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April 30, 1987

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Subject: Oconee Nuclear Station
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Annual Radiological Environmental Operating Report

Gentlemen:

Pursuant to Technical Specification 6.6.1.5, please find enclosed the Oconee Nuclear Station Annual Radiological Environmental Operating Report for the calendar year 1986.

Very truly yours,

Hal B. Tucker

WHM/31/sbn

Enclosure

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OCONEE NUCLEAR STATION

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM

ANNUAL OPERATING REPORT

January 1, 1986 - December 31, 1986

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SECTION 1.
EXECUTIVE SUMMARY

This Annual Radiological Environmental Operating Report describes the Oconee Nuclear Station Radiological Environmental Program and the results of the program for the calendar year 1986.

Included in the report are identification of sampling locations, descriptions of environmental sampling and analysis procedures, comparisons of doses calculated from environmental measurements and doses calculated from effluent data, a summary of the results of the 1986 program, discussion of the results (including the effects of the Chernobyl reactor accident), and discussion of the quality assurance activities associated with the program. Deviations from program requirements and changes made to the program are also included.

Sampling activities were conducted as prescribed by Technical Specifications. Required analyses were performed and detection capabilities met Technical Specifications.

Concentrations observed in the environment in 1986 for station related radionuclides were within the ranges of concentrations observed in the past. All positive indications of radioactivity due to plant operations were less than reporting levels as specified by the Nuclear Regulatory Commission (NRC) and as given in Technical Specifications. Visual inspection of data indicated that since the operation of Oconee Nuclear Station, radionuclide concentrations in fish have increased; however, statistical analysis of the historical data for trend determination purposes showed that the probability of an increasing trend was poor. All other possible trends for other sample media were decreasing. Comparisons of doses calculated from environmental measurements and doses calculated from effluent data demonstrated that levels of radioactivity were not higher than expected and were within the Technical Specification limits.

SECTION 2.
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 Hydro-electric Plant near the station joins Lake Keowee and the upper reaches of Lake Hartwell. To the north the Jocassee Hydro-electric Plant joins Lake Jocassee and Lake Keowee. Jocassee is a pumped storage plant.

ONS consists of three pressurized water reactor units with a combined generating capacity of 2658 megawatts. Unit 1 began commercial operation 7/15/73. Unit 2 began commercial operation 9/09/74, and Unit 3 began 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. The samples obtained from the locations include Airborne Radioiodine and Particulates, Drinking Water, Surface Water, Milk, Broadleaf Vegetation, Shoreline Sediment and Fish. Table 2.1-1 lists the specific samples required for each location. Figure 2.1-2 is a map showing the TLD locations within a 1 mile radius of the site. Table 2.1-2 lists the locations of all the TLDs.

2.2 SCOPE AND REQUIREMENTS OF ENVIRONMENTAL MONITORING PROGRAM

An environmental surveillance program has been continuously conducted at ONS since 1969, four years prior to operation of Unit 1. The purpose of the preoperational program was to document the existing environmental radioactivity levels and their variability during sampling in order to develop a baseline to which operational levels may be compared. The current operational program was established to detect changes in radioactivity levels in the environs of the plant and to supplement the radiological effluent monitoring program by verifying that the measurable activity and radiation levels are not higher than those expected based on effluent measurements and modeling of the environmental exposure pathways. In addition, measured concentrations and dose rates are compared to the levels and limits specified in Technical Specifications. Trends are identified so that corrective actions may be taken prior to levels and limits being exceeded.

The sample media used, the sampling locations, and the sampling frequencies are selected in regard to the important dose pathways as

well as the anticipated types and quantities of radionuclides released from the plant. Locations and media are utilized that would demonstrate physical and biological sites of activity accumulation. Control locations are utilized to distinguish between activity of plant origin and environmental background levels. Frequencies of sampling and sample quantities utilized are based on the release rate of plant effluents, the half lives of the radionuclides, and the required detection capabilities of the analyses. In turn, the concentrations specified for the detection capabilities correspond to environmental concentrations that could result in doses that are fractions of the allowable dose limits.

The specific locations and sample frequencies given in Table 2.1-1 and 2.1-2 meet the program conditions of ONS Technical Specification 4.11. The Technical Specification also defines the analysis type, frequency and detection capabilities for each sample. These are repeated in Tables 2.2-1 and 2.2-2. Table 2.2-3 lists the activity levels established for making a non-routine report of concentrations found in environmental samples. These reporting levels are based on the activity in the pathway resulting in potential doses corresponding to the 10CFR50 Appendix I calendar year dose objectives for effluents for one reactor.

An additional surveillance requirement is that an annual Land Use Census be conducted. The census assures that changes in the use of the plant environs are identified. The census results are used to make appropriate modifications to the monitoring program and the parameters utilized to calculate doses from plant effluents.

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 ($\bar{x}$) is a widely known example of statistics. This value was used in the reduction of the data generated by the sampling and analysis of the various media in the Environmental Monitoring Program. The following equation was used to estimate the mean:

$$\bar{x} = \frac{\sum_{i=1}^{N} x_i}{N} \qquad \text{(eq. 2-1)}$$

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. This may be the Minimum Detectable Activity (MDA) value if no detectable activity (or concentration) was found (see Section 2.3.2), and it may be either a positive or negative value.

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

The Lower Level of Detection (LLD), the Minimum Detectable Activity (MDA), and the Critical Level (Lc) are used throughout the Environmental Monitoring Program, both in Technical Specifications and in the implementation of these specifications.

The LLD, as defined in the Technical Specifications, is the smallest concentration of radioactive material in a sample that will yield a net count, above 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 a "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 as given in the Technical Specifications are listed in Table 2.2-2.

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. In gamma spectroscopy analyses, the sample background may be elevated above the system background due to the continuum produced by higher energy gammas from other radionuclides (either man-made or naturally produced). This continuum increases the smallest concentration of a particular radionuclide that could be positively identified in the sample. Therefore, to insure that the "required" LLD is not exceeded for any radionuclide in a sample medium, the MDA is calculated based on the actual background in the area of the identifying gamma energy and is compared to the "required" LLD. If the MDA exceeds the "required" LLD, the sample is counted for a longer time period so that the standard deviation of the sample background is minimized. If the "required" LLD exceeds the MDA, then the analysis of the sample meets the requirements for the detection capability for environmental sample analysis.

The Critical Level (Lc) is a test applied to low-level counting data to determine if the sample count-rate is significantly different from the background. This test is often expressed as a net count-rate equal to some multiple of the background standard deviation. The Critical Level, by definition, is that net count-rate which must be exceeded before the sample is said to contain any measureable radioactive material above background. The following equation is used to calculate the Critical Level:

$$Lc = K \left[\frac{Rb}{Tb} \left(1 + \frac{Tb}{Tg} \right) \right]^{\frac{1}{2}} \qquad \text{(eq. 2-2)}$$

where, Lc = Critical Level
K = 1.65 (one-sided 95% confidence level)
Rb = Total background count-rate
Tb = Background count time
Tg = Sample count time

When a sample is analyzed and a MDA is reported for a radionuclide in the sample, a critical level is calculated. When a radionuclide's radioactivity concentration is less than the Critical Level, the radionuclide activity is considered to be undetectable.

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. This is traditionally done by looking at historical data (including preoperational data) and determining if a trend exists. Trends, if they exist, may be either positive or negative. Since nuclear reactor operations do not normally remove radioactivity from the surrounding environment, a negative trend 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.

In some cases, visual inspection of tabular or graphical presentations of data may be sufficient to determine if a trend exists. In other cases, it may not be so obvious. Therefore, it is desirable to obtain a single numerical value from the data which will permit a meaningful

interpretation of the relationship existing between the variations in the data. If it is assumed that a linear relationship exists between the time after startup of the reactor and the amount of radionuclides in a particular environmental medium, the least squares regression method may be used to define the linear relationship. To determine if the data actually correlates to the straight line assumption, the theoretical variance is compared to the actual variance. The numerical value that summarizes this comparison is known as the correlation coefficient. This correlation coefficient, symbolized by "r", is a determination of how closely the data fit a straight line and may be calculated from the following equation:

$$r = \frac{N\Sigma XY - \Sigma X \Sigma Y}{\{[N\Sigma X^2 - (\Sigma X)^2]\,[N\Sigma Y^2 - (\Sigma Y)^2]\}^{\frac{1}{2}}} \qquad \text{(eq. 2-3)}$$

where, r = correlation coefficient for the data set of X and Y
X = the year or point in time
Y = the radionuclide concentration associated with X
N = number of observations.

The range of values as calculated by the correlation coefficient lie between positive one (+1) and negative one (-1). The absolute value of the correlation coefficient represents the probability of a trend. Zero (0) represents no indication of either a positive or negative trend. A positive (+) correlation coefficient indicates an increasing trend, and, conversely, a negative (-) correlation coefficient indicates a decreasing trend. The ranges of a correlation coefficient may be summarized as below:

$1 \geq \lvert r \rvert \geq 0.7$	High to moderate probability of a trend.
$0.7 \geq \lvert r \rvert \geq 0.3$	Moderate to poor probability of a trend.
$0.3 \geq \lvert r \rvert \geq 0$	Poor to no probability of a trend.

Identifying a trend by using the correlation coefficient is only useful for the time periods where the discharge from the nuclear plant is relatively stable. 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. Whether or not a trend exists, the operation of a nuclear plant may have affected the levels of radioactivity or radiation in the environment. This is especially obvious if significant amounts of radionuclides were released by the plant in the past, but there are small or no releases occurring presently.

Other factors that may affect environmental levels of radionuclides include prevailing weather conditions (periods of drought or heavier than normal precipitation), construction in or around either the nuclear plant or the sampling location, addition or deletion of other sources of radioactive materials, etc.. Some of these factors may be obvious while others are sometimes unknown to the plant personnel.

Because of the above considerations, how trends are identified will depend not only on the least squares regression method, but will include some judgement by plant personnel on the factors affecting environmental levels.

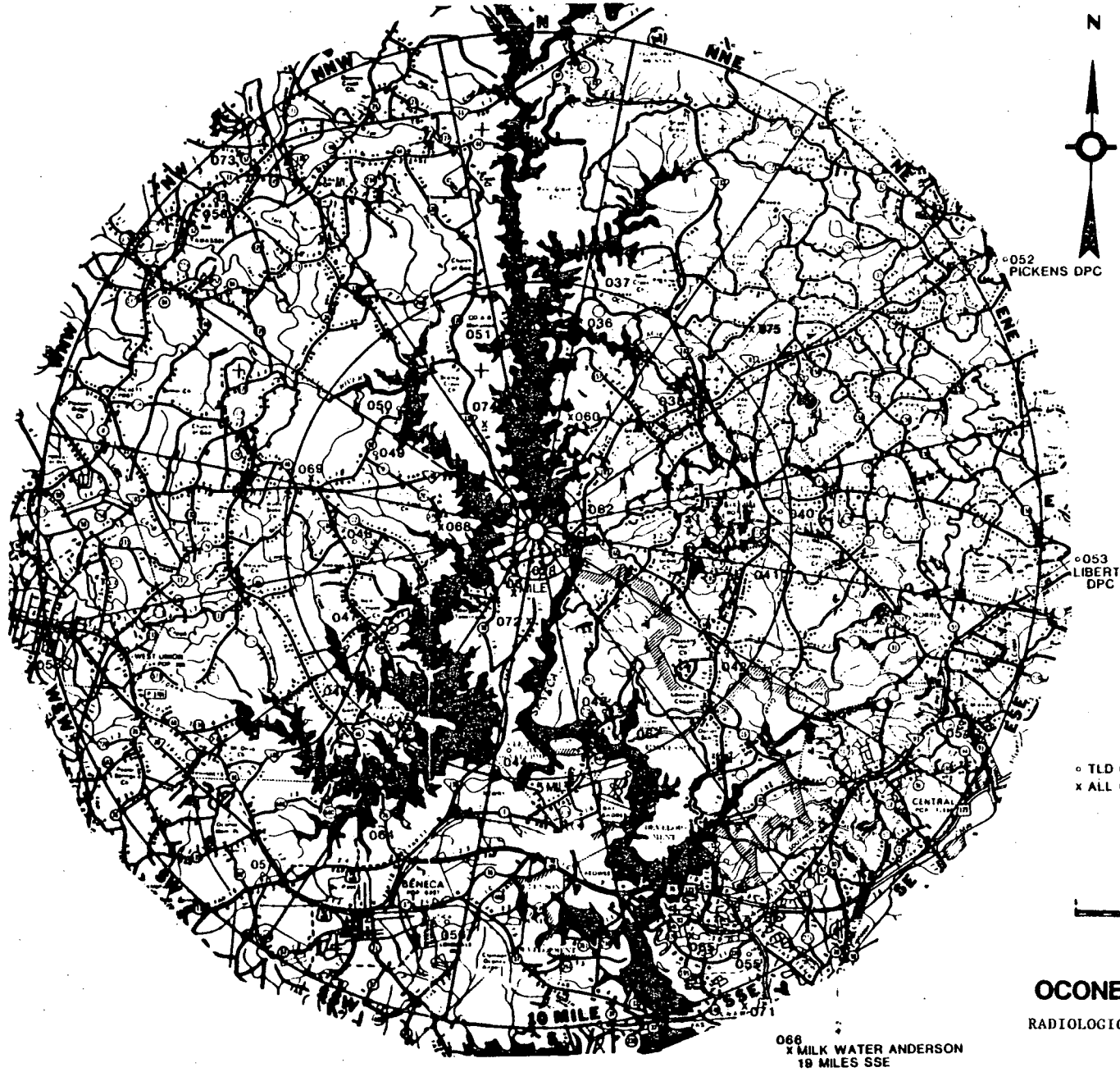

Figure 2.1-1

OCONEE NUCLEAR STATION

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM LOCATIONS

Figure 2.1-2

TLD MONITORING LOCATIONS AT THE SITE BOUNDARY

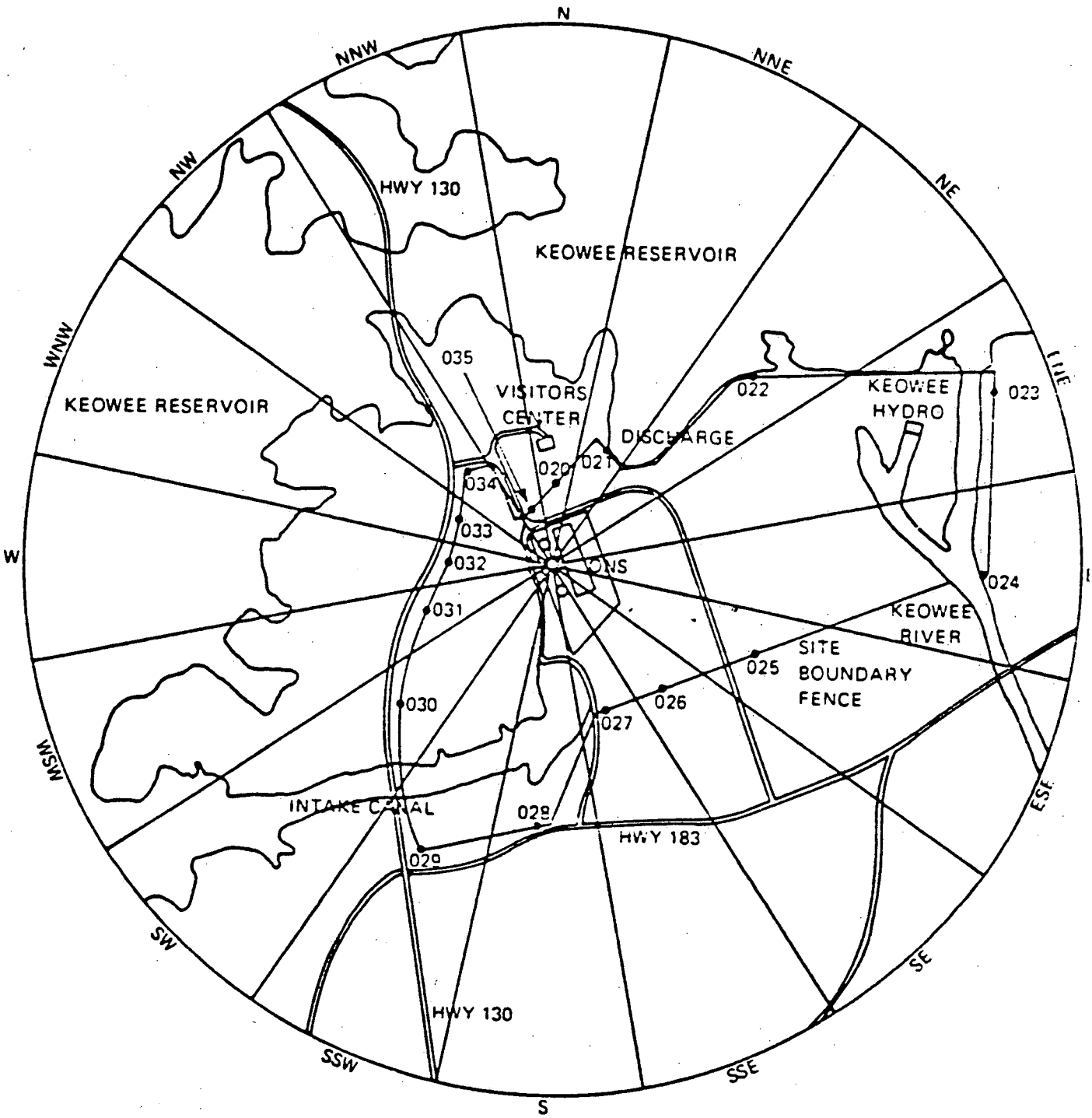

Table 2.1-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLING LOCATIONS

CODE:

W - Weekly (≤ 7 days)
SM - Semimonthly (≤ 15 days)
M - Monthly (≤ 31 days)
SA - Semiannually (≤ 184 days)

	SAMPLING LOCATION DESCRIPTION	Air Radioiodines and Particulates	Surface Water	Drinking Water	Shoreline Sediment	Milk	Fish	Broadleaf Vegetation
028	Site Boundary (0.5 miles S)							M
060	New Greenville Water Intake Rd. (2.5 miles NNE)	W		M			SA	M
061	Old Hwy. 183 (1.5 miles SSW)	W						
062	Lake Keowee/Hydro Intake (0.7 mile ENE) (CONTROL)		M					
063	Lake Hartwell - Hwy 183 Bridge (0.8 mile ESE) (000.7)		M		SA		SA	
064	Seneca (6.7 miles SW) (004.1) (CONTROL)			M				
065	Clemson (8.1 miles SSE) (006.1)			M				
066	Anderson (19.0 miles SSE) (012) (CONTROL FOR MILK ONLY)			M		SM		
067	Lawrence Ramsey Bridge, Hwy 27 (4.2 miles SSE) (005.2)				SA		SA	
068	High Falls County Park (2.0 miles W) (CONTROL)				SA			
069	Powell Residence (4.5 miles WNW) (002.1)					SM		
071	Clemson Dairy (10.3 miles SSE) (006.3)					SM		
072	Hwy 130 (1.7 miles S)	W						
073	Tamassee Dar School (9.0 miles NNW) (CONTROL)	W						M
074	Keowee Key Resort (1.7 miles NNW)	W						
075	Willimon Residence (6.0 miles NE)					SM		

Table 2.1-2

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

TLD LOCATIONS

LOCATION	DESCRIPTION		LOCATION	DESCRIPTION	
020	0.2 MILES N	SITE BOUNDARY	040	4.5 MILES E	MICROWAVE TOWER, SIX MILE
021	0.2 MILES NNE	SITE BOUNDARY	041	4.0 MILES ESE	JCT. HWY.101 & 133
022	0.5 MILES NE	SITE BOUNDARY	042	5.0 MILES SE	LAWRENCE CHAPEL CHURCH, HWY.133
023	0.9 MILES ENE	SITE BOUNDARY	043	4.0 MILES SSE	HWY.291 AT ISAQUEENA PARK ENTRANCE
024	0.8 MILES E	SITE BOUNDARY	044	4.0 MILES S	HWY.130 AT LITTLE RIVER DAM
025	0.6 MILES ESE	SITE BOUNDARY	045	5.0 MILES SSW	TERMINUS OF HWY.588 INTO LAKE KEOWEE
026	0.3 MILES SE	SITE BOUNDARY	046	4.5 MILES SW	HWY.188 AT CROOKED CREEK BRIDGE
027	0.3 MILES SSE	SITE BOUNDARY	047	4.0 MILES WSW	NEW HOPE CHURCH, HWY.188
028	0.5 MILES S	SITE BOUNDARY	048	4.0 MILES W	JCT. HWY.175 & 188
029	0.6 MILES SSW	SITE BOUNDARY	049	4.0 MILES WNW	JCT. HWY.201 & 92
030	0.4 MILES SW	SITE BOUNDARY	050	4.0 MILES NW	STAMP CREEK LANDING-END OF HWY.92
031	0.2 MILES WSW	SITE BOUNDARY	051	4.5 MILES NNW	HWY.128 ≈1 MILE N OF HWY.130
032	0.2 MILES W	SITE BOUNDARY	052	12.0 MILES ENE	DPC BRANCH OFFICE - PICKENS
033	0.2 MILES WNW	SITE BOUNDARY	053	11.0 MILES E	DPC BRANCH OFFICE - LIBERTY
034	0.2 MILES NW	SITE BOUNDARY	054	9.5 MILES ESE	POST OFFICE - HWY.93 NORRIS
035	0.1 MILES NNW	SITE BOUNDARY	055	9.5 MILES SSE	CLEMSON METEROLOGY PLOT
036	4.0 MILES N	MILE CREEK LANDING	056	8.5 MILES SSW	WATER TOWER - SENECA
037	4.5 MILES NNE	KEOWEE CHURCH, HWY.327	057	9.0 MILES SW	OCONEE MEMORIAL HOSPITAL
038	4.0 MILES NE	MAULDINS GROCERY, JCT. HWY.183 & 133	058	10.0 MILES WSW	BRANCH ROAD SUBSTATION-WALHALLA(CONTROL)
039	4.0 MILES ENE	HWY.133, ≈1 MILE EAST OF JCT. HWY.183 & 133	059	9.0 MILES NW	TAMASSEE DAR SCHOOL

Table 2.2-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANALYSES

SAMPLE MEDIUM	ANALYSIS SCHEDULE	ANALYSES				
		GAMMA ISOTOPIC	TRITIUM	LOW LEVEL I-131	GROSS BETA	TLD
1. Air Radioiodine and Particulates	Weekly	X				
2. Direct Radiation	Quarterly					X
3. Surface Water	Monthly	X				
	Quarterly Composite		X			
4. Drinking Water	Monthly	X			X	
	Quarterly Composite		X			
5. Shoreline Sediment	Semiannually	X				
6. Milk	Semimonthly	X		X		
7. Fish	Semiannually	X				
8. Broadleaf Vegetation	Monthly		X			

Table 2.2-2

MAXIMUM VALUES FOR THE LOWER LIMITS OF DETECTION (LLD)

Analysis	Water (pCi/l)	Airborne Particulate or Gas (pCi/m^3)	Fish (pCi/kg,wet)	Milk (pCi/l)	Broadleaf Vegetation (pCi/kg,wet)	Sediment (pCi/kg,dry)
gross beta	4					
H-3	2000					
Mn-54	15		130			
Fe-59	30		260			
Co-58,60	15		130			
Zn-65	30		260			
Zr-95	30					
Nb-95	15					
I-131	15	7×10^{-2}		1	60	
Cs-134,137	15,18	$5,6 \times 10^{-2}$	130,150	15,18	60,80	150,180
Ba-140	60			60		
La-140	15			15		

Table 2.2-3

REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

Analysis	Reporting Levels				
	Water (pCi/l)	Airborne Particulate or Gases (pCi/m^3)	Fish (pCi/Kg,wet)	Milk (pCi/l)	Broadleaf Vegetation (pCi/Kg,wet)
H-3	2×10^4*				
Mn-54	1×10^3		3×10^4		
Fe-59	4×10^2		1×10^4		
Co-58	1×10^3		3×10^4		
Co-60	3×10^2		1×10^4		
Zn-65	3×10^2		2×10^4		
Zr-Nb-95	4×10^2				
I-131	2**	1.0		3	1×10^2
Cs-134	30	10	1×10^3	60	1×10^3
Cs-137	50	20	2×10^3	70	2×10^3
Ba-La-140	2×10^2			3×10^2	

*For drinking water samples. This is 40 CFR Part 141 value.
**If low level I-131 analyses are performed.

SECTION 3.
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
DISCUSSION, INTERPRETATION, AND TRENDING OF RESULTS

Data from the 1986 environmental monitoring program was compared to preoperational and all historical data whenever possible. Direct comparisons were possible for direct gamma radiation and fish data. However, other sample media were not necessarily comparable because of either significant changes in the analysis methods or in the reporting of the results.

Data in Sections 3.1 - 3.9 support the conclusion that there was no significant increase in radionuclides in the environment around ONS due to plant operations in 1986. Similarly, there was no significant increase in ambient background radiation levels in the surrounding areas. However, there was some noticeable activity related to the Chernobyl reactor accident found in environmental samples. For this reason, sample results evaluated to determine plant impacts on the environment did not include results from the period where Chernobyl effects were detected (4/29/86 to 6/24/86). Both sets of sample results, those unaffected by Chernobyl and those affected, are discussed in the following sections. In addition, the results of the Land Use Census are discussed.

Section 2 and Appendix A provide additional information regarding sampling locations, sampling and analysis requirements, trend identification methods, and a description of the sampling and analysis procedures. Appendix B contains the summary of sample results excluding the Chernobyl period samples and another summary including all samples.

3.1 AIRBORNE RADIOIODINE AND PARTICULATES

Gamma spectroscopy was performed on 255 fiber filters and 255 charcoal cartridges collected during 1986. Table 3.1-1 summarizes the radionuclides that were detected more frequently at the indicator location with the highest annual mean concentration than they were at the control location. Though slight differences between the high indicator location and the control location exist, activities have not increased over those found in 1985.

Visual inspection of tabular data taken from previous environmental report summaries and the 1986 summary did not reveal any trends. Linear regression analysis was applied to a radionuclide when the fraction of detectable measurements for the indicator location with the highest mean exceeded the fraction of detectable measurements at the control location in over 50% of the years reviewed. The list of radionuclides included Co-58, I-131, Cs-137, and Ba-La-140. Table 3.1-2 lists the data used and the resulting correlation coefficients. The results indicate some probability of a trend for Cs-137 and I-131. The probability of a trend for Co-58 and Ba-La-140 is not as great. All the radionuclides had negative correlation coefficients so the trends would be decreasing.

Thirty samples were collected during the Chernobyl period. Activities for I-131, Cs-134, and Cs-137 were 10 to 100 times higher than the mean observed for the remainder of the year. Ru-103 and Ba-La-140 were also detected during the period. Control location and indicator location sample results were very similar. These sample results are summarized in Table 3.1-3.

Table 3.1-1
AIRBORNE RADIOIODINE AND PARTICULATES
MEAN ANNUAL CONCENTRATIONS (pCi/m^3)(a)

Isotope	1985 Highest Mean(b)	1986 Highest Mean(b)	1986 Control Mean(b)
Mn-54	4.74E-4 (0/51)	2.77E-4 (2/44)	2.28E-4 (1/41)
Fe-59	6.50E-4 (1/51)	6.59E-4 (3/43)	-1.21E-4 (0/41)
Co-60	6.99E-4 (8/51)	4.72E-4 (7/44)	-2.67E-5 (0/41)
Zr-95	9.88E-4 (1/51)	9.40E-4 (2/44)	-6.77E-4 (0/41)
Nb-95	5.52E-4 (4/51)	1.19E-3 (3/43)	8.79E-4 (1/41)
Cs-134	5.93E-4 (4/51)	6.57E-4 (4/43)	1.11E-4 (2/41)
Ba-La-140	4.42E-4 (1/51)	5.67E-4 (1/44)	6.34E-4 (0/41)

(a) Mean is based on all net activity measurements.
(b) Value in parenthesis is the fraction of total measurements with statistically positive results.

Table 3.1-2
AIRBORNE RADIOIODINE AND PARTICULATES
TREND ANALYSIS OF MEAN ANNUAL CONCENTRATIONS

Year	Co-58 pCi/m^3	I-131 pCi/m^3	Cs-137 pCi/m^3	Ba-La-140 pCi/m^3
1986	2.31E-4	9.33E-4	9.01E-4	5.67E-4
1985	2.93E-4	7.71E-4	5.90E-4	4.42E-4
1984	1.38E-4	8.11E-4	6.63E-4	5.34E-4
1983	5.03E-4	1.48E-3	2.53E-3	4.36E-4
1982	9.91E-4	2.87E-3	4.24E-3	6.07E-4
1981	2.76E-4	6.31E-3	5.36E-3	1.40E-3
1980	4.41E-4	3.07E-3	2.96E-3	1.42E-3
1979	5.56E-4	7.54E-3	5.69E-3	1.53E-4

Co-58 r = -0.42; moderate to poor probability of a trend, and decreasing
I-131 r = -0.84; high to moderate probability of a trend, and decreasing
Cs-137 r = -0.86; high to moderate probability of a trend, and decreasing
Ba-La-140 r = -0.30; moderate to poor probability of a trend, and decreasing

(Data prior to was 1979 not included. A different method was used to calculate the annual mean before '79.)

Table 3.1-3
AIRBORNE RADIOIODINE AND PARTICULATES
CHERNOBYL PERIOD MEAN CONCENTRATIONS (pCi/m^3)(a)

Isotope	Highest Mean(b)	Control Mean(b)
I-131	3.07E-2 (5/8)	3.80E-2 (5/8)
Cs-134	6.63E-3 (5/8)	4.92E-3 (4/8)
Cs-137	1.30E-2 (6/8)	1.04E-2 (5/8)
Ru-103	2.43E-2 (3/8)	2.39E-2 (3/8)
Ba-La-140	7.09E-4 (1/8)	1.82E-3 (2/8)

(a) Mean based on all net activity measurements reported.
(b) Value in parenthesis is the fraction of total measurements with statistically positive results.

3.2 DRINKING WATER

Gross beta analysis and gamma spectroscopy were performed on 52 monthly drinking water samples. These samples were composited to form 16 quarterly period samples for Tritium analysis. Eight of the monthly samples were collected during the Chernobyl period. Their analysis results did not contain any noticeable activity as a result of the accident.

Table 3.2-1 summarizes the radionuclides that were detected more frequently at the indicator location with the highest annual mean than they were at the control location. Though slight differences exist between the indicator and control concentrations, activities have not increased significantly since 1985.

Visual inspection of tabular data summarizing activity observed from the preoperational period through 1986 did not show the existence of any trends. Linear regression analysis was applied to the highest indicator location mean for Tritium for the past 13 years since the indicator location activity has been consistently higher than the control location. Table 3.2-2 lists the data used. The results indicate poor probability of a trend. The negative correlation coefficient indicates a decreasing trend.

Table 3.2-1
DRINKING WATER MEAN ANNUAL CONCENTRATIONS (pCi/liter)(a)

Measurement	1985 Highest Mean(b)	1986 Highest Mean(b)	1986 Control Mean(b)
Gross Beta	2.14E 0 (13/13)	1.93E 0 (11/11)	1.03E 0 (10/11)
Co-58	9.94E-1 (0/13)	2.18E-1 (1/11)	-2.94E-1 (0/11)
Zr-95	1.72E 0 (0/13)	1.43E 0 (1/11)	-1.64E-1 (0/11)
I-131	8.39E-1 (0/13)	1.81E 0 (1/11)	7.86E-1 (0/11)
H-3	8.56E+2 (5/5)	1.24E+3 (4/4)	5.03E+2 (2/4)

(a) Mean is based on all net activity measurements.
(b) Value in parenthesis is the fraction of total measurements with statistically positive results.

Table 3.2-2
DRINKING WATER
TREND ANALYSIS OF MEAN ANNUAL CONCENTRATIONS

Year	H-3 pCi/liter	Year	H-3 pCi/liter
1986	1240	1979	578
1985	856	1978	1050
1984	765	1977	1200
1983	937	1976	2196
1982	643	1975	1795
1981	830	1974	440
1980	660		

H-3 $r = -0.29$; poor to no probability of a trend, and decreasing

(No data listed in reports prior to 1974)

3.3 SURFACE WATER

Gamma spectroscopy was performed on 26 monthly surface water samples. These samples were composited to form 8 quarterly period samples for Tritium analysis. Four of the monthly samples were collected during the Chernobyl period. Their analysis results did not contain any noticeable activity as a result of the accident.

Table 3.3-1 summarizes the radionuclides that were detected more frequently at the indicator location with the highest annual mean than they were at the control location. The indicator location is near the liquid effluent release point and differences between the indicator and control samples are expected. Comparison of 1985 and 1986 highest mean annual concentrations also showed a difference in that 1986 concentrations were slightly higher. The concentrations are low and the number of samples with detectable activity is small (with the exception of Tritium). Observed surface water concentrations were well below any reporting levels.

Visual inspection of tabular data covering the preoperational period through 1986 did not reveal any trends. Linear regression analysis was applied to the highest indicator location mean for Tritium from the preoperational period through 1986, and for Cs-137 for the past eight years. Both Tritium and Cesium are main contributors to the doses calculated from liquid effluents and have had larger fractions of detectable results than other radionuclides. Table 3.3-2 lists the data used. The results indicate poor to no probability of a trend for Tritium and moderate probability of a trend for Cs-137. Both radionuclides have a negative correlation coefficient which indicates a decreasing trend.

Table 3.3-1
SURFACE WATER
MEAN ANNUAL CONCENTRATIONS (pCi/liter)(a)

Isotope	1985 Highest Mean(b)	1986 Highest Mean(b)	1986 Control Mean(b)
Mn-54	9.34E-2 (1/12)	1.12E 0 (2/11)	2.57E-1 (1/11)
Co-58	2.15E-1 (0/12)	2.85E 0 (4/11)	2.21E-1 (0/11)
Co-60	6.27E-1 (2/12)	9.21E-1 (1/11)	-7.02E-1 (0/11)
Nb-95	4.95E-1 (1/12)	1.22E 0 (3/11)	1.18E 0 (0/11)
Cs-134	1.00E 0 (0/12)	8.00E-1 (1/11)	9.92E-1 (0/11)
H-3	1.05E+4 (5/5)	1.26E+4 (4/4)	4.48E+2 (1/4)

(a) Mean is based on all net activity measurements.
(b) Value in parenthesis is the fraction of total measurements with statistically positive results.

Table 3.3-2
SURFACE WATER
TREND ANALYSIS OF MEAN ANNUAL CONCENTRATIONS

Year	H-3 pCi/liter	Cs-137 pCi/liter
1986	1.26E+4	5.49E-1
1985	1.05E+4	9.90E-1
1984	9.93E+3	4.83E-1
1983	8.40E+3	6.83E-1
1982	6.13E+3	4.85E 0
1981	7.21E+3	3.90E 0
1980	4.93E+3	5.40E 0
1979	4.67E+3	2.82E 0
1978	8.00E+2	
1977	2.90E+3	
1976	2.95E+4	
1975	2.90E+4	
1974	1.55E+3	
1972	4.80E+2	

H-3 r = -0.009; poor to no probability of a trend, and decreasing
Cs-137 r = -0.74; high to moderate probability of a trend, and decreasing

(1972 mean is the mean of the 1969-1972 preoperational period. No statistically positive Tritium results were listed in the 1973 summaries. Data prior to 1979 was not used for Cs-137 since a different method was used to calculate the annual mean before '79.)

3.4 MILK

Gamma spectroscopy was performed on 89 milk samples, and low-level iodine analysis was performed on 90 samples collected in 1986. Table 3.4-1 summarizes the radionuclides that were detected more frequently at the indicator location with the highest annual mean concentration than they were at the control location. Comparisons of the data in the table show that differences between the indicator and control locations are small. Concentrations are low as well as the fraction of detectable results. No appreciable changes have occurred at the indicator locations since 1985.

Visual inspections of tabular data taken from previous environmental report summaries and the 1986 summary did not reveal any trends. Linear regression analysis was applied to the highest indicator location annual means for I-131 and Cs-137. Both Iodine and Cesium have had larger fractions of detectable measurements than other radionuclides. Table 3.4-2 lists the data used. The results indicate a moderate probability of a trend for I-131, and a slightly higher probability of a trend for Cs-137. Both trends indicate concentrations are decreasing.

Thirteen samples were collected during the Chernobyl period. Activities for I-131, Cs-134, and Cs-137 observed in milk during the period are summarized in Table 3.4-3. Control and indicator location sample results were very similar. I-131 levels were 10 to 100 times higher than the mean observed for the remainder of the year. One sample contained iodine in excess of the Technical Specification reporting level. Appropriate reports were made. Cesium levels were comparable to the means observed for the remainder of the year.

Table 3.4-1
MILK MEAN ANNUAL CONCENTRATIONS (pCi/liter)(a)

Isotope	1985 Highest Mean(b)	1986 Highest Mean(b)	1986 Control Mean(b)
Fe-59	-1.40E-1 (1/27)	2.22E 0 (1/22)	-8.07E-1 (0/22)
Cs-134	1.01E 0 (0/27)	1.16E 0 (2/22)	6.44E-1 (1/22)
Ba-La-140	5.90E-1 (3/27)	2.96E-2 (1/22)	-1.03E-2 (0/22)

(a) Mean is based on all net activity measurements.
(b) Value in parenthesis is the fraction of total measurements with statistically positive results.

Table 3.4-2
MILK TREND ANALYSIS OF MEAN ANNUAL CONCENTRATIONS

Year	I-131 pCi/liter	Cs-137 pCi/liter
1986	3.72E-2	2.79E 0
1985	-6.98E-2	2.38E 0
1984	9.62E-4	2.30E 0
1983	2.76E-3	5.04E 0
1982	7.38E-3	2.71E 0
1981	4.70E-2	5.52E 0
1980	7.46E-1	3.58E 0
1979	1.48E-1	7.25E 0

I-131 $r = -0.56$; moderate to poor probability of a trend, and decreasing
Cs-137 $r = -0.72$; high to moderate probability of a trend, and decreasing

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Table 3.4-3
MILK CHERNOBYL PERIOD MEAN CONCENTRATIONS (pCi/liter)(a)

Isotope	Highest Mean (b)	Control Mean (b)
I-131	9.63E-1 (2/4)	6.67E-1 (3/4)
Cs-134	1.56E 0 (0/4)	1.99E 0 (1/4)
Cs-137	3.66E 0 (1/4)	2.96E 0 (1/4)

(a) Mean is based on all net activity measurements.
(b) Value in parenthesis is the fraction of total measurements with statistically positive results.

3.5 BROADLEAF VEGETATION

Gamma spectroscopy was performed on 39 broadleaf vegetation samples according to the required sampling schedule and on four extra samples collected during the Chernobyl period (Extra samples were not included in the annual summary but are included in Table 3.5-2). Ba-La-140 was the only radionuclide detected more frequently at the indicator location with the highest annual mean concentration than at the control location. The highest indicator location mean was 4.00 pCi/kilogram. Only one indicator sample out of 20 analyzed contained detectable Ba-La-140. None was detected in the control location samples or in any 1985 broadleaf vegetation samples. The low frequency of detectable measurements (1/20) is not indicative of an increase.

Visual inspections of tabular data taken from previous environmental report summaries and the 1986 summary did not reveal any trends. Linear regression analysis was applied to the highest indicator location annual means for I-131 and Cs-137. Table 3.5-1 lists the data used. The results indicate a moderate probability of a decreasing trend for both radionuclides.

Nine regularly scheduled samples and four extra samples were collected over the Chernobyl period. Activities observed for I-131, Cs-134, Cs-137, Ba-La-140, and Ru-103 are summarized in Table 3.5-2. Control location and indicator location sample results are very similar. I-131 levels were approximately 100 times higher than the highest annual mean for the remainder of the year. Iodine levels exceeded the Technical Specification reporting level in three of the regularly scheduled samples and two of the extra samples. Appropriate reports were made. Cesium levels were less than 2 times their highest annual means for the remainder of the year. Ru-103 and Ba-La-140 were also detected during the period.

Table 3.5-1
BROADLEAF VEGETATION
TREND ANALYSIS OF MEAN ANNUAL CONCENTRATIONS

Year	I-131 pCi/kilogram	Cs-137 pCi/kilogram
1986	-1.03E 0	2.90E+1
1985	3.15E 0	1.62E+1
1984	4.55E 0	1.37E+1
1983	5.47E 0	7.44E 0
1982	9.30E 0	2.42E+1
1981	1.74E+1	2.99E+1
1980	3.59E 0	2.80E+1
1979	2.45E+1	5.04E+1

I-131 r = -0.77; high to moderate probability of a trend, and decreasing
Cs-137 r = -0.61; moderate to poor probability of a trend, and decreasing

(Data prior to 1979 was not included. A different method was used to calculate the annual mean before '79.)

Table 3.5-2
BROADLEAF VEGETATION
CHERNOBYL PERIOD MEAN CONCENTRATIONS (pCi/kilogram)(a)

Isotope	Highest Mean (b)	Control Mean (b)
I-131	7.13E+1 (4/5)	7.40E+1 (4/5)
Cs-134	1.74E+1 (2/5)	3.28E+1 (4/5)
Cs-137	4.55E+1 (2/3)	3.75E+2 (5/5)
Ba-La-140	6.36E 0 (1/3)	6.69E 0 (0/5)
Ru-103	6.26E+1 (2/3)	5.49E+1 (3/5)

(a) Mean based on all net activity measurements reported
(b) Value in parenthesis is the fraction of total measurements with statistically positive results.

3.6 SHORELINE SEDIMENT

Gamma spectroscopy was performed on 6 shoreline sediment samples. Three of the samples were collected during the Chernobyl period, and their analysis results did not contain any noticeable activity as a result of the accident.

Table 3.6-1 summarizes the radionuclides that were detected at the indicator location with the highest mean. The Cesium increase is attributed to differences in the actual point of sampling at the location. Samples are collected at the edge of the water. The severe drought of 1986 reduced lake levels and caused the sample to be taken at points that are normally submerged. The locations sampled in 1986 were more similar to the those where bottom sediment samples were collected until 1984. Bottom sediment samples were taken under the water level. Insufficient data exists for the trending of shoreline sediment results. The sample type has been collected since 1984.

Table 3.6-1
SHORELINE SEDIMENT
MEAN ANNUAL CONCENTRATIONS (pCi/kilogram)(a)

	1984	1985	1986
Isotope	Highest Mean (b,c)	Highest Mean (b,c)	Highest Mean (b,c)
Mn-54	1.10E+1 (1/3)	9.39E 0 (1/2)	2.53E+1 (1/1)
Co-60	1.19E+1 (1/3)	4.79E 0 (0/2)	2.63E+1 (1/1)
Cs-134	7.77E+1 (2/3)	7.63E+1 (2/2)	1.19E+2 (1/1)
Cs-137	5.16E+1 (2/3)	9.47E+1 (2/2)	5.87E+2 (1/1)

(a) Mean is based on all net activity measurements.
(b) Value in parenthesis is the fraction of total measurements with statistically positive results.
(c) All results are for location #067.

3.7 FISH

Gamma spectroscopy was performed on thirteen fish samples. An additional sample from location 067 was mistakenly picked up by a South Carolina Department of Health and Environmental control (DHEC) representative. This occurred during an exchange of samples for the cross check program ONS has with the state. The DHEC lab performed the analysis, and the results are included in Appendix B. A replacement sample was collected by ONS personnel and analyzed by Duke Power's Environmental Radiological Laboratory (ERL). Its results are also in Appendix B. One of the thirteen samples was collected during the Chernobyl period but there is no noticeable activity as a result of the accident.

Table 3.7-1 summarizes the radionuclides that were detected more frequently at the indicator location with the highest mean, location #063-Highway 183 Bridge, than they were at the control location. Cesiums are also included since they were detected in a higher concentration at the indicator location. 1986 mean concentrations are greater than the 1985 means, but higher levels have existed as evidenced by the 1984 means in Table 3.7-1.

Visual inspections of tabular data taken from previous environmental report summaries and the 1986 summary did not reveal any trends. An insufficient amount of data exists for linear regression analysis of the current highest mean indicator location which is near the liquid effluent release point. Trendable data does exist from the preoperational period for the next downstream fish location (location #067). Using this data, the correlation coefficients for Cs-134 and Cs-137 were calculated using the annual mean concentrations for the location. Table 3.7-2 lists the data used. The results indicate poor probability of a trend for Cs-137, and a moderate to poor probability of a trend for Cs-134. Both isotopes had a positive correlation coefficients, indicating increasing trends.

Table 3.7-1
FISH MEAN ANNUAL CONCENTRATION (pCi/kilogram) (a)

Isotope	1984 Highest Mean (b)	1985 Highest Mean (b)	1986 Highest Mean (b)
Co-58	1.21E+2 (8/18)	1.62E+1 (1/6)	9.56E+1 (2/4)
Co-60	6.23E+1 (6/18)	1.10E+1 (1/6)	2.59E+1 (2/4)
Cs-134	3.87E+2 (16/18)	7.93E+1 (5/6)	2.57E+2 (3/4)
Cs-137	1.04E+3 (18/18)	2.85E+2 (6/6)	7.36E+2 (4/4)

(a) Mean is based on all net activity measurements.
(b) Value in parenthesis is the fraction of total measurements with statistically positive results.

Table 3.7-2
FISH TREND ANALYSIS OF MEAN ANNUAL CONCENTRATIONS(a)

Year	Cs-134 pCi/kg	Cs-137 pCi/kg
1986	1.75E+1	1.06E+2
1985	1.16E+1	8.70E+1
1984	3.89E+1	1.19E+2
1983	1.24E+2	3.06E+2
1982	1.17E+2	2.94E+2
1981	9.19E+1	3.38E+2
1980	8.14E+1	3.93E+2
1979	7.56E+1	4.09E+2
1978	2.76E+2	6.89E+2
1977	1.17E+2	3.22E+2
1976	3.23E+1	1.66E+2
1975	2.16E+1	1.88E+2
1974	(b)	1.84E+1
1973	(b)	1.89E+2
1972	(b)	1.41E+2
1971	(b)	1.90E+2
1970	(b)	1.66E+2
1969	(b)	1.29E+2

Cs-134 r = 0.36; moderate to poor probability of a trend, and increasing
Cs 137 r = 0.16; poor to no probability of a trend, and increasing

(a) Means are for location #067.
(b) No statistically positive results for Cs-134 for the year.

3.8 DIRECT GAMMA RADIATION

Thermoluminescent Dosimeter (TLD) measurements for direct gamma radiation were made each quarter at forty locations. One hundred and fifty-seven of the TLDs were recovered and processed. The highest annual mean for an indicator location was 1.93E-2 millirem per hour. This TLD was located at the site boundary. The annual mean for the control location was 1.75E-2 millirem per hour.

Least squares regression analysis was applied to the highest annual mean for the past seventeen years. Table 3.8-1 lists the data used. The results indicate a poor probability of a decreasing trend.

Table 3.8-1
DIRECT RADIATION
TREND ANALYSIS OF MEAN ANNUAL DOSE RATES

Year	Doserate mrem/hr	Year	Doserate mrem/hr
1986	1.93E-2	1977	4.60E-1
1985	2.15E-2	1976	4.72E-1
1984	1.68E-2	1975	1.31E-1
1983	6.03E-2	1974	1.80E-1
1982	5.83E-2	1973	1.10E-2
1981	7.50E-2	1972	1.60E-2
1980	5.75E-2	1971	1.30E-2
1979	9.70E-2	1970	1.50E-2
1978	2.32E-1		

r = -0.13; poor to no probability of a trend, and decreasing

3.9 LAND USE CENSUS

The Land Use Census was conducted in July of 1986. The census results are contained in Table 3.9-1. A number of milk animals were identified in direction sectors having higher deposition parameters than those for the program milk sample locations. The milk animal owners were contacted and requested to participate in the sampling program. A memorandum in Appendix E lists their responses. An agreement was made with one of the owners, and location #075 (6.0 miles north northeast) was added even though it was outside the Technical Specification range that requires adding the location.

Table 3.9-1

LAND USE CENSUS DATA SHEET

Date(s) Performed 7/2/86, 7/3/86, 7/7/86, 7/8/86

Sector		Distance (Miles)	Sector		Distance (Miles)
N	Nearest Residence	3.5	S	Nearest Residence	2.0
	Nearest Meat Animal	---		Nearest Meat Animal	2.0

	Nearest Cow	---		Nearest Cow	---
	Nearest Goat	---		Nearest Goat	---
NNE	Nearest Residence	2.0	SSW	Nearest Residence	2.0
	Nearest Meat Animal	4.5		Nearest Meat Animal	---
	Nearest Cow	4.5		Nearest Cow	---
	Nearest Goat	4.0		Nearest Goat	---
NE	Nearest Residence	1.0	SW	Nearest Residence	2.0
	Nearest Meat Animal	1.5		Nearest Meat Animal	2.0
	Nearest Cow	4.5		Nearest Cow	---
	Nearest Goat	---		Nearest Goat	---
ENE	Nearest Residence	1.0	WSW	Nearest Residence	2.2
	Nearest Meat Animal	3.0		Nearest Meat Animal	2.5
	Nearest Cow	---		Nearest Cow	4.0
	Nearest Goat	3.0		Nearest Goat	---
E	Nearest Residence	1.0	W	Nearest Residence	1.2
	Nearest Meat Animal	2.5		Nearest Meat Animal	1.2
	Nearest Cow	3.0		Nearest Cow	---
	Nearest Goat	---		Nearest Goat	---
ESE	Nearest Residence	1.5	WNW	Nearest Residence	2.0
	Nearest Meat Animal	2.0		Nearest Meat Animal	2.0
	Nearest Cow	---		Nearest Cow	4.5
	Nearest Goat	3.25		Nearest Goat	---
SE	Nearest Residence	1.75	NW	Nearest Residence	1.0
	Nearest Meat Animal	2.25		Nearest Meat Animal	4.0
	Nearest Cow	---		Nearest Cow	---
	Nearest Goat	---		Nearest Goat	---
SSE	Nearest Residence	1.75	NNW	Nearest Residence	1.0
	Nearest Meat Animal	4.5		Nearest Meat Animal	---
	Nearest Cow	---		Nearest Cow	---
	Nearest Goat	---		Nearest Goat	---

SECTION 4.
EVALUATION OF DOSE FROM ENVIRONMENTAL MEASUREMENTS
VERSUS ESTIMATED DOSE FROM RELEASES

4.1 DOSE FROM ENVIRONMENTAL MEASUREMENTS

Doses were estimated for measured concentrations of radionuclides in direct pathways to man using NRC Regulatory Guide 1.109 methodology. Only those samples that were not affected by the fallout from the Chernobyl accident were used to calculate these doses. The highest annual mean values for each sample type and radionuclide were used after the background concentrations, as measured at the control location, had been subtracted; the maximum exposed individual's doses are summarized below:

Organ	Critical Age	Critical Pathway	Maximum Dose (mrem/yr)
Skin	Teen	Shoreline Sediment	2.46E-3
Bone	Child	Fish	2.00E 0
Liver	Teen	Fish	2.48E 0
T.Body	Adult	Fish	1.70E 0
Thyroid	Infant	Drinking Water	4.77E 0
Kidney	Teen	Fish	8.24E-1
Lung	Teen	Fish	3.18E-1
GI-LLI	Child	Drinking Water	9.80E-2

4.2 ESTIMATED DOSE FROM RELEASES

Doses were estimated for released concentrations of radionuclides in direct pathways to man using NRC Regulatory Guide 1.109 methodology. The doses were calculated using GASPAR and LADTAP computer programs. The maximum exposed individual's doses are summarized below:

LIQUID RELEASES

Organ	Critical Age	Critical Pathway	Maximum Dose (mrem/yr)
Skin	Teen	Shoreline Sediment	2.60E-2
Bone	Child	Fish	1.48E 0

Liver	Teen	Fish	1.92E 0
T.Body	Adult	Fish	1.40E 0
Thyroid	Infant	Drinking Water	8.13E-1
Kidney	Child	Fish	7.51E-1
Lung	Child	Drinking Water	4.52E-1
GI-LLI	Adult	Fish	1.20E 0

GASEOUS RELEASES

Organ	Critical Age	Critical Pathway	Maximum Dose (mrem/yr)
Thyroid	Infant	Cow Milk	9.67E-1

4.3 COMPARISON OF DOSES

The two (2) sets of doses given in sections 4.1 and 4.2 agree reasonable well. The doses associated with radionuclide concentrations in fish are expected to be higher than the estimated doses based on effluent releases since LADTAP does not include buildup from releases that occurred in previous years. This has been identified in previous annual environmental operating reports.

The only significant difference between the estimated doses based on environmental samples and the estimated doses based on effluent releases is for the infant thyroid. I-131 through the Drinking Water pathway contributes the majority of the infant thyroid dose estimated from environmental samples. The annual mean for I-131 used to estimate the dose is based on gamma spectroscopy measurements. Gamma spectroscopy has a higher "required" LLD for I-131 than that for low-level iodine analysis (see Section 2.3.2). Special low-level iodine analysis was performed on the one sample observed during the year to have I-131 exceeding the Critical Level for the gamma spectroscopy measurement. No I-131 was detected by the low-level analysis and the MDA for the low-level measurement was less than 2.90E-1 pCi/liter. The difference in the infant thyroid doses is due to the sample mean being based on gamma spectroscopy results.

The doses calculated do no exceed the 40CFR190 annual dose commitment limits for any member of the public.

SECTION 5.
QUALITY ASSURANCE

5.1 DUKE POWER COMPANY'S ENVIRONMENTAL LABORATORY

The Environmental Radiological Laboratory (ERL) participates in the EPA Interlaboratory Comparison Program and the Duke Power corporate cross-check program. The EPA sample types include mixed gamma in water (2-3 times per year), mixed gamma in milk (1-2 times per year), low-level iodine in milk (1-2 times per year), tritium in water (3 times per year) and alpha-beta in water (3 times per year). The ERL prepares and analyzes each sample as quickly as possible and performs and documents follow-up investigations should the data obtained by the ERL be out of limits. The ERL code designation in the EPA program is "CP". The corporate cross-check sample types included mixed gamma in many forms (body-burden standards, Marinelli beakers, filters), alpha-beta on filters, and tritium in water. The frequency of each cross-check is variable. As with EPA checks, an investigation is performed and documented should the data not meet the acceptance criteria.

In conjunction with the EPA and corporate quality assurance programs, the ERL has an internal quality assurance program which monitors each type of instrumentation for reliability and accuracy. Daily source checks ensure that the instruments are in proper working order and these checks are used to monitor instrument performance. Additionally, standards 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.

To ensure that ERL data is accurate and reliable, the NRC performed an audit of its operations in 1986. The inspectors found no violations or problems with laboratory operations and the associated data. An in-house assessment was performed later in 1986 in order to demonstrate an ability and willingness to perform self-audits and also aid the ERL in performing its duties.

5.2 CONTRACTOR LABORATORY

Teledyne Isotopes supplied Tritium (H-3) analyses for environmental samples during the first and second quarters of 1986. The ERL implemented their Tritium analysis procedure in 1986 and supplied analyses for the third and fourth quarter samples. On an annual basis, Duke Power Company's Quality Assurance Department conducts an audit of Teledyne Isotopes to verify that the requirements of Regulatory Guide 4.15 are met. This audit is normally conducted in October of each year. The audit resulted in Teledyne Isotopes remaining on the approved vendor list. In addition, Teledyne Isotopes participates in the EPA Interlaboratory Comparison Program. Their code designation is "CJ" and their performance in the program was acceptable (see Section 5.3).

5.3 EPA INTERLABORATORY COMPARISON PROGRAM

As described in Section 5.1, the ERL participates in the EPA Interlaboratory Comparison Program. The performance by the Laboratory is documented in Table 5.3-1. Teledyne Isotopes performance for analysis of Tritium in water was also included in the comparison program. Their performance is documented in Table 5.3-2.

Of the thirty analyses performed in 1986, three analyses were out of EPA limits (three normalized deviations). The missed analyzes and actions taken are described below.

5.3.1 Low-Level Iodine in Water on April 4, 1986

This water sample was analyzed using a method that is no longer used by the ERL (See Appendix A). Therefore, no action was necessary to determine the cause of data being out of limits. Additionally, the EPA did not notify the ERL of the data falling out of limits until December 8, 1986.

5.3.2 Potassium-40 in Milk on June 27, 1986

The K-40 data yielded a normalized deviation of 3.17, indicating a slight positive bias of the results. Examination of the data from each detector indicated that one detector (SN 25-PJ21A) caused the reported results to be positively biased. Daily source checks and routine verifications were found to be valid, but indicated slight trends. This detector was recalibrated and has passed all verifications.

5.3.3 Gamma in Water (Zinc-65) on February 7, 1986

The mixed gamma in water sample contained Cr-51, Co-60, Zn-65, Ru-106, Cs-134, and Cs-137. All radionuclide activities were within acceptance limits except Zn-65. Daily source checks were reviewed and found to be normal. A calibration check performed 3/27/86 was within control limits of ±5% of known. Therefore, the calibration was determined to be valid. An investigation comparing detectors with their associated shields indicated that the data obtained from detectors in shields manufactured in-house had higher interfering backgrounds than did the data from detectors in vendor supplied shields. The higher backgrounds reduced the accuracy of analyses performed on detectors located in shields made in-house. New low-background shields were requisitioned from a vendor.

5.4 DUKE POWER COMPANY'S DOSIMETRY LABORATORY

Duke Power Company's Dosimetry Laboratory participated in the International Environmental Dosimeter Intercomparison Project for 1986. The results are summarized in Table 5.4-1. The International Environmental Dosimeter Intercomparison Projects are sponsored by the United States Department of Energy's Environmental Measurements Laboratory. The intercomparisons typically attract about 125 participants from thirty countries. The objective of these studies is to assess the state of the art of environmental dosimetry as indicated by statistical analysis of the results. The participants compare their performance with the delivered exposures and the performance of their counterparts in other laboratories.

Table 5.3-1

U.S. ENVIRONMENTAL PROTECTION AGENCY
INTERLABORATORY COMPARISON PROGRAM
1986 CROSS CHECK RESULTS FOR THE ERL

Analysis	Date	Nuclide	Known Value	Control Limits (3 sigma; n = 3)	Reported Value
Air Filter	April	Gross Alpha	15 pCi/filter	±8.7 pCi/filter	18 pCi/filter
		Gross Beta	47 pCi/filter	±8.7 pCi/filter	48.66 pCi/filter
		Cs-137	10 pCi/filter	±8.7 pCi/filter	9.33 pCi/filter
ALPHA/BETA In Water	January	Gross Alpha	3 pCi/ℓ	±8.7 pCi/ℓ	3 pCi/ℓ
		Gross Beta	7 pCi/ℓ	±8.7 pCi/ℓ	7.33 pCi/ℓ
	July	Gross Alpha	6 pCi/ℓ	±8.7 pCi/ℓ	6 pCi/ℓ
		Gross Beta	18 pCi/ℓ	±8.7 pCi/ℓ	17 pCi/ℓ
	Sept.	Gross Alpha	15 pCi/ℓ	±8.7 pCi/ℓ	16.66 pCi/ℓ
		Gross Beta	8 pCi/ℓ	±8.7 pCi/ℓ	7.67 pCi/ℓ
Milk	February	Low-Level I-131	9 pCi/ℓ	±10.4 pCi/ℓ	11.33 pCi/ℓ
	June	I-131	41 pCi/ℓ	±10.4 pCi/ℓ	48.66 pCi/ℓ
		Cs-137	31 pCi/ℓ	±8.7 pCi/ℓ	38 pCi/ℓ
		K-40	1600 mg/ℓ	±138.6 mg/ℓ	(a) 1746 mg/ℓ

Analysis	Date	Nuclide	Known Value	Control Limits (3 sigma; n = 3)	Reported Value
Tritium in Water	February	H-3	5227 pCi/ℓ	±905 pCi/ℓ	5130 pCi/ℓ
	June	H-3	3125 pCi/ℓ	±623 pCi/ℓ	2853 pCi/ℓ
	October	H-3	5973 pCi/ℓ	±1034 pCi/ℓ	6046.67 pCi/ℓ
Gamma in Water	February	Cr-51	38 pCi/ℓ	±8.7 pCi/ℓ	<59 pCi/ℓ
		Co-60	18 pCi/ℓ	±8.7 pCi/ℓ	18.66 pCi/ℓ
		Zn-65	40 pCi/ℓ	±8.7 pCi/ℓ	(b) 31 pCi/ℓ
		Ru-106	0 pCi/ℓ	±5 pCi/ℓ	<1 pCi/ℓ
		Cs-134	30 pCi/ℓ	±8.7 pCi/ℓ	29.33 pCi/ℓ
		Cs-137	22 pCi/ℓ	±8.7 pCi/ℓ	23.33 pCi/ℓ
	June	Cr-51	0 pCi/ℓ	±5 pCi/ℓ	<1 pCi/ℓ
		Co-60	66 pCi/ℓ	±8.7 pCi/ℓ	68.33 pCi/ℓ
		Zn-65	86 pCi/ℓ	±8.7 pCi/ℓ	84.33 pCi/ℓ
		Ru-106	50 pCi/ℓ	±8.7 pCi/ℓ	49.33 pCi/ℓ
		Cs-134	49 pCi/ℓ	±8.7 pCi/ℓ	49 pCi/ℓ
		Cs-137	10 pCi/ℓ	±8.7 pCi/ℓ	9.33 pCi/ℓ
Low-Level I-131 in Water	April	I-131	9 pCi/ℓ	±1.4 pCi/ℓ	(c) 5.33 pCi/ℓ
	August	I-131	45 pCi/ℓ	±10.4 pCi/ℓ	41.66 pCi/ℓ

(a) The detectors involved in this deviation were calibrated again and passed all verifications.
(b) All of the detectors involved in the deviation had calibration checks performed. All were within ±5%. The one detector that passed this EPA cross-check for Zn-65 was in a new Nuclear Data shield with lower background interference. Requisition have been submitted for new shields to replace all those made by Duke Power. The new ND-9900 gamma spectroscopy system will have improved software and will be calibrated at .5 KeV per channel.
(c) The EPA mistakenly indicated an expected laboratory one sigma precision of 6.0 pCi/liter. The ERL notified the EPA in June of the unusually high precision and the EPA did not send out a revised report until December 1986. The ERL had already discontinued this kind of analysis method in June; therefore, no corrective action or investigation was necessary.

Table 5.3-2

U. S. ENVIRONMENTAL PROTECTION AGENCY
INTERLABORATORY COMPARISON PROGRAM
1986 CROSS CHECK RESULTS FOR TELEDYNE ISOTOPES

Analysis	Date	Nuclide	Known Value	Control Limits (3 Sigma;n=3)	Reported Value
Tritium in Water	February	H^3	5227 pCi/ℓ	906 pCi/ℓ	5266.76 pCi/ℓ
Tritium in Water	June	H^3	3125 pCi/ℓ	623 pCi/ℓ	2853.33 pCi/ℓ

Table 5.4-1

INTERNATIONAL ENVIRONMENTAL DOSIMETER INTERCOMPARISON PROJECT FOR 1986
SPONSORED BY UNITED STATES DEPARTMENT OF ENERGY

	Dosimetry Laboratory Results			Estimated Values		
	Exposure (mR)	±	Estimated Uncertainty (1 S.D.)mR	Exposure (mR)	±	Estimated Uncertainty (mR)
Field Site #1	28.7	±	1.98	29.7	±	1.5
Field Site #2	12.7	±	0.21	10.4	±	0.5
Laboratory	19.4	±	0.14	17.2	±	0.9

SECTION 6.
REFERENCES

1. ONS Technical Specifications, 4.11 Radiological Environmental Monitoring
2. Duke Power Company, Offsite Dose Calculation Manual, Section A5.0 Radiological Environmental Monitoring
3. ONS Chemistry Procedures for sample collection and Land Use Census
4. Production Environmental Services, Environmental Radiological Laboratory Procedures
5. Production Environmental Services, Dosimetry Laboratory Procedures
6. Teledyne Isotopes Inc. Procedures for Tritium analysis
7. ONS Final Safety Analysis Report
8. ONS Preoperational Environmental Radioactivity Monitoring Reports and Annual Radiological Environmental Operation Reports, 1969-1985
9. NRC Regulatory Guide 1.109, Calculation Of Annual Doses To Man From Routine Releases Of Reactor Effluents For The Purpose Of Evaluating Complience With 10 CFR Part 50, Appendix I
10. NRC Regulatory Guide 4.15, Quality Assurance For Radiological Monitoring Programs (Normal Operations)-Effluent Streams And The Environment

APPENDIX A
ENVIRONMENTAL SAMPLING AND ANALYSIS PROCEDURES

Adherence to established procedures for sampling and analysis of environmental media is required to ensure compliance to the Radiological Environmental Monitoring Program as defined by ONS Technical Specifications and the ODCM. These procedures ensure that environmental media is sampled and analyzed according to the specific locations, frequencies, and types of analyses given in the ODCM (Tables 2.1-1, 2.1-2 and 2.2-1). Analysis procedures ensure the detection capabilities given in Technical Specifications will be achieved (Table 2.2-2).

The required detection capabilities were met for the analyses performed in 1986. Deviations from analytical procedures are listed in Appendix D. Collection requirements were also met with the exceptions listed in Appendix C. For some sample media, collection is performed at more locations than required by Technical Specifications. These include Milk, Broadleaf Vegetation, Shoreline Sediment, and Fish.

Environmental sampling is performed by the ONS Chemistry group. Sample analyses are performed by Duke Power Company's Environmental Radiological Laboratory (ERL) and by Teledyne Isotopes. TLDs are processed by Duke Power Company's Dosimetry Laboratory. Sections A.1-A.9 describe the sampling and analysis procedures by media type. The actual procedures which are applicable to the sampling and analysis are found in References 3-6.

A.1 Airborne Radioiodine And Particulates

Radioiodine and Particulate activity in air is collected through use of fiber filters for particulate collection followed by charcoal cartridges for iodine adsorption. Air samplers are operated continuously and samples are changed on a weekly frequency. The samplers are designed to operate at a constant flow rate and are set to sample around 5 cubic feet per minute. The volume of air usually sampled over the weekly period is around 1.4E3 cubic meters. Gamma spectroscopy is performed on each fiber filter and each charcoal cartridge separately.

A.2 Drinking Water

Drinking Water samples are collected by operation of a composite sampler. The sampler is operated to collect an aliquot at least once every two hours. The sample is collected monthly with 3500 milliliters utilized for gamma spectroscopy and 500 milliliters used for gross beta analysis. The beta analysis is made with a proportional counter. A separate portion (50 milliliters) is saved to form a quarterly composite with two other monthly period samples. Tritium analysis is performed on this quarterly composite.

The ERL initiated in-house analysis of water samples for Tritium in 1986. First and second quarter samples were analyzed for Tritium by Teledyne Isotopes using a gas counting procedure. Third and fourth quarter samples were analyzed by the ERL using liquid scintillation.

One additional location was added in 1986. Sampling of the Greenville Water Plant on Lake Keowee began in late 1985.

A.3 Surface Water

Surface Water samples are collected by operation of a composite sampler. The sampler is operated to collect an aliquot at least every two hours. The sample is collected monthly with 3500 milliliters utilized for gamma spectroscopy. A separate portion (50 milliliters) is saved to form a quarterly composite with two other monthly period samples. Tritium analysis is performed on the quarterly composite. Teledyne Isotopes performed the first and second quarter analyses by gas counting and the ERL performed the third and fourth quarter analyses by liquid scintillation.

A.4 Milk

Milk samples are collected on a semi-monthly frequency. The normal volume collected is three gallons. A portion of the milk is utilized for gamma spectroscopy. The remaining portion is used for low-level iodine analysis. An ion exchange resin is used to remove and concentrate any iodine in the milk. The resin is then analyzed by gamma spectroscopy. This procedure was changed during the year. Previously, a wet chemical separation and precipitation for the iodine was performed. The final precipitate, containing the iodine, was analyzed with a gas-flow proportional counter. The procedure change was made since using the ion exchange resin is a faster and more reliable process. Samples collected after July 16, 1986 were processed using the ion exchange method. Appendix E contains a report prepared by the ERL describing the technique comparability study.

An additional monitoring location was added to the program after performing the 1986 Land Use Census. Location 075 is outside the five mile Technical Specification range which requires addition of the location, but was added since the owner was willing to participate.

A.5 Broadleaf Vegetation

Broadleaf vegetation sampling is performed on a monthly frequency. At least 1 kilogram of vegetation is collected. The most recent growth possible is sampled. Gamma spectroscopy is performed on each sample.

A.6 Shoreline Sediment

Shoreline Sediment is collected on a semi-annual frequency. At least 500 grams of sample are collected from the top 7.5

centimeters of sediment at the water's edge. Gamma spectroscopy is performed on each sample after drying.

A location near the liquid effluent release boundary (Location 063) was added in 1986. This was done to have a sample to coincide with the water and fish sampling performed at the location. The addition also makes comparison of current results with historical data more practical.

A.7 Fish

Fish are collected on a semi-annual frequency. Gillnets are put in place at the monitoring locations and fish are collected until the required sample size is met (500 grams each species). Only fish fillets are utilized for the gamma spectroscopy analysis.

The control location was changed to near the Greenville Water Plant Intake on Lake Keowee. This was done because of the difficulties in obtaining catfish from the previous control location.

A.8 Direct Gamma Radiation

Direct Radiation measurements are accomplished by using $CaSO_4$:Dy TLDs. The TLDs are changed out on a quarterly frequency. The gamma dose determined for each TLD after processing is converted to a dose rate for reporting purposes.

A.9 Land Use Census

The Land Use Census is conducted to identify the location of the nearest milk animal, meat animal, and nearest residence in each of the sixteen meteorological sectors within a distance of 5 miles of the station. The census is accomplished by a vehicle search of each sector. Aerial surveys or consulting local authorities may also be utilized to collect information. The census is performed between April and October each year. In lieu of a survey of gardens in the area, sampling of Broadleaf Vegetation is performed at the site boundary in the direction sector having the highest deposition parameter. This location ensures the highest potential exposure from the vegetation pathway is monitored.

APPENDIX B

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

SUMMARY OF RESULTS

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

OCONEE NUCLEAR STATION

DOCKET NUMBER 50-269,-270,-287
JANUARY 1,1986 - DECEMBER 31,1986

MEDIUM SAMPLED UNITS	* TYPE & TOTAL NO. OF ANALYSES PERFORMED		(LLD)	ALL INDICATOR LOCATIONS MEANS (F) RANGE	LOCATION W/ HIGHEST ANN. MEAN NAME DIST/ DIRECTION	MEAN (F) RANGE	CONTROL LOCATIONS MEAN (F) RANGE	NO. OF NON-ROUTINE REPORT MEAS.
AIRBORNE RADIOIODINES PCI/CUB.METERS 5 LOCATIONS							073 9.0 MI/NW	
	MN-54	215	0.00	2.15E-04(5/ 174)	072	5.00E-04(2/ 43)	-6.26E-05(2/ 41)	
				2.42E-03-- 5.58E-03	1.7 MI/S	2.42E-03-- 5.58E-03	2.42E-03-- 4.37E-03	
	FE-59	215	0.00	7.34E-05(3/ 174)	060	5.14E-04(1/ 44)	5.20E-04(2/ 41)	
				5.05E-03-- 6.52E-03	2.5 MI/NNE	6.52E-03-- 6.52E-03	8.90E-03-- 1.11E-02	
	CO-58	215	0.00	7.39E-05(4/ 174)	072	1.53E-04(1/ 43)	7.37E-05(1/ 41)	
				2.46E-03-- 4.15E-03		4.15E-03-- 4.15E-03	3.56E-03-- 3.56E-03	
	CO-60	215	0.00	3.53E-04(10/ 174)	060	5.44E-04(4/ 44)	4.82E-04(2/ 41)	
				2.79E-03-- 6.53E-03		2.88E-03-- 4.54E-03	4.95E-03-- 5.50E-03	
	ZN-65	215	0.00	-1.53E-03(2/ 174)	061	-5.30E-04(0/ 43)	-1.26E-03(1/ 41)	
				6.44E-03-- 7.20E-03	1.5 MI/SSW	0.00E-01-- 0.00E-01	5.16E-03-- 5.16E-03	
	ZR-95	215	0.00	4.11E-04(4/ 174)	060	9.60E-04(1/ 44)	9.56E-04(0/ 41)	
				3.09E-03-- 7.60E-03		7.60E-03-- 7.60E-03	0.00E-01-- 0.00E-01	
	NB-95	215	0.00	9.27E-04(17/ 174)	074	1.30E-03(7/ 44)	3.50E-04(2/ 41)	
				2.78E-03-- 6.62E-03	1.7 MI/NNW	2.78E-03-- 5.98E-03	3.06E-03-- 3.14E-03	
	I-131	215	0.07	4.73E-04(4/ 174)	061	9.33E-04(2/ 43)	1.29E-03(4/ 41)	
				4.49E-03-- 6.84E-03		4.63E-03-- 6.84E-03	2.83E-03-- 2.47E-02	
	CS-134	215	0.05	3.29E-04(5/ 174)	072	6.10E-04(4/ 43)	2.12E-04(3/ 41)	
				2.85E-03-- 4.61E-03		2.85E-03-- 4.61E-03	2.11E-03-- 4.06E-03	
	CS-137	215	0.06	1.82E-03(38/ 174)	061	2.15E-03(13/ 43)	2.53E-03(4/ 41)	
				2.12E-03-- 1.78E-02		3.67E-03-- 1.71E-02	3.97E-03-- 5.45E-02	
	BALA-140	215	0.00	2.62E-04(4/ 174)	060	5.44E-04(1/ 44)	7.29E-04(2/ 41)	
				3.44E-03-- 5.30E-03		5.30E-03-- 5.30E-03	4.29E-03-- 4.49E-03	

MEAN BASED UPON ALL NET ACTIVITY MEASUREMENTS
RANGE BASED UPON DETECTABLE ACTIVITY MEASUREMENTS ONLY
ZERO RANGE INDICATES NO DETECTABLE ACTIVITY MEASUREMENTS
FRACTION OF DETECTABLE ACTIVITY MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES, (F)
*DOES NOT INCLUDE SAMPLES DURING CHERNOBYL FALLOUT PERIOD 4/29 - 6/24/86.

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

OCONEE NUCLEAR STATION

DOCKET NUMBER 50-269,-270,-287
JANUARY 1,1986 - DECEMBER 31,1986

MEDIUM SAMPLED UNITS	*TYPE & TOTAL NO. OF ANALYSES PERFORMED		(LLD)	ALL INDICATOR LOCATIONS MEANS (F) RANGE	LOCATION W/ HIGHEST ANN. MEAN NAME DIST/ DIRECTION	MEAN (F) RANGE	CONTROL LOCATIONS MEAN (F) RANGE	NO. OF NON-ROUTINE REPORT MEAS.
AIRBORNE PARTICULATES PCI/CUB.METERS 5 LOCATIONS							073 9.0 MI/NW	
	MN-54	215	0.00	1.71E-04(7/ 174)	060	2.77E-04(2/ 44)	2.26E-04(1/ 41)	
				1.76E-03-- 5.06E-03	2.5 MI/NNE	2.43E-03-- 3.29E-03	2.37E-03-- 2.37E-03	
	FE-59	215	0.00	-2.26E-06(5/ 174)	061	6.59E-04(3/ 43)	-1.21E-04(0/ 41)	
				5.37E-03-- 8.96E-03	1.5 MI/SSW	5.37E-03-- 7.50E-03	0.00E-01-- 0.00E-01	
	CO-58	215	0.00	8.42E-05(6/ 174)	072	2.31E-04(3/ 43)	4.31E-04(3/ 41)	
				1.99E-03-- 4.51E-03	1.7 MI/S	1.99E-03-- 4.51E-03	1.61E-03-- 4.65E-03	
	CO-60	215	0.00	1.48E-04(11/ 174)	060	4.72E-04(7/ 44)	-2.67E-05(0/ 41)	
				1.62E-03-- 5.91E-03		1.94E-03-- 5.91E-03	0.00E-01-- 0.00E-01	
	ZN-65	215	0.00	-1.24E-03(1/ 174)	061	-3.93E-04(0/ 43)	-8.92E-04(0/ 41)	
				4.22E-03-- 4.22E-03		0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	ZR-95	215	0.00	6.43E-04(12/ 174)	060	9.40E-04(2/ 44)	-6.77E-04(0/ 41)	
				2.95E-03-- 1.70E-02		2.95E-03-- 3.86E-03	0.00E-01-- 0.00E-01	
	NB-95	215	0.00	5.76E-04(10/ 174)	061	1.19E-03(3/ 43)	8.79E-04(1/ 41)	
				2.00E-03-- 5.78E-03		2.06E-03-- 2.65E-03	1.97E-03-- 1.97E-03	
	I-131	215	0.07	6.13E-04(7/ 174)	061	8.21E-04(2/ 43)	2.02E-03(2/ 41)	
				2.96E-03-- 6.26E-03		2.96E-03-- 3.00E-03	5.44E-03-- 8.18E-02	
	CS-134	215	0.05	3.58E-04(11/ 174)	061	6.57E-04(4/ 43)	1.11E-04(2/ 41)	
				2.39E-03-- 7.44E-03		2.79E-03-- 3.98E-03	2.50E-03-- 2.88E-03	
	CS-137	215	0.06	5.21E-04(9/ 174)	072	9.01E-04(4/ 43)	5.52E-04(5/ 41)	
				2.50E-03-- 8.92E-03		2.74E-03-- 8.92E-03	2.03E-03-- 3.31E-03	
	BALA-140	215	0.00	1.54E-04(4/ 174)	060	5.67E-04(1/ 44)	6.34E-04(0/ 41)	
				9.84E-04-- 5.38E-03		4.62E-03-- 4.62E-03	0.00E-01-- 0.00E-01	

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ZERO RANGE INDICATES NO DETECTABLE ACTIVITY MEASUREMENTS
FRACTION OF DETECTABLE ACTIVITY MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES, (F)
*DOES NOT INCLUDE SAMPLES DURING CHERNOBYL FALLOUT PERIOD 4/29 - 6/24/86.

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

OCONEE NUCLEAR STATION

DOCKET NUMBER 50-269,-270,-287
JANUARY 1,1986 - DECEMBER 31,1986

MEDIUM SAMPLED UNITS	TYPE & TOTAL NO. OF ANALYSES PERFORMED		(LLD)	ALL INDICATOR LOCATIONS MEAN (F) RANGE	LOCATION W/ HIGHEST ANN. MEAN NAME DIST/ DIRECTION	MEAN (F) RANGE	CONTROL LOCATIONS MEAN (F) RANGE	NO. OF NON-ROUTINE REPORT MEAS.
DRINKING WATER PCI/LITER 4 LOCATIONS							064 6.7 MI/SW	
	BETA-T	44	4.00	1.63E 00(32/ 33)	066	1.93E 00(11/ 11)	1.03E 00(10/ 11)	
				9.96E-01-- 2.74E 00	19.0 MI/SSE	1.18E 00-- 2.74E 00	7.62E-01-- 1.37E 00	
	MN-54	44	15.00	2.66E-01(0/ 33)	066	4.30E-01(0/ 11)	-2.10E-01(0/ 11)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	FE-59	44	30.00	8.60E-02(1/ 33)	066	9.73E-01(0/ 11)	-5.87E-01(0/ 11)	
				8.83E 00-- 8.83E 00		0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	CO-58	44	15.00	-1.11E-01(2/ 33)	065	2.18E-01(1/ 11)	-2.94E-01(0/ 11)	
				3.19E 00-- 3.55E 00	8.1 MI/SSE	3.19E 00-- 3.19E 00	0.00E-01-- 0.00E-01	
	CO-60	44	15.00	-6.39E-02(0/ 33)	065	1.18E-01(0/ 11)	9.19E-02(0/ 11)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	ZN-65	44	30.00	-1.78E 00(0/ 33)	066	-4.03E-01(0/ 11)	-1.39E 00(0/ 11)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	ZR-95	44	30.00	4.64E-01(1/ 33)	065	1.43E 00(1/ 11)	-1.64E-01(0/ 11)	
				7.10E 00-- 7.10E 00		7.10E 00-- 7.10E 00	0.00E-01-- 0.00E-01	
	NB-95	44	15.00	8.39E-01(2/ 33)	065	1.05E 00(0/ 11)	2.35E 00(4/ 11)	
				3.20E 00-- 5.60E 00		0.00E-01-- 0.00E-01	3.71E 00-- 5.97E 00	
	I-131 **	44	15.00	9.78E-01(1/ 33)	060	1.81E 00(1/ 11)	7.86E-01(0/ 11)	
				6.92E 00-- 6.92E 00	2.5 MI/NNE	6.92E 00-- 6.92E 00	0.00E-01-- 0.00E-01	
	CS-134	44	15.00	6.62E-01(0/ 33)	060	1.20E 00(0/ 11)	1.06E 00(1/ 11)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	5.66E 00-- 5.66E 00	
	CS-137	44	18.00	6.82E-01(3/ 33)	066	1.09E 00(2/ 11)	8.01E-01(2/ 11)	
				3.46E 00-- 3.76E 00		3.46E 00-- 3.68E 00	4.27E 00-- 4.35E 00	
	BALA-140	44	15.00	2.13E-01(0/ 33)	066	4.36E-01(0/ 11)	8.43E-01(1/ 11)	
				0.00E-01--, 0.00E-01		0.00E-01-- 0.00E-01	6.91E 00-- 6.91E 00	

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FRACTION OF DETECTABLE ACTIVITY MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES, (F)
*DOES NOT INCLUDE SAMPLES DURING CHERNOBYL FALLOUT PERIOD 4/29-6/24/86

**LOW LEVEL I-131 ANALYSIS WAS PERFORMED ON THE ONE SAMPLE WITH GAMMA SPECTROSCOPY RESULTS EXCEEDING THE I-131 CRITICAL LEVEL. LOW LEVEL ANALYSIS DID NOT DETECT I-131 AND THE MDA FOR THE ANALYSIS WAS < 2.90E-1 pCi/l.

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

OCONEE NUCLEAR STATION

DOCKET NUMBER 50-269,-270,-287
JANUARY 1,1986 - DECEMBER 31,1986

MEDIUM SAMPLED UNITS	*TYPE & TOTAL NO. OF ANALYSES PERFORMED		(LLD)	ALL INDICATOR LOCATIONS MEAN (F) RANGE	LOCATION W/ HIGHEST ANN. MEAN NAME DIST/ DIRECTION	MEAN (F) RANGE	CONTROL LOCATIONS MEAN (F) RANGE	NO. OF NON-ROUTINE REPORT MEAS.
SURFACE WATER PCI/LITER 2 LOCATIONS							062 0.7 MI/ENE	
	MN-54	22	15.00	1.12E 00(2/ 11)	063	1.12E 00(2/ 11)	2.57E-01(1/ 11)	
				2.98E 00-- 3.08E 00	0.8 MI/ESE	2.98E 00-- 3.08E 00	3.63E 00-- 3.63E 00	
	FE-59	22	30.00	-8.09E-01(0/ 11)	063	-8.09E-01(0/ 11)	-7.80E-01(0/ 11)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	CO-58	22	15.00	2.85E 00(4/ 11)	063	2.85E 00(4/ 11)	2.21E-01(0/ 11)	
				5.41E 00-- 1.05E 01		5.41E 00-- 1.05E 01	0.00E-01-- 0.00E-01	
	CO-60	22	15.00	9.21E-01(1/ 11)	063	9.21E-01(1/ 11)	-7.02E-01(0/ 11)	
				2.63E 00-- 2.63E 00		2.63E 00-- 2.63E 00	0.00E-01-- 0.00E-01	
	ZN-65	22	30.00	-1.28E 00(0/ 11)	063	-1.28E 00(0/ 11)	-1.56E-01(0/ 11)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	ZR-95	22	30.00	1.46E-01(0/ 11)	063	1.46E-01(0/ 11)	2.66E-01(0/ 11)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	NB-95	22	15.00	1.22E 00(3/ 11)	063	1.22E 00(3/ 11)	1.18E 00(0/ 11)	
				3.31E 00-- 5.42E 00		3.31E 00-- 5.42E 00	0.00E-01-- 0.00E-01	
	I-131	22	15.00	9.10E-01(0/ 11)	063	9.10E-01(0/ 11)	-9.46E-02(0/ 11)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	CS-134	22	15.00	8.00E-01(1/ 11)	063	8.00E-01(1/ 11)	9.92E-01(0/ 11)	
				4.63E 00-- 4.63E 00		4.63E 00-- 4.63E 00	0.00E-01-- 0.00E-01	
	CS-137	22	18.00	5.49E-01(0/ 11)	063	5.49E-01(0/ 11)	9.75E-01(1/ 11)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	6.88E 00-- 6.88E 00	
	BALA-140	22	15.00	4.47E-01(1/ 11)	063	4.47E-01(1/ 11)	-2.40E-01(1/ 11)	
				3.57E 00-- 3.57E 00		3.57E 00-- 3.57E 00	3.82E 00-- 3.82E 00	

MEAN BASED UPON ALL NET ACTIVITY MEASUREMENTS
RANGE BASED UPON DETECTABLE ACTIVITY MEASUREMENTS ONLY
ZERO RANGE INDICATES NO DETECTABLE ACTIVITY MEASUREMENTS
FRACTION OF DETECTABLE ACTIVITY MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES. (F)
*DOES NOT INCLUDE SAMPLES DURING CHERNOBYL FALLOUT PERIOD 4/29 - 6/24/86.

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

OCONEE NUCLEAR STATION

DOCKET NUMBER 50-269,-270,-287
JANUARY 1,1986 - DECEMBER 31,1986

MEDIUM SAMPLED UNITS	*TYPE & TOTAL NO. OF ANALYSES PERFORMED		(LLD)	ALL INDICATOR LOCATIONS MEANS (F) RANGE	LOCATION W/ HIGHEST ANN. MEAN NAME DIST/ DIRECTION	MEAN (F) RANGE	CONTROL LOCATIONS MEAN (F) RANGE	NO. OF NON-ROUTINE REPORT MEAS.
MILK							066	
PCI/LITER							19.0 MI/SSE	
4 LOCATIONS								
	I-131/LL	78	1.00	-3.31E-03(0/ 56)	069	3.72E-02(0/ 22)	2.34E-02(2/ 22)	
				0.00E-01-- 0.00E-01	4.5 MI/WNW	0.00E-01-- 0.00E-01	3.24E-01-- 5.56E-01	
	MN-54	77	0.00	5.81E-01(2/ 55)	069	1.16E 00(1/ 22)	-2.07E-01(1/ 22)	
				4.46E 00-- 6.95E 00		6.95E 00-- 6.95E 00	6.06E 00-- 6.06E 00	
	FE-59	77	0.00	1.29E 00(3/ 55)	069	2.22E 00(1/ 22)	-8.07E-01(0/ 22)	
				6.98E 00-- 2.07E 01		2.07E 01-- 2.07E 01	0.00E-01-- 0.00E-01	
	CO-58	77	0.00	-2.51E-01(0/ 55)	069	-1.12E-01(0/ 22)	2.79E-01(1/ 22)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	5.30E 00-- 5.30E 00	
	CO-60	77	0.00	1.18E-01(1/ 55)	071	4.63E-01(1/ 22)	6.52E-01(1/ 22)	
				3.85E 00-- 3.85E 00	10.3 MI/SSE	3.85E 00-- 3.85E 00	5.78E 00-- 5.78E 00	
	ZN-65	77	0.00	-1.54E 00(0/ 55)	069	-1.14E 00(0/ 22)	-3.39E 00(0/ 22)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	ZR-95	77	0.00	4.48E-01(1/ 55)	071	8.34E-01(0/ 22)	1.19E-01(0/ 22)	
				7.65E 00-- 7.65E 00		0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	NB-95	77	0.00	9.93E-01(4/ 55)	075	1.08E 00(0/ 11)	1.38E 00(3/ 22)	
				3.06E 00-- 5.84E 00	6.0 MI/NE	0.00E-01-- 0.00E-01	4.60E 00-- 6.90E 00	
	I-131	77	15.00	2.34E-01(0/ 55)	075	1.28E 00(0/ 11)	-2.55E-02(0/ 22)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	CS-134	77	15.00	9.33E-01(7/ 55)	071	1.16E 00(2/ 22)	6.44E-01(1/ 22)	
				3.63E 00-- 7.03E 00		3.63E 00-- 5.63E 00	6.23E 00-- 6.23E 00	
	CS-137	77	18.00	1.93E 00(9/ 55)	069	2.79E 00(5/ 22)	2.97E 00(6/ 22)	
				3.98E 00-- 1.02E 01		4.63E 00-- 1.02E 01	2.62E 00-- 1.73E 01	
	BALA-140	77	15.00	-2.61E-01(1/ 55)	069	2.96E-02(1/ 22)	-1.03E-02(0/ 22)	
				4.00E 00-- 4.00E 00		4.00E 00-- 4.00E 00	0.00E-01-- 0.00E-01	

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ZERO RANGE INDICATES NO DETECTABLE ACTIVITY MEASUREMENTS
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ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

OCONEE NUCLEAR STATION

DOCKET NUMBER 50-269,-270,-287
JANUARY 1,1986 - DECEMBER 31,1986

MEDIUM SAMPLED UNITS	* TYPE & TOTAL NO. OF ANALYSES PERFORMED		(LLD)	ALL INDICATOR LOCATIONS MEANS (F) RANGE	LOCATION W/ HIGHEST ANN. MEAN NAME DIST/ DIRECTION	MEAN (F) RANGE	CONTROL LOCATIONS MEAN (F) RANGE	NO. OF NON-ROUTINE REPORT MEAS.
BROADLEAF VEGETATION PCI/KG (WET) 3 LOCATIONS							073 9.0 MI/NW	
	MN-54	30	0.00	2.79E 00(4/ 20)	060	4.76E 00(3/ 10)	7.17E 00(3/ 10)	
				6.11E 00-- 2.02E 01	2.5 MI/NNE	9.86E 00-- 2.02E 01	1.85E 01-- 2.60E 01	
	FE-59	30	0.00	2.81E 00(2/ 20)	060	3.46E 00(1/ 10)	-7.42E-01(1/ 10)	
				2.63E 01-- 2.73E 01		2.63E 01-- 2.63E 01	2.50E 01-- 2.50E 01	
	CO-58	30	0.00	-1.30E 00(0/ 20)	028	-9.41E-01(0/ 10)	1.13E 00(0/ 10)	
				0.00E-01-- 0.00E-01	0.5 MI/S	0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	CO-60	30	0.00	1.85E 00(0/ 20)	060	3.89E 00(0/ 10)	9.71E-01(1/ 10)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	8.76E 00-- 8.76E 00	
	ZN-65	30	0.00	-6.51E 00(0/ 20)	060	-8.11E 00(0/ 10)	-2.65E 00(0/ 10)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	ZR-95	30	0.00	5.50E-01(0/ 20)	060	7.07E-01(0/ 10)	8.45E 00(1/ 10)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	2.57E 01-- 2.57E 01	
	NB-95	30	0.00	4.16E 00(1/ 20)	028	4.64E 00(0/ 10)	6.65E 00(3/ 10)	
				1.73E 01-- 1.73E 01		0.00E-01-- 0.00E-01	1.39E 01-- 3.34E 01	
	I-131	30	60.00	-1.53E 00(0/ 20)	028	-1.03E 00(0/ 10)	7.90E 00(1/ 10)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	7.39E 01-- 7.39E 01	
	CS-134	30	60.00	1.22E 01(11/ 20)	028	1.34E 01(7/ 10)	3.22E 01(7/ 10)	
				5.27E 00-- 4.02E 01		5.27E 00-- 4.02E 01	1.58E 01-- 7.11E 01	
	CS-137	30	80.00	2.52E 01(10/ 20)	060	2.90E 01(5/ 10)	2.94E 02(10/ 10)	
				1.33E 01-- 1.03E 02		2.04E 01-- 1.03E 02	1.86E 01-- 7.59E 02	
	BALA-140	30	0.00	2.49E 00(1/ 20)	028	4.00E 00(1/ 10)	-8.26E-02(0/ 10)	
				3.64E 01-- 3.64E 01		3.64E 01-- 3.64E 01	0.00E-01-- 0.00E-01	

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ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

OCONEE NUCLEAR STATION

DOCKET NUMBER 50-269,-270,-287
JANUARY 1,1986 - DECEMBER 31,1986

MEDIUM SAMPLED UNITS	* TYPE & TOTAL NO. OF ANALYSES PERFORMED	(LLD)	ALL INDICATOR LOCATIONS MEANS (F) RANGE	LOCATION W/ HIGHEST ANN. MEAN NAME DIST/ DIRECTION	MEAN (F) RANGE	CONTROL LOCATIONS MEAN (F) RANGE	NO. OF NON-ROUTINE REPORT MEAS.
SHORELINE SEDIMENT PCI/KG (DRY) 3 LOCATIONS						068 2.0 MI/W	
	MN-54 3	0.00	1.60E 01(1/ 2) 2.53E 01-- 2.53E 01	I 067 4.2 MI/SSE	2.53E 01(1/ 1) 2.53E 01-- 2.53E 01	3.76E 00(0/ 1) 0.00E-01-- 0.00E-01	
	FE-59 3	0.00	-1.35E 00(0/ 2) 0.00E-01-- 0.00E-01	I 067	0.00E-01(0/ 1) 0.00E-01-- 0.00E-01	6.31E 00(0/ 1) 0.00E-01-- 0.00E-01	
	CO-58 3	0.00	4.60E-01(0/ 2) 0.00E-01-- 0.00E-01	I 063 0.8 MI/ESE	2.26E 00(0/ 1) 0.00E-01-- 0.00E-01	-1.31E 00(0/ 1) 0.00E-01-- 0.00E-01	
	CO-60 3	0.00	1.16E 01(1/ 2) 2.63E 01-- 2.63E 01	I 067	2.63E 01(1/ 1) 2.63E 01-- 2.63E 01	1.76E 00(0/ 1) 0.00E-01-- 0.00E-01	
	ZN-65 3	0.00	-3.94E 00(0/ 2) 0.00E-01-- 0.00E-01	I 063	5.61E 00(0/ 1) 0.00E-01-- 0.00E-01	-3.16E 00(0/ 1) 0.00E-01-- 0.00E-01	
	ZR-95 3	0.00	1.32E 01(0/ 2) 0.00E-01-- 0.00E-01	I 067	3.21E 01(0/ 1) 0.00E-01-- 0.00E-01	2.45E 01(0/ 1) 0.00E-01-- 0.00E-01	
	NB-95 3	0.00	1.24E 01(0/ 2) 0.00E-01-- 0.00E-01	I 063	2.62E 01(0/ 1) 0.00E-01-- 0.00E-01	6.77E 00(0/ 1) 0.00E-01-- 0.00E-01	
	I-131 3	0.00	1.34E 01(0/ 2) 0.00E-01-- 0.00E-01	I 067	2.68E 01(0/ 1) 0.00E-01-- 0.00E-01	-3.13E 00(0/ 1) 0.00E-01-- 0.00E-01	
	CS-134 3	150.00	8.36E 01(2/ 2) 4.82E 01-- 1.19E 02	I 067	1.19E 02(1/ 1) 1.19E 02-- 1.19E 02	3.18E 01(1/ 1) 3.18E 01-- 3.18E 01	
	CS-137 3	180.00	3.23E 02(2/ 2) 5.81E 01-- 5.87E 02	I 067	5.87E 02(1/ 1) 5.87E 02-- 5.87E 02	2.87E 01(1/ 1) 2.87E 01-- 2.87E 01	
	BALA-140 3	0.00	6.12E 00(0/ 2) 0.00E-01-- 0.00E-01	I 067	6.80E 00(0/ 1) 0.00E-01-- 0.00E-01	7.17E 00(0/ 1) 0.00E-01-- 0.00E-01	

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ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

OCONEE NUCLEAR STATION

DOCKET NUMBER 50-269.-270.-287
JANUARY 1.1986 - DECEMBER 31.1986

MEDIUM SAMPLED UNITS	TYPE & TOTAL NO. OF ANALYSES PERFORMED		(LLD)	ALL INDICATOR LOCATIONS MEANS (F) RANGE	LOCATION W/ HIGHEST ANN. MEAN NAME DIST/ DIRECTION	MEAN (F) RANGE	CONTROL LOCATIONS MEAN (F) RANGE	NO. OF NON-ROUTINE REPORT MEAS.
AIRBORNE RADIOIODINES PCI/CUB.METERS 5 LOCATIONS							073 9.0 MI/NW	
	MN-54	255	0.00	1.85E-04(6/ 206) 2.42E-03-- 5.58E-03	072 1.7 MI/S	4.39E-04(2/ 51) 2.42E-03-- 5.58E-03	1.38E-04(3/ 49) 2.42E-03-- 4.37E-03	
	FE-59	255	0.00	1.28E-04(3/ 206) 5.05E-03-- 6.52E-03	060 2.5 MI/NNE	7.27E-04(1/ 52) 6.52E-03-- 6.52E-03	9.79E-04(3/ 49) 4.73E-03-- 1.11E-02	
	CO-58	255	0.00	8.85E-05(4/ 206) 2.46E-03-- 4.15E-03	072	2.20E-04(1/ 51) 4.15E-03-- 4.15E-03	1.42E-04(1/ 49) 3.56E-03-- 3.56E-03	
	CO-60	255	0.00	2.55E-04(11/ 206) 2.79E-03-- 6.53E-03	061 1.5 MI/SSW	4.00E-04(2/ 51) 2.88E-03-- 4.68E-03	4.51E-04(2/ 49) 4.95E-03-- 5.50E-03	
	ZN-65	255	0.00	-1.44E-03(2/ 206) 6.44E-03-- 7.20E-03	061	-4.91E-04(0/ 51) 0.00E-01-- 0.00E-01	-1.34E-03(1/ 49) 5.16E-03-- 5.16E-03	
	ZR-95	255	0.00	3.78E-04(4/ 206) 3.09E-03-- 7.60E-03	060	8.50E-04(1/ 52) 7.60E-03-- 7.60E-03	1.19E-03(1/ 49) 5.75E-03-- 5.75E-03	
	NB-95	255	0.00	8.70E-04(18/ 206) 2.69E-03-- 6.62E-03	074 1.7 MI/NNW	1.18E-03(7/ 52) 2.78E-03-- 5.98E-03	3.94E-04(2/ 49) 3.06E-03-- 3.14E-03	
	I-131	255	0.07	4.91E-03(24/ 206) 4.48E-03-- 8.96E-02	061	5.02E-03(7/ 51) 4.48E-03-- 8.42E-02	7.86E-03(9/ 49) 2.63E-03-- 2.11E-01	
	CS-134	255	0.05	3.15E-04(6/ 206) 2.60E-03-- 4.61E-03	072	6.02E-04(4/ 51) 2.85E-03-- 4.61E-03	2.46E-04(3/ 49) 2.11E-03-- 4.06E-03	
	CS-137	255	0.06	1.78E-03(45/ 206) 2.12E-03-- 1.78E-02	060	2.05E-03(14/ 52) 2.12E-03-- 1.11E-02	2.35E-03(5/ 49) 3.97E-03-- 5.45E-02	
	BALA-140	255	0.00	2.08E-04(4/ 206) 3.44E-03-- 5.30E-03	074	4.38E-04(3/ 52) 3.44E-03-- 4.57E-03	3.55E-04(3/ 49) 4.29E-03-- 4.49E-03	

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OCONEE NUCLEAR STATION

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MEDIUM SAMPLED UNITS	TYPE & TOTAL NO. OF ANALYSES PERFORMED		(LLD)	ALL INDICATOR LOCATIONS MEAN (F) RANGE	LOCATION W/ HIGHEST ANN. MEAN NAME DIST/ DIRECTION	MEAN (F) RANGE	CONTROL LOCATIONS MEAN (F) RANGE	NO. OF NON-ROUTINE REPORT MEAS.
AIRBORNE PARTICULATES PCI/CUB.METERS 5 LOCATIONS							073 9.0 MI/NW	
	MN-54	255	0.00	1.59E-04(8/ 206)	072	2.66E-04(1/ 51)	1.41E-04(1/ 49)	
				1.76E-03-- 5.06E-03	1.7 MI/S	5.06E-03-- 5.06E-03	2.37E-03-- 2.37E-03	
	FE-59	255	0.00	-5.93E-05(5/ 206)	061	5.00E-04(3/ 51)	8.72E-06(0/ 49)	
				5.37E-03-- 8.95E-03	1.5 MI/SSW	5.37E-03-- 7.50E-03	0.00E-01-- 0.00E-01	
	CO-58	255	0.00	6.83E-05(6/ 206)	072	2.00E-04(3/ 51)	4.05E-04(3/ 49)	
				1.99E-03-- 4.51E-03		1.99E-03-- 4.51E-03	1.81E-03-- 4.65E-03	
	CO-60	255	0.00	6.16E-05(12/ 206)	060	3.74E-04(8/ 52)	1.53E-05(1/ 49)	
				1.62E-03-- 5.91E-03	2.5 MI/NNE	1.94E-03-- 5.91E-03	2.28E-03-- 2.28E-03	
	ZN-65	255	0.00	-1.13E-03(1/ 206)	061	-4.55E-04(0/ 51)	-7.91E-04(0/ 49)	
				4.22E-03-- 4.22E-03		0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	ZR-95	255	0.00	5.88E-04(13/ 206)	060	8.79E-04(2/ 52)	-5.86E-04(0/ 49)	
				2.95E-03-- 1.70E-02		2.95E-03-- 3.86E-03	0.00E-01-- 0.00E-01	
	NB-95	255	0.00	5.54E-04(14/ 206)	061	1.21E-03(6/ 51)	8.69E-04(2/ 49)	
				2.00E-03-- 5.78E-03		2.06E-03-- 3.46E-03	1.97E-03-- 2.62E-03	
	I-131	255	0.07	1.42E-03(18/ 206)	072	1.70E-03(5/ 51)	2.78E-03(4/ 49)	
				2.96E-03-- 1.69E-02		5.79E-03-- 1.70E-02	5.44E-03-- 6.18E-02	
	CS-134	255	0.05	9.66E-04(28/ 206)	072	1.17E-03(9/ 51)	8.96E-04(6/ 49)	
				2.39E-03-- 1.95E-02		2.39E-03-- 1.95E-02	2.50E-03-- 1.90E-02	
	CS-137	255	0.06	1.86E-03(32/ 206)	072	2.80E-03(10/ 51)	2.17E-03(10/ 49)	
				2.38E-03-- 3.33E-02		2.74E-03-- 3.33E-02	2.03E-03-- 3.84E-02	
	BALA-140	255	0.00	2.41E-04(5/ 206)	060	5.88E-04(2/ 52)	8.28E-04(2/ 49)	
				9.84E-04-- 5.38E-03		4.62E-03-- 4.97E-03	3.04E-03-- 6.19E-03	

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ZERO RANGE INDICATES NO DETECTABLE ACTIVITY MEASUREMENTS
FRACTION OF DETECTABLE ACTIVITY MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES. (F)

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

OCONEE NUCLEAR STATION

DOCKET NUMBER 50-269,-270,-287
JANUARY 1,1986 - DECEMBER 31,1986

MEDIUM SAMPLED UNITS	TYPE & TOTAL NO. OF ANALYSES PERFORMED		(LLD)	ALL INDICATOR LOCATIONS MEAN (F) RANGE	LOCATION W/ HIGHEST ANN. MEAN NAME DIST/ DIRECTION	MEAN (F) RANGE	CONTROL LOCATIONS MEAN (F) RANGE	NO. OF NON-ROUTINE REPORT MEAS.
DRINKING WATER PCI/LITER 4 LOCATIONS							064 6.7 MI/SW	
	BETA-T	52	4.00	1.66E 00(38/ 39)	066	1.91E 00(13/ 13)	1.04E 00(12/ 13)	
				9.96E-01-- 2.74E 00	19.0 MI/SSE	1.18E 00-- 2.74E 00	7.62E-01-- 1.37E 00	
	MN-54	52	15.00	1.58E-01(0/ 39)	066	3.37E-01(0/ 13)	6.08E-02(0/ 13)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	FE-59	52	30.00	5.27E-02(1/ 39)	066	9.28E-01(0/ 13)	2.69E-01(0/ 13)	
				8.83E 00-- 8.83E 00		0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	CO-58	52	15.00	-1.98E-01(2/ 39)	065	3.78E-02(1/ 13)	-1.99E-01(0/ 13)	
				3.19E 00-- 3.55E 00	8.1 MI/SSE	3.19E 00-- 3.19E 00	0.00E-01-- 0.00E-01	
	CO-60	52	15.00	-3.13E-02(1/ 39)	065	2.80E-01(1/ 13)	-3.08E-01(0/ 13)	
				3.20E 00-- 3.20E 00		3.20E 00-- 3.20E 00	0.00E-01-- 0.00E-01	
	ZN-65	52	30.00	-1.72E 00(0/ 39)	066	-3.59E-01(0/ 13)	-1.08E 00(0/ 13)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	ZR-95	52	30.00	5.84E-01(2/ 39)	065	1.54E 00(2/ 13)	-3.41E-02(0/ 13)	
				5.53E 00-- 7.10E 00		5.53E 00-- 7.10E 00	0.00E-01-- 0.00E-01	
	NB-95	52	15.00	8.03E-01(4/ 39)	066	1.02E 00(2/ 13)	2.29E 00(5/ 13)	
				2.46E 00-- 5.60E 00		3.18E 00-- 5.60E 00	3.71E 00-- 5.97E 00	
	I-131 **	52	15.00	1.05E 00(1/ 39)	060	1.59E 00(1/ 13)	5.66E-01(0/ 13)	
				6.92E 00-- 6.92E 00	2.5 MI/NNE	6.92E 00-- 6.92E 00	0.00E-01-- 0.00E-01	
	CS-134	52	15.00	5.50E-01(0/ 39)	060	1.04E 00(0/ 13)	9.55E-01(1/ 13)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	5.66E 00-- 5.66E 00	
	CS-137	52	18.00	6.16E-01(4/ 39)	066	9.12E-01(2/ 13)	5.76E-01(2/ 13)	
				3.15E 00-- 3.76E 00		3.46E 00-- 3.68E 00	4.27E 00-- 4.35E 00	
	BALA-140	52	15.00	1.55E-01(0/ 39)	066	4.63E-01(0/ 13)	9.15E-01(1/ 13)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	6.91E 00-- 6.91E 00	

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**LOW LEVEL I-131 ANALYSIS WAS PERFORMED ON THE ONE SAMPLE WITH GAMMA SPECTROSCOPY RESULTS EXCEEDING THE I-131 CRITICAL LEVEL. LOW LEVEL ANALYSIS DID NOT DETECT I-131 AND THE MDA FOR THE ANALYSIS WAS < 2.90E-1 pCi/l.

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

OCONEE NUCLEAR STATION

DOCKET NUMBER 50-269.-270.-287
JANUARY 1.1986 - DECEMBER 31.1986

MEDIUM SAMPLED UNITS	TYPE & TOTAL NO. OF ANALYSES PERFORMED	(LLD)	ALL INDICATOR LOCATIONS MEANS (F) RANGE	LOCATION W/ HIGHEST ANN. MEAN NAME DIST/ DIRECTION	MEAN (F) RANGE	CONTROL LOCATIONS MEAN (F) RANGE	NO. OF NONROUTINE REPORT MEAS.
DRINKING WATER QRT.COMPOSITE PCI/LITER 4 LOCATIONS	H-3 16	2000.00	8.28E 02(10/ 12) 3.60E 02-- 1.60E 03	065 8.1 MI/SSE	1.24E 03(4/ 4) 4.86E 02-- 1.60E 03	064 6.7 MI/SW 5.03E 02(2/ 4) 2.50E 02-- 1.04E 03	

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SURFACE WATER PCI/LITER 2 LOCATIONS	MN-54	26	15.00	1.21E 00(2/ 13) 2.98E 00-- 3.06E 00	063 0.8 MI/ESE	1.21E 00(2/ 13) 2.98E 00-- 3.06E 00	062 0.7 MI/ENE 1.63E-01(1/ 13) 3.63E 00-- 3.63E 00	
	FE-59	26	30.00	-3.77E-01(0/ 13) 0.00E-01-- 0.00E-01	063	-3.77E-01(0/ 13) 0.00E-01-- 0.00E-01	-7.70E-01(0/ 13) 0.00E-01-- 0.00E-01	
	CO-58	26	15.00	3.28E 00(5/ 13) 5.41E 00-- 1.05E 01	063	3.28E 00(5/ 13) 5.41E 00-- 1.05E 01	2.19E-01(0/ 13) 0.00E-01-- 0.00E-01	
	CO-60	26	15.00	1.23E 00(2/ 13) 2.63E 00-- 6.85E 00	063	1.23E 00(2/ 13) 2.63E 00-- 6.85E 00	-6.22E-01(0/ 13) 0.00E-01-- 0.00E-01	
	ZN-65	26	30.00	-1.59E 00(0/ 13) 0.00E-01-- 0.00E-01	063	-1.59E 00(0/ 13) 0.00E-01-- 0.00E-01	-3.81E-01(0/ 13) 0.00E-01-- 0.00E-01	
	ZR-95	26	30.00	3.53E-01(0/ 13) 0.00E-01-- 0.00E-01	063	3.53E-01(0/ 13) 0.00E-01-- 0.00E-01	3.86E-01(0/ 13) 0.00E-01-- 0.00E-01	
	NB-95	26	15.00	1.14E 00(3/ 13) 3.31E 00-- 5.42E 00	063	1.14E 00(3/ 13) 3.31E 00-- 5.42E 00	1.45E 00(2/ 13) 2.04E 00-- 3.84E 00	
	I-131	26	15.00	7.91E-01(0/ 13) 0.00E-01-- 0.00E-01	063	7.91E-01(0/ 13) 0.00E-01-- 0.00E-01	1.94E-01(0/ 13) 0.00E-01-- 0.00E-01	
	CS-134	26	15.00	1.07E 00(2/ 13) 4.63E 00-- 4.71E 00	063	1.07E 00(2/ 13) 4.63E 00-- 4.71E 00	8.12E-01(0/ 13) 0.00E-01-- 0.00E-01	
	CS-137	26	18.00	3.07E-01(0/ 13) 0.00E-01-- 0.00E-01	063	3.07E-01(0/ 13) 0.00E-01-- 0.00E-01	7.12E-01(1/ 13) 6.86E 00-- 6.86E 00	
	BALA-140	26	15.00	4.67E-01(1/ 13) 3.57E 00-- 3.57E 00	063	4.67E-01(1/ 13) 3.57E 00-- 3.57E 00	-1.36E-01(1/ 13) 3.82E 00-- 3.82E 00	

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DOCKET NUMBER 50-269,-270,-287
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SURFACE WATER ORT.COMPOSITE PCI/LITER 2 LOCATIONS	H-3	8	2000.00	1.26E 04(4/ 4) 5.73E 03-- 1.66E 04	063 0.8 MI/ESE	1.26E 04(4/ 4) 5.73E 03-- 1.66E 04	062 0.7 MI/ENE 4.48E 02(1/ 4) 4.00E 02-- 4.00E 02	

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MILK							066	
PCI/LITER 4 LOCATIONS							19.0 M1/SSE	
	I-131/LL	90	1.00	7.35E-02(5/ 64)	069	1.74E-01(2/ 26)	1.22E-01(5/ 26)	1 *
				2.27E-01-- 3.23E 00	4.5 M1/WNW	4.89E-01-- 3.23E 00	1.67E-01-- 1.91E 00	
	MN-54	89	0.00	5.02E-01(2/ 63)	069	7.95E-01(1/ 26)	-2.64E-01(1/ 26)	
				4.46E 00-- 8.95E 00		8.95E 00-- 8.95E 00	6.06E 00-- 6.06E 00	
	FE-59	89	0.00	1.14E 00(4/ 63)	075	1.74E 00(1/ 11)	-9.33E-01(0/ 26)	
				6.98E 00-- 2.07E 01	6.0 M1/NE	9.43E 00-- 9.43E 00	0.00E-01-- 0.00E-01	
	CO-58	89	0.00	-2.20E-01(1/ 63)	069	5.27E-03(1/ 26)	1.87E-01(1/ 26)	
				3.98E 00-- 3.98E 00		3.98E 00-- 3.98E 00	5.30E 00-- 5.30E 00	
	CO-60	89	0.00	-9.12E-02(1/ 63)	075	1.63E-01(0/ 11)	7.61E-01(1/ 26)	
				3.85E 00-- 3.85E 00		0.00E-01-- 0.00E-01	5.78E 00-- 5.78E 00	
	ZN-65	89	0.00	-1.57E 00(0/ 63)	071	-1.20E 00(0/ 26)	-3.30E 00(0/ 26)	
				0.00E-01-- 0.00E-01	10.3 M1/SSE	0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	ZR-95	89	0.00	7.46E-01(2/ 63)	069	9.14E-01(1/ 26)	2.25E-01(0/ 26)	
				7.65E 00-- 1.67E 01		1.67E 01-- 1.67E 01	0.00E-01-- 0.00E-01	
	NB-95	89	0.00	9.96E-01(5/ 63)	075	1.08E 00(0/ 11)	1.34E 00(4/ 26)	
				3.06E 00-- 5.84E 00		0.00E-01-- 0.00E-01	4.60E 00-- 6.90E 00	
	I-131	89	15.00	2.64E-01(0/ 63)	075	1.28E 00(0/ 11)	4.08E-01(1/ 26)	1 *
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	8.29E 00-- 8.29E 00	
	CS-134	89	15.00	8.64E-01(7/ 63)	071	9.69E-01(2/ 26)	8.50E-01(2/ 26)	
				3.63E 00-- 7.03E 00		3.63E 00-- 5.63E 00	6.23E 00-- 6.52E 00	
	CS-137	89	18.00	1.99E 00(10/ 63)	069	2.92E 00(6/ 26)	2.97E 00(7/ 26)	
				3.98E 00-- 1.02E 01		4.23E 00-- 1.02E 01	2.62E 00-- 1.73E 01	
	BALA-140	89	15.00	-2.63E-01(1/ 63)	069	-4.56E-02(1/ 26)	1.29E-01(0/ 26)	
				4.00E 00-- 4.00E 00		4.00E 00-- 4.00E 00	0.00E-01-- 0.00E-01	

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*REPORTING LEVEL CONCENTRATIONS WERE ONLY OBSERVED IN ONE SAMPLE. BOTH GAMMA SPECTROSCOPY ANALYSIS AND LOW LEVEL IODINE ANALYSIS PERFORMED ON THE SAMPLE HAD I-131 RESULTS EXCEEDING THE REPORTING LEVEL.

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

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BROADLEAF VEGETATION PCI/KG (WET) 3 LOCATIONS							073 9.0 MI/NW	
	MN-54	39	0.00	1.80E 00(4/ 26) 6.11E 00-- 2.02E 01	060 2.5 MI/NNE	3.11E 00(3/ 13) 9.86E 00-- 2.02E 01	6.05E 00(3/ 13) 1.85E 01-- 2.60E 01	
	FE-59	39	0.00	1.30E 00(3/ 26) 1.80E 01-- 2.73E 01	060	1.77E 00(2/ 13) 1.80E 01-- 2.63E 01	-1.63E 00(1/ 13) 2.50E 01-- 2.50E 01	
	CO-58	39	0.00	-1.15E 00(0/ 26) 0.00E-01-- 0.00E-01	028 0.5 MI/S	-8.57E-01(0/ 13) 0.00E-01-- 0.00E-01	1.92E-01(0/ 13) 0.00E-01-- 0.00E-01	
	CO-60	39	0.00	8.48E-01(0/ 26) 0.00E-01-- 0.00E-01	060	2.60E 00(0/ 13) 0.00E-01-- 0.00E-01	1.93E 00(2/ 13) 8.78E 00-- 1.26E 01	
	ZN-65	39	0.00	-6.72E 00(0/ 26) 0.00E-01-- 0.00E-01	028	-5.60E 00(0/ 13) 0.00E-01-- 0.00E-01	-2.17E 00(0/ 13) 0.00E-01-- 0.00E-01	
	ZR-95	39	0.00	1.17E 00(1/ 26) 2.53E 01-- 2.53E 01	028	2.28E 00(1/ 13) 2.53E 01-- 2.53E 01	5.93E 00(1/ 13) 2.57E 01-- 2.57E 01	
	NB-95	39	0.00	4.37E 00(3/ 26) 9.43E 00-- 1.73E 01	028	4.98E 00(1/ 13) 1.48E 01-- 1.48E 01	5.95E 00(4/ 13) 1.39E 01-- 3.34E 01	
	I-131	39	60.00	1.22E 01(4/ 26) 1.95E 01-- 1.63E 02	028	1.34E 01(2/ 13) 2.32E 01-- 1.63E 02	1.99E 01(3/ 13) 3.44E 01-- 1.46E 02	3
	CS-134	39	60.00	1.41E 01(15/ 26) 5.27E 00-- 4.65E 01	028	1.57E 01(9/ 13) 5.27E 00-- 4.65E 01	2.79E 01(9/ 13) 1.54E 01-- 7.11E 01	
	CS-137	39	80.00	2.69E 01(15/ 26) 9.31E 00-- 1.03E 02	060	3.28E 01(7/ 13) 2.04E 01-- 1.03E 02	3.12E 02(13/ 13) 1.86E 01-- 7.59E 02	
	BALA-140	39	0.00	2.80E 00(2/ 26) 1.18E 01-- 3.64E 01	028	3.38E 00(1/ 13) 3.64E 01-- 3.64E 01	1.53E 00(0/ 13) 0.00E-01-- 0.00E-01	

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SHORELINE SEDIMENT PCI/KG (DRY) 3 LOCATIONS							068 2.0 MI/W	
	MN-54	6	0.00	1.55E 01(1/ 4) 2.53E 01-- 2.53E 01	067 4.2 MI/SSE	2.24E 01(1/ 2) 2.53E 01-- 2.53E 01	1.88E 00(0/ 2) 0.00E-01-- 0.00E-01	
	FE-59	6	0.00	1.60E 01(0/ 4) 0.00E-01-- 0.00E-01	063 0.8 MI/ESE	2.38E 01(0/ 2) 0.00E-01-- 0.00E-01	3.15E 00(0/ 2) 0.00E-01-- 0.00E-01	
	CO-58	6	0.00	1.00E 01(1/ 4) 3.77E 01-- 3.77E 01	067	1.82E 01(1/ 2) 3.77E 01-- 3.77E 01	-6.55E-01(0/ 2) 0.00E-01-- 0.00E-01	
	CO-60	6	0.00	1.36E 01(2/ 4) 2.38E 01-- 2.63E 01	067	2.50E 01(2/ 2) 2.38E 01-- 2.63E 01	6.80E-01(0/ 2) 0.00E-01-- 0.00E-01	
	ZN-65	6	0.00	1.24E 01(0/ 4) 0.00E-01-- 0.00E-01	063	1.82E 01(0/ 2) 0.00E-01-- 0.00E-01	-1.58E 00(0/ 2) 0.00E-01-- 0.00E-01	
	ZR-95	6	0.00	1.35E 01(0/ 4) 0.00E-01-- 0.00E-01	063	1.65E 01(0/ 2) 0.00E-01-- 0.00E-01	1.22E 01(0/ 2) 0.00E-01-- 0.00E-01	
	NB-95	6	0.00	2.12E 01(1/ 4) 5.53E 01-- 5.53E 01	067	2.70E 01(1/ 2) 5.53E 01-- 5.53E 01	3.38E 00(0/ 2) 0.00E-01-- 0.00E-01	
	I-131	6	0.00	1.61E 01(0/ 4) 0.00E-01-- 0.00E-01	067	3.22E 01(0/ 2) 0.00E-01-- 0.00E-01	-1.57E 00(0/ 2) 0.00E-01-- 0.00E-01	
	CS-134	6	150.00	9.59E 01(4/ 4) 4.62E 01-- 1.62E 02	067	1.41E 02(2/ 2) 1.19E 02-- 1.62E 02	1.59E 01(1/ 2) 3.16E 01-- 3.16E 01	
	CS-137	6	180.00	3.81E 02(4/ 4) 4.02E 01-- 8.37E 02	067	7.12E 02(2/ 2) 5.87E 02-- 8.37E 02	1.44E 01(1/ 2) 2.87E 01-- 2.87E 01	
	BALA-140	6	0.00	1.59E 00(0/ 4) 0.00E-01-- 0.00E-01	063	2.71E 00(0/ 2) 0.00E-01-- 0.00E-01	3.59E 00(0/ 2) 0.00E-01-- 0.00E-01	

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FISH							060	
PCI/KG (WET)							2.5 MI/NNE	
3 LOCATIONS								
	MN-54	13	130.00	-1.45E 00(0/ 9)	067	-1.36E 00(0/ 5)	-2.47E 00(0/ 4)	
				0.00E-01-- 0.00E-01	4.2 MI/SSE	0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	FE-59	13	260.00	-8.48E-01(0/ 9)	063	-5.82E-01(0/ 4)	2.90E 00(0/ 4)	
				0.00E-01-- 0.00E-01	0.8 MI/ESE	0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	CO-58	13	130.00	4.37E 01(2/ 9)	063	9.56E 01(2/ 4)	2.31E 00(0/ 4)	
				1.11E 02-- 2.66E 02		1.11E 02-- 2.66E 02	0.00E-01-- 0.00E-01	
	CO-60	13	130.00	1.26E 01(3/ 9)	063	2.59E 01(2/ 4)	2.41E 00(0/ 4)	
				7.90E 00-- 8.07E 01		2.16E 01-- 8.07E 01	0.00E-01-- 0.00E-01	
	ZN-65	13	260.00	-7.91E 00(0/ 9)	067	-6.42E 00(0/ 5)	-6.39E 00(0/ 4)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	ZR-95	13	0.00	-3.97E 00(0/ 9)	063	-3.78E 00(0/ 4)	4.84E-01(0/ 4)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	NB-95	13	0.00	-3.64E 03(0/ 9)	067	4.87E 00(0/ 5)	5.08E 00(0/ 4)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	I-131	13	0.00	-9.09E 00(0/ 9)	067	-7.43E 00(0/ 5)	2.82E 01(0/ 4)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	
	CS-134	14	130.00	1.24E 02(8/ 10)	063	2.57E 02(3/ 4)	4.75E 00(0/ 4)	
				9.45E 00-- 7.21E 02		3.17E 01-- 7.21E 02	0.00E-01-- 0.00E-01	
	CS-137	14	150.00	3.98E 02(10/ 10)	063	7.36E 02(4/ 4)	3.22E 01(4/ 4)	
				5.50E 01-- 1.98E 03		1.19E 02-- 1.98E 03	2.60E 01-- 4.14E 01	
	BALA-140	13	0.00	6.37E-01(0/ 9)	067	4.75E 00(0/ 5)	-6.52E 00(0/ 4)	
				0.00E-01-- 0.00E-01		0.00E-01-- 0.00E-01	0.00E-01-- 0.00E-01	

MEAN BASED UPON ALL NET ACTIVITY MEASUREMENTS
RANGE BASED UPON DETECTABLE ACTIVITY MEASUREMENTS ONLY
ZERO RANGE INDICATES NO DETECTABLE ACTIVITY MEASUREMENTS
FRACTION OF DETECTABLE ACTIVITY MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES, (F)

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

OCONEE NUCLEAR STATION

DOCKET NUMBER 50-269,-270,-287
JANUARY 1,1986 - DECEMBER 31,1986

MEDIUM SAMPLED UNITS	TYPE & TOTAL NO. OF ANALYSES PERFORMED	(LLD)	ALL INDICATOR LOCATIONS MEANS (F) RANGE	LOCATION W/ HIGHEST ANN. MEAN NAME DIST/ DIRECTION	MEAN (F) RANGE	CONTROL LOCATIONS MEAN (F) RANGE	NO. OF NON-ROUTI REPORT MEAS.
DIRECT RADIATION(TLD) MR/HOUR 40 LOCATIONS	MR/HOUR 157	0.00	1.29E-02(153/ 153) 9.00E-03-- 2.10E-02	I034 I0.2 MI/NW	1.93E-02(4/ 4) 1.70E-02-- 2.10E-02	058 10.0 MI/WSW 1.75E-02(4/ 4) 1.50E-02-- 2.00E-02	

MEAN BASED UPON ALL NET ACTIVITY MEASUREMENTS
RANGE BASED UPON DETECTABLE ACTIVITY MEASUREMENTS ONLY
ZERO RANGE INDICATES NO DETECTABLE ACTIVITY MEASUREMENTS
FRACTION OF DETECTABLE ACTIVITY MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES. (F)

APPENDIX C

SAMPLING DEVIATIONS

The deviations from sampling procedures that occurred during 1986 are listed below. The air particulate and radioiodine sampling deviations have been attributed to sampler failures caused by the wear and deterioration of the vanes in the sampler pump. This was not realized until wear had progressed to the point where it could be identified by visual inspection. A preventive maintenance action has been implemented where vanes are replaced in samplers on an annual basis.

A. Air Filter/Cartridge

1. Location #060, 4/01/86 to 4/08/86
   Reason: Fuse blown in sampler after 113 hour run time.
   Action: Sampler replaced. Sampler checked and determined to be operating properly.

2. Location #072, 4/15/86 to 4/22/86
   Reason: Fuse blown in sampler after 147.3 hour run time.
   Action: Replaced fuse. Procedure change made to require "slow-blow" fuses be used and replaced at each calibration.

3. Location #072, 4/22/86 to 4/29/86
   Reason: Fuse blown in sampler after 80 hour run time.
   Action: Determined fuses being used were mislabeled as "slow-blow" fuses. Replaced fuse in this sampler and all others with actual "slow-blow" fuses.

4. Location #060, 4/29/86 to 5/06/86
5. Location #073, 5/13/86 to 5/20/86
   Reason: Fuses blown in sampler after 50 hour run time (060) and 67.5 hour run time (073). Both felt to be due to storm activity.
   Action: Replaced fuses.

6. Location #073, 7/08/86 to 7/15/86
   Reason: Fuse blown in sampler after 80.2 hour run time.
   Action: Sampler replaced. Sampler checked and determined to be operating properly. Test performed where sampler ran continuously for five days at station lab without failure.

7. Location #073, 7/15/86 to 7/22/86
8. Location #073, 7/29/86 to 8/05/86
   Reason: Fuse blown in sampler after 4.6 hour run time (7/15) and 76 hour run time (7/29).
   Action: Replaced fuses.

9. Location #060, 8/05/86 to 8/12/86
   Reason: Fuse blown in sampler after 105.6 hour run time. Felt to be due to power outage in the area.
   Action: Replaced fuse.

10. Location #073, 8/19/86 to 8/26/86
    Reason: Fuse blown in sampler after 108.6 hour run time.
    Action: Replaced fuse. Lighting arresters put in place at all sampler locations on 9/02/86.

11. Location #073, 9/02/86 to 9/09/86
    Reason: Fuse blown in sampler after 34.5 hour run time.
    Action: Replaced fuse.

12. Location #073, 9/30/86 to 10/07/86
    Reason: Fuse blown in sampler after 160.7 hour run time.
    Action: Replaced fuse. Blue Ridge Electrical Cooperative contacted to check the sampler power supply. A loose neutral contact was identified and corrected 10/10/86.

13. Location #072, 10/07/86 to 10/14/86
14. Location #060, 10/07/86 to 10/14/86
15. Location #060, 10/14/86 to 10/21/86
    Reason: Fuses blown in sampler after 47 hours (072), 46.6 hours (060 on 10/07), and 50.2 hours (060 on 10/14).
    Action: Replaced fuses.

16. Location #073, 11/04/86 to 11/11/86
    Reason: Fuse blown in sampler. Malfunction discovered the same day.
    Action: Replaced sampler. Different type of fuse was installed in all samplers on 11/11/86 after consulting the sampler manufacturer. Back up sampler placed at location.

17. Location #072, 12/02/86 to 12/09/86
    Reason: Sampler running, but flow rate had decreased.
    Action: Replaced sampler. Air flow verified.

B. Surface Water

1. Location #063, 11/11/86 to 12/09/86
   Reason: Fuse blown in sampler. No sample in compositor.
   Action: Replaced fuse. Sampler operation verified. Grab sample collected.

C. Direct Radiation

1. Location #056, 12/13/85 to 3/14/86
   Reason: TLD missing.
   Action: Placed second quarter's TLD in less obvious location at the site.

2. Location #051, 3/14/86 to 6/13/86
   Reason: TLD missing.
   Action: Third quarter's TLD put in place.

3. Location #051, 9/12/86 to 12/10/86
   Reason: TLD determined to be missing after fourth quarter's TLDs were received by the Dosimetry Laboratory. A TLD was picked up at the site, and first quarter '87 TLD put in its place, but the Dosimetry Laboratory later determined that the TLD picked up at 051 was the second quarter '86 TLD.
   Action: Labels are being placed on all TLDs stating that they are Duke Power property and giving a phone number for any questions about the TLDs. This was implemented first quarter '87. Second quarter '87 TLD at location #051 was moved to a less obvious location at the site.

APPENDIX D

ANALYTICAL DEVIATIONS

The unavailable analyses that occurred during 1986 are listed below. The air particulate and radioiodine unavailable analyses were due to low sampling volumes caused by sampler failures. These failures have been attributed to pump vane wear and deterioration. This was not realized until wear had progressed to the point where it could be identified by visual inspection. A preventive maintenance action has been implemented where vanes are replaced in samplers on an annual basis.

A. Broadleaf Vegetation

1. Location #028, 3/25/86
2. Location #060, 3/25/86
3. Location #073, 3/25/86

   Reason: Samples were inadvertently disposed of before they were counted.

   Action: Sample handling system changed to require review and signing off of form listing all samples received by the ERL before disposing of samples. Sign off is performed after verifying analyses are complete and data is filed.

B. Air Filter/Cartridge

1. Location #073, 9/09,86 to 9/16/86
2. Location #073, 10/07/86 to 10/14/86
3. Location #073, 10/14/86 to 10/21/86
4. Location #072, 12/09/86 to 12/16/86

   Reason: Samplers blew fuse after short collection times (0.1 to 2.5 hours). A week or longer count time would be necessary to meet LLDs. Such long count times are impractical.

   Action: Fuse replaced in samplers. Blue Ridge Electrical Cooperative contacted to perform check of #073 power supply. A loose neutral contact was identified and corrected on 10/10/86. On 11/11/86 a different fuse was installed on all samplers after consulting the sampler manufacturer.

5. Location #061, 12/16/86 to 12/23/86

   Reason: Carbon vanes on sampler pump found to be damaged. Timer on sampler indicated a complete run but flow rate could not be determined. An Unavailable Analysis is necessary since the volume is unknown.

   Action: Replaced sampler. Replacement parts obtained from ERL for immediate use and order for parts added to stations warehousing system to ensure future availability.

C. Milk

1. Location #075, 12/30/86, Gamma Analysis only

   Reason: Milk was analyzed for I-131 before the gamma analysis was done. The technician depleted the milk supply for the I-131 process before realizing there was none available for the gamma analysis.

   Action: The resin used for the I-131 process was counted for other gamma isotopes as a qualitative check. Changes were made to the sample transmittal form to provide more information to the technician performing the analyses. The transmittal informs the technician of any sample deviation associated with the sample and the status of the analyses (i.e., which analyses have been completed).

APPENDIX E

SUPPORTING DOCUMENTATION

September 22, 1986

MEMO TO FILE
OCONEE NUCLEAR STATION

SUBJECT: Land Use Census, 1986 -
Milch Animals

File Nos.: 778.05

During the 1986 Land Use Census, 8 locations with either cows or goats were identified. (Census attached) One of these was Powell's dairy (4.5 miles WNW) which is already included in the monitoring program.

All of the other locations were in an area of a higher D/Q than those which are currently sampled. The owners of the milch animals were contacted the week of July 21. One owner of a cow (3 miles E) was in the hospital during that time and could not be contacted. He was subsequently contacted the week of August 25th and was willing to participate, and supply a sample the following week. A procedure change was initiated to insure faster follow up on future potential samples. (CP/0/B/4005/18A)

The sample, however, was not available upon the prearranged date. The owner stated that he had just purchased several calves which were consuming all of the available milk and therefore could not participate in the monitoring program. The response of the other owners are listed below:

4.5 miles NNE (cow)	Owner unwilling to participate
4.0 miles NNE (goat)	Owner unwilling to participate
4.5 miles NE (cow)	Cows were nursing calves and not milked for human consumption
3.0 miles ENE (goat)	Owner unwilling to participate
3.0 miles E (cow)	Cows were nursing calves and not milked for human consumption
3.25 miles ESE (goat)	Owner had only one milch goat which produced 1 pint of milk each day, which is an insufficient quantity for analysis
4.0 miles WSW (cow)	Cows were nursing calves and not milked for human consumption
4.5 miles WNW (cow)	Powell's dairy - already included in monitoring program

In addition to the above owners, one owner was located in the NNE sector, 6 miles from the plant who was willing to participate in the monitoring program. The location was added in July.

Gary W. Sain

GWS/nrb

xc: Craig Harlin
Libby Wehrman
Leff Benge

DUKE POWER COMPANY
ENVIRONMENTAL RADIOLOGICAL LABORATORY
PRODUCTION ENVIRONMENTAL SERVICES

TECHNIQUE COMPARABILITY STUDY

COMPARISON OF TWO METHODS OF LOW-LEVEL IODINE-131 ANALYSIS IN WATER AND MILK SAMPLES TO FACILITATE AND JUSTIFY ADOPTION OF A PROPOSED METHOD

MARCIA D. LANE

MAY 1986

3RDH2003

ABSTRACT

This report outlines a study performed by the Environmental Radiological Laboratory (ERL) to determine the feasibility of a proposed method of low-level iodine-131 analysis. Experiments were performed using replicate blank and spiked milk and water samples that were analyzed via the proposed and current (Procedure ER/O/B/2300/03) methods for low-level iodine-131 analysis. The data obtained indicate that the proposed method is equivalent to the current method and, therefore, the proposed method can be adopted for low-level iodine-2131 analysis.

INTRODUCTION

Analysis of milk and water samples for low-level iodine-131 is required by the Nuclear Regulatory Commission and the Technical Specifications of the nuclear stations. The current mode of analysis is lengthy and involves a series of chemical extractions (organic and inorganic phase separations) and precipitations. The extensive and time-consuming extractions and precipitations increase the probability of human error during the procedure. Additionally, each step in the method represents the possibility of iodine losses due to inadequate extraction or precipitation caused by the nature of the chemical reactions involved.

Therefore, a new method of low-level iodine-131 analysis was researched by ERL personnel. The method chosen for this study parallels a method currently used by the South Carolina Department of Health and Environmental Control. The proposed method has no extraction or precipitation steps and would reduce the time and chemicals needed for low-level iodine-131 analysis. The comparison of the two methods (current vs. proposed) was performed using milk and water samples spiked with low levels of iodine-131.

Based on the data obtained in this study, the following recommendation has been made: implementation of the proposed method of low-level iodine-131 analysis as soon as practicable.

MATERIALS AND METHODS

(a) Samples:

Milk samples were obtained from three local dairies and stored under refrigeration (4°C). Water samples were obtained from the laboratory water supply.

(b) Sample Preparation:

Milk and water samples were spiked with iodine-131 (Analytics, Inc.) to obtain final concentrations ranging from 0.5 to 4.0 pCi/liter of iodine-131. Milk and water samples were also not spiked to provide for blanks in the analysis.

(c) Chemicals:

Sodium chloride, sodium hypochlorite, nitric acid, carbon tetrachloride, hydroxylamine hydrochloride, sodium nitrite, silver nitrate, and sodium bisulfite were purchased from Fisher Scientific (Fairlawn, N.J.), Dowex 1-X8 resin, chloride form (20-50 mesh for milk, 50-100 mesh for water) was purchased from Bio-Rad Laboratories (Rockville Centre, N.Y.).

(d) Method (current):

Procedure ER/O/B/2300/03 was employed in this analysis. Briefly this procedure entails the following:

- -passing the samples over the Dowex ion exchange column
- -eluting the iodine with sodium hypochlorite
- -acidification of eluate with nitric acid
- -two phase separations with carbon tetrachloride and hydroxylamine hydrochloride
- -phase separation with sodium bisulfite
- -two phase separations with carbon tetrachloride, nitric acid and sodium nitrite
- -phase separation with sodium bisulfite
- -precipitation of iodine with silver nitrate
- -weigh precipitate
- -determine radioactivity on a gas flow proportional counter

(e) Method (proposed):

The milk and water samples were passed over the appropriate mesh Dowex ion exchange column. For milk samples, the resin was then washed with warm water. All resins were allowed to dry in the columns and then the resins were carefully transferred to a 65 mm plastic petri dish. Analysis was performed on a Nuclear Data gamma spectroscopy system employing germanium detectors.

RESULTS AND DISCUSSION

Table 1 lists the means and standard deviations calculated for each method for both milk and water samples.

Table 1

Spike Concentration (pCi/liter)	Type Sample (milk,water)	Mean Concentration ± Standard Deviation	
		Current method	Proposed method
blank	milk	0.026 ± 0.009	0.021 ± 0.006
	water	0.019 ± 0.062	0.026 ± 0.029
0.5	milk	0.502 ± 0.333	0.400 ± 0.060
	water	0.403 ± 0.023	0.490 ± 0.040
1.0	milk	0.859 ± 0.077	0.813 ± 0.096
	water	0.647 ± 0.029	0.903 ± 0.090
2.0	milk	1.59 ± 0.15	1.69 ± 0.45
	water	1.56 ± 0.15	2.22 ± 0.38
3.65	water	2.44 ± 0.39	3.26 ± 0.25
4.0	milk	3.76 ± 0.45	3.59 ± 0.41

The data indicate a high degree of correlation between the current and proposed methods. Additionally, in five of eight comparisons, the detected mean activity of the proposed method is much closer than the current method to the actual activity. This is magnified by the fact that 100% of the water spikes were detected more accurately by the proposed method than the current method. The difference between the water and milk spikes can be attributed to 1) the milk spikes were performed first, 2) coagulation of the milk during ion exchange and 3) most importantly, a more accurate calibration for the water spikes on the gamma system. A commercial NBS traceable calibration resin dish was used with the water spikes, while an in-house calibration resin dish was used with the milk spikes for this study. The commercially prepared NBS traceable dish will be used in all future low-level iodine-131 analyses on

samples collected for the environmental monitoring programs for the nuclear stations.

Statistical analysis of the data using an Analysis of Variance (ANOVA) table indicated that the proposed method was as good as, or better than, the current method. The ANOVA technique measures the difference between the two methods. The following parameters are calculated:

F-value: tests how well the model (current vs. proposed method) accounts for all variables; denotes if variation is greater in one method; must compare calculated vs. table F values to determine if data is good.

R-square: measures how much variation is accounted for in the model; also known as "goodness of fit"; value ranges from zero to one with one representing the best data fit.

The calculated values for F and R-square are listed in Table 2. These parameters were determined using milk data only, water data only and a combination of milk and water data.

Table 2

samples used	F-value (pass/fail) *	R-square
milk only	pass	0.98
water only	pass	0.99
milk and water	pass	0.99

* The pass/fail criteria are based on an alpha of 0.01.

The satisfaction of the F-value criteria and the high R-square value indicates that the proposed method of low-level iodine-131 analysis is at least as effective and sensitive as the current method. The author of this report suggests that the proposed method be implemented without delay.