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April 30, 1990

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Annual Radiological Environmental Operating Report

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Pursuant to Technical Specification 6.6.1.5, please find enclosed the Oconee Nuclear Station Annual Radiological Environmental Operating Report for the calendar year 1989.

Very truly yours,

Hal B. Tucker

MAH/87/lcs

Attachment

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DUKE POWER COMPANY

OCONEE NUCLEAR STATION

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM

ANNUAL OPERATING REPORT

January 1, 1989 - December 31, 1989

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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 1989.

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 1989 program, discussion of the results, 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. In addition, supplemental samples were taken and additional analyses performed to better assess radioactivity in the environment.

Concentrations observed in the environment in 1989 for station related radionuclides were generally within the ranges of concentrations observed in the past. Compared to 1988, there was very little difference in the radionuclides detected and their concentrations. All positive indications of radioactivity due to plant operations were well below the reporting levels specified by the Nuclear Regulatory Commission (NRC) as given in Technical Specifications. Visual inspection of data indicated that radionuclide concentrations in drinking water, surface water, shoreline sediment, and fish have increased since the operation of Oconee Nuclear Station began. Statistical analysis of the historical data to determine the existence of a continuing increase showed high probability of a trend for Cs-137 and Sb-125 in shoreline sediment. All other possible increasing trends had moderate to no probability. 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. In conclusion, Oconee Nuclear Station's contribution to environmental radioactivity is small and has had no significant radiological impact upon the health and safety of the general public.

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 07/15/73. Unit 2 began commercial operation 09/09/74, 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 to monitor significant 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. Non-routine reporting levels for activity found in environmental samples are listed in Table 2.2-3. 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 (x) is a widely used statistic. This value was used in the reduction of the data generated by the sampling and analysis of the various media in the 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. No "Minimum Detectable Activity", "Lower Limit of Detection", "Less Than Level", or negative activities or concentrations are included in the calculation of the mean. Prior to 1987 Minimum Detectable Activities (MDA) were included in the calculation of the mean when no detectable activity was found. Both positive and negative MDA values were used in the mean calculations.

2.3.2 LOWER LEVEL OF DETECTION AND MINIMUM DETECTABLE ACTIVITY

The Lower Level of Detection (LLD) and Minimum Detectable Activity (MDA) are used throughout the Environmental Monitoring Program, both in the Technical Specifications and in the implementation of the 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 an a priori lower limit of detection. The actual LLD is dependent upon the standard deviation of the background counting rate, the counting efficiency, the sample size (mass or volume), the radiochemical yield, and the radioactive decay of the sample between sample collection and counting. The "required" LLD's for each sample medium and selected radionuclides are given in the Technical Specifications and 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 spectrocopy 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). The 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.

For "gross" counters (such as alpha/beta proportional counters and liquid scintillation counters), the MDA is calculated using a batch background count. This MDA is then 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 batch 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.

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 correlate 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:

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

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 lies 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 are summarized below:

$1 \geq \lvert r \rvert > 0.7$	High to moderate probability of a trend.
$0.7 \geq \lvert r \rvert > 0.3$	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 and no other sources of radioactivity are present. 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. 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 (such as the Chernobyl accident), etc.. Some of these factors may be obvious while others are sometimes unknown to the plant personnel.

The change in 1987 in the method of calculating the mean (using only net positive results) will also affect the apparent trends.

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.

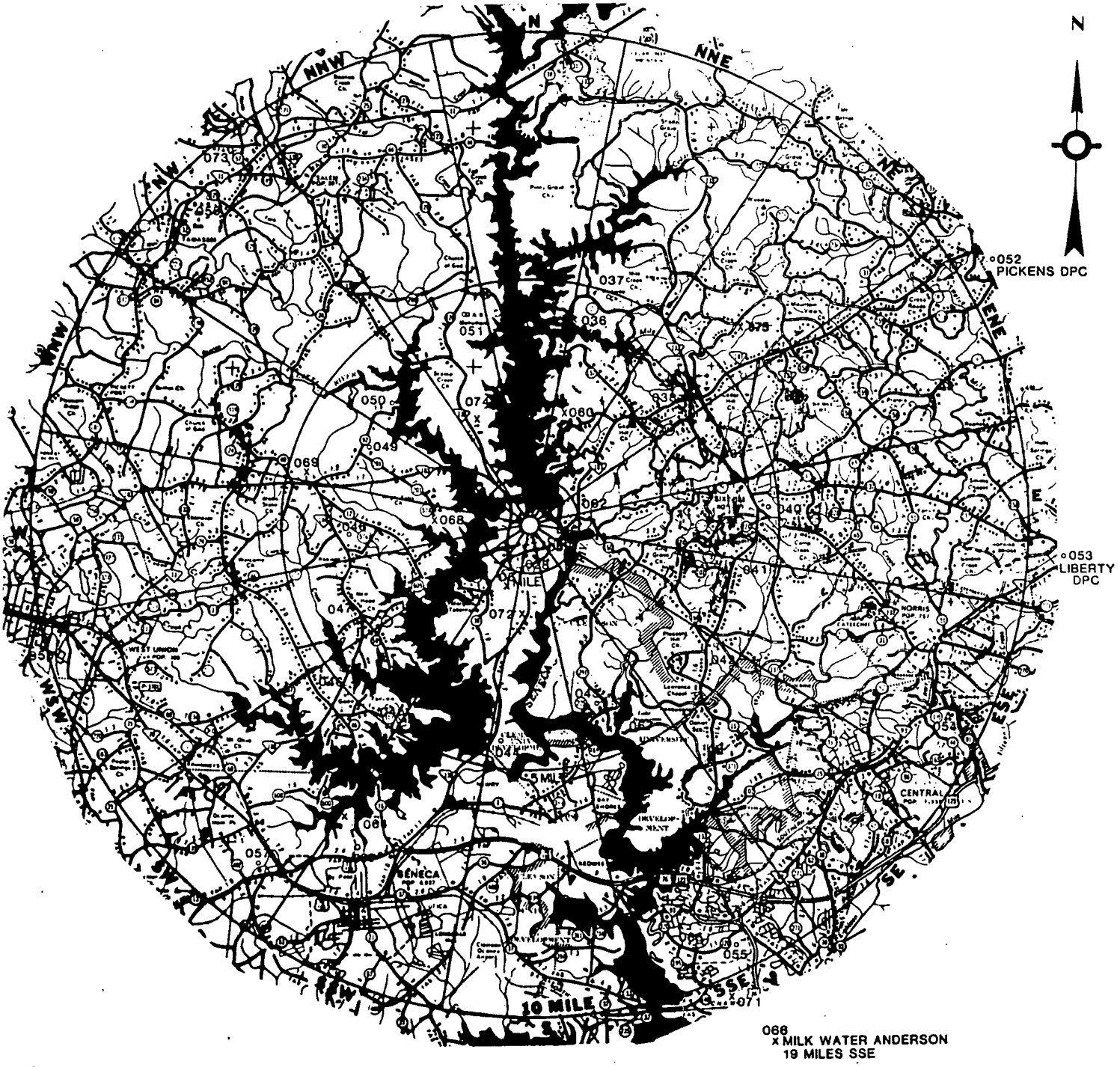


FIGURE 2.1-1
OCONEE NUCLEAR STATION
RADIOLOGICAL ENVIRONMENTAL
MONITORING PROGRAM LOCATIONS

FIGURE 2.1-2

TLD MONITORING LOCATIONS AT THE SITE BOUNDARY

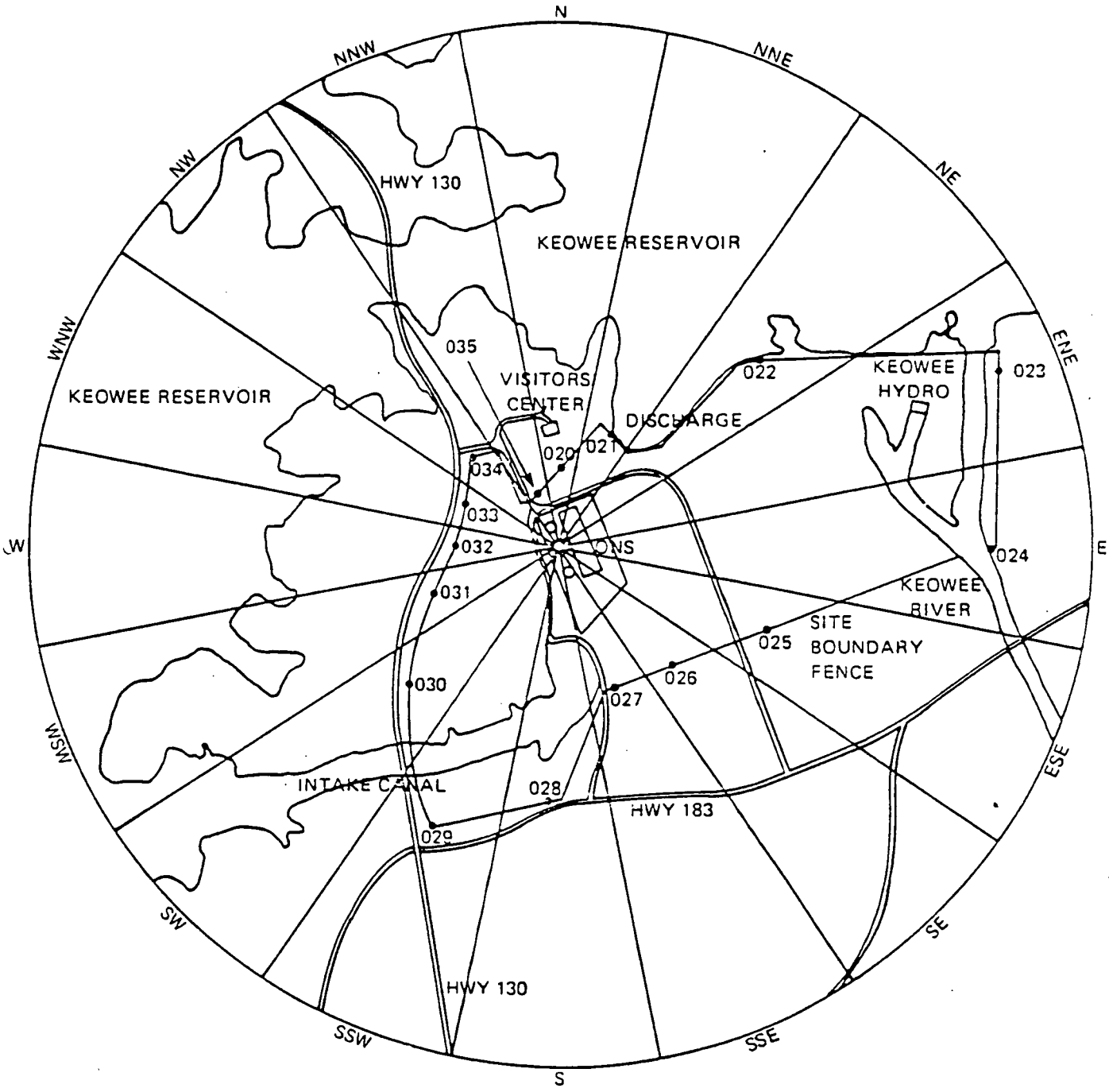


TABLE 2.1-1

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] (Deleted)			M				
066	Anderson (19.0 miles SSE) [012]#			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						

*Control for Fish only
#Control for Milk only
[ ] Location Numbers prior to 1984

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	8.4 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

			ANALYSES				
	SAMPLE MEDIUM	ANALYSIS SCHEDULE	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	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 1989 environmental monitoring program was compared to preoperational and historical data whenever comparable. Comparisons from preoperational through the present were possible for fish samples and direct gamma radiation as measured by TLD. Analysis results for other sample media were not necessarily comparable because of either significant changes in the analysis methods or changes in the reporting of the results.

Trend analysis was performed for the radionuclides listed in Technical Specification 4.11. These radionuclides are collectively referred to as "Technical Specification radionuclides" and include H-3, Mn-54, Fe-59, Co-58, Co-60, Zn-65, Zr-95, Nb-95, I-131, Cs-134, Cs-137, Ba-140, La-140, and gross beta for drinking water. In addition to these, trending was performed for other radionuclides that were detected and could have been the result of station effluents. For 1989, this included Ag-110m and Sb-125 in surface water and shoreline sediment.

Trending was performed using visual inspection and statistical analysis of data. Trend methods included comparing annual mean concentrations of any detected radionuclide to the previous year's concentration. Factors evaluated included the frequency of detection and the concentration in terms of the percent of the radionuclide's reporting level. The highest annual mean concentration of each Technical Specification radionuclide and any other detected effluent related radionuclide was used for the estimation of the linear regression correlation coefficient. Graphs of individual sample results were plotted for any detected radionuclide that was a major dose contributor for the sample media's pathway according to dose calculations based on effluents. A radionuclide is considered a major dose contributor when 5% or more of the pathway dose is due to the radionuclide. Graphs were also drawn for a radionuclide whenever linear regression analysis showed high probability of a positive trend.

Data presented in Sections 3.1 - 3.8 support the conclusion that there was no significant increase in radionuclides in the environment around ONS due to

station operations in 1989. Similarly, there was no significant increase in ambient background radiation levels in the surrounding areas.

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 tables summarizing sample results. These tables include detectable results of Technical Specification radionuclides only. Other radionuclides that were detected, as well as Technical Specification radionuclides, are summarized in this section. Section 4 contains dose calculations based on the radionuclides and concentrations observed during 1989. Section 5 summarizes the quality assurance activities for the year associated with radiological environmental monitoring. Appendices C and D list deviations from Technical Specification sampling and analysis requirements for environmental monitoring.

3.1 AIRBORNE RADIOIODINE AND PARTICULATES

Gamma spectroscopy was performed on 260 fiber filters and 260 charcoal cartridges collected during 1989. Tables 3.1-1 and 3.1-2 summarize the radionuclides that were detected. Comparison of the data in the tables show that differences between the indicator and control locations are small. Concentrations are low as well as the fraction of detectable results. No appreciable increases in radioactivity have occurred at the indicator locations. All concentrations were below reporting levels.

Mn-54 was detected in one of the control location cartridges. Mn-54 also appeared in other sample types at locations that would not be expected to be affected by station effluents. Radioanalysis personnel investigated the matter and concluded that an energy line from a currently unidentified natural product is probably being incorrectly identified as the Mn-54. The routine procedure, when possible, is to recount the sample that was identified as having Mn-54 using a different detector.

Another unexpected observation was that of Cs-137 being present in air cartridges but not the corresponding particulate filter. Thirty-one airborne radioiodine charcoal cartridges collected from around all three Duke Power nuclear stations were observed in 1989 to have detectable levels of Cs-137. These observations were equally divided between all three stations. No activity was detected on associated air filters for the same samples, with the exception of one sample. An initial investigation has lead to the conclusion that the Cs-137 activity detected was not attributed by station effluents but is an active constituent of the activated charcoal. An investigation is continuing into 1990, using various vendors, to establish possible trends between activities and the following: locations of mined charcoal used by the various vendors; activity levels per mesh size; differing retention efficiencies; and several other indicators that the data may reveal. This study is expected to be concluded in 1990.

Visual inspection of tabular data taken from previous environmental report summaries and the 1989 summary did not reveal any increasing

trends. Linear regression analysis results give a low probability of a trend for the majority of the radionuclides. None of the radionuclides that had indications of increasing trends (positive correlation coefficient) were detected in any of the indicator location samples taken during 1989. Table 3.1-3 and 3.1-4 summarizes the data used and the results of the linear regression analysis.

K-40 and Be-7 were observed in air samples in addition to the radionuclides listed in the tables.

TABLE 3.1-1

AIRBORNE PARTICULATES FILTERS
MEAN ANNUAL CONCENTRATIONS (pCi/m^3)

Isotope	1988 Highest Mean		1989 Highest Mean		% Reporting Level	1989 Control Mean		%Reporting Level
Cs-137	---	(0/53)	---	(0/52)	---	5.12E-4	(1/52)	<0.01%

Value in parenthesis is the fraction of detectable measurements.

TABLE 3.1-2

AIRBORNE RADIOIODINE CARTRIDGES
MEAN ANNUAL CONCENTRATIONS (pCi/m^3)

Isotope	1988 Highest Mean		1989 Highest Mean		% Reporting Level	1989 Control Mean		%Reporting Level
Mn-54	---	(0/53)	---	(0/52)	---	8.77E-4	(1/52)	NS
I-131	---	(0/53)	4.99E-4	(1/52)	0.05%	---	(0/52)	---
Cs-137	2.94E-3	(2/53)	3.95E-3	(2/52)	0.02%	1.44E-3	(1/52)	<0.01%

Value in parenthesis is the fraction of detectable measurements.
NS = none specified by Technical Specifications.

TABLE 3.1-3

AIRBORNE PARTICULATES
TREND ANALYSIS OF MEAN ANNUAL CONCENTRAITONS

CONCENTRATION (pCi/m3)

YEAR	Mn-54 INDICATOR	Co-58 INDICATOR	Fe-59 INDICATOR	Co-60 INDICATOR	Zn-65 INDICATOR	Nb-95 INDICATOR	Zr-95 INDICATOR	I-131 INDICATOR	Cs-134 INDICATOR	Cs-137 INDICATOR	BaLa-140 INDICATOR
1979	5.52E-04	5.56E-04	1.85E-03	7.22E-04	-4.85E-04	7.57E-04	7.57E-04	7.54E-03	5.66E-04	5.69E-03	1.56E-04
1980	3.83E-04	4.41E-04	1.92E-03	6.48E-04	1.70E-04	3.18E-03	3.18E-03	3.07E-03	-9.56E-05	2.96E-03	1.42E-03
1981	7.14E-04	2.76E-04	1.83E-03	1.11E-03	-2.90E-04	6.39E-02	3.93E-02	6.31E-03	2.47E-04	5.36E-03	1.41E-03
1982	9.06E-04	9.91E-04	1.70E-03	1.60E-03	1.30E-03	2.31E-03	9.31E-04	2.87E-03	1.66E-04	4.24E-03	6.07E-04
1983	2.64E-04	5.03E-04	1.91E-03	1.35E-03	-1.73E-03	4.50E-04	4.92E-04	1.48E-03	-1.45E-04	2.53E-03	4.36E-04
1984	4.30E-04	1.38E-04	6.66E-04	2.80E-04	2.34E-04	5.89E-04	1.50E-03	9.35E-04	7.18E-05	6.63E-04	5.34E-04
1985	4.74E-04	2.93E-04	6.50E-04	6.99E-04	-8.77E-04	5.52E-04	9.88E-04	3.94E-04	5.93E-04	5.90E-04	4.42E-04
1986	2.77E-04	2.31E-04	6.59E-04	4.72E-04	-3.93E-04	1.19E-03	9.40E-04	8.21E-04	6.57E-04	9.01E-04	5.67E-04
1987	2.52E-03	3.44E-03	6.60E-03	2.65E-03	6.11E-03	9.55E-03	6.58E-03	5.94E-03	3.43E-02	3.21E-03	6.23E-03
1988	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1989	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Correlation Coefficient	3.39E-03	9.95E-02	-9.88E-02	-1.73E-01	2.71E-01	-2.90E-01	-2.98E-01	-6.19E-01	2.97E-01	-7.96E-01	1.35E-01
Trend Probability	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Moderate	Poor	High	Poor
Type Trend	Increasing	Increasing	Decreasing	Decreasing	Increasing	Decreasing	Decreasing	Decreasing	Increasing	Decreasing	Increasing

TABLE 3.1-4

AIRBORNE RADIOIODINE
TREND ANALYSIS OF MEAN ANNUAL CONCENTRATIONS

CONCENTRATION (pCi/m3)

YEAR	Mn-54 INDICATOR	Co-58 INDICATOR	Fe-59 INDICATOR	Co-60 INDICATOR	Zn-65 INDICATOR	Nb-95 INDICATOR	Zr-95 INDICATOR	I-131 INDICATOR	Cs-134 INDICATOR	Cs-137 INDICATOR	BaLa-140 INDICATOR
1979	5.52E-04	5.56E-04	1.85E-03	7.22E-04	-4.85E-04	7.57E-04	7.57E-04	7.54E-03	5.66E-04	5.69E-03	1.56E-04
1980	3.83E-04	4.41E-04	1.92E-03	6.48E-04	1.70E-04	3.18E-03	3.18E-03	3.07E-03	-9.56E-05	2.96E-03	1.42E-03
1981	7.14E-04	2.76E-04	1.83E-03	1.11E-03	-2.90E-04	6.39E-02	3.93E-02	6.31E-03	2.47E-04	5.36E-03	1.41E-03
1982	9.06E-04	9.91E-04	1.70E-03	1.60E-03	1.30E-03	2.31E-03	9.31E-04	2.87E-03	1.66E-04	4.24E-03	6.07E-04
1983	2.64E-04	5.03E-04	1.91E-03	1.35E-03	-1.73E-03	4.50E-04	4.92E-04	1.48E-03	-1.45E-04	2.53E-03	4.36E-04
1984	8.57E-04	5.66E-04	1.55E-03	6.77E-04	5.47E-04	5.66E-04	1.10E-03	8.11E-04	6.47E-04	2.86E-03	7.96E-03
1985	3.72E-04	1.13E-04	2.11E-03	9.48E-04	-8.61E-04	9.78E-04	1.05E-03	7.71E-04	5.66E-04	1.86E-03	3.89E-04
1986	5.00E-04	1.53E-04	5.14E-04	5.44E-04	-5.30E-04	1.30E-03	9.60E-04	9.33E-04	6.10E-04	2.15E-03	5.44E-04
1987	4.29E-03	3.47E-03	7.56E-03	4.95E-03	0.00E+00	4.24E-03	7.46E-03	4.29E-03	5.04E-03	4.79E-03	7.30E-03
1988	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.94E-03	0.00E+00
1989	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.99E-04	0.00E+00	3.95E-03	0.00E+00
Correlation Coefficient	1.45E-01	9.11E-02	-2.83E-02	6.23E-02	-6.83E-03	-3.14E-01	-2.90E-01	-6.98E-01	2.77E-01	-3.54E-01	1.14E-01
Trend Probability	Poor	Poor	Poor	Poor	Poor	Moderate	Poor	Moderate	Poor	Moderate	Poor
Type Trend	Increasing	Increasing	Decreasing	Increasing	Decreasing	Decreasing	Decreasing	Decreasing	Increasing	Decreasing	Increasing

3.2 DRINKING WATER

Gross beta analysis and gamma spectroscopy were performed on 46 monthly drinking water samples. These samples were composited to form 18 quarterly period samples for Tritium analysis.

Table 3.2-1 summarizes the radionuclides that were detected. Though differences exist between the indicator and control concentrations, activities have not increased significantly since 1988. All concentrations were well below any reporting levels.

Visual inspection of tabular data summarizing activity observed from the preoperational period through 1989 did not show any increasing trends. None of the radionuclides evaluated by linear regression analysis had a high probablity of a trend. Of the radionuclides that were detected in samples taken during 1989, Total Beta results had moderate probability of an increasing trend, and H-3 had poor probability of a decreasing trend. Linear regression analysis data and results are contained in Table 3.2-2. Figure 3.2-1 is a graph of H-3 levels in individual samples for the past four years. No apparent trends are shown by the graph.

One of the drinking water locations stopped operations during the year. Clemson Water Plant, location number 065, was closed 7/01/89. The raw water that supplied the plant continues to be sampled and results trended. Only H-3 and K-40 have been detected in the raw water samples since the plant closure. The H-3 concentration averages to 1.10E3 pCi/liter, and is similar to the finished drinking water H-3 levels obtained from the plant.

K-40 and Be-7 were observed in drinking water samples in addition to the radionuclides listed in the tables.

TABLE 3.2-1

DRINKING WATER MEAN ANNUAL CONCENTRATIONS (pCi/liter)

Isotope	1988 Highest Mean	1989 Highest Mean	% Reporting Level	1989 Control Mean	%Reporting Level
Gross Beta	2.0E0 (13/13)	2.3E0 (11/13)	NS	1.8E0 (7/13)	NS
H-3	1.57E3 (3/5)	1.35E3 (3/3)	6.75%	5.59E2 (1/5)	2.80%

Value in parenthesis is the fraction of detectable measurements.
NS = none specified by Technical Specifications.

TABLE 3.2-2

DRINKING WATER
TREND ANALYSIS OF MEAN ANNUAL CONCENTRATIONS

CONCENTRATION (pCi/liter)

YEAR	Mn-54 INDICATOR	Co-58 INDICATOR	Fe-59 INDICATOR	Co-60 INDICATOR	Zn-65 INDICATOR	Nb-95 INDICATOR	Zr-95 INDICATOR	I-131 INDICATOR	Cs-134 INDICATOR	Cs-137 INDICATOR	BaLa-140 INDICATOR	Gross Beta INDICATOR
1979	1.24E+00	6.04E-01	1.42E+00	1.13E+00	6.35E-01	1.64E+00	1.64E+00	8.28E-01	-1.14E-01	3.55E-01	3.73E-01	1.83E+00
1980	9.17E-01	9.39E-01	2.05E+00	1.79E+00	-1.24E-01	1.54E+00	1.54E+00	1.72E+00	-4.10E-01	9.43E-01	4.90E-01	1.86E+00
1981	1.42E+00	-2.11E-01	5.85E+00	1.44E+00	7.30E-01	4.92E-01	9.21E-01	1.52E+00	5.54E-01	1.34E+00	1.71E-01	1.98E+00
1982	1.29E-01	7.28E-01	-8.36E-01	2.25E+00	1.12E-01	1.21E+00	1.79E+00	9.71E-01	1.92E+00	4.61E-01	3.20E-01	2.04E+00
1983	5.83E-04	-5.83E-01	2.21E+00	6.26E+00	-1.41E+00	-7.21E-01	2.41E+00	6.27E-01	3.70E-01	8.14E-01	2.21E+00	1.85E+00
1984	5.41E-01	1.74E-01	3.59E+00	2.51E+00	1.01E+00	1.66E+00	1.29E+00	9.45E-01	6.13E-01	1.81E-01	4.45E-01	1.87E+00
1985	-2.72E-02	9.94E-01	-4.20E-01	5.50E-01	6.81E-01	8.72E-01	1.72E+00	8.39E-01	1.08E+00	5.77E-01	1.68E+00	2.14E+00
1986	4.30E-01	2.18E-01	9.73E-01	1.18E-01	-4.03E-01	1.05E+00	1.43E+00	1.81E+00	1.20E+00	1.09E+00	4.36E-01	1.93E+00
1987	4.30E+00	3.20E+00	1.30E+01	5.10E+00	8.10E+00	5.50E+00	1.40E+01	0.00E+00	6.20E+00	5.50E+00	0.00E+00	2.00E+00
1988	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.90E+00	0.00E+00	2.00E+00
1989	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.30E+00
Correlation Coefficient	-1.55E-02	1.20E-01	5.40E-02	-1.72E-01	2.48E-01	3.61E-02	1.81E-01	-6.25E-01	3.02E-01	3.68E-01	-1.94E-01	6.47E-01
Trend Probability	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Moderate	Moderate	Moderate	Poor	Moderate
Type Trend	Decreasing	Increasing	Increasing	Decreasing	Increasing	Increasing	Increasing	Decreasing	Increasing	Increasing	Decreasing	Increasing

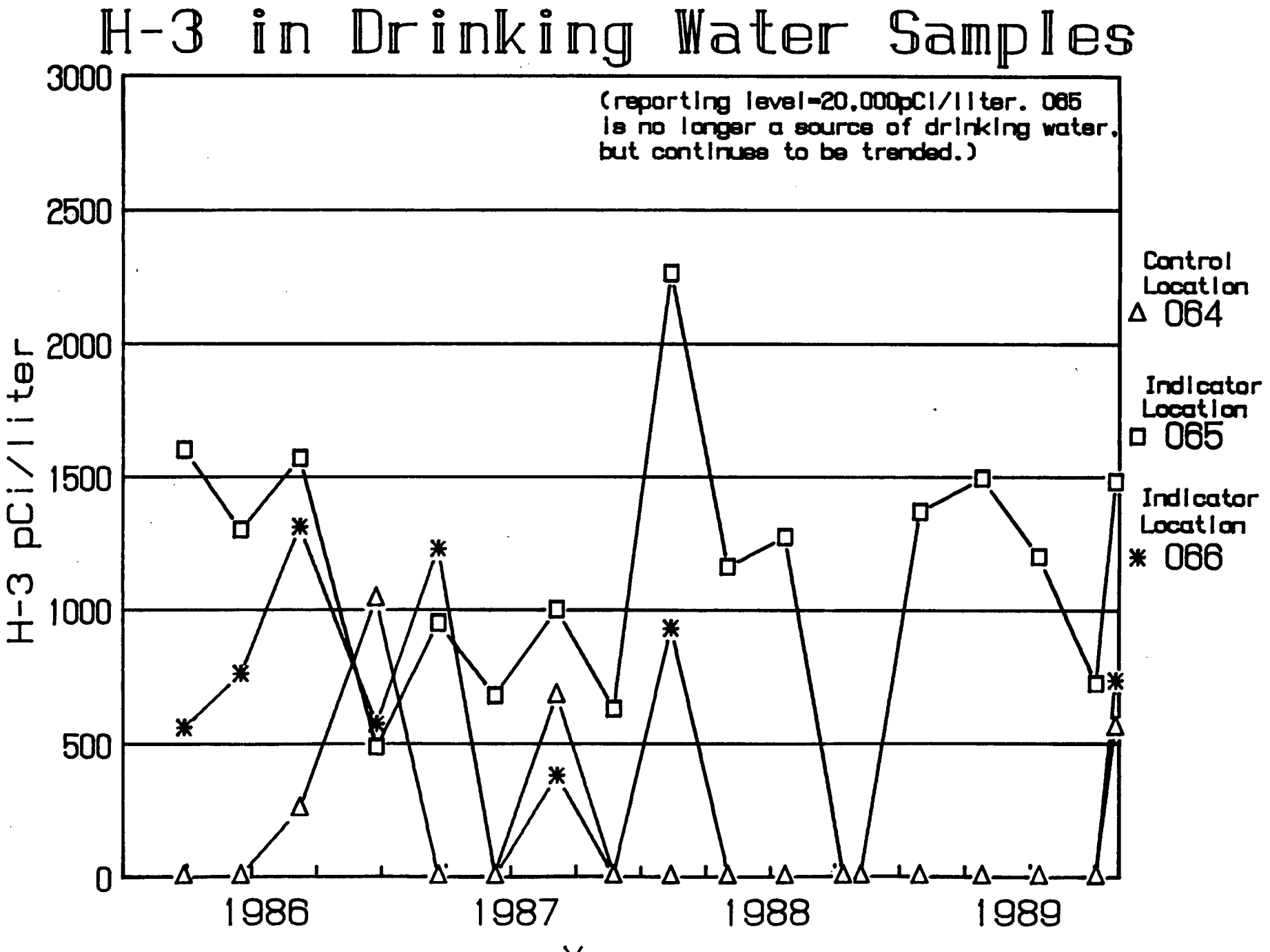
TABLE 3.2-2

DRINKING WATER
TREND ANALYSIS OF MEAN ANNUAL CONCENTRATIONS

CONCENTRATION (pCi/liter)

YEAR	H-3 INDICATOR
1974	4.40E+02
1975	1.80E+03
1976	2.20E+03
1977	1.20E+03
1978	1.05E+03
1979	5.78E+02
1980	6.60E+02
1981	8.30E+02
1982	6.43E+02
1983	9.37E+02
1984	7.65E+02
1985	8.56E+02
1986	1.24E+03
1987	8.15E+02
1988	1.57E+03
1989	1.35E+03
Correlation Coefficient	-5.68E-02
Trend Probability	Poor
Type Trend	Decreasing

Figure 4.2-1



1986-1989 SERs

3.3 SURFACE WATER

Gamma spectroscopy was performed on 26 monthly surface water samples. These samples were composited to form 10 quarterly period samples for Tritium analysis.

Table 3.3-1 summarizes the radionuclides that were detected. The indicator location is near the liquid effluent release point and differences between the indicator and control samples are expected. Comparison of 1988 and 1989 highest mean annual concentrations show there is no significant change in concentrations. For the majority of the radionuclides, the concentrations are low and the number of samples with detectable activity is small (with the exception of Tritium). Observed surface water concentrations were below any reporting levels.

Visual inspection of tabular data covering the preoperational period through 1989 did not reveal any increasing trends. Linear regression analysis was applied to the highest indicator location mean for Tritium from the preoperational period through 1989, and for the past eleven years for the remaining radionuclides. The data used and the results are in Table 3.3-2. H-3, Co-58, Co-60, Nb-95, Ag-110m, and Sb-125 had positive correlation coefficients, which indicates an increasing trend. However, none of the radionuclides show a high probability of a trend. All but Nb-95 were detected in 1989 samples.

K-40 was observed in surface water samples in addition to the radionuclides listed in the tables.

TABLE 3.3-1

SURFACE WATER
MEAN ANNUAL CONCENTRATIONS (pCi/liter)

Isotope	1988 Highest Mean	1989 Highest Mean	% Reporting Level	1989 Control Mean	%Reporting Level
Co-58	6.2E0 (7/13)	5.3E0 (4/13)	0.5%	--- (0/13)	---
Co-60	5.0E0 (1/13)	3.0E0 (2/13)	1.0%	--- (0/13)	---
Cs-137	3.5E0 (1/13)	3.4E0 (2/13)	6.8%	--- (0/13)	---
Ag-110m	2.71E1(1/13)	7.60E0(4/13)	NS	--- (0/13)	---
Sb-125	3.70E1(4/13)	2.22E1(4/13)	NS	--- (0/13)	---
H-3	1.10E4 (5/5)	1.02E4 (5/5)	51.0% *	--- (0/5)	---

Value in parenthesis is the fraction of detectable measurements.
NS = none specified by Technical Specifications.
* Reporting Level used is for Drinking Water. None specified for Surface Water.

TABLE 3.3-2

SURFACE WATER
TREND ANALYSIS OF MEAN ANNUAL CONCENTRATIONS

CONCENTRATION (pCi/liter)

YEAR	Mn-54 INDICATOR	Co-58 INDICATOR	Fe-59 INDICATOR	Co-60 INDICATOR	Zn-65 INDICATOR	Nb-95 INDICATOR	Zr-95 INDICATOR	I-131 INDICATOR	Cs-134 INDICATOR	Cs-137 INDICATOR	BaLa-140 INDICATOR	Ag-110m INDICATOR	Sb-125 INDICATOR
1979	1.37E+00	1.33E+00	3.71E+00	2.60E+00	3.24E-01	1.78E+00	1.78E+00	2.03E+00	2.92E-01	2.82E+00	2.26E-03	0.00E+00	0.00E+00
1980	2.08E-01	1.56E+00	2.57E+00	2.30E+00	3.05E-01	1.22E+00	1.22E+00	1.53E+00	2.11E-01	5.40E+00	5.01E-01	0.00E+00	0.00E+00
1981	4.28E-01	1.10E+00	2.66E+00	6.10E-01	1.58E+00	1.70E+00	2.39E+00	2.65E+00	3.26E+00	3.90E+00	8.36E-01	0.00E+00	0.00E+00
1982	5.63E-01	6.14E-01	2.29E+00	1.99E+00	1.17E+00	2.29E+00	2.27E+00	3.88E+00	1.93E+00	4.85E+00	1.25E+00	0.00E+00	0.00E+00
1983	9.97E-01	6.99E-01	2.86E+00	3.02E+00	9.61E-01	3.91E-01	1.91E+00	2.48E+00	5.67E-01	6.83E-01	1.30E+00	0.00E+00	0.00E+00
1984	7.51E-01	9.40E-01	2.54E+00	6.30E-01	5.40E-01	7.90E-01	1.70E+00	2.26E+00	3.03E-01	4.83E-01	-1.25E-01	0.00E+00	0.00E+00
1985	9.34E-02	2.15E-01	2.83E+00	6.27E-01	1.40E-01	4.95E-01	1.03E+00	1.44E-01	1.00E+00	9.90E-01	-3.30E-01	0.00E+00	7.89E+01
1986	1.12E+00	2.85E+00	-8.09E-01	9.21E-01	-1.28E+00	1.22E+00	1.46E-01	9.10E-01	8.00E-01	5.49E-01	4.47E-01	0.00E+00	0.00E+00
1987	0.00E+00	5.10E+01	0.00E+00	3.40E+00	0.00E+00	4.00E+00	0.00E+00	0.00E+00	4.10E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1988	0.00E+00	6.20E+00	0.00E+00	5.00E+00	0.00E+00	2.50E+00	0.00E+00	0.00E+00	0.00E+00	3.50E+00	0.00E+00	2.71E+01	3.70E+01
1989	0.00E+00	5.30E+00	0.00E+00	3.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.40E+00	0.00E+00	7.60E+00	2.22E+01
Correlation Coefficient	-5.32E-01	3.89E-01	-8.31E-01	3.56E-01	-5.33E-01	2.85E-02	-8.26E-01	-7.36E-01	-3.50E-02	-3.85E-01	-4.16E-01	5.34E-01	4.04E-01
Trend Probability	Moderate	Moderate	High	Moderate	Moderate	Poor	High	High	Poor	Moderate	Moderate	Moderate	Moderate
Type Trend	Decreasing	Increasing	Decreasing	Increasing	Decreasing	Increasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Increasing	Increasing

TABLE 3.3-2

SURFACE WATER
TREND ANALYSIS OF MEAN ANNUAL CONCENTRATIONS

CONCENTRATION (pCi/liter)

YEAR	H-3 INDICATOR
1972	4.80E+02
1974	1.55E+03
1975	2.90E+04
1976	2.95E+04
1977	2.90E+03
1978	8.00E+02
1979	4.67E+03
1980	4.93E+03
1981	7.21E+03
1982	6.13E+03
1983	8.40E+03
1984	9.93E+03
1985	1.05E+04
1986	1.26E+04
1987	7.08E+03
1988	1.10E+04
1989	1.02E+04
Correlation Coefficient	4.47E-03
Trend Probability	Poor
Type Trend	Increasing

3.4 MILK

Gamma spectroscopy and low level iodine analysis was performed on 79 milk samples collected in 1989. Table 3.4-1 summarizes the radionuclides that were detected. Cs-137 was the only radionuclide observed in indicator location milk samples (besides naturally occurring ones). Cs-137 was also detected at the control location. No concentrations above reporting levels were identified.

Visual inspections of tabular data taken from previous environmental report summaries and the 1989 summary did not reveal any increasing trends. Linear regression analysis data and results are found in Table 3.4-2. None of the radionuclides had a high probability of a positive trend. Trend analysis for I-131, which is the main contributor to doses calculated from gaseous particulate and iodine effluent data, indicates with moderate probability that iodine concentrations are decreasing.

K-40 was observed in milk samples in addition to the radionuclides listed in the tables.

TABLE 3.4-1

MILK
MEAN ANNUAL CONCENTRATIONS (pCi/liter)

Isotope	1988 Highest Mean	1989 Highest Mean	% Reporting Level	1989 Control Mean	%Reporting Level
Cs-137	3.9E0 (2/26)	4.7E0 (6/26)	6.71%	2.9E0 (3/26)	4.14%

Value in parenthesis is the fraction of detectable measurements.

TABLE 3.4-2

MILK
TREND ANALYSIS OF MEAN ANNUAL CONCENTRATIONS

CONCENTRATION (pCi/liter)

YEAR	Mn-54 INDICATOR	Co-58 INDICATOR	Fe-59 INDICATOR	Co-60 INDICATOR	Zn-65 INDICATOR	Nb-95 INDICATOR	Zr-95 INDICATOR	I-131(LL) INDICATOR	Cs-134 INDICATOR	Cs-137 INDICATOR	BaLa-140 INDICATOR
1979	2.83E+00	6.67E-01	5.60E+00	8.39E-01	2.11E+00	2.32E+00	2.32E+00	1.48E-01	-6.88E-02	7.25E+00	-8.33E-01
1980	8.41E-02	3.99E-01	2.94E+00	1.88E+00	1.37E-01	1.16E+00	1.16E+00	7.46E-01	-7.70E-03	3.58E+00	1.58E-01
1981	8.54E-02	1.40E+00	4.53E-01	5.20E-01	-1.10E-01	4.29E-01	1.38E+00	4.70E-02	6.53E-01	5.52E+00	9.51E-02
1982	9.83E-01	2.94E-01	3.39E+00	1.12E+00	8.47E-01	5.63E-01	2.55E+00	7.38E-03	1.25E+00	2.71E+00	1.64E+00
1983	1.02E+00	1.95E+00	3.75E+00	1.41E+00	-6.81E-01	-9.08E-01	1.90E+00	2.76E-03	2.19E+00	5.04E+00	6.03E-01
1984	-5.89E-02	5.94E-01	2.30E+00	1.02E+00	3.30E-01	1.37E+00	2.43E-01	9.62E-04	-9.87E-02	2.30E+00	1.27E+00
1985	9.25E-01	9.80E-01	-1.40E-01	6.70E-01	1.17E+00	5.61E-01	1.88E+00	-6.98E-02	1.01E+00	2.38E+00	5.90E-01
1986	1.16E+00	-1.12E-01	2.22E+00	4.63E-01	-1.14E+00	1.08E+00	8.34E-01	3.72E-02	1.16E+00	2.79E+00	2.96E-02
1987	7.90E+00	5.60E+00	0.00E+00	8.30E+00	9.90E+00	6.80E+00	9.30E+00	0.00E+00	6.60E+00	4.90E+00	4.20E+00
1988	0.00E+00	0.00E+00	0.00E+00	4.30E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.90E+00	0.00E+00
1989	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.70E+00	0.00E+00
Correlation Coefficient	1.19E-01	1.09E-01	-7.35E-01	3.34E-01	1.67E-01	7.97E-02	4.73E-02	-5.18E-01	2.60E-01	-3.08E-01	2.84E-01
Trend Probability	Poor	Poor	High	Moderate	Poor	Poor	Poor	Moderate	Poor	Moderate	Poor
Type Trend	Increasing	Increasing	Decreasing	Increasing	Increasing	Increasing	Increasing	Decreasing	Increasing	Decreasing	Increasing

3.5 BROADLEAF VEGETATION

Gamma spectroscopy was performed on 39 broadleaf vegetation samples during 1989. There were no radionuclides detected at the indicator locations. Cs-137 and Mn-54 were the only radionuclides, other than those occurring naturally, that were observed in broadleaf vegetation samples. Both were detected in control location samples. Cs-137 is often detected at this location. Mn-54 was detected in one sample. As discussed in section 3.1, Mn-54 was probably incorrectly identified from an energy line due to an unidentified natural product. The sample results are summarized in Table 3.5-1. Concentrations that were detected are below reporting levels.

Visual inspection of tabular data taken from previous environmental report summaries and the 1989 summary did not reveal any increasing trends. Linear regression analysis data and results are given in Table 3.5-2. Only two radionuclides had probabilities of increasing trends. BaLa-140 had a poor and Cs-134 had a moderate probability.

K-40 and Be-7 were observed in broadleaf vegetation samples in addition to those listed in the table.

TABLE 3.5-1

BROADLEAF VEGETATION
MEAN ANNUAL CONCENTRATIONS (pCi/kg, wet)

Isotope	1988 Highest Mean	1989 Highest Mean	% Reporting Level	1989 Control Mean	%Reporting Level
Mn-54	--- (0/13)	--- (0/13)	---	2.20E1 (1/13)	NS
Cs-137	2.40E1 (3/13)	--- (0/13)	---	1.08E2 (10/13)	5.4%

Value in parenthesis is the fraction of detectable measurements.
NS = none specified by Technical Specifications.

TABLE 3.5-2

BROADLEAF VEGETATION
TREND ANALYSIS OF MEAN ANNUAL CONCENTRATIONS

CONCENTRATION (pCi/kg)

YEAR	Mn-54 INDICATOR	Co-58 INDICATOR	Fe-59 INDICATOR	Co-60 INDICATOR	Zn-65 INDICATOR	Nb-95 INDICATOR	Zr-95 INDICATOR	I-131 INDICATOR	Cs-134 INDICATOR	Cs-137 INDICATOR	BaLa-140 INDICATOR
1979	1.54E+01	7.22E+00	1.62E+01	1.87E+01	1.36E+01	2.01E+01	2.01E+01	2.45E+01	-7.91E-01	5.04E+01	1.14E+01
1980	1.14E+01	1.40E+01	4.16E+01	1.48E+01	3.21E+00	1.45E+01	1.45E+01	3.59E+00	-6.07E+00	2.80E+01	1.10E+00
1981	1.89E+01	4.67E+00	7.96E+00	2.84E+00	6.41E+00	4.55E+02	2.35E+02	1.74E+01	2.30E+00	2.99E+01	8.95E+00
1982	1.16E+01	1.38E+01	2.98E+01	7.32E+00	2.78E+00	1.86E+01	1.10E+01	9.30E-01	6.65E+00	2.42E+01	9.10E+00
1983	8.36E+00	4.91E+00	3.94E+01	-1.45E-01	-1.18E+01	8.00E+00	5.54E+00	5.47E+00	1.23E+01	7.44E+00	5.30E+00
1984	4.37E-01	1.24E+00	2.56E+00	1.38E+00	1.54E+00	4.06E-01	3.79E+00	4.55E+00	1.01E+01	1.37E+01	4.47E+00
1985	2.85E+00	5.40E-01	7.49E+00	1.13E+01	-3.22E+00	-1.87E+00	2.87E+00	3.15E+00	1.15E+01	1.62E+01	2.05E+00
1986	4.76E+00	-9.41E-01	3.46E+00	3.99E+00	-6.11E+00	4.64E+00	7.07E-01	-1.03E+00	1.34E+01	2.90E+01	4.00E+00
1987	2.20E+01	0.00E+00	3.30E+01	1.70E+01	0.00E+00	2.10E+01	5.40E+01	4.80E+01	1.80E+01	2.70E+01	4.30E+01
1988	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.40E+01	0.00E+00
1989	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Correlation Coefficient	-5.11E-01	-7.71E-01	-4.74E-01	-4.39E-01	-5.03E-01	-3.35E-01	-3.16E-01	-1.03E-01	3.54E-01	-5.84E-01	6.75E-02
Trend Probability	Moderate	High	Moderate	Moderate	Moderate	Moderate	Moderate	Poor	Moderate	Moderate	Poor
Type Trend	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Increasing	Decreasing	Increasing

3.6 SHORELINE SEDIMENT

Gamma Spectroscopy was performed on four Technical Specifications required sediment samples. Gamma spectroscopy was performed on eight additional shoreline samples to better assess the concentrations being observed in the required samples. The results of the additional samples are included in the shoreline sediment tables and graphs.

Table 3.6-1 summarizes the radionuclides that were detected. The 1988 and 1989 highest annual means are very similar in the radionuclides detected and concentration.

Visual inspection of tabular data from previous environmental report summaries and the 1989 summary indicated some increases in shoreline sediment concentrations. Linear regression analysis data and results are found in Table 3.6-2. High positive trends resulted for Cs-137 and Sb-125. Moderate positive trends resulted for Mn-54, Co-58, Co-60, Zn-65, and Ag-110m. All but Zn-65 were detected in 1989 samples.

Graphs of individual sample results can be found in Figures 3.6-1 through 3.6-3. The period plotted begins when shoreline sediment sampling was initiated in 1984. Cs-137 and Sb-125 were graphed because of their high probability of increasing trend and because Sb-125 is a major dose contributor to shoreline sediment doses based on effluent data. Co-60 and Ag-110m are also major dose contributors in effluent calculations and were graphed. The graphs show an increasing trend is possible, but fluctuations in the results are large. The data clearly shows that ONS operations have added radioactive material to sediments. However, 1989 doses from shoreline sediments were low and well within any dose limits.

K-40 and Be-7 were observed in shoreline sediment samples in addition to the radionuclides listed in the tables.

TABLE 3.6-1

SHORELINE SEDIMENT
MEAN ANNUAL CONCENTRATIONS (pCi/kg, dry)

Isotope	1988 Highest Mean	1989 Highest Mean	1989 Control Mean
Mn-54	3.30E1 (2/4)	2.30E1 (2/4)	7.10E0 (1/4)
Co-58	1.20E2 (2/4)	1.24E2 (3/4)	- (0/4)
Co-60	1.87E2 (4/4)	1.96E2 (2/4)	- (0/4)
Cs-134	6.60E2 (3/4)	5.40E1 (2/4)	- (0/4)
Cs-137	7.59E2 (4/4)	8.48E2 (4/4)	1.80E+1 (3/4)
Ag-110m	1.62E2 (2/4)	5.50E1 (3/4)	- (0/4)
Sb-125	3.67E2 (3/4)	1.86E2 (2/4)	- (0/4)

Value in parenthesis is the fraction of detectable measurements.
Technical Specifications do not contain a reporting level for Shoreline Sediment.

TABLE 3.6-2

SHORELINE SEDIMENT
TREND ANALYSIS OF MEAN ANNUAL CONCENTRATIONS

CONCENTRATION (pCi/kg)

YEAR	Mn-54 INDICATOR	Co-58 INDICATOR	Fe-59 INDICATOR	Co-60 INDICATOR	Zn-65 INDICATOR	Nb-95 INDICATOR	Zr-95 INDICATOR	I-131 INDICATOR	Cs-134 INDICATOR	Cs-137 INDICATOR	BaLa-140 INDICATOR	Ag-110m INDICATOR	Sb-125 INDICATOR
1984	1.10E+01	1.09E+01	-3.61E+00	1.19E+01	-1.39E+01	3.11E+01	6.05E+01	3.66E+01	7.77E+01	5.16E+01	-3.66E+00	0.00E+00	0.00E+00
1985	9.39E+00	1.27E+00	3.82E+01	4.79E+00	0.00E+00	0.00E+00	5.48E+00	4.95E-01	7.63E+01	9.47E+01	9.77E+00	0.00E+00	0.00E+00
1986	2.53E+01	2.28E+00	0.00E+00	2.63E+01	5.61E+00	2.62E+01	3.21E+01	2.68E+01	1.19E+02	5.87E+02	6.80E+00	0.00E+00	0.00E+00
1987	5.40E+01	4.70E+02	0.00E+00	5.07E+02	0.00E+00	0.00E+00	5.80E+01	0.00E+00	1.01E+02	6.22E+02	0.00E+00	3.46E+02	0.00E+00
1988	3.30E+01	1.20E+02	0.00E+00	1.87E+02	6.70E+01	0.00E+00	0.00E+00	0.00E+00	6.60E+01	7.59E+02	0.00E+00	1.62E+02	3.67E+02
1989	2.30E+01	1.24E+02	0.00E+00	1.96E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.40E+01	8.48E+02	0.00E+00	5.50E+01	1.86E+02
Correlation Coefficient	5.20E-01	4.12E-01	-3.23E-01	5.40E-01	4.92E-01	-6.53E-01	-5.52E-01	-6.80E-01	-3.77E-01	9.47E-01	-1.89E-01	4.27E-01	7.06E-01
Trend Probability	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	High	Poor	Moderate	High
Type Trend	Increasing	Increasing	Decreasing	Increasing	Increasing	Decreasing	Decreasing	Decreasing	Decreasing	Increasing	Decreasing	Increasing	Increasing

Figure 3.6-1

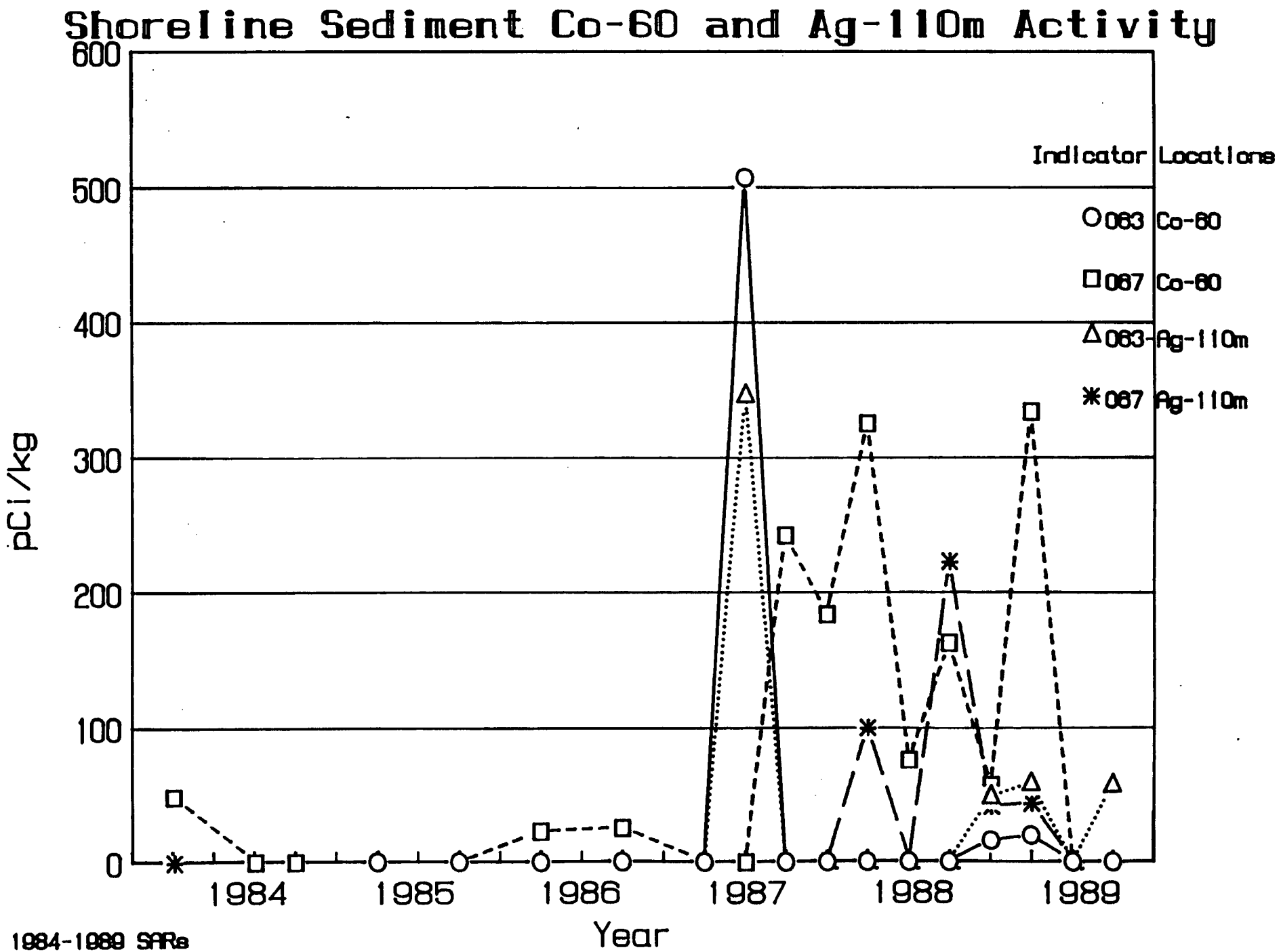

Shoreline Sediment Co-60 and Ag-110m Activity
600
500
400
300
200
100
0
pCi/kg
1984
1985
1986
1987
1988
1989
Year
Indicator Locations
063 Co-60
067 Co-60
063-Ag-110m
067 Ag-110m
1984-1989 SARs

Figure 3.6-2

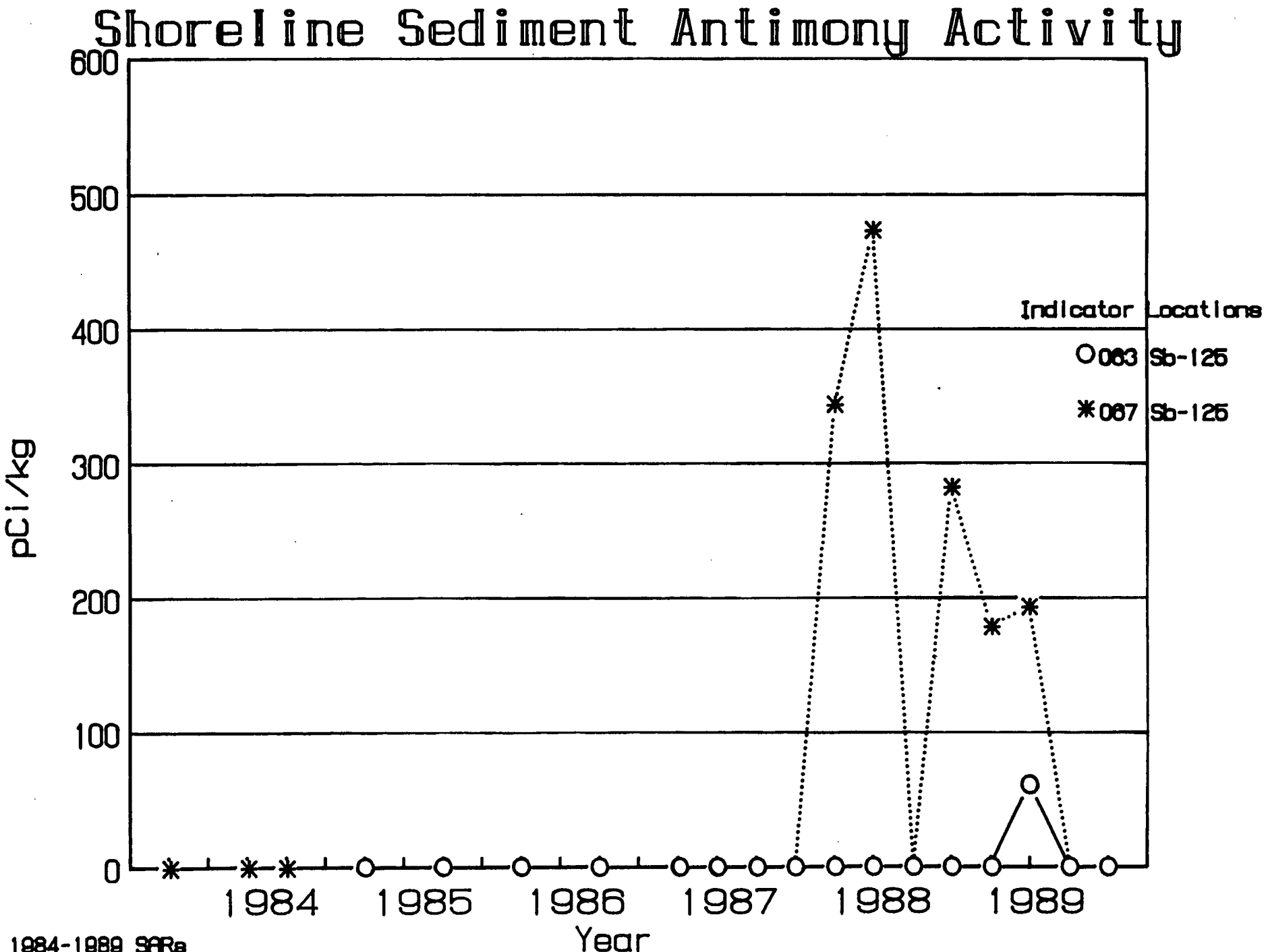
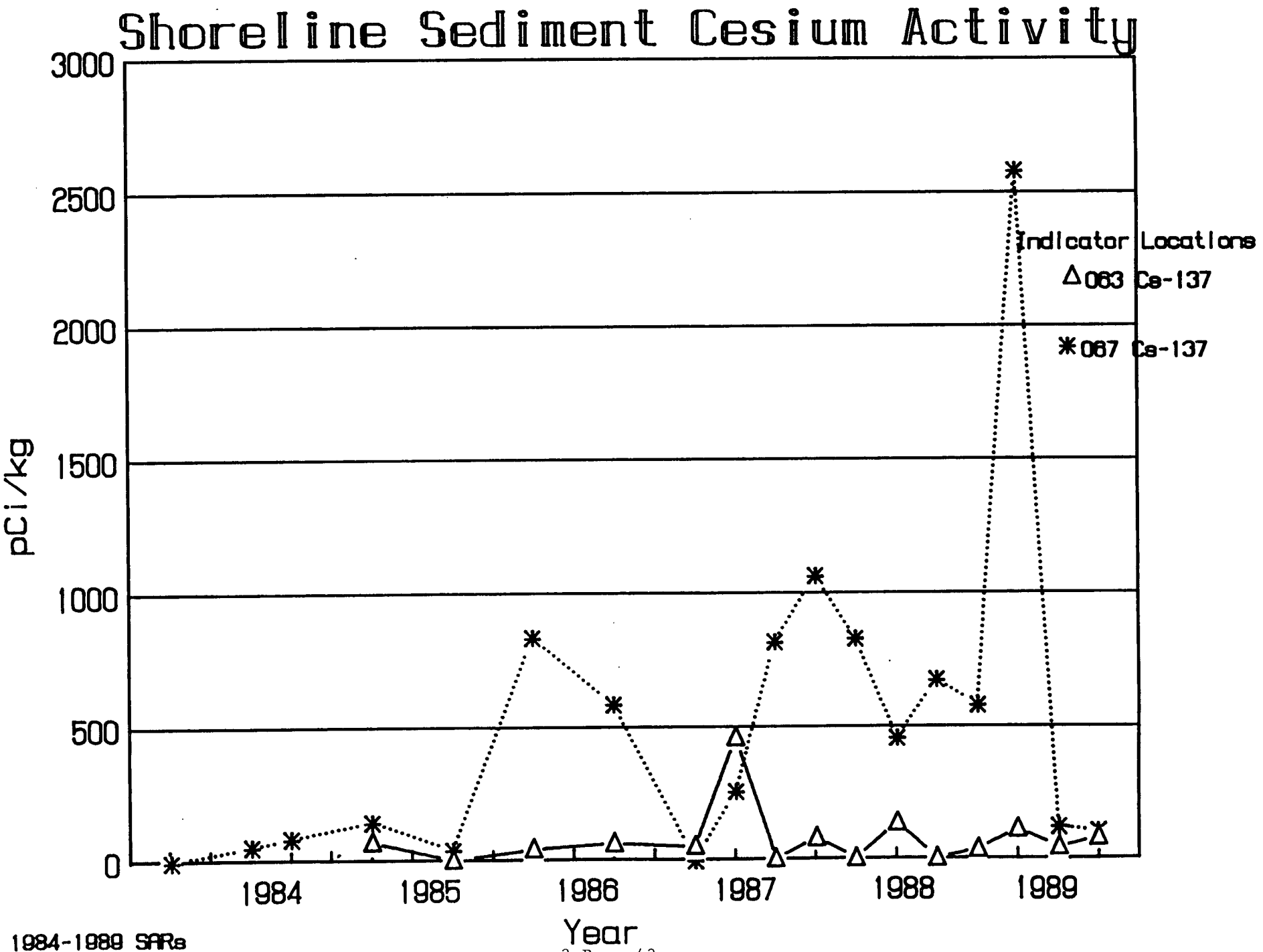

Shoreline Sediment Antimony Activity
600
500
400
300
200
100
0
pCi/kg
1984
1985
1986
1987
1988
1989
Year
Indicator Locations
063 Sb-125
067 Sb-125
1984-1989 SARs

Figure 3.6-3


Shoreline Sediment Cesium Activity
3000
2500
2000
1500
1000
500
0
pCi/kg
1984
1985
1986
1987
1988
1989
Year
Indicator Locations
Δ063 Cs-137
*067 Cs-137
1984-1989 SARs

3.7 FISH

Gamma spectroscopy was performed on 12 fish samples. Table 3.7-1 summarizes the radionuclides that were detected. Comparison of data between 1988 and 1989 does not indicate any significant increases in concentrations. There were no 1989 fish sample results determined to have concentrations of radionuclides that exceeded reporting levels.

Visual inspection of tabular data from previous environmental report summaries and the 1989 summary did not reveal any increasing trends. Linear regression analysis was applied to radionuclides routinely evaluated for in fish samples. Table 3.7-2 lists the data used. None of the radionuclides indicated a high probability of an increasing trend. Cs-134 and Cs-137 results indicated moderate probability of an increasing trend. One factor affecting the trend analysis is a change in sampling locations. In 1984, a second downstream fish location was added. Location 063 is closer to the liquid effluent discharge point and has been the highest mean indicator since it was added.

Graphs showing Cesium levels in both bass and catfish were prepared since Cs-134 and Cs-137 are major effluent dose contributors through the fish pathway. Figures 3.7-1 and 3.7-2 contain the graphs displaying individual sample results. Based on these graphs, the levels at the two downstream locations do not appear to be increasing.

K-40 was observed in fish samples in addition to the radionuclides listed in the tables.

TABLE 3.7-1

FISH
MEAN ANNUAL CONCENTRATIONS (pCi/kg,wet)

Isotope	1988 Highest Mean	1989 Highest Mean	% Reporting Level	1989 Control Mean	%Reporting Level
Co-58	9.60E1 (2/2)	4.30E1 (2/4)	0.14%	--- (0/4)	---
Co-60	--- (0/2)	1.5E1 (1/4)	0.15%	--- (0/4)	---
Cs-134	7.20E1 (2/2)	8.60E1 (4/4)	8.60%	--- (0/4)	---
Cs-137	2.60E2 (2/2)	3.36E2 (4/4)	16.80%	3.10E1 (4/4)	1.55%

Value in parenthesis is the fraction of detectable measurements.

FISH
TREND ANALYSIS OF MEAN ANNUAL CONCENTRATIONS

CONCENTRATION (pCi/kg)

YEAR	Mn-54 INDICATOR	Co-58 INDICATOR	Fe-59 INDICATOR	Co-60 INDICATOR	Zn-65 INDICATOR	Nb-95 INDICATOR	Zr-95 INDICATOR	I-131 INDICATOR	BaLa-140 INDICATOR
1979	-2.02E+00	1.91E+00	2.81E+00	1.56E+01	-2.18E+00	9.63E+00	9.63E+00	1.72E+01	-3.06E+00
1980	3.33E-01	1.45E+01	-6.46E+00	1.90E+01	-2.49E+00	7.78E+00	7.78E+00	1.29E+01	1.85E+00
1981	-1.59E+00	2.25E+01	-8.22E+00	1.49E+01	1.93E+01	6.97E+00	-4.71E+00	2.54E+01	1.44E+00
1982	-1.16E+00	9.83E-01	1.29E+01	8.03E+00	-8.47E+00	1.69E+00	-3.04E+00	1.66E+01	1.17E+01
1983	-6.51E+00	3.35E+01	7.85E-01	4.53E+00	-3.18E-01	-7.07E+00	7.03E+00	1.49E+00	5.73E+01
1984	4.36E+00	1.21E+02	2.30E+01	6.23E+01	8.27E+00	1.93E+01	7.76E+00	3.56E+01	-3.25E+00
1985	2.81E+00	1.62E+01	1.11E+01	1.10E+01	-1.37E-01	1.01E+01	1.92E+00	1.41E+01	3.26E-01
1986	-1.36E+00	9.56E+01	-5.82E-01	2.59E+01	-6.42E+00	4.87E+00	-3.78E+00	-7.43E+00	4.75E+00
1987	2.20E+01	1.63E+02	0.00E+00	6.30E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1988	0.00E+00	9.60E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1989	0.00E+00	4.30E+01	0.00E+00	1.50E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Correlation Coefficient	3.64E-01	6.20E-01	6.58E-02	1.52E-01	-1.32E-01	-3.29E-01	-4.19E-01	-5.79E-01	-1.17E-01
Trend Probability	Moderate	Moderate	Poor	Poor	Poor	Moderate	Moderate	Moderate	Poor
Type Trend	Increasing	Increasing	Increasing	Increasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing

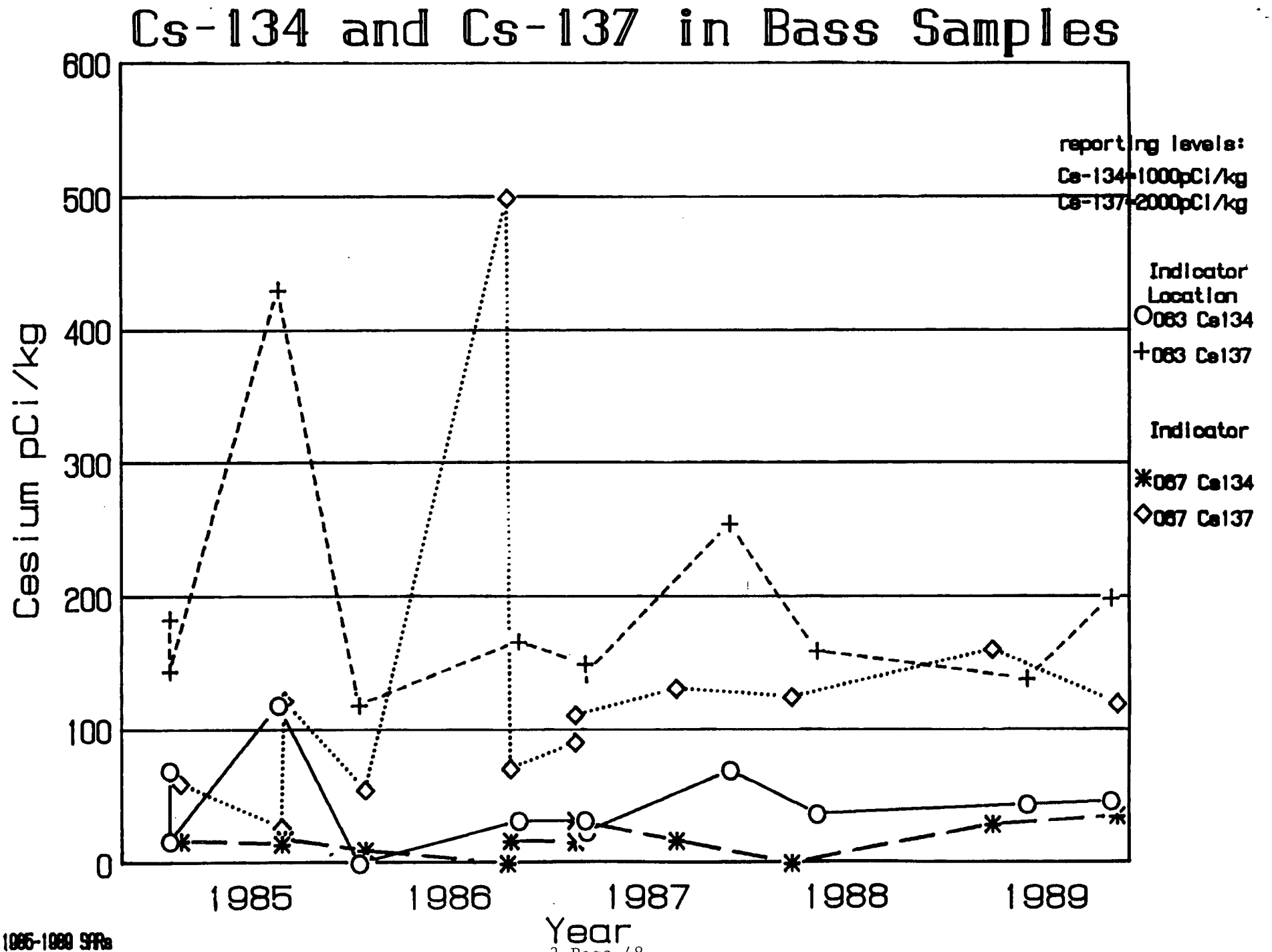
TABLE 3.7-2

FISH
TREND ANALYSIS OF MEAN ANNUAL CONCENTRATIONS

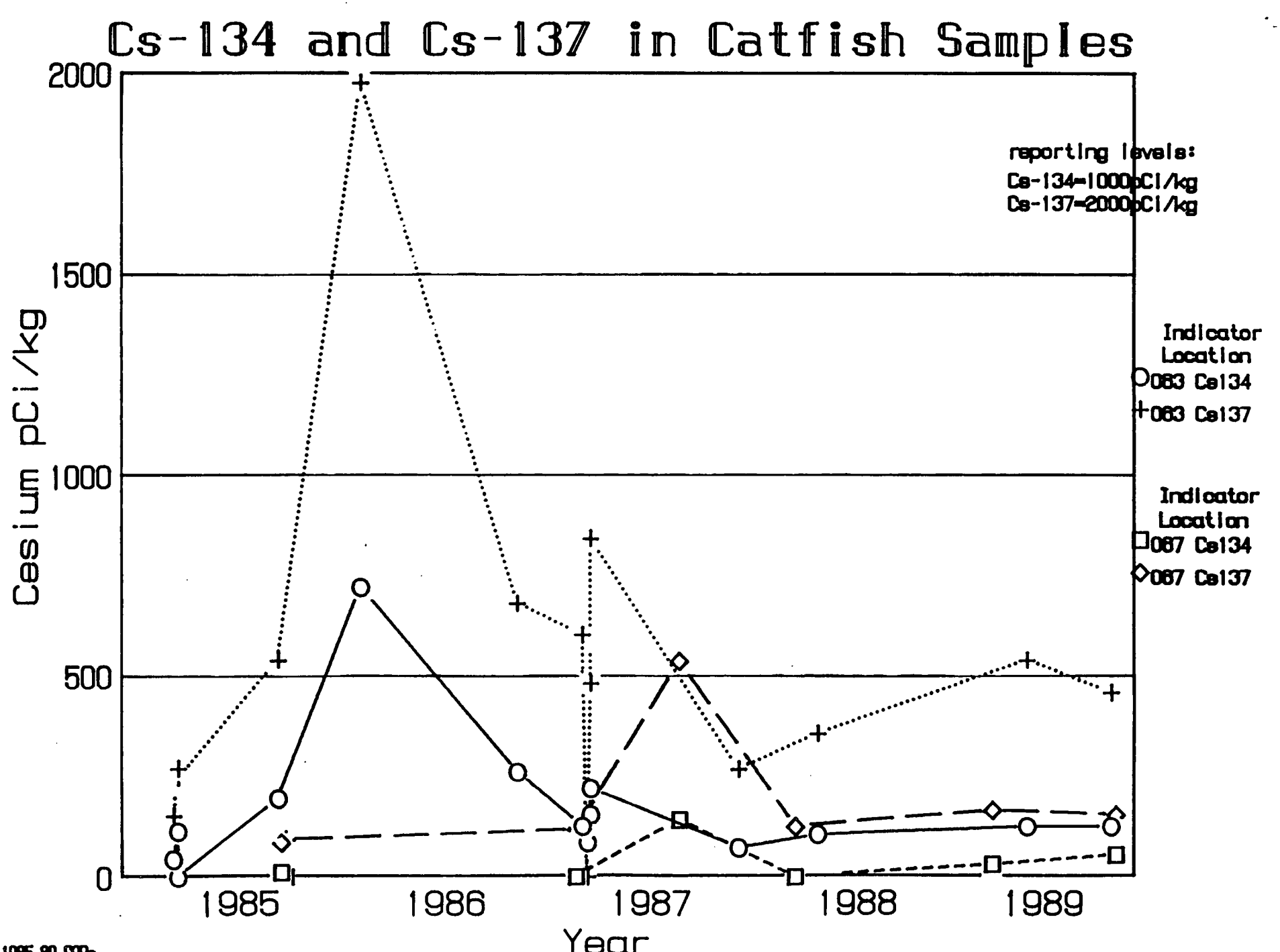
CONCENTRATION (pCi/kg)

YEAR	Cs-134 INDICATOR	Cs-137 INDICATOR
1969	0.00E+00	1.29E+02
1970	0.00E+00	1.66E+02
1971	0.00E+00	1.90E+02
1972	0.00E+00	1.41E+02
1973	0.00E+00	1.89E+02
1974	0.00E+00	1.84E+01
1975	2.16E+01	1.87E+02
1976	3.23E+01	1.66E+02
1977	1.17E+02	3.22E+02
1978	2.76E+02	6.90E+02
1979	7.56E+01	4.09E+02
1980	8.14E+01	3.93E+02
1981	9.19E+01	3.38E+02
1982	1.18E+02	2.94E+02
1983	1.24E+02	3.06E+02
1984	3.79E+02	1.04E+03
1985	8.95E+01	2.93E+02
1986	2.42E+02	7.36E+02
1987	9.80E+01	3.93E+02
1988	7.20E+01	2.60E+02
1989	8.60E+01	3.36E+02
Correlation Coefficient	5.50E-01	3.21E-01
Trend Probability	Moderate	Moderate
Type Trend	Increasing	Increasing

Figure 3.7-1


Cs-134 and Cs-137 in Bass Samples
600
500
400
300
200
100
0
Cesium pCi/kg
1985
1986
1987
1988
1989
Year
reporting levels:
Cs-134=1000pCi/kg
Cs-137=2000pCi/kg
Indicator Location
063 Cs134
063 Cs137
Indicator
067 Cs134
067 Cs137
1985-1989 SMRs

Figur 7-2


Cs-134 and Cs-137 in Catfish Samples
2000
1500
1000
500
0
Cesium pCi/kg
1985
1986
1987
1988
1989
Year
reporting levels:
Cs-134=1000pCi/kg
Cs-137=2000pCi/kg
Indicator Location
063 Cs134
063 Cs137
Indicator Location
067 Cs134
067 Cs137
1985-89 SRRs

3.8 DIRECT GAMMA RADIATION

Thermoluminescent Dosimeter (TLD) measurements for direct gamma radiation were made each quarter at forty locations. Many of the TLDs are placed at the same site used by the NRC in their TLD Direct Radiation Monitoring Network. One hundred and fifty-five of the TLDs were recovered and processed. The highest annual mean for an indicator location was 1.13E-2 millirem per hour. This TLD was located at indicator location 024, which is at the site boundary. The annual mean for the control location was 1.03E-2 millirem per hour.

Least squares regression analysis was applied to the highest annual mean for the past twenty 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 AS MEASURED BY TLDS
TREND ANALYSIS OF MEAN ANNUAL DOSE RATES

DOSE RATE MREM/HR

YEAR	MREM/HR INDICATOR
1970	1.50E-02
1971	1.30E-02
1972	1.60E-02
1973	1.10E-02
1974	1.80E-01
1975	1.31E-01
1976	4.72E-01
1977	4.60E-01
1978	2.32E-01
1979	9.70E-02
1980	5.75E-02
1981	7.50E-02
1982	5.83E-02
1983	6.03E-02
1984	1.68E-02
1985	2.15E-02
1986	1.93E-02
1987	1.45E-02
1988	1.53E-02
1989	1.13E-02
Correlation Coefficient	-2.59E-01
Trend Probability	Poor
Type Trend	Decreasing

3.9 LAND USE CENSUS

The Land Use Census was conducted during the month of August in 1989. The census results are contained in Table 3.9-1. Milk animals were identified in two sectors other than the one where milk samples were being collected. The milk was not being used for human consumption. The owners were asked to participate in the program but both owners declined.

TABLE 3.9-1

LAND USE CENSUS DATA SHEET

Dates(s) Performed: 8-2-89 through 8-10-89

Sector		Distance (Miles)	Sector		Distance (Miles)
N	Nearest Residence	3.5	S	Nearest Residence	1.75
	Nearest Meat Animal	-		Nearest Meat Animal	-
	Nearest Cow	-		Nearest Cow	-
	Nearest Goat	-		Nearest Goat	-
NNE	Nearest Residence	2.25	SSW	Nearest Residence	1.5
	Nearest Meat Animal	3.25		Nearest Meat Animal	-
	Nearest Cow	-		Nearest Cow	-
	Nearest Goat	3.25*		Nearest Goat	-
NE	Nearest Residence	1.25	SW	Nearest Residence	1.5
	Nearest Meat Animal	2.75		Nearest Meat Animal	-
	Nearest Cow	-		Nearest Cow	-
	Nearest Goat	-		Nearest Goat	-
ENE	Nearest Residence	1.0	WSW	Nearest Residence	1.75
	Nearest Meat Animal	2.8		Nearest Meat Animal	3.75
	Nearest Cow	-		Nearest Cow	-
	Nearest Goat	-		Nearest Goat	-
E	Nearest Residence	1.0	W	Nearest Residence	1.75
	Nearest Meat Animal	2.75		Nearest Meat Animal	-
	Nearest Cow	-		Nearest Cow	-
	Nearest Goat	-		Nearest Goat	-
ESE	Nearest Residence	1.5	WNW	Nearest Residence	1.75
	Nearest Meat Animal	2.5		Nearest Meat Animal	2.25
	Nearest Cow	-		Nearest Cow	4.5
	Nearest Goat	2.25*		Nearest Goat	-
SE	Nearest Residence	1.75	NW	Nearest Residence	1.5
	Nearest Meat Animal	-		Nearest Meat Animal	-
	Nearest Cow	-		Nearest Cow	-
	Nearest Goat	-		Nearest Goat	-
SSE	Nearest Residence	1.4	NNW	Nearest Residence	1.5
	Nearest Meat Animal	-		Nearest Meat Animal	-
	Nearest Cow	-		Nearest Cow	-
	Nearest Goat	-		Nearest Goat	-

*Milk not used for human consumption.

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 and factors. NUREG/CR-1276 Appendix C dose factors were used when a radionuclide was not listed in Regulatory Guide 1.109. A dose factor of zero was used when the Guides listed "NO DATA" for a factor. The highest annual mean values for each sample type and radionuclide as given in Section 3 and Appendix B were used after the background concentrations, as measured at the control location, had been subtracted. The maximum exposed individual doses are summarized in Table 4.1. The individual population and pathway dose calculations are contained in Table 4.2.

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 doses are summarized in Table 4.1.

4.3 COMPARISON OF DOSES

The environmental and release data doses given in Table 4.1 agree reasonably well. The similarity of the doses indicate that the radioactivity levels in the environment do not differ from those expected based on effluent measurements and modeling of the environmental exposure pathways.

The doses calculated do not exceed the 40 CFR 190 annual dose commitment limits for members of the public.

1989 ENVIRONMENTAL AND EFFLUENT DOSES

Liquid Release Pathway

Organ	Environmental or Effluent Data	Critical Age	Critical Pathway	Maximum Dose(mrem/yr)
Skin	Env.	Teen	Shoreline Sediment	6.26E-3
Skin	Eff.	Teen	Shoreline Sediment	3.13E-2
Bone	Env.	Child	Fish	8.27E-1
Bone	Eff.	Child	Fish	5.33E-1
Liver	Env.	Teen	Fish	1.02E0
Liver	Eff.	Teen	Fish	8.02E-1
T. Body	Env.	Adult	Fish	6.99E-1
T. Body	Eff.	Adult	Fish	6.22E-1
Thyroid	Env.	Child	Drinking Water	8.19E-2
Thyroid	Eff.	Infant	Drinking Water	7.85E-1
Kidney	Env.	Teen	Fish	3.49E-1
Kidney	Eff.	Child	Fish	3.66E-1
Lung	Env.	Teen	Fish	1.45E-1
Lung	Eff.	Child	Drinking Water	2.40E-1
GI-LLI	Env.	Child	Drinking Water	8.19E-2
GI-LLI	Eff.	Adult	Fish	2.61E0

1989 ENVIRONMENTAL AND EFFLUENT DOSES

Gaseous Release Pathway

Noble Gas Exposure

Organ	Environmental or Effluent Data	Critical Age	Critical Pathway	Maximum Dose(mrem/yr)
Skin	Env.	-	-	Noble Gas not sampled
Skin	Eff.	N/A	Noble Gas Exposure	8.46E-2
T. Body	Env.	-	-	Noble Gas not sampled
T. Body	Eff.	N/A	Noble Gas Exposure	2.76E-2

Iodine, Particulate, and Tritium Exposure

Organ	Environmental or Effluent Data	Critical Age	Critical Pathway	Maximum Dose(mrem/yr)
Bone	Env.	Infant	Cow Milk	3.10E-1
Liver	Env.	Infant	Cow Milk	3.63E-1
T. Body	Env.	Adult	Cow Milk	3.98E-2
Thyroid	Env.	Child	Air Radioiodine	8.11E-3
Thyroid	Eff.	Infant	Cow Milk	3.13E-1
Kidney	Env.	Infant	Cow Milk	9.74E-2
Lung	Env.	Infant	Cow Milk	3.94E-2
GI-LLI	Env.	Teen	Cow Milk	1.53E-3

DOSES FROM 1989 ENVIRONMENTAL MEASUREMENTS

Dose from Inhalation Pathway for 1989 Data

"Airborne Particulate" Samples
Breathing rate = 8000 m3/yr

Maximum Exposed Adult

Adult Inhalation Dose Factor (mrem per pCi inhaled)

Radionuclide	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	4.95E-06	7.87E-07	NO DATA	1.23E-06	1.75E-04	9.67E-06
Co-58	NO DATA	1.98E-07	2.59E-07	NO DATA	NO DATA	1.16E-04	1.33E-05
Fe-59	1.47E-06	3.47E-06	1.32E-06	NO DATA	NO DATA	1.27E-04	2.35E-05
Co-60	NO DATA	1.44E-06	1.85E-06	NO DATA	NO DATA	7.46E-04	3.56E-05
Zn-65	4.05E-06	1.29E-05	5.82E-06	NO DATA	8.62E-06	1.08E-04	6.68E-06
Nb-95	1.76E-06	9.77E-07	5.26E-07	NO DATA	9.67E-07	6.31E-05	1.30E-05
Zr-95	1.34E-05	4.30E-06	2.91E-06	NO DATA	6.77E-06	2.21E-04	1.88E-05
I-131	3.15E-06	4.47E-06	2.56E-06	1.49E-03	7.66E-06	NO DATA	7.85E-07
Cs-134	4.66E-05	1.06E-04	9.10E-05	NO DATA	3.59E-05	1.22E-05	1.30E-06
Cs-137	5.98E-05	7.76E-05	5.35E-05	NO DATA	2.78E-05	9.40E-06	1.05E-06
BaLa-140	4.88E-06	2.17E-08	3.21E-07	NO DATA	2.09E-09	1.59E-04	5.73E-05

Radionuclide	Highest Ann. Mean Location Dist/ Direction	Conc. in Air (pCi/m)	Dose (mrem/yr) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BaLa-140	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Total Dose (mrem/yr) = 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00

Dose from Inhalation Pathway for 1989 Data

"Airborne Radioiodine" Samples

Maximum Exposed Adult

Breathing rate = 8000 m3/yr

Radionuclide	Adult Inhalation Dose Factor (mrem per pCi inhaled) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Highest Ann. Mean Conc. Location Dist/ Direction	in Air (pCi/m)	Dose (mrem/yr) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	4.95E-06	7.87E-07	NO DATA	1.23E-06	1.75E-04	9.67E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	1.98E-07	2.59E-07	NO DATA	NO DATA	1.16E-04	1.33E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	1.47E-06	3.47E-06	1.32E-06	NO DATA	NO DATA	1.27E-04	2.35E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	1.44E-06	1.85E-06	NO DATA	NO DATA	7.46E-04	3.56E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	4.05E-06	1.29E-05	5.82E-06	NO DATA	8.62E-06	1.08E-04	6.68E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	1.76E-06	9.77E-07	5.26E-07	NO DATA	9.67E-07	6.31E-05	1.30E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	1.34E-05	4.30E-06	2.91E-06	NO DATA	6.77E-06	2.21E-04	1.88E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	3.15E-06	4.47E-06	2.56E-06	1.49E-03	7.66E-06	NO DATA	7.85E-07	060 2.5mi/NNE	4.99E-04	1.26E-05	1.78E-05	1.02E-05	5.95E-03	3.06E-05	0.00E+00	3.13E-06
Cs-134	4.66E-05	1.06E-04	9.10E-05	NO DATA	3.59E-05	1.22E-05	1.30E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	5.98E-05	7.76E-05	5.35E-05	NO DATA	2.78E-05	9.40E-06	1.05E-06	072 1.7mi/S	2.51E-03	1.20E-03	1.56E-03	1.07E-03	0.00E+00	5.58E-04	1.89E-04	2.11E-05
BaLa-140	4.88E-06	2.17E-08	3.21E-07	NO DATA	2.09E-09	1.59E-04	5.73E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
								Total Dose (mrem/yr) =		1.21E-03	1.58E-03	1.08E-03	5.95E-03	5.89E-04	1.89E-04	2.42E-05

Dose from Drinking Water Pathway for 1989 Data

Maximum Exposed Adult

Usage (intake rate) = 730 L/yr

Radionuclide	Adult Ingestion Dose Factor (mrem per pCi ingested) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Highest Ann. Mean Conc. Location Dist/ Direction	in Water (pCi/L)	Dose (mrem/yr) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	4.57E-06	8.72E-07	NO DATA	1.36E-06	NO DATA	1.40E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	7.45E-07	1.67E-06	NO DATA	NO DATA	NO DATA	1.51E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	4.34E-06	1.02E-05	3.91E-06	NO DATA	NO DATA	2.85E-06	3.40E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	2.14E-06	4.72E-06	NO DATA	NO DATA	NO DATA	4.02E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	4.84E-06	1.54E-05	6.96E-06	NO DATA	1.03E-05	NO DATA	9.70E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	6.22E-09	3.46E-09	1.86E-09	NO DATA	3.42E-09	NO DATA	2.10E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	3.04E-08	9.75E-09	6.60E-09	NO DATA	1.53E-08	NO DATA	3.09E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	NO DATA	1.57E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	6.22E-05	1.48E-04	1.21E-04	NO DATA	4.79E-05	1.59E-05	2.59E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	7.97E-05	1.09E-04	7.14E-05	NO DATA	3.70E-05	1.23E-05	2.11E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BaLa-140	2.03E-05	2.55E-08	1.33E-06	NO DATA	8.67E-09	1.46E-08	9.25E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	NO DATA	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	065 8.1mi/SSE	7.91E+02	0.00E+00	6.06E-02	6.06E-02	6.06E-02	6.06E-02	6.06E-02	6.06E-02
								Total Dose (mrem/yr)=		0.00E+00	6.06E-02	6.06E-02	6.06E-02	6.06E-02	6.06E-02	6.06E-02

Dose from Broadleaf Veg. Pathway for 1989 Data

Maximum Exposed Adult

Usage (intake rate) = 64 kg/yr

Radionuclide	Adult Ingestion Dose Factor (mrem per pCi ingested) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Highest Ann. Mean Location Dist/ Direction	Conc. in Vegetation (pCi/L)	Dose (mrem/yr) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	4.57E-06	8.72E-07	NO DATA	1.36E-06	NO DATA	1.40E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	7.45E-07	1.67E-06	NO DATA	NO DATA	NO DATA	1.51E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	4.34E-06	1.02E-05	3.91E-06	NO DATA	NO DATA	2.85E-06	3.40E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	2.14E-06	4.72E-06	NO DATA	NO DATA	NO DATA	4.02E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	4.84E-06	1.54E-05	6.96E-06	NO DATA	1.03E-05	NO DATA	9.70E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	6.22E-09	3.46E-09	1.86E-09	NO DATA	3.42E-09	NO DATA	2.10E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	3.04E-08	9.75E-09	6.60E-09	NO DATA	1.53E-08	NO DATA	3.09E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	NO DATA	1.57E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	6.22E-05	1.48E-04	1.21E-04	NO DATA	4.79E-05	1.59E-05	2.59E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	7.97E-05	1.09E-04	7.14E-05	NO DATA	3.70E-05	1.23E-05	2.11E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BaLa-140	2.03E-05	2.55E-08	1.33E-06	NO DATA	8.67E-09	1.46E-08	9.25E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
								Total Dose (mrem/yr)=		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Dose from Milk Pathway for 1989 Data

Maximum Exposed Adult

Usage (intake rate) = 310 L/yr

Radionuclide	Adult Ingestion Dose Factor (mrem per pCi ingested) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Highest Ann. Mean Location Dist/ Direction	Conc. in Milk (pCi/L)	Dose (mrem/yr) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	4.57E-06	8.72E-07	NO DATA	1.36E-06	NO DATA	1.40E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	7.45E-07	1.67E-06	NO DATA	NO DATA	NO DATA	1.51E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	4.34E-06	1.02E-05	3.91E-06	NO DATA	NO DATA	2.85E-06	3.40E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	2.14E-06	4.72E-06	NO DATA	NO DATA	NO DATA	4.02E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	4.84E-06	1.54E-05	6.96E-06	NO DATA	1.03E-05	NO DATA	9.70E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	6.22E-09	3.46E-09	1.86E-09	NO DATA	3.42E-09	NO DATA	2.10E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	3.04E-08	9.75E-09	6.60E-09	NO DATA	1.53E-08	NO DATA	3.09E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	NO DATA	1.57E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	6.22E-05	1.48E-04	1.21E-04	NO DATA	4.79E-05	1.59E-05	2.59E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	7.97E-05	1.09E-04	7.14E-05	NO DATA	3.70E-05	1.23E-05	2.11E-06	069 4.5mi/WNW	1.80E+00	4.45E-02	6.08E-02	3.98E-02	0.00E+00	2.06E-02	6.86E-03	1.18E-03
BaLa-140	2.03E-05	2.55E-08	1.33E-06	NO DATA	8.67E-09	1.46E-08	9.25E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
								Total Dose (mrem/yr)=		4.45E-02	6.08E-02	3.98E-02	0.00E+00	2.06E-02	6.86E-03	1.18E-03

Dose from Fish Pathway for 1989 Data

Maximum Exposed Adult

Usage (intake rate) = 21 kg/yr
H-3 conc. in Fish = Surface Water pCi/l x Bio. Factor 0.9 pCi/kg per pCi/l
= 1.02E+04 pCi/L x 0.9 = 9.18E+03 pCi/kg

Radionuclide	Adult Ingestion Dose Factor (mrem per pCi ingested) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Highest Ann. Mean Conc. Location Dist/ Direction	in Fish (pCi/L)	Dose (mrem/yr) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	4.57E-06	8.72E-07	NO DATA	1.36E-06	NO DATA	1.40E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	7.45E-07	1.67E-06	NO DATA	NO DATA	NO DATA	1.51E-05	063 0.8mi/ESE	4.30E+01	0.00E+00	6.73E-04	1.51E-03	0.00E+00	0.00E+00	0.00E+00	1.36E-02
Fe-59	4.34E-06	1.02E-05	3.91E-06	NO DATA	NO DATA	2.85E-06	3.40E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	2.14E-06	4.72E-06	NO DATA	NO DATA	NO DATA	4.02E-05	063 0.8mi/ESE	1.50E+01	0.00E+00	6.74E-04	1.49E-03	0.00E+00	0.00E+00	0.00E+00	1.27E-02
Zn-65	1.84E-06	1.54E-05	6.96E-06	NO DATA	1.03E-05	NO DATA	9.70E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	6.22E-09	3.46E-09	1.86E-09	NO DATA	3.42E-09	NO DATA	2.10E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	3.04E-08	9.75E-09	6.60E-09	NO DATA	1.53E-08	NO DATA	3.09E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	NO DATA	1.57E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	6.22E-05	1.48E-04	1.21E-04	NO DATA	4.79E-05	1.59E-05	2.59E-06	063 0.8mi/ESE	8.60E+01	1.12E-01	2.67E-01	2.19E-01	0.00E+00	8.65E-02	2.87E-02	4.68E-03
Cs-137	7.97E-05	1.09E-04	7.14E-05	NO DATA	3.70E-05	1.23E-05	2.11E-06	063 0.8mi/ESE	3.05E+02	5.10E-01	6.98E-01	4.57E-01	0.00E+00	2.37E-01	7.88E-02	1.35E-02
BaLa-140	2.03E-05	2.55E-08	1.33E-06	NO DATA	8.67E-09	1.46E-08	9.25E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	NO DATA	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	063 0.8mi/ESE	9.18E+03	0.00E+00	2.02E-02	2.02E-02	2.02E-02	2.02E-02	2.02E-02	2.02E-02
								Total Dose (mrem/yr)=		6.23E-01	9.87E-01	6.99E-01	2.02E-02	3.44E-01	1.28E-01	6.47E-02

Dose from Shoreline Sediment Pathway for 1989 Data

Maximum Exposed Adult

Shoreline Recreation= 12 hr/yr
Shore Width Factor = 0.2 (river shoreline)
Sediment Surface Mass 40 kg/m2

Radionuclide	External Dose Factor for Standing on Contaminated Ground (mrem/hr per pCi/m2) T. Body	Skin	Location Dist/ Direction	Highest Ann. Mean Conc. in Sediment (pCi/kg)	T. Body	Skin
Mn-54	5.80E-09	6.80E-09	067 4.2mi/SSE	1.59E+01	8.85E-06	1.04E-05
Co-58	7.00E-09	8.20E-09	063 0.8mi/ESE	1.24E+02	8.33E-05	9.76E-05
Fe-59	8.00E-09	9.40E-09	ALL	0.00E+00	0.00E+00	0.00E+00
Co-60	1.70E-08	2.00E-08	067 4.2mi/SSE	1.96E+02	3.20E-04	3.76E-04
Zn-65	4.00E-09	4.60E-09	ALL	0.00E+00	0.00E+00	0.00E+00
Nb-95	5.10E-09	6.00E-09	ALL	0.00E+00	0.00E+00	0.00E+00
Zr-95	5.00E-09	5.80E-09	ALL	0.00E+00	0.00E+00	0.00E+00
I-131	2.80E-09	3.40E-09	ALL	0.00E+00	0.00E+00	0.00E+00
Cs-134	1.20E-08	1.40E-08	067 4.2mi/SSE	5.40E+01	6.22E-05	7.26E-05
Cs-137	4.20E-09	4.90E-09	067 4.2mi/SSE	8.30E+02	3.35E-04	3.90E-04
BaLa-140	1.50E-08	1.70E-08	ALL	0.00E+00	0.00E+00	0.00E+00
Ag-110m	1.80E-08	2.10E-08	063 0.8mi/ESE	5.50E+01	9.50E-05	1.11E-04
Sb-125	0.00E+00	3.50E-09	067 4.2mi/SSE	1.86E+02	0.00E+00	6.25E-05
			Total Dose (mrem/yr) =		9.04E-04	1.12E-03

Dose from Inhalation Pathway for 1989 Data

"Airborne Particulate" Samples
Breathing rate = 8000 m3/yr

Maximum Exposed Teenager

Radionuclide	Teenager Inhalation Dose Factor (mrem per pCi inhaled) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Highest Ann. Mean Location Dist/ Direction	Conc. in Air (pCi/m)	Dose (mrem/yr) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	6.39E-06	1.05E-06	NO DATA	1.59E-06	2.48E-04	8.35E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	2.59E-07	3.47E-07	NO DATA	NO DATA	1.68E-04	1.19E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	1.99E-06	4.62E-06	1.79E-06	NO DATA	NO DATA	1.91E-04	2.23E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	1.89E-06	2.48E-06	NO DATA	NO DATA	1.09E-03	3.24E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	4.82E-06	1.67E-05	7.80E-06	NO DATA	1.08E-05	1.55E-04	5.83E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	2.32E-06	1.29E-06	7.08E-07	NO DATA	1.25E-06	9.39E-05	1.21E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	1.82E-05	5.73E-06	3.94E-06	NO DATA	8.42E-06	3.36E-04	1.86E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	4.43E-06	6.14E-06	3.30E-06	1.83E-03	1.05E-05	NO DATA	8.11E-07	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	6.28E-05	1.41E-04	6.86E-05	NO DATA	4.69E-05	1.83E-05	1.22E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	8.38E-05	1.06E-04	3.89E-05	NO DATA	3.80E-05	1.51E-05	1.06E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BaLa-140	6.84E-06	2.95E-08	4.40E-07	NO DATA	2.85E-09	2.54E-04	6.09E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
									Total Dose (mrem/yr) =	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Dose from Inhalation Pathway for 1989 Data

"Airborne Radioiodine" Samples

Maximum Exposed Teenager

Breathing rate = 8000 m3/yr

Radionuclide	Teenager Inhalation Dose Factor (mrem per pCi inhaled) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Highest Ann. Mean Conc. Location Dist/ Direction	in Air (pCi/m)	Dose (mrem/yr) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	6.39E-06	1.05E-06	NO DATA	1.59E-06	2.48E-04	8.35E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	2.59E-07	3.47E-07	NO DATA	NO DATA	1.68E-04	1.19E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	1.99E-06	4.62E-06	1.79E-06	NO DATA	NO DATA	1.91E-04	2.23E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	1.89E-06	2.48E-06	NO DATA	NO DATA	1.09E-03	3.24E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	4.82E-06	1.67E-05	7.80E-06	NO DATA	1.08E-05	1.55E-04	5.83E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	2.32E-06	1.29E-06	7.08E-07	NO DATA	1.25E-06	9.39E-05	1.21E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	1.82E-05	5.73E-06	3.94E-06	NO DATA	8.42E-06	3.36E-04	1.86E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	4.43E-06	6.14E-06	3.30E-06	1.83E-03	1.05E-05	NO DATA	8.11E-07	060 2.5mi/NNE	4.99E-04	1.77E-05	2.45E-05	1.32E-05	7.31E-03	4.19E-05	0.00E+00	3.24E-06
Cs-134	6.28E-05	1.41E-04	6.86E-05	NO DATA	4.69E-05	1.83E-05	1.22E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	8.38E-05	1.06E-04	3.89E-05	NO DATA	3.80E-05	1.51E-05	1.06E-06	072 1.7mi/S	2.51E-03	1.68E-03	2.13E-03	7.81E-04	0.00E+00	7.63E-04	3.03E-04	2.13E-05
BaLa-140	6.84E-06	2.95E-08	4.40E-07	NO DATA	2.85E-09	2.54E-04	6.09E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
								Total Dose (mrem/yr) =		1.70E-03	2.15E-03	7.94E-04	7.31E-03	8.05E-04	3.03E-04	2.45E-05

Dose from Drinking Water Pathway for 1989 Data

Maximum Exposed Teenager

Usage (intake rate) = 510 L/yr

Radionuclide	Teenager Ingestion Dose Factor (mrem per pCi ingested) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Highest Ann. Mean Conc. Location Dist/ Direction	in Water (pCi/L)	Dose (mrem/yr) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	5.90E-06	1.17E-06	NO DATA	1.76E-06	NO DATA	1.21E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	9.72E-07	2.24E-06	NO DATA	NO DATA	NO DATA	1.34E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	5.87E-06	1.37E-05	5.29E-06	NO DATA	NO DATA	4.32E-06	3.24E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	2.81E-06	6.33E-06	NO DATA	NO DATA	NO DATA	3.66E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	5.76E-06	2.00E-05	9.33E-06	NO DATA	1.28E-05	NO DATA	8.47E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	8.22E-09	4.56E-09	2.51E-09	NO DATA	4.42E-09	NO DATA	1.95E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	4.12E-08	1.30E-08	8.94E-09	NO DATA	1.91E-08	NO DATA	3.00E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	NO DATA	1.62E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	8.37E-05	1.97E-04	9.14E-05	NO DATA	6.26E-05	2.39E-05	2.45E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	1.12E-04	1.49E-04	5.19E-05	NO DATA	5.07E-05	1.97E-05	2.12E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BaLa-140	2.84E-05	3.48E-08	1.83E-06	NO DATA	1.18E-08	2.34E-08	9.82E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	NO DATA	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	065 8.1mi/SSE	7.91E+02	0.00E+00	4.28E-02	4.28E-02	4.28E-02	4.28E-02	4.28E-02	4.28E-02
								Total Dose (mrem/yr)=		0.00E+00	4.28E-02	4.28E-02	4.28E-02	4.28E-02	4.28E-02	4.28E-02

Dose from Broadleaf Veg. Pathway for 1989 Data

Maximum Exposed Teenager

Usage (intake rate) = 42 kg/yr

Radionuclide	Teenager Ingestion Dose Factor (mrem per pCi ingested) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Highest Ann. Mean Location Dist/ Direction	Conc. in Vegetation (pCi/L)	Dose (mrem/yr) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	5.90E-06	1.17E-06	NO DATA	1.76E-06	NO DATA	1.21E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	9.72E-07	2.24E-06	NO DATA	NO DATA	NO DATA	1.34E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	5.87E-06	1.37E-05	5.29E-06	NO DATA	NO DATA	4.32E-06	3.24E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	2.81E-06	6.33E-06	NO DATA	NO DATA	NO DATA	3.66E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	5.76E-06	2.00E-05	9.33E-06	NO DATA	1.28E-05	NO DATA	8.47E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	8.22E-09	4.56E-09	2.51E-09	NO DATA	4.42E-09	NO DATA	1.95E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	4.12E-08	1.30E-08	8.94E-09	NO DATA	1.91E-08	NO DATA	3.00E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	NO DATA	1.62E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	8.37E-05	1.97E-04	9.14E-05	NO DATA	6.26E-05	2.39E-05	2.45E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	1.12E-04	1.49E-04	5.19E-05	NO DATA	5.07E-05	1.97E-05	2.12E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BaLa-140	2.84E-05	3.48E-08	1.83E-06	NO DATA	1.18E-08	2.34E-08	9.82E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
								Total Dose (mrem/yr)=		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Dose from Milk Pathway for 1989 Data

Maximum Exposed Teenager

Usage (intake rate) = 400 L/yr

Radionuclide	Teenager Ingestion Dose Factor (mrem per pCi ingested) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Highest Ann. Mean Conc. Location Dist/ Direction	in Milk (pCi/L)	Dose (mrem/yr) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	5.90E-06	1.17E-06	NO DATA	1.76E-06	NO DATA	1.21E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	9.72E-07	2.24E-06	NO DATA	NO DATA	NO DATA	1.34E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	5.87E-06	1.37E-05	5.29E-06	NO DATA	NO DATA	4.32E-06	3.24E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	2.81E-06	6.33E-06	NO DATA	NO DATA	NO DATA	3.66E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	5.76E-06	2.00E-05	9.33E-06	NO DATA	1.28E-05	NO DATA	8.47E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	8.22E-09	4.56E-09	2.51E-09	NO DATA	4.42E-09	NO DATA	1.95E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	4.12E-08	1.30E-08	8.94E-09	NO DATA	1.91E-08	NO DATA	3.00E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	NO DATA	1.62E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	8.37E-05	1.97E-04	9.14E-05	NO DATA	6.26E-05	2.39E-05	2.45E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	1.12E-04	1.49E-04	5.19E-05	NO DATA	5.07E-05	1.97E-05	2.12E-06	069 4.5mi/WNW	1.80E+00	8.06E-02	1.07E-01	3.74E-02	0.00E+00	3.65E-02	1.42E-02	1.53E-03
BaLa-140	2.84E-05	3.48E-08	1.83E-06	NO DATA	1.18E-08	2.34E-08	9.82E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
								Total Dose (mrem/yr)=		8.06E-02	1.07E-01	3.74E-02	0.00E+00	3.65E-02	1.42E-02	1.53E-03

Dose from Fish Pathway for 1989 Data

Maximum Exposed Teenager

Usage (intake rate) = 16 kg/yr
H-3 Conc. in Fish = Surface Water pCi/l x Bio. Factor 0.9 pci/kg per pCi/L
= 1.02E+04 pCi/L x 0.9 = 9.18E+03 pCi/kg

Radionuclide	Teenager Ingestion Dose Factor (mrem per pCi ingested) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Highest Ann. Mean Conc. Location Dist/ Direction	in Fish (pCi/L)	Dose (mrem/yr) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	5.90E-06	1.17E-06	NO DATA	1.76E-06	NO DATA	1.21E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	9.72E-07	2.24E-06	NO DATA	NO DATA	NO DATA	1.34E-05	063 0.8mi/ESE	4.30E+01	0.00E+00	6.69E-04	1.54E-03	0.00E+00	0.00E+00	0.00E+00	9.22E-03
Fe-59	5.87E-06	1.37E-05	5.29E-06	NO DATA	NO DATA	4.32E-06	3.24E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	2.81E-06	6.33E-06	NO DATA	NO DATA	NO DATA	3.66E-05	063 0.8mi/ESE	1.50E+01	0.00E+00	6.74E-04	1.52E-03	0.00E+00	0.00E+00	0.00E+00	8.78E-03
Zn-65	5.76E-06	2.00E-05	9.33E-06	NO DATA	1.28E-05	NO DATA	8.47E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	8.22E-09	4.56E-09	2.51E-09	NO DATA	4.42E-09	NO DATA	1.95E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	4.12E-08	1.30E-08	8.94E-09	NO DATA	1.91E-08	NO DATA	3.00E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	NO DATA	1.62E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	8.37E-05	1.97E-04	9.14E-05	NO DATA	6.26E-05	2.39E-05	2.45E-06	063 0.8mi/ESE	8.60E+01	1.15E-01	2.71E-01	1.26E-01	0.00E+00	8.61E-02	3.29E-02	3.37E-03
Cs-137	1.12E-04	1.49E-04	5.19E-05	NO DATA	5.07E-05	1.97E-05	2.12E-06	063 0.8mi/ESE	3.05E+02	5.47E-01	7.27E-01	2.53E-01	0.00E+00	2.47E-01	9.61E-02	1.03E-02
BaLa-140	2.84E-05	3.48E-08	1.83E-06	NO DATA	1.18E-08	2.34E-08	9.82E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	NO DATA	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	063 0.8mi/ESE	9.18E+03	0.00E+00	1.56E-02	1.56E-02	1.56E-02	1.56E-02	1.56E-02	1.56E-02
								Total Dose (mrem/yr)=		6.62E-01	1.02E+00	3.98E-01	1.56E-02	3.49E-01	1.45E-01	4.73E-02

Dose from Shoreline Sediment Pathway for 1989 Data

Maximum Exposed Teenager

Shoreline Recreation= 67 hr/yr
Shore Width Factor = 0.2 (river shoreline)
Sediment Surface Mass 40 kg/m2

Radionuclide	External Dose Factor for Standing on Contaminated Ground (mrem/hr per pCi/m2) T. Body	Skin	Location Dist/ Direction	Highest Ann. Mean Conc. in Sediment (pCi/kg)	T. Body	Skin
Mn-54	5.80E-09	6.80E-09	067 4.2mi/SSE	1.59E+01	4.94E-05	5.80E-05
Co-58	7.00E-09	8.20E-09	063 0.8mi/ESE	1.24E+02	4.65E-04	5.45E-04
Fe-59	8.00E-09	9.40E-09	ALL	0.00E+00	0.00E+00	0.00E+00
Co-60	1.70E-08	2.00E-08	067 4.2mi/SSE	1.96E+02	1.79E-03	2.10E-03
Zn-65	4.00E-09	4.60E-09	ALL	0.00E+00	0.00E+00	0.00E+00
Nb-95	5.10E-09	6.00E-09	ALL	0.00E+00	0.00E+00	0.00E+00
Zr-95	5.00E-09	5.80E-09	ALL	0.00E+00	0.00E+00	0.00E+00
I-131	2.80E-09	3.40E-09	ALL	0.00E+00	0.00E+00	0.00E+00
Cs-134	1.20E-08	1.40E-08	067 4.2mi/SSE	5.40E+01	3.47E-04	4.05E-04
Cs-137	4.20E-09	4.90E-09	067 4.2mi/SSE	8.30E+02	1.87E-03	2.18E-03
BaLa-140	1.50E-08	1.70E-08	ALL	0.00E+00	0.00E+00	0.00E+00
Ag-110m	1.80E-08	2.10E-08	063 0.8mi/ESE	5.50E+01	5.31E-04	6.19E-04
Sb-125	0.00E+00	3.50E-09	067 4.2mi/SSE	1.86E+02	0.00E+00	3.49E-04

Total Dose (mrem/yr) = 5.05E-03 6.26E-03

Dose from Inhalation Pathway for 1989 Data

"Airborne Particulate" Samples
Breathing rate = 3700 m3/yr

Maximum Exposed Child

Radionuclide	Child Inhalation Dose Factor (mrem per pCi inhaled) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Highest Ann. Mean Conc. Location Dist/ Direction	in Air (pCi/m)	Dose (mrem/yr) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	1.16E-05	2.57E-06	NO DATA	2.71E-06	4.26E-04	6.19E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	4.79E-07	8.55E-07	NO DATA	NO DATA	2.99E-04	9.29E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	5.59E-06	9.04E-06	4.51E-06	NO DATA	NO DATA	3.43E-04	1.91E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	3.55E-06	6.12E-06	NO DATA	NO DATA	1.91E-03	2.60E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	1.15E-05	3.06E-05	1.90E-05	NO DATA	1.93E-05	2.69E-04	4.41E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	6.35E-06	2.48E-06	1.77E-06	NO DATA	2.33E-06	1.66E-04	1.00E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	5.13E-05	1.13E-05	1.00E-05	NO DATA	1.61E-05	6.03E-04	1.65E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	1.30E-05	1.30E-05	7.37E-06	4.39E-03	2.13E-05	NO DATA	7.68E-07	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	1.76E-04	2.74E-04	6.07E-05	NO DATA	8.93E-05	3.27E-05	1.04E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	2.45E-04	2.23E-04	3.47E-05	NO DATA	7.63E-05	2.81E-05	9.78E-07	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BaLa-140	2.00E-05	6.08E-08	1.17E-06	NO DATA	5.71E-09	4.71E-04	6.10E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Dose (mrem/yr) =										0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Dose from Inhalation Pathway for 1989 Data

"Airborne Radioiodine" Samples

Maximum Exposed Child

Breathing rate = 3700 m3/yr

Radionuclide	Child Inhalation Dose Factor (mrem per pCi inhaled) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Highest Ann. Mean Location Dist/ Direction	Conc. in Air (pCi/m)	Dose (mrem/yr) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	1.16E-05	2.57E-06	NO DATA	2.71E-06	4.26E-04	6.19E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	4.79E-07	8.55E-07	NO DATA	NO DATA	2.99E-04	9.29E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	5.59E-06	9.04E-06	4.51E-06	NO DATA	NO DATA	3.43E-04	1.91E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	3.55E-06	6.12E-06	NO DATA	NO DATA	1.91E-03	2.60E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	1.15E-05	3.06E-05	1.90E-05	NO DATA	1.93E-05	2.69E-04	4.41E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	6.35E-06	2.48E-06	1.77E-06	NO DATA	2.33E-06	1.66E-04	1.00E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	5.13E-05	1.13E-05	1.00E-05	NO DATA	1.61E-05	6.03E-04	1.65E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	1.30E-05	1.30E-05	7.37E-06	4.39E-03	2.13E-05	NO DATA	7.68E-07	060 2.5mi/NNE	4.99E-04	2.40E-05	2.40E-05	1.36E-05	8.11E-03	3.93E-05	0.00E+00	1.42E-06
Cs-134	1.76E-04	2.74E-04	6.07E-05	NO DATA	8.93E-05	3.27E-05	1.04E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	2.45E-04	2.23E-04	3.47E-05	NO DATA	7.63E-05	2.81E-05	9.78E-07	072 1.7mi/S	2.51E-03	2.28E-03	2.07E-03	3.22E-04	0.00E+00	7.09E-04	2.61E-04	9.08E-06
BaLa-140	2.00E-05	6.08E-08	1.17E-06	NO DATA	5.71E-09	4.71E-04	6.10E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
								Total Dose (mrem/yr) =		2.30E-03	2.10E-03	3.36E-04	8.11E-03	7.48E-04	2.61E-04	1.05E-05

Dose from Drinking Water Pathway for 1989 Data

Maximum Exposed Child

Usage (intake rate) = 510 kg/yr

Radionuclide	Child Ingestion Dose Factor (mrem per pCi ingested) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Highest Ann. Mean Conc. Location Dist/ Direction	in Water (pCi/kg)	Dose (mrem/yr) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	1.07E-05	2.85E-06	NO DATA	3.00E-06	NO DATA	8.98E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	1.80E-06	5.51E-06	NO DATA	NO DATA	NO DATA	1.05E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	1.65E-05	2.67E-05	1.33E-05	NO DATA	NO DATA	7.74E-06	2.78E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	5.29E-06	1.56E-05	NO DATA	NO DATA	NO DATA	2.93E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	1.37E-05	3.65E-05	2.27E-05	NO DATA	2.30E-05	NO DATA	6.41E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	2.25E-08	8.76E-09	6.26E-09	NO DATA	8.23E-09	NO DATA	1.62E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	1.16E-07	2.55E-08	2.27E-08	NO DATA	3.65E-08	NO DATA	2.66E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	1.72E-05	1.73E-05	9.83E-06	5.72E-03	2.84E-05	NO DATA	1.54E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	2.34E-04	3.84E-04	8.10E-05	NO DATA	1.19E-04	4.27E-05	2.07E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	3.27E-04	3.13E-04	4.62E-05	NO DATA	1.02E-04	3.67E-05	1.96E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BaLa-140	8.31E-05	7.28E-08	4.85E-06	NO DATA	2.37E-08	4.34E-08	9.84E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	NO DATA	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	065 8.1mi/SSE	7.91E+02	0.00E+00	8.19E-02	8.19E-02	8.19E-02	8.19E-02	8.19E-02	8.19E-02
								Total Dose (mrem/yr)=		0.00E+00	8.19E-02	8.19E-02	8.19E-02	8.19E-02	8.19E-02	8.19E-02

Dose from Broadleaf Veg. Pathway for 1989 Data

Maximum Exposed Child

Usage (intake rate) = 26 kg/yr

Radionuclide	Child Ingestion Dose Factor (mrem per pCi ingested) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Highest Ann. Mean Conc. Location Dist/ Direction	in Vegetation (pCi/kg)	Dose (mrem/yr) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	1.07E-05	2.85E-06	NO DATA	3.00E-06	NO DATA	8.98E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	1.80E-06	5.51E-06	NO DATA	NO DATA	NO DATA	1.05E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	1.65E-05	2.67E-05	1.33E-05	NO DATA	NO DATA	7.74E-06	2.78E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	5.29E-06	1.56E-05	NO DATA	NO DATA	NO DATA	2.93E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	1.37E-05	3.65E-05	2.27E-05	NO DATA	2.30E-05	NO DATA	6.41E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	2.25E-08	8.76E-09	6.26E-09	NO DATA	8.23E-09	NO DATA	1.62E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	1.16E-07	2.55E-08	2.27E-08	NO DATA	3.65E-08	NO DATA	2.66E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	1.72E-05	1.73E-05	9.83E-06	5.72E-03	2.84E-05	NO DATA	1.54E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	2.34E-04	3.84E-04	8.10E-05	NO DATA	1.19E-04	4.27E-05	2.07E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	3.27E-04	3.13E-04	4.62E-05	NO DATA	1.02E-04	3.67E-05	1.96E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BaLa-140	8.31E-05	7.28E-08	4.85E-06	NO DATA	2.37E-08	4.34E-08	9.84E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
								Total Dose (mrem/yr)=		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Dose from Milk Pathway for 1989 Data

Maximum Exposed Child

Usage (intake rate) = 330 kg/yr

Radionuclide	Child Ingestion Dose Factor (mrem per pCi ingested) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Highest Ann. Mean Conc. Location Dist/ Direction	in Milk (pCi/kg)	Dose (mrem/yr) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	1.07E-05	2.85E-06	NO DATA	3.00E-06	NO DATA	8.98E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	1.80E-06	5.51E-06	NO DATA	NO DATA	NO DATA	1.05E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	1.65E-05	2.67E-05	1.33E-05	NO DATA	NO DATA	7.74E-06	2.78E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	5.29E-06	1.56E-05	NO DATA	NO DATA	NO DATA	2.93E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	1.37E-05	3.65E-05	2.27E-05	NO DATA	2.30E-05	NO DATA	6.41E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	2.25E-08	8.76E-09	6.26E-09	NO DATA	8.23E-09	NO DATA	1.62E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	1.16E-07	2.55E-08	2.27E-08	NO DATA	3.65E-08	NO DATA	2.66E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	1.72E-05	1.73E-05	9.83E-06	5.72E-03	2.84E-05	NO DATA	1.54E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	2.34E-04	3.84E-04	8.10E-05	NO DATA	1.19E-04	4.27E-05	2.07E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	3.27E-04	3.13E-04	4.62E-05	NO DATA	1.02E-04	3.67E-05	1.96E-06	069 4.5mi/WNW	1.80E+00	1.94E-01	1.86E-01	2.74E-02	0.00E+00	6.06E-02	2.18E-02	1.16E-03
BaLa-140	8.31E-05	7.28E-08	4.85E-06	NO DATA	2.37E-08	4.34E-08	9.84E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
								Total Dose (mrem/yr)=		1.94E-01	1.86E-01	2.74E-02	0.00E+00	6.06E-02	2.18E-02	1.16E-03

Dose from Fish Pathway for 1989 Data

Maximum Exposed Child

Usage (intake rate) = 6.9 kg/yr
H-3 conc. in Fish = Surface Water pCi/L x Bio. Factor 0.9 pCi/kg per pCi/L
= 1.02E+04 pCi/L x 0.9 = 9.18E+03 pCi/kg

Radionuclide	Child Ingestion Dose Factor (mrem per pCi ingested) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Highest Ann. Mean Conc. Location Dist/ Direction	in Fish (pCi/kg)	Dose (mrem/yr) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	1.07E-05	2.85E-06	NO DATA	3.00E-06	NO DATA	8.98E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	1.80E-06	5.51E-06	NO DATA	NO DATA	NO DATA	1.05E-05	063 0.8mi/ESE	4.30E+01	0.00E+00	5.34E-04	1.63E-03	0.00E+00	0.00E+00	0.00E+00	3.12E-03
Fe-59	1.65E-05	2.67E-05	1.33E-05	NO DATA	NO DATA	7.74E-06	2.78E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	5.29E-06	1.56E-05	NO DATA	NO DATA	NO DATA	2.93E-05	063 0.8mi/ESE	1.50E+01	0.00E+00	5.48E-04	1.61E-03	0.00E+00	0.00E+00	0.00E+00	3.03E-03
Zn-65	1.37E-05	3.65E-05	2.27E-05	NO DATA	2.30E-05	NO DATA	6.41E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	2.25E-08	8.76E-09	6.26E-09	NO DATA	8.23E-09	NO DATA	1.62E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	1.16E-07	2.55E-08	2.27E-08	NO DATA	3.65E-08	NO DATA	2.66E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	1.72E-05	1.73E-05	9.83E-06	5.72E-03	2.84E-05	NO DATA	1.54E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	2.34E-04	3.84E-04	8.10E-05	NO DATA	1.19E-04	4.27E-05	2.07E-06	063 0.8mi/ESE	8.60E+01	1.39E-01	2.28E-01	4.81E-02	0.00E+00	7.06E-02	2.53E-02	1.23E-03
Cs-137	3.27E-04	3.13E-04	4.62E-05	NO DATA	1.02E-04	3.67E-05	1.96E-06	063 0.8mi/ESE	3.05E+02	6.88E-01	6.59E-01	9.72E-02	0.00E+00	2.15E-01	7.72E-02	4.12E-03
BaLa-140	8.31E-05	7.28E-08	4.85E-06	NO DATA	2.37E-08	4.34E-08	9.84E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	NO DATA	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	063 0.8mi/ESE	9.18E+03	0.00E+00	1.29E-02	1.29E-02	1.29E-02	1.29E-02	1.29E-02	1.29E-02
Total Dose (mrem/yr)=										8.27E-01	9.01E-01	1.61E-01	1.29E-02	2.98E-01	1.15E-01	2.44E-02

Dose from Shoreline Sediment Pathway for 1989 Data

Maximum Exposed Child

Shoreline Recreation= 14 hr/yr
Shore Width Factor = 0.2 (river shoreline)
Sediment Surface Mass 40 kg/m2

Radionuclide	External Dose Factor for Standing on Contaminated Ground (mrem/hr per pCi/m2) T. Body	Skin	Location Dist/ Direction	Highest Ann. Mean Conc. in Sediment (pCi/kg)	T. Body	Skin
Mn-54	5.80E-09	6.80E-09	067 4.2mi/SSE	1.59E+01	1.03E-05	1.21E-05
Co-58	7.00E-09	8.20E-09	063 0.8mi/ESE	1.24E+02	9.72E-05	1.14E-04
Fe-59	8.00E-09	9.40E-09	ALL	0.00E+00	0.00E+00	0.00E+00
Co-60	1.70E-08	2.00E-08	067 4.2mi/SSE	1.96E+02	3.73E-04	4.39E-04
Zn-65	4.00E-09	4.60E-09	ALL	0.00E+00	0.00E+00	0.00E+00
Nb-95	5.10E-09	6.00E-09	ALL	0.00E+00	0.00E+00	0.00E+00
Zr-95	5.00E-09	5.80E-09	ALL	0.00E+00	0.00E+00	0.00E+00
I-131	2.80E-09	3.40E-09	ALL	0.00E+00	0.00E+00	0.00E+00
Cs-134	1.20E-08	1.40E-08	067 4.2mi/SSE	5.40E+01	7.26E-05	8.47E-05
Cs-137	4.20E-09	4.90E-09	067 4.2mi/SSE	8.30E+02	3.90E-04	4.56E-04
BaLa-140	1.50E-08	1.70E-08	ALL	0.00E+00	0.00E+00	0.00E+00
Ag-110m	1.80E-08	2.10E-08	063 0.8mi/ESE	5.50E+01	1.11E-04	1.29E-04
Sb-125	0.00E+00	3.50E-09	067 4.2mi/SSE	1.86E+02	0.00E+00	7.29E-05
			Total Dose (mrem/yr) =		1.05E-03	1.31E-03

Dose from Inhalation Pathway for 1989 Data

"Airborne Particulate" Samples

Maximum Exposed Infant

Breathing rate = 1400 m3/yr

Radionuclide	Infant Inhalation Dose Factor (mrem per pCi inhaled) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Highest Ann. Mean Location Dist/ Direction	Conc. in Air (pCi/m)	Dose (mrem/yr) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	1.81E-05	3.56E-06	NO DATA	3.56E-06	7.14E-04	5.04E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	8.71E-07	1.30E-06	NO DATA	NO DATA	5.55E-04	7.95E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	9.69E-06	1.68E-05	6.77E-06	NO DATA	NO DATA	7.25E-04	1.77E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	5.73E-06	8.41E-06	NO DATA	NO DATA	3.22E-03	2.28E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	1.38E-05	4.47E-05	2.22E-05	NO DATA	2.32E-05	4.62E-04	3.67E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	1.12E-05	4.59E-06	2.70E-06	NO DATA	3.37E-06	3.42E-04	9.05E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	8.24E-05	1.99E-05	1.45E-05	NO DATA	2.22E-05	1.25E-03	1.55E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	2.71E-05	3.17E-05	1.40E-05	1.06E-02	3.70E-05	NO DATA	7.56E-07	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	2.83E-04	5.02E-04	5.32E-05	NO DATA	1.36E-04	5.69E-05	9.53E-07	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	3.92E-04	4.37E-04	3.25E-05	NO DATA	1.23E-04	5.09E-05	9.53E-07	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BaLa-140	4.00E-05	1.43E-07	2.07E-06	NO DATA	9.59E-09	1.14E-03	6.06E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
								Total Dose (mrem/yr) =		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Dose from Inhalation Pathway for 1989 Data

"Airborne Radioiodine" Samples — Maximum Exposed Infant

Breathing rate = 1400 m3/yr

Radionuclide	Infant Inhalation Dose Factor (mrem per pCi inhaled) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Highest Ann. Mean Conc. in Air Location Dist/ Direction	(pCi/m)	Dose (mrem/yr) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	1.81E-05	3.56E-06	NO DATA	3.56E-06	7.14E-04	5.04E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	8.71E-07	1.30E-06	NO DATA	NO DATA	5.55E-04	7.95E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	9.69E-06	1.68E-05	6.77E-06	NO DATA	NO DATA	7.25E-04	1.77E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	5.73E-06	8.41E-06	NO DATA	NO DATA	3.22E-03	2.28E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	1.38E-05	4.47E-05	2.22E-05	NO DATA	2.32E-05	4.62E-04	3.67E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	1.12E-05	4.59E-06	2.70E-06	NO DATA	3.37E-06	3.42E-04	9.05E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	8.24E-05	1.99E-05	1.45E-05	NO DATA	2.22E-05	1.25E-03	1.55E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	2.71E-05	3.17E-05	1.40E-05	1.06E-02	3.70E-05	NO DATA	7.56E-07	060 2.5mi/NNE	4.99E-04	1.89E-05	2.21E-05	9.78E-06	7.41E-03	2.58E-05	0.00E+00	5.28E-07
Cs-134	2.83E-04	5.02E-04	5.32E-05	NO DATA	1.36E-04	5.69E-05	9.53E-07	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	3.92E-04	4.37E-04	3.25E-05	NO DATA	1.23E-04	5.09E-05	9.53E-07	072 1.7mi/S	2.51E-03	1.38E-03	1.54E-03	1.14E-04	0.00E+00	4.32E-04	1.79E-04	3.35E-06
BaLa-140	4.00E-05	1.43E-07	2.07E-06	NO DATA	9.59E-09	1.14E-03	6.06E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
								Total Dose (mrem/yr) =		1.40E-03	1.56E-03	1.24E-04	7.41E-03	4.58E-04	1.79E-04	3.88E-06

Dose from Drinking Water Pathway for 1989 Data

Maximum Exposed Infant

Usage (intake rate) = 330 L/yr

Radionuclide	Infant Ingestion Dose Factor (mrem per pCi ingested) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Highest Ann. Mean Conc. Location Dist/ Direction	in Water (pCi/L)	Dose (mrem/yr) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	1.99E-05	4.51E-06	NO DATA	4.41E-06	NO DATA	7.31E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	3.60E-06	8.93E-06	NO DATA	NO DATA	NO DATA	8.97E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	3.08E-05	5.38E-05	2.12E-05	NO DATA	NO DATA	1.59E-05	2.57E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	1.08E-05	2.55E-05	NO DATA	NO DATA	NO DATA	2.57E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	1.84E-05	6.31E-05	2.91E-05	NO DATA	3.06E-05	NO DATA	5.33E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	4.20E-08	1.73E-08	1.00E-08	NO DATA	1.24E-08	NO DATA	1.46E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	2.06E-07	5.02E-08	3.56E-08	NO DATA	5.41E-08	NO DATA	2.50E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	3.77E-04	7.03E-04	7.10E-05	NO DATA	1.81E-04	7.42E-05	1.91E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	5.22E-04	6.11E-04	4.33E-05	NO DATA	1.64E-04	6.64E-05	1.91E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BaLa-140	1.71E-04	1.71E-07	8.81E-06	NO DATA	4.06E-08	1.05E-07	9.77E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	NO DATA	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07	065 0.1mi/SSE	7.91E+02	0.00E+00	8.04E-02	8.04E-02	8.04E-02	8.04E-02	8.04E-02	8.04E-02
Total Dose (mrem/yr) =										0.00E+00	8.04E-02	8.04E-02	8.04E-02	8.04E-02	8.04E-02	8.04E-02

Dose from Milk Pathway for 1989 Data

Maximum Exposed Infant

Usage (intake rate) = 330 L/yr

Radionuclide	Infant Ingestion Dose Factor (mrem per pCi ingested) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI	Highest Ann. Mean Conc. Location Dist/ Direction	in Milk (pCi/L)	Dose (mrem/yr) Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Mn-54	NO DATA	1.99E-05	4.51E-06	NO DATA	4.41E-06	NO DATA	7.31E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-58	NO DATA	3.60E-06	8.93E-06	NO DATA	NO DATA	NO DATA	8.97E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-59	3.08E-05	5.38E-05	2.12E-05	NO DATA	NO DATA	1.59E-05	2.57E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	NO DATA	1.08E-05	2.55E-05	NO DATA	NO DATA	NO DATA	2.57E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zn-65	1.84E-05	6.31E-05	2.91E-05	NO DATA	3.06E-05	NO DATA	5.33E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nb-95	4.20E-08	1.73E-08	1.00E-08	NO DATA	1.24E-08	NO DATA	1.46E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-95	2.06E-07	5.02E-08	3.56E-08	NO DATA	5.41E-08	NO DATA	2.50E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-134	3.77E-04	7.03E-04	7.10E-05	NO DATA	1.81E-04	7.42E-05	1.91E-06	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cs-137	5.22E-04	6.11E-04	4.33E-05	NO DATA	1.64E-04	6.64E-05	1.91E-06	069 4.5mi/WNW	1.80E+00	3.10E-01	3.63E-01	2.57E-02	0.00E+00	9.74E-02	3.94E-02	1.13E-03
BaLa-140	1.71E-04	1.71E-07	8.81E-06	NO DATA	4.06E-08	1.05E-07	9.77E-05	ALL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Dose (mrem/yr) =										3.10E-01	3.63E-01	2.57E-02	0.00E+00	9.74E-02	3.94E-02	1.13E-03

SECTION 5.

QUALITY ASSURANCE

5.1 DUKE POWER COMPANY'S ENVIRONMENTAL LABORATORIES

5.1.1 SAMPLE COLLECTION

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

5.1.2 SAMPLE ANALYSIS

The Radioanalysis Laboratory performs the environmental sample analyses as specified by approved analysis procedures.

5.1.3 DOSIMETRY ANALYSIS

The Dosimetry Laboratory performs environmental dosimetry measurements as specified by approved dosimetry analysis procedures.

5.1.4 INTRALABORATORY QUALITY ASSURANCE

The Radioanalysis Laboratory and the Dosimetry Laboratory performed an internal review during 1989 in order to demonstrate an ability and willingness to perform self-audits, and also to aid in performing duties.

The Radioanalysis Laboratory has an internal quality assurance program which monitors each type of instrumentation for reliability and accuracy. Daily quality control checks ensure that instruments are in proper working order and these checks are used to monitor instrument performance. Additionally, National Institute of Standards and Technology (NIST) standards that represent counting geometries are analyzed as unknowns at various frequencies ranging from weekly to annually to verify that efficiency calibrations are valid. The frequency is

dependent upon instrument use and performance. Investigations are performed and documented should calibration verification data fall out of limits.

5.1.5 INTERLABORATORY QUALITY ASSURANCE

5.1.5.1 DUKE POWER'S AUDIT DIVISION

The Radioanalysis Laboratory and Dosimetry Laboratory were participants in a Quality Assurance audit in 1989, performed by Duke Power's Audit Division. Two recommendations were identified in the audit. Actions were taken to enhance laboratory operations based upon the two recommendations.

The ONS Chemistry Section responsible for environmental monitoring was also evaluated in 1989. No findings were identified or recommendations made.

5.1.5.2 DUKE POWER'S NUCLEAR PRODUCTION INTERCOMPARISON PROGRAM

The Radioanalysis Laboratory participated in the Duke Power Nuclear Production Intercomparison Program during 1989. Unknown body burden standards, marinelli beakers, air filters, air cartridges, gross alpha/beta on air filters, and tritium in water samples are analyzed at various times of the year by the four counting laboratories in Duke Power Company for this program.

5.1.5.3 U.S. NUCLEAR REGULATORY COMMISSION INSPECTIONS

An NRC audit performed at ONS in 1989 included the review of the 1987 and 1988 Annual Radiological Environmental Operating Report. No violations or deviations were identified by the inspector.

5.1.5.4 UNITED STATES ENVIRONMENTAL PROTECTION AGENCY INTERCOMPARISON PROGRAM

The Radioanalysis Laboratory participates in the Environmental Protection Agency (EPA) Environmental Monitoring Systems Laboratory Intercomparison Program. The EPA sample types include mixed gamma in water (3 times per year), mixed gamma in milk (2 times per year), gamma in air filters (2 times per year), iodine in milk (2 times per year), tritium in water (3 times per year), iodine in water (3 times per year), gross alpha/ beta in air filters (1 time per year), and gross alpha/beta in water (3 times per year). The Radioanalysis Laboratory subunit prepares and analyzes each sample as quickly as possible and performs and documents follow-up investigations should the data obtained by the Radioanalysis Laboratory be out of EPA limits. The Radioanalysis Laboratory EPA Intercomparison Report code is "CP". A summary of the EPA Intercomparison Reports for 1989 is documented in Table 5.1. Of the forty-one (41) analyses performed in 1989, no analyses were out of EPA acceptance limits.

5.1.5.5 NRC/STATE OF S.C. ENVIRONMENTAL MONITORING PROGRAM

The ONS Chemistry Section and Radioanalysis Laboratory routinely participate with the State of South Carolina in their NRC/State Contract Enviromental Monitoring Program. The ONS Chemistry Section splits water, milk, vegetation, sediment, and fish samples with the Bureau of Radiological Health of the State's Department of Health and Environmental Control (DHEC) for analysis. DHEC collects air samples from two of the locations sampled for air by ONS. Results of the analyses performed on split and

duplicate samples by the Radioanalysis Laboratory and DHEC Laboratory are compiled by DHEC and provided to the NRC.

5.1.5.6 STATE OF N.C. INTERCOMPARISON PROGRAM

Health and Radiological Projects, Radioanalysis Laboratory, and Dosimetry Laboratory routinely participate with the State of North Carolina in an intercomparison program. Health and Radiological Projects sends air, water, milk, vegetation, sediment, and fish samples which have been collected to the State of North Carolina Radiation Protection Section for intercomparison analysis. Also, every six to eight months, the State of North Carolina Radiation Protection Section irradiates environmental dosimeters and sends them to the Dosimetry Laboratory for analysis of the unknown estimated delivered exposure. A summary of the State of North Carolina Environmental Dosimetry Intercomparison Report for 1989 is documented in Table 5.2. The results are in agreement.

5.1.5.7 U.S. DEPARTMENT OF ENERGY INTERCOMPARISON PROGRAM

There was no DOE intercomparison program during calendar year 1989.

5.2 CONTRACTOR LABORATORY

No contractor laboratories were used during 1989.

U.S. ENVIRONMENTAL PROTECTION AGENCY
INTERLABORATORY COMPARISON PROGRAM
1989 CROSS-CHECK RESULTS FOR THE ERL

ANALYSIS	DATE	NUCLIDE(S)	KNOWN VALUE	CONTROL LIMITS (3 SIGMA; N=3)	REPORTED VALUE
Gamma in Water	2/10/89	Cr-51	235 pCi/l	41.5 pCi/l	238 pCi/l
		Co-60	10 pCi/l	8.7 pCi/l	11 pCi/l
		Zn-65	159 pCi/l	27.7 pCi/l	166 pCi/l
		Ru-106	178 pCi/l	31.1 pCi/l	187 pCi/l
		Cs-134	10 pCi/l	8.7 pCi/l	10 pCi/l
		Cs-137	10 pCi/l	8.7 pCi/l	11 pCi/l
	6/09/89	Ba-133	49 pCi/l	8.7 pCi/l	52 pCi/l
		Co-60	31 pCi/l	8.7 pCi/l	32 pCi/l
		Zn-65	165 pCi/l	29.4 pCi/l	173 pCi/l
		Ru-106	128 pCi/l	22.5 pCi/l	128 pCi/l
		Cs-134	39 pCi/l	8.7 pCi/l	38 pCi/l
		Cs-137	20 pCi/l	8.7 pCi/l	21 pCi/l
	10/06/89	Ba-133	59 pCi/l	10.4 pCi/l	62 pCi/l
		Co-60	30 pCi/l	8.7 pCi/l	31 pCi/l
		Zn-65	129 pCi/l	22.5 pCi/l	136 pCi/l
		Ru-106	161 pCi/l	27.7 pCi/l	159 pCi/l
		Cs-134	29 pCi/l	8.7 pCi/l	29 pCi/l
		Cs-137	59 pCi/l	8.7 pCi/l	62 pCi/l
	12/09/88	I-131	115 pCi/l	20.8 pCi/l	118 pCi/l
	2/17/89	I-131	106 pCi/l	19 pCi/l	99 pCi/l
	8/04/89	I-131	83 pCi/l	13.8 pCi/l	80 pCi/l
Air Filter	3/31/89	Cs-137	20 pCi/Filter	8.7 pCi/Filter	21 pCi/Filter
		Gross Alpha	21 pCi/Filter	8.7 pCi/Filter	31 pCi/Filter
		Gross Beta	62 pCi/Filter	8.7 pCi/Filter	62 pCi/Filter

U.S. ENVIRONMENTAL PROTECTION AGENCY
INTERLABORATORY COMPARISON PROGRAM
1989 CROSS-CHECK RESULTS FOR THE ERL

ANALYSIS	DATE	NUCLIDE(S)	KNOWN VALUE	CONTROL LIMITS (3 SIGMA; N=3)	REPORTED VALUE
Air Filter	8/25/89	I-131	*	*	*
		Cs-137	10 pCi/Filter	8.7 pCi/Filter	11 pCi/Filter
		Gross Alpha	6 pCi/Filter	8.7 pCi/Filter	8 pCi/Filter
		Gross Beta	*	*	*
Tritium in Water	2/24/89	H-3	2754 pCi/l	615.9 pCi/l	2856 pCi/l
	6/23/89	H-3	4503 pCi/l	778.5 pCi/l	4685 pCi/l
	10/20/89	H-3	3496 pCi/l	629.7 pCi/l	3590 pCi/l
Gamma in Milk	10/28/88	I-131	91 pCi/l	15.6 pCi/l	90 pCi/l
		Cs-137	50 pCi/l	8.7 pCi/l	49 pCi/l
	4/28/89	I-131	*	*	*
		Cs-137	50 pCi/l	8.7 pCi/l	49 pCi/l
Alpha-Beta in Water	1/20/89	Gross Alpha	8 pCi/l	8.7 pCi/l	8.2 pCi/l
		Gross Beta	4 pCi/l	8.7 pCi/l	4.6 pCi/l
	5/12/89	Gross Alpha	30 pCi/l	13.8 pCi/l	27 pCi/l
		Gross Beta	50 pCi/l	8.7 pCi/l	50 pCi/l
	9/22/89	Gross Alpha	4 pCi/l	8.7 pCi/l	3 pCi/l
		Gross Beta	6 pCi/l	8.7 pCi/l	7 pCi/l

*NOTE: Calculational/Measurement error by EPA; no data reported by EPA.

TABLE 5.2

NORTH CAROLINA DEPARTMENT OF HUMAN RESOURCES
ENVIRONMENTAL DOSIMETER CROSS-CHECK 1989

Dosimetry Laboratory Results		Estimated Values	
Exposure ± Estimated Uncertainty		Exposure ± Estimated Uncertainty	
(mR)	(1 S.D.)mR	(mR)	(mR)
46.8	1.9	43.0	8.8

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, Radioanalysis Laboratory Procedures

5. Production Environmental Services, Dosimetry Laboratory Procedures

6. ONS Final Safety Analysis Report

7. ONS Preoperational Environmental Radioactivity Monitoring Reports and Annual Radiological Environmental Operation Reports, 1969-1988

8. NRC Regulatory Guide 1.109, Calculation Of Annual Doses To Man From Routine Releases Of Reactor Effluents For The Purpose Of Evaluating Compliance With 10 CFR Part 50, Appendix I

9. NRC Regulatory Guide 4.15, Quality Assurance For Radiological Monitoring Programs (Normal Operations) - Effluent Streams And The Environment

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

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 are 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 1989. 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 Broadleaf Vegetation, Shoreline Sediment and Fish. The additional samples make it possible to compare different sample media collected from the same location.

Environmental sampling is performed by the ONS Chemistry Section. Sample analyses are performed by Duke Power Company's Radioanalysis Laboratory. 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 3-5.

CHANGE OF SAMPLING PROCEDURES

The number of Drinking Water monitoring locations was reduced to three due to closure of the Clemson University Water Plant (location 065) on 7/01/89. Arrangements were made to sample the raw water which supplied the drinking water plant and also supplies the University's condenser water line at the Clemson University Central Energy Facility. The raw water sample will be considered a supplemental sample since it is neither a surface water or drinking water sample as required by Technical Specifications. The raw water

sample results will be used, as necessary, to evaluate results of required samples.

CHANGE OF ANALYSIS PROCEDURES

The Radioanalysis Radiological Laboratory performed a comparison study of tritium analysis with biodegradable and the currently used nonbiodegradable liquid scintillation cocktails. The study consisted of dual sets of environmental water samples and EPA cross-check tritium spikes which were analyzed in both cocktails. Results obtained from the biodegradable liquid scintillation fluid were compared to results obtained from the nonbiodegradable liquid scintillation fluid and were found to be well within EPA normal deviation and range acceptance limits.

Tritium data for the 1989 environmental sampling year and future tritium data will be obtained from analyses utilizing the biodegradable liquid scintillaiton cocktail. This change in analysis medium will allow the Radioanalysis Laboratory to continue to obtain quality tritium data and also achieve a reduction in hazardous substances within the laboratory, lowering the chances for potential employee exposure and reducing waste disposal costs.

SAMPLING AND ANALYSIS PROCEDURES

A.1 AIRBORNE PARTICULATES AND RADIOIODINE

Particulate and Radioiodine activity in air is collected through use of fiber filters for particulate collection followed by charcoal cartridges for iodine absorption. Air samplers are operated continuously and samples are changed on a weekly frequency. The samplers are designed to operate at a constant flow rate (in order to compensate for any filter loading) and are set to sample approximately 5 cubic feet per minute. The volume of air usually sampled over the weekly period is approximately 1.3E3 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 and utilized for gamma spectroscopy, gross beta analysis, and low-level I-131. The beta analysis is performed with a proportional counter. A separate portion is saved to form a quarterly composite with two other monthly period samples. Tritium analysis is performed on this quarterly composite.

The Radioanalysis Laboratory initiated in-house analysis of water samples for Tritium in 1986. All samples were analyzed by using liquid scintillation.

Low-level iodine analysis is performed in addition to the analyses required by Technical Specifications. An ion exchange resin is used to remove and concentrate any iodine in the drinking water. The resin is then analyzed by gamma spectroscopy.

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 and utilized for gamma spectroscopy. A separate portion is saved to form a quarterly composite with two other monthly period samples. Tritium analysis is performed on the quarterly composite.

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.

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 quarterly, although Technical Specifications requires semi-annual collection. At least 500 grams of sample are collected from the top 7.5 centimeters of sediment at the edge of the water. Gamma spectroscopy is performed on each sample after drying and removal of rocks and clams.

A.7 FISH

Fish are collected on a semi-annual frequency. Gillnets and traps 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.

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

Summary sheets for each media have been included in this Appendix.

Name of Facility : ONS
Location of Facility : OCONEE COUNTY, S.C.
Time Report Generated : 26-JAN-1990 11:22:13
Docket Number : 50-269,270,287
Reporting Period : 1-JAN-1989 through 31-DEC-1989
Database Name : $DISK1:[USER.ASC]ONS89.SAF;1

Medium or Pathway Sampled (Units)	Type & Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Mean: Name, Distance and Direction; Location Code	Location with Highest Mean: Mean (Fraction) Range	Control Locations Mean (Fraction) Range	No. of Non-Routine Report Meas.
AIR PARTICULATE (PCI/M3)						073(9.0 Mi NW)	
5 Locations	MN-54 260	0.00E+00	0.00E+00(0/ 208) 0.00E+00-- 0.00E+00		0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0
	CO-58 260	0.00E+00	0.00E+00(0/ 208) 0.00E+00-- 0.00E+00		0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0
	FE-59 260	0.00E+00	0.00E+00(0/ 208) 0.00E+00-- 0.00E+00		0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0
	CO-60 260	0.00E+00	0.00E+00(0/ 208) 0.00E+00-- 0.00E+00		0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0
	ZN-65 260	0.00E+00	0.00E+00(0/ 208) 0.00E+00-- 0.00E+00		0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0
	NB-95 260	0.00E+00	0.00E+00(0/ 208) 0.00E+00-- 0.00E+00		0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0
	ZR-95 260	0.00E+00	0.00E+00(0/ 208) 0.00E+00-- 0.00E+00		0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0
	I-131 260	7.00E-02	0.00E+00(0/ 208) 0.00E+00-- 0.00E+00		0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0
	CS-134 260	5.00E-02	0.00E+00(0/ 208) 0.00E+00-- 0.00E+00		0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0
	CS-137 260	6.00E-02	0.00E+00(0/ 208) 0.00E+00-- 0.00E+00		0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	5.12E-04(1/ 52) 5.12E-04-- 5.12E-04	0
	BALA-140 260	0.00E+00	0.00E+00(0/ 208) 0.00E+00-- 0.00E+00		0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements
If LLD is equal to 0, then LLD is not required by Technical Specifications
Location 060 = Greenville Water Intake Road
Location 061 = Old Highway 183
Location 072 = Highway 130
Location 073 = Tamassee Dar School
Location 074 = Keowee Kee Resort

Name of Facility : ONS
Location of Facility : OCONEE COUNTY, S.C.
Time Report Generated : 26-JAN-1990 11:22:13
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Reporting Period : 1-JAN-1989 through 31-DEC-1989
Database Name : $DISK1:[USER.ASCIONS89.SAF;1

Medium or Pathway Sampled (Units)	Type & Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Mean Name, Distance and Direction Location Code	Location with Highest Mean Name, Distance and Direction Mean (Fraction) Range	Control Locations Mean (Fraction) Range	No. of Non-Routine Report Meas.
AIR RADIOIODINES (PCI/M3)					073(9.0 Mi NW)		
	MN-54 260	0.00E+00	0.00E+00(0/ 208) 0.00E+00-- 0.00E+00		0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	8.77E-04(1/ 52) 8.77E-04-- 8.77E-04	0
5 Locations							
	CO-58 260	0.00E+00	0.00E+00(0/ 208) 0.00E+00-- 0.00E+00		0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0
	FE-59 260	0.00E+00	0.00E+00(0/ 208) 0.00E+00-- 0.00E+00		0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0
	CO-60 260	0.00E+00	0.00E+00(0/ 208) 0.00E+00-- 0.00E+00		0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0
	ZN-65 260	0.00E+00	0.00E+00(0/ 208) 0.00E+00-- 0.00E+00		0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0
	NB-95 260	0.00E+00	0.00E+00(0/ 208) 0.00E+00-- 0.00E+00		0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0
	ZR-95 260	0.00E+00	0.00E+00(0/ 208) 0.00E+00-- 0.00E+00		0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0
	I-131 260	7.00E-02	4.99E-04(1/ 208) 4.99E-04-- 4.99E-04	060(2.5 Mi NNE)	4.99E-04(1/ 52) 4.99E-04-- 4.99E-04	0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0
	CS-134 260	5.00E-02	0.00E+00(0/ 208) 0.00E+00-- 0.00E+00		0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0
	CS-137 260	6.00E-02	2.78E-03(7/ 208) 6.12E-04-- 5.31E-03	072(1.7 Mi S)	3.95E-03(2/ 52) 3.79E-03-- 4.12E-03	1.44E-03(1/ 52) 1.44E-03-- 1.44E-03	0
	BALA-140 260	0.00E+00	0.00E+00(0/ 208) 0.00E+00-- 0.00E+00		0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0.00E+00(0/ 52) 0.00E+00-- 0.00E+00	0

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements
If LLD is equal to 0, then LLD is not required by Technical Specifications
Location 060 = Greenville Water Intake Road
Location 061 = Old Highway 183
Location 072 = Highway 130
Location 073 = Tamassee Dar School
Location 074 = Keowee Kee Resort

Name of Facility : ONS
Location of Facility : OCONEE COUNTY, S.C.
Time Report Generated : 26-JAN-1990 11:22:13
Docket Number : 50-269,270,287
Reporting Period : 1-JAN-1989 through 31-DEC-1989
Database Name : $DISK1:[USER.ASC]ONS89.SAF;1

Medium or Pathway Sampled (Units)	Type & Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Mean: Name, Distance and Direction; Location Code	Location with Highest Mean: Mean (Fraction) Range	Control Locations Mean (Fraction) Range	No. of Non-Routine Report Meas.
BROAD LEAF VEGET (PCI/WET/KG)					073(9.0 Mi NW)		
3 Locations	MN-54 39	0.00E+00	0.00E+00(0/ 26) 0.00E+00-- 0.00E+00		0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	22. (1/ 13) 22. -- 22.	0
	CO-58 39	0.00E+00	0.00E+00(0/ 26) 0.00E+00-- 0.00E+00		0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0
	FE-59 39	0.00E+00	0.00E+00(0/ 26) 0.00E+00-- 0.00E+00		0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0
	CO-60 39	0.00E+00	0.00E+00(0/ 26) 0.00E+00-- 0.00E+00		0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0
	ZN-65 39	0.00E+00	0.00E+00(0/ 26) 0.00E+00-- 0.00E+00		0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0
	NB-95 39	0.00E+00	0.00E+00(0/ 26) 0.00E+00-- 0.00E+00		0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0
	ZR-95 39	0.00E+00	0.00E+00(0/ 26) 0.00E+00-- 0.00E+00		0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0
	I-131 39	60.	0.00E+00(0/ 26) 0.00E+00-- 0.00E+00		0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0
	CS-134 39	60.	0.00E+00(0/ 26) 0.00E+00-- 0.00E+00		0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0
	CS-137 39	80.	0.00E+00(0/ 26) 0.00E+00-- 0.00E+00		0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	1.08E+02(10/ 13) 42. -- 3.08E+02	0
	BALA-140 39	0.00E+00	0.00E+00(0/ 26) 0.00E+00-- 0.00E+00		0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses. (Fraction)
Zero range indicates no detectable activity measurements
If LLD is equal to 0, then LLD is not required by Technical Specifications
Location 028 = Site Boundary
Location 060 = Greenville Water Intake Road
Location 073 = Tamassee Dar School

Name of Facility : ONS
Location of Facility : OCONEE COUNTY, S.C.
Time Report Generated : 26-JAN-1990 11:22:13
Docket Number : 50-269,270,287
Reporting Period : 1-JAN-1989 through 31-DEC-1989
Database Name : $DISK1:[USER.ASCIONS89.SAF;1

Medium or Pathway Sampled (Units)	Type & Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Mean: Name, Distance and Direction; Location Code	Location with Highest Mean: Mean (Fraction) Range	Control Locations Mean (Fraction) Range	No. of Non-Routine Report Meas.
DRINKING WATER (PCI/LITERS)						064(6.7 Mi SW)	
4 Locations	LLI-131 46	1.0	0.00E+00(0/ 33) 0.00E+00-- 0.00E+00		0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0
	MN-54 46	15.	0.00E+00(0/ 33) 0.00E+00-- 0.00E+00		0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0
	CO-58 46	15.	0.00E+00(0/ 33) 0.00E+00-- 0.00E+00		0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0
	FE-59 46	30.	0.00E+00(0/ 33) 0.00E+00-- 0.00E+00		0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0
	CO-60 46	15.	0.00E+00(0/ 33) 0.00E+00-- 0.00E+00		0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0
	ZN-65 46	30.	0.00E+00(0/ 33) 0.00E+00-- 0.00E+00		0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0
	NB-95 46	15.	0.00E+00(0/ 33) 0.00E+00-- 0.00E+00		0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0
	ZR-95 46	15.	0.00E+00(0/ 33) 0.00E+00-- 0.00E+00		0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0
	I-131 46	15.	0.00E+00(0/ 33) 0.00E+00-- 0.00E+00		0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0
	CS-134 46	15.	0.00E+00(0/ 33) 0.00E+00-- 0.00E+00		0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0
	CS-137 46	18.	0.00E+00(0/ 33) 0.00E+00-- 0.00E+00		0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0
	BALA-140 46	15.	0.00E+00(0/ 33) 0.00E+00-- 0.00E+00		0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0.00E+00(0/ 13) 0.00E+00-- 0.00E+00	0

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements
If LLD is equal to 0, then LLD is not required by Technical Specifications
Location 060 = Greenville Water Intake Road
Location 064 = Seneca, SC
Location 065 = Clemson, SC
Location 066 = Anderson, SC

Name of Facility : ONS
Location of Facility : OCONEE COUNTY, S.C.
Time Report Generated : 26-JAN-1990 11:22:13
Docket Number : 50-269,270,287
Reporting Period : 1-JAN-1989 through 31-DEC-1989
Database Name : $DISK1:[USER.ASC]ONS89.SAF;1

Medium or Pathway Sampled (Units)	Type & Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Mean: Name, Distance and Direction; Location Code; Mean (Fraction) Range	Control Locations Mean (Fraction) Range	No. of Non-Routine Report Meas.
DRINKING WATER (PCI/LITERS)					064(6.7 Mi SW)	
				066(19.0 Mi SSE)		
4 Locations	BETA 46	4.0	2.0 (27/ 33)	2.3 (11/ 13)	1.8 (7/ 13)	0
			0.73 -- 4.1	1.3 -- 4.1	0.88 -- 4.6	
DW TRITIUM (PCI/LITERS)						
				065(8.1 Mi SSE)		
	H-3 18	2.00E+03	9.81E+02(6/ 13)	1.35E+03(3/ 3)	5.59E+02(1/ 5)	0
			5.01E+02-- 1.50E+03	1.20E+03-- 1.50E+03	5.59E+02-- 5.59E+02	

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements
If LLD is equal to 0, then LLD is not required by Technical Specifications
Location 060 = Greenville Water Intake Road
Location 064 = Seneca, SC
Location 065 = Clemson, SC
Location 066 = Anderson, SC

Name of Facility : ONS
Location of Facility : OCONEE COUNTY, S.C.
Time Report Generated : 26-JAN-1990 11:22:13
Docket Number : 50-269,270,287
Reporting Period : 1-JAN-1989 through 31-DEC-1989
Database Name : $DISK1:[USER.ASC]ONS89.SAF;1

Medium or Pathway Sampled (Units)	Type & Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Mean Name, Distance and Direction Location Code	Location with Highest Mean Mean (Fraction) Range	Control Locations Mean (Fraction) Range	No. of Non-Routine Report Meas.
FISH (PCI/WET/KG)						060(2.5 Mi NNE)	
3 Locations	MN-54 12	1.30E+02	0.00E+00(0/ 8) 0.00E+00-- 0.00E+00		0.00E+00(0/ 4) 0.00E+00-- 0.00E+00	0.00E+00(0/ 4) 0.00E+00-- 0.00E+00	0
	CO-58 12	1.30E+02	40. (3/ 8) 12. -- 74.	063(0.8 Mi ESE)	43. (2/ 4) 12. -- 74.	0.00E+00(0/ 4) 0.00E+00-- 0.00E+00	0
	FE-59 12	2.60E+02	0.00E+00(0/ 8) 0.00E+00-- 0.00E+00	063(0.8 Mi ESE)	0.00E+00(0/ 4) 0.00E+00-- 0.00E+00	0.00E+00(0/ 4) 0.00E+00-- 0.00E+00	0
	CO-60 12	1.30E+02	15. (1/ 8) 15. -- 15.	063(0.8 Mi ESE)	15. (1/ 4) 15. -- 15.	0.00E+00(0/ 4) 0.00E+00-- 0.00E+00	0
	ZN-65 12	2.60E+02	0.00E+00(0/ 8) 0.00E+00-- 0.00E+00		0.00E+00(0/ 4) 0.00E+00-- 0.00E+00	0.00E+00(0/ 4) 0.00E+00-- 0.00E+00	0
	NB-95 12	0.00E+00	0.00E+00(0/ 8) 0.00E+00-- 0.00E+00		0.00E+00(0/ 4) 0.00E+00-- 0.00E+00	0.00E+00(0/ 4) 0.00E+00-- 0.00E+00	0
	ZR-95 12	0.00E+00	0.00E+00(0/ 8) 0.00E+00-- 0.00E+00		0.00E+00(0/ 4) 0.00E+00-- 0.00E+00	0.00E+00(0/ 4) 0.00E+00-- 0.00E+00	0
	I-131 12	0.00E+00	0.00E+00(0/ 8) 0.00E+00-- 0.00E+00		0.00E+00(0/ 4) 0.00E+00-- 0.00E+00	0.00E+00(0/ 4) 0.00E+00-- 0.00E+00	0
	CS-134 12	1.30E+02	63. (8/ 8) 29. -- 1.28E+02	063(0.8 Mi ESE)	86. (4/ 4) 44. -- 1.28E+02	0.00E+00(0/ 4) 0.00E+00-- 0.00E+00	0
	CS-137 12	1.50E+02	2.43E+02(8/ 8) 1.20E+02-- 5.43E+02	063(0.8 Mi ESE)	3.36E+02(4/ 4) 1.38E+02-- 5.43E+02	31. (4/ 4) 19. -- 44.	0
	BALA-140 12	0.00E+00	0.00E+00(0/ 8) 0.00E+00-- 0.00E+00		0.00E+00(0/ 4) 0.00E+00-- 0.00E+00	0.00E+00(0/ 4) 0.00E+00-- 0.00E+00	0

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements
If LLD is equal to 0, then LLD is not required by Technical Specifications
Location 060 = Greenville Water Intake Road
Location 063 = Lake Hartwell - Highway 183 Bridge
Location 067 = Highway 27 - Lawrence Ramsey Bridge

Name of Facility : ONS
Location of Facility : OCONEE COUNTY, S.C.
Time Report Generated : 26-JAN-1990 11:22:13

Docket Number : 50-269,270,287
Reporting Period : 1-JAN-1989 through 31-DEC-1989
Database Name : $DISK1:[USER.ASC]ONS89.SAF;1

Medium or Pathway Sampled (Units)	Type & Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Mean Name, Distance and Direction Location Code	Location with Highest Mean Mean (Fraction) Range	Control Locations Mean (Fraction) Range	No. of Non-Routine Report Meas.
MILK (PCI/LITERS)						066(19.0 Mi SSE)	
3 Locations	MN-54 79	0.00E+00	0.00E+00(0/ 53) 0.00E+00-- 0.00E+00		0.00E+00(0/ 26) 0.00E+00-- 0.00E+00	0.00E+00(0/ 26) 0.00E+00-- 0.00E+00	0
	CO-58 79	0.00E+00	0.00E+00(0/ 53) 0.00E+00-- 0.00E+00		0.00E+00(0/ 26) 0.00E+00-- 0.00E+00	0.00E+00(0/ 26) 0.00E+00-- 0.00E+00	0
	FE-59 79	0.00E+00	0.00E+00(0/ 53) 0.00E+00-- 0.00E+00		0.00E+00(0/ 26) 0.00E+00-- 0.00E+00	0.00E+00(0/ 26) 0.00E+00-- 0.00E+00	0
	CO-60 79	0.00E+00	0.00E+00(0/ 53) 0.00E+00-- 0.00E+00		0.00E+00(0/ 26) 0.00E+00-- 0.00E+00	0.00E+00(0/ 26) 0.00E+00-- 0.00E+00	0
	ZN-65 79	0.00E+00	0.00E+00(0/ 53) 0.00E+00-- 0.00E+00		0.00E+00(0/ 26) 0.00E+00-- 0.00E+00	0.00E+00(0/ 26) 0.00E+00-- 0.00E+00	0
	NB-95 79	0.00E+00	0.00E+00(0/ 53) 0.00E+00-- 0.00E+00		0.00E+00(0/ 26) 0.00E+00-- 0.00E+00	0.00E+00(0/ 26) 0.00E+00-- 0.00E+00	0
	ZR-95 79	0.00E+00	0.00E+00(0/ 53) 0.00E+00-- 0.00E+00		0.00E+00(0/ 26) 0.00E+00-- 0.00E+00	0.00E+00(0/ 26) 0.00E+00-- 0.00E+00	0
	I-131 79	15.	0.00E+00(0/ 53) 0.00E+00-- 0.00E+00		0.00E+00(0/ 26) 0.00E+00-- 0.00E+00	0.00E+00(0/ 26) 0.00E+00-- 0.00E+00	0
	LLI-131 79	1.0	0.00E+00(0/ 53) 0.00E+00-- 0.00E+00		0.00E+00(0/ 26) 0.00E+00-- 0.00E+00	0.00E+00(0/ 26) 0.00E+00-- 0.00E+00	0
	CS-134 79	15.	0.00E+00(0/ 53) 0.00E+00-- 0.00E+00		0.00E+00(0/ 26) 0.00E+00-- 0.00E+00	0.00E+00(0/ 26) 0.00E+00-- 0.00E+00	0
	CS-137 79	18.	4.7 (6/ 53) 3.5 -- 6.9	069(4.5 Mi WNW)	4.7 (6/ 26) 3.5 -- 6.9	2.9 (3/ 26) 2.3 -- 3.4	0
	BALA-140 79	15.	0.00E+00(0/ 53) 0.00E+00-- 0.00E+00		0.00E+00(0/ 26) 0.00E+00-- 0.00E+00	0.00E+00(0/ 26) 0.00E+00-- 0.00E+00	0

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements
If LLD is equal to 0, then LLD is not required by Technical Specifications
Location 066 = Anderson, SC
Location 069 = Powell Residence
Location 071 = Clemson Dairy

Name of Facility : ONS
Location of Facility : OCONEE COUNTY, S.C.
Time Report Generated : 26-JAN-1990 11:22:13
Docket Number : 50-269,270,287
Reporting Period : 1-JAN-1989 through 31-DEC-1989
Database Name : $DISK1:[USER.ASCIONS89.SAF;1

Medium or Pathway Sampled (Units)	Type & Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Mean Name, Distance and Direction Location Code	Mean (Fraction) Range	Control Locations Mean (Fraction) Range	No. of Non-Routine Report Meas.
SEDIMENT (PCI/DRY/KG)						068(2.0 Mi W)	
				067(4.2 Mi SSE)			
	MN-54 12	0.00E+00	18. (3/ 8)		23. (2/ 4)	7.1 (1/ 4)	0
3 Locations			10. -- 28.		17. -- 28.	7.1 -- 7.1	
				063(0.8 Mi ESE)			
	CO-58 12	0.00E+00	86. (6/ 8)		1.24E+02(3/ 4)	0.00E+00(0/ 4)	0
			33. -- 2.33E+02		57. -- 2.33E+02	0.00E+00-- 0.00E+00	
	FE-59 12	0.00E+00	0.00E+00(0/ 8)		0.00E+00(0/ 4)	0.00E+00(0/ 4)	0
			0.00E+00-- 0.00E+00		0.00E+00-- 0.00E+00	0.00E+00-- 0.00E+00	
				067(4.2 Mi SSE)			
	CO-60 12	0.00E+00	1.07E+02(4/ 8)		1.96E+02(2/ 4)	0.00E+00(0/ 4)	0
			17. -- 3.34E+02		58. -- 3.34E+02	0.00E+00-- 0.00E+00	
	ZN-65 12	0.00E+00	0.00E+00(0/ 8)		0.00E+00(0/ 4)	0.00E+00(0/ 4)	0
			0.00E+00-- 0.00E+00		0.00E+00-- 0.00E+00	0.00E+00-- 0.00E+00	
	NB-95 12	0.00E+00	0.00E+00(0/ 8)		0.00E+00(0/ 4)	0.00E+00(0/ 4)	0
			0.00E+00-- 0.00E+00		0.00E+00-- 0.00E+00	0.00E+00-- 0.00E+00	
	ZR-95 12	0.00E+00	0.00E+00(0/ 8)		0.00E+00(0/ 4)	0.00E+00(0/ 4)	0
			0.00E+00-- 0.00E+00		0.00E+00-- 0.00E+00	0.00E+00-- 0.00E+00	
	I-131 12	0.00E+00	0.00E+00(0/ 8)		0.00E+00(0/ 4)	0.00E+00(0/ 4)	0
			0.00E+00-- 0.00E+00		0.00E+00-- 0.00E+00	0.00E+00-- 0.00E+00	
				067(4.2 Mi SSE)			
	CS-134 12	1.50E+02	37. (4/ 8)		54. (2/ 4)	0.00E+00(0/ 4)	0
			13. -- 81.		26. -- 81.	0.00E+00-- 0.00E+00	
				067(4.2 Mi SSE)			
	CS-137 12	1.80E+02	4.57E+02(8/ 8)		8.48E+02(4/ 4)	18. (3/ 4)	0
			36. -- 2.58E+03		1.03E+02-- 2.58E+03	12. -- 28.	
	BALA-140 12	0.00E+00	0.00E+00(0/ 8)		0.00E+00(0/ 4)	0.00E+00(0/ 4)	0
			0.00E+00-- 0.00E+00		0.00E+00-- 0.00E+00	0.00E+00-- 0.00E+00	

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements
If LLD is equal to 0, then LLD is not required by Technical Specifications
Location 063 = Lake Hartwell - Highway 183 Bridge
Location 067 = Highway 27 - Lawrence Ramsey Bridge
Location 068 = High Falls County Park

Name of Facility : ONS
Location of Facility : OCONEE COUNTY, S.C.
Time Report Generated : 26-JAN-1990 11:22:13
Docket Number : 50-269,270,287
Reporting Period : 1-JAN-1989 through 31-DEC-1989
Database Name : $DISK1:[USER.ASC]ONS89.SAF;1

Medium or Pathway Sampled (Units)	Type & Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Mean Name, Distance and Direction Location Code	Location with Highest Mean Mean (Fraction) Range	Control Locations Mean (Fraction) Range	No. of Non-Routine Report Meas.
SURFACE WATER (PCI/LITERS)						062(0.7 Mi ENE)	
	MN-54 26	15.	0.00E+00 (0/ 13)		0.00E+00 (0/ 13)	0.00E+00 (0/ 13)	0
2 Locations			0.00E+00 -- 0.00E+00		0.00E+00 -- 0.00E+00	0.00E+00 -- 0.00E+00	
				063(0.8 Mi ENE)			
	CO-58 26	15.	5.3 (4/ 13)		5.3 (4/ 13)	0.00E+00 (0/ 13)	0
			2.6 -- 8.4		2.6 -- 8.4	0.00E+00 -- 0.00E+00	
	FE-59 26	30.	0.00E+00 (0/ 13)		0.00E+00 (0/ 13)	0.00E+00 (0/ 13)	0
			0.00E+00 -- 0.00E+00		0.00E+00 -- 0.00E+00	0.00E+00 -- 0.00E+00	
				063(0.8 Mi ESE)			
	CO-60 26	15.	3.0 (2/ 13)		3.0 (2/ 13)	0.00E+00 (0/ 13)	0
			2.7 -- 3.4		2.7 -- 3.4	0.00E+00 -- 0.00E+00	
	ZN-65 26	30.	0.00E+00 (0/ 13)		0.00E+00 (0/ 13)	0.00E+00 (0/ 13)	0
			0.00E+00 -- 0.00E+00		0.00E+00 -- 0.00E+00	0.00E+00 -- 0.00E+00	
	NB-95 26	15.	0.00E+00 (0/ 13)		0.00E+00 (0/ 13)	0.00E+00 (0/ 13)	0
			0.00E+00 -- 0.00E+00		0.00E+00 -- 0.00E+00	0.00E+00 -- 0.00E+00	
	ZR-95 26	15.	0.00E+00 (0/ 13)		0.00E+00 (0/ 13)	0.00E+00 (0/ 13)	0
			0.00E+00 -- 0.00E+00		0.00E+00 -- 0.00E+00	0.00E+00 -- 0.00E+00	
	I-131 26	15.	0.00E+00 (0/ 13)		0.00E+00 (0/ 13)	0.00E+00 (0/ 13)	0
			0.00E+00 -- 0.00E+00		0.00E+00 -- 0.00E+00	0.00E+00 -- 0.00E+00	
	CS-134 26	15.	0.00E+00 (0/ 13)		0.00E+00 (0/ 13)	0.00E+00 (0/ 13)	0
			0.00E+00 -- 0.00E+00		0.00E+00 -- 0.00E+00	0.00E+00 -- 0.00E+00	
				063(0.8 Mi ESE)			
	CS-137 26	18.	3.4 (2/ 13)		3.4 (2/ 13)	0.00E+00 (0/ 13)	0
			1.9 -- 4.9		1.9 -- 4.9	0.00E+00 -- 0.00E+00	
	BALA-140 26	15.	0.00E+00 (0/ 13)		0.00E+00 (0/ 13)	0.00E+00 (0/ 13)	0
			0.00E+00 -- 0.00E+00		0.00E+00 -- 0.00E+00	0.00E+00 -- 0.00E+00	
SW TRITIUM (PCI/LITERS)							
				063(0.8 Mi ESE)			
	H-3 10	2.00E+03	1.02E+04 (5/ 5)		1.02E+04 (5/ 5)	0.00E+00 (0/ 5)	0
			7.01E+03 -- 1.33E+04		7.01E+03 -- 1.33E+04	0.00E+00 -- 0.00E+00	

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements
If LLD is equal to 0, then LLD is not required by Technical Specifications
Location 062 = Lake Keowee/Hydro Intake
Location 063 = Lake Hartwell - Highway 183 Bridge

Name of Facility : ONS
Location of Facility : OCONEE COUNTY, S.C.
Time Report Generated : 26-JAN-1990 11:20:47
Docket Number : 50-269,270,287
Reporting Period : 1-JAN-1989 through 31-DEC-1989
Database Name : $DISK1:[USER.ASCIONS89.SAF;1

Medium or Pathway Sampled (Units)	Type & Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (Fraction) Range	Location with Highest Mean Name, Distance and Direction Location Code	Location with Highest Mean Mean (Fraction) Range	Control Locations Mean (Fraction) Range	No. of Non-Routine Report Meas.
DIRECT RAD-TLD (MR/HOUR)						058(10.0 WSW)	
				024(0.8 Mi E)			
40 Locations	MR/HOUR 155	0.00E+00	7.63E-03(151/ 151)		1.13E-02(4/ 4)	1.03E-02(4/ 4)	0
			4.00E-03-- 1.50E-02		8.00E-03-- 1.40E-02	9.00E-03-- 1.20E-02	

Mean and range based upon detectable measurements only
Fraction of detectable measurements at specified locations is indicated in parentheses, (Fraction)
Zero range indicates no detectable activity measurements
Location 034 = Site Boundary

APPENDIX C

SAMPLING DEVIATIONS AND UNAVAILABLE ANALYSES

SAMPLING DEVIATIONS

The deviations from sampling procedures that occurred during 1989 are listed below.

A. Air Filter/Cartridge

1. Location #060, 3/28 to 4/4/89

   Reason: Blown fuse in transformer. The sampler ran for 140.4 hours with the actual sampling period being 3/28 to 4/3/89.

   Action: Duke Power Retail replaced fuse in transformer. Available sample analyzed.

2. Location #072, 11/28 to 12/5/89

   Reason: Runtime integrator reading was 75 instead of expected 167 hour range. Fan for sample pump motor was running but sample pump was not.

   Action: Sampler changed out for repair. Available sample analyzed.

B. Surface Water

1. Location #063, 5/16 to 6/13/89

   Reason: Dead battery on sampler.

   Action: Collected grab sample for analysis, replaced battery.

2. Location #063, 6/13 to 7/11/89

   Reason: Sampler pulled less than expected volume (310 aliquots instead of 336) due to loss of power when power source was changed. The battery was replaced with an AC power source due to problems during provious sampling period.

   Action: Used sample collected for analysis.

3. Location #063, 7/11 to 8/8/89

   Reason: Sampling tube had been vandalized. Sampler had pulled the correct volume but sample was suspect due to damaged tubing.

   Action: Used sample collected for analysis. Moved sampler to locked box to prevent vandalism.

4. Location #062, 7/11/to 8/8/89

   Reason: Sampler determined not to be pumping into collection reservior. Check valve in pump malfunctioned. Sampler had pulled the correct number of samples, but sample was suspect due to valve malfunction.

   Action: Used sample collected for analysis. Repaired pump on 8/8/89.

5. Location #063, 8/8 to 9/5/89

   Reason: Pump supplying water to sampler failed sometime during the sample period. Last known date that pump was operating was 9/1/89.

   Action: Used sample collected for analysis. Work request submitted to replace pump.

6. Location #063, 9/5 to 10/3/89

   Reason: Pump supplying water to samples was not working during the first part of the sample period due to a malfunction during the previous sample period. Also, composite sampler did not collect expected volume.

   Action: Used sample collected for analysis. Pump supplying sampler was repaired about 3 days into the sample period. Composite sampler was reprogrammed to collect a larger volume.

7. Location #062, 10/3 to 10/31/89

   Reason: Pump supplying water to the sampler failed sometime during sample period.

   Action: Used sample collected for analysis. Work request submitted to repair pump.

8. Location #062, 10/31 to 11/28/89

Reason: Pump supplying water to the sampler was not working during the first two days of the sample period due to a malfunction during the previous sample period.

Action: Used sample collected for analysis. Pump supplying sampler was returned to service 11/2/89.

9. Location #063, 11/28 to 12/27/89

Reason: Sample line froze and valve broke sometime after 12/21/89 (sampler was checked on this date).

Action: Used sample collected for analysis. Work request submitted to repair valve. Valve was repaired; insulation and heat tracing added to sample line.

C. Drinking Water

1. Location #060, 12/20/88 to 1/17/89

Reason: Sampler collected less than expected volume. Sampler was operable and pulled the correct number of samples; however, the volume pulled each time was not consistent. This was determined after changing out the sampler and monitoring its operation in the lab.

Action: Used sample collected for analysis. Changed out pump.

2. Location #064, 3/13 to 4/11/89

Reason: Sampler setting left in improper position when last sampled.

Action: Collected grab sample for analysis. Returned sampler to correct position.

3. Location #064, 5/16 to 6/13/89

Reason: Sampler malfunctioned.

Action: Collected grab sample for analysis. Sampler changed out but returned to service after operating reliably in the lab. Sampler failed again 7/11/89 and was returned to the manufacturer.

4. Location #064, 6/13 to 7/11/89

   Reason: Sampler pump malfunctioned.

   Action: Collected grab sample for analysis. Sampler changed out and returned to manufacturer.

5. Location #065, 6/13 to 7/11/89

   Reason: Less than normal sample period due to water treatment plant being permanetly closed 7/1/89.

   Action: Used sample collected for analysis. Removed sampling equipment from site.

D. Fish

1. Location #060, 9/18 to 11/3/89

   Reason: Unable to catch more than 300 grams of catfish during sampling period. Procedure specifies 500 grams.

   Action: Used available sample for analysis after fishing with gillnets and baskets in various spots at the location.

UNAVAILABLE ANALYSIS

Some unavailable analyses due to inappropriate or lost samples occurred during the year. These are described below:

A. TLD

1. Location #045, 12/8/88 to 3/8/89

   Reason: TLD missing.

   Action: Replaced with next quarter's TLD.

2. Location #050, 12/8/88 to 3/8/89

   Reason: TLD missing.

   Action: Replaced with next quarter's TLD.

3. Location #053, 12/8/88 to 3/8/89

   Reason: TLD missing.

   Action: Placed the next quarter's TLD in a more remote area of the location.

4. Location #044, 3/8 to 6/7/89

   Reason: Unable to locate TLD.

   Action: Replaced with next quarter's TLD. Missing TLD later found on 9/13/89 and processed.

5. Location #059, 6/7 to 9/13/89

   Reason: TLD missing.

   Action: Placed the next quarter's TLD in a more remote area of the location.

6. Location #046, 6/7 to 9/13/89

   Reason: TLD was found by a local resident lying beside the road. It had been removed from the monitoring location and vandalized. TLD was turned over to ONS personnel 7/10/89.

   Action: TLD replaced 7/19/89.

7. Location #059, 9/13 to 12/14/89

   Reason: TLD discovered missing 10/17/89.

   Action: TLD was replaced 10/25/89.

APPENDIX D

ANALYTICAL DEVIATIONS

No analytical deviations occurred during calendar year 1989.