacement TLDs were placed on power boxes at rear of building at this location.

APPENDIX D

ANALYTICAL DEVIATIONS

No analytical deviations were incurred for the 1996 Radiological Environmental Monitoring Program.

APPENDIX E

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM RESULTS

1996

This appendix includes all of the sample analysis reports generated from each sample medium for 1996. 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.