50-390 WATTS BAR, 1 TVA

ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT - 1986

Rec'd. w/ltr. 7/7/87.....8707230796

ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT
WATTS BAR NUCLEAR PLANT
1986

TENNESSEE VALLEY AUTHORITY
DIVISION OF NUCLEAR SERVICES
RADIOLOGICAL CONTROL

May 1986

CONTENTS

	Page
List of Tables	iii
List of Figures	iv
Introduction	1
Atmospheric Monitoring	11
Terrestrial Monitoring	23
Reservoir Monitoring	43
Quality Control	57
Conclusions	57

LIST OF TABLES

	Page
Table 1 - Environmental Radioactivity Sampling Schedule	3
Table 2 - Environmental Monitoring Station Locations - Watts Bar Nuclear Plant	4
Table 3 - Detection Capabilities for Environmental Sample Analysis	5
Table 4 - Results Obtained in Interlaboratory Comparison Program	7
Table 5 - Maximum Permissible Concentrations for Nonoccupational Exposure	14
Table 6 - Radioactivity in Air Filter	15
Table 7 - Radioactivity in Rainwater	16
Table 8 - Radioactivity in Heavy Particle Fallout	17
Table 9 - Radioactivity in Charcoal Filters	18
Table 10 - Radioactivity in Atmospheric Moisture	19
Table 11 - Radioactivity in Milk	26
Table 12 - Radioactivity in Vegetation	27
Table 13 - Radioactivity in Soil	28
Table 14 - Radioactivity in Well Water	29
Table 15 - Radioactivity in Public Water Supply	30
Table 16 - Environmental Gamma Radiation Levels	31
Table 17 - Radioactivity in Cabbage	32
Table 18 - Radioactivity in Corn	33
Table 19 - Radioactivity in Pears	34
Table 20 - Radioactivity in Potatoes	35
Table 21 - Radioactivity in Tomatoes	36
Table 22 - Radioactivity in Turnip Greens	37
Table 23 - Sampling Schedule - Reservoir Monitoring	45
Table 24 - Radioactivity in Surface Water	46
Table 25 - Radioactivity in Channel Catfish (Flesh)	47
Table 26 - Radioactivity in White Crappie (Flesh)	48
Table 27 - Radioactivity in Smallmouth Buffalo (Flesh)	49
Table 28 - Radioactivity in Smallmouth Buffalo (Whole)	50
Table 29 - Radioactivity in Sediment	51
Table 30 - Radioactivity in Shoreline Sediment	52
Table 31 - Radioactivity in Clam Flesh	53

LIST OF FIGURES

Page

Figure 1 - Tennessee Valley Region 9

Figure 2 - Atmospheric and Terrestrial Monitoring Network 20

Figure 3 - Watts Bar Nuclear Plant Site Monitoring Stations . . . 21

Figure 4 - Annual Average Gross Beta Activity in Air (Particulate Filters) - Watts Bar Nuclear Plant 22

Figure 5 - Annual Average Gross Beta Activity in Drinking Water - Watts Bar Nuclear Plant 38

Figure 6 - Annual Average Gross Beta Activity in Surface Water - Watts Bar Nuclear Plant 39

Figure 7 - TLD Locations - Watts Bar Nuclear Plant 40

Figure 8 - Direct Radiation Levels - Watts Bar Nuclear Plant . . . 41

Figure 9 - Direct Radiation Levels - Watts Bar Nuclear Plant, 4-Quarter Moving Average 41

Figure 10 - Reservoir Monitoring Network 54

Figure 11 - Annual Average Cesium-137 in Sediment - Watts Bar Nuclear Plant 55

Figure 12 - Annual Average Cobalt-60 in Sediment - Watts Bar Nuclear Plant 56

ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT

WATTS BAR NUCLEAR PLANT

1986

Introduction

The Watts Bar Nuclear Plant (WBN), being constructed by the Tennessee Valley Authority, is located on a site owned by TVA containing 1770 acres of land in Rhea County, Tennessee, bounded on the east by Chickamauga Reservoir (see figure 1). The site is approximately 50 miles (80 kilometers) northeast of Chattanooga, Tennessee, and 8 miles (13 kilometers) southeast of Spring City, Tennessee. The plant will consist of two pressurized water reactors; each unit is rated at 3,411 MWt and 1,160 MWe.

A preoperational environmental radiological monitoring program was implemented in December 1976. This program has the objective of establishing a baseline of data on the distribution of natural and manmade radioactivity in the environment near the plant site. This report presents the results obtained from that program during 1986.

Radiological Control (Office of Nuclear Power) and the Office of Natural Resources and Economic Development carried out the sampling program outlined in tables 1 and 23. Sampling locations are shown in figures 2, 3, 7, and 10, and table 2 describes the locations of the atmospheric and terrestrial monitoring stations. All the radiochemical and instrumental analyses were conducted in TVA's Western Area Radiological Laboratory (WARL) located at Muscle Shoals, Alabama. Alpha and beta analyses were performed on Beckman Low Beta II and Tennelec LB5100 low-background proportional counters. Gamma spectral analyses were performed with a Nuclear Data (ND) Model 6700 multichannel analyzer system utilizing germanium detectors. Specific analysis for I-131 in charcoal filters is routinely counted with NaI(Tl) detection systems. TVA-fabricated beta-gamma coincidence counting systems are utilized for the determination of I-131 concentrations in milk. Tritium determinations are made with Packard Tri-carb 3255 or 4000 series liquid scintillation counting systems.

Data were entered into computer storage for processing specific to the analysis conducted. The data obtained by germanium detectors were resolved by the appropriate analyzer software and the software program routine HYPERMET.

The detection capabilities for environmental sample analysis given as the nominal lower limits of detection (LLD) are listed in table 3. All photopeaks found in germanium spectra were identified and quantified. Many of the isotopes identified by germanium spectral analysis are naturally occurring or naturally produced radioisotopes, such as Be-7, K-40, Bi-212, Bi-214, Pb-212, Pb-214, Ra-226, etc. LLDs for additional radionuclides identified by germanium analysis were calculated for each analysis, and nominal values are listed in table 3. In the instance where an LLD has not been established, an LLD value of zero is assumed. An isotope may be identified and a valid result obtained and yet a mean and a range of 0 can be shown if the activity is between 0 and 0.01 since the output program displays results to two decimal places. A notation in a table of "__ values <LLD" for an isotope with no established LLD does not imply a value less than 0; rather, it indicates that the isotope was not identified in that specific group of samples. For each sample type, only the radionuclides for which values greater than the LLD were reported are listed in the data tables.

TVA's WARL participates in the Environmental Radioactivity Laboratory Intercomparison Studies Program conducted by the Environmental Protection Agency (EPA)-Las Vegas. This program provides periodic cross-checks on samples of the type and radionucide composition normally analyzed in an environmental radiological monitoring program. Routine sample handling and analysis procedures were employed in the evaluation of these samples. The results received during calendar year 1986 are shown in table 4. The $\pm 3\sigma$ limits based on one measurement were divided by the square root of 3 to correct for triplicate determinations.

Table 1

ENVIRONMENTAL RADIOACTIVITY SAMPLING SCHEDULE

Station Location	Air Filter	Charcoal Filter	Rain-water	Heavy Particle Fallout	Atmospheric Moisture	Soil	Vegetation	Milk	Well Water	Public Water	Aquatic Life and Sediment
Site SSW	W	W	M	M	BW	A	M				
Site SE	W	W	M	M		A	M				
Site N	W	W	M	M	BW	A	M				
Site NNE	W	W	M	M		A	M				
Spring City	W	W	M	M		A	M				
Cedine	W	W	M	M		A	M				
Ten Mile	W	W	M	M		A	M				
Decatur	W	W	M	M		A	M				
Dayton[a]	W	W	M	M	BW	A	M			M	
Alloway	W	W	M	M		A	M				
Farm Bn							M				
Farm R							M				
Farm H							M	BM			
Farm L							M	BM	M		
Farm Mo							M	BM			
Farm Mu							M	BM			
Control Farms (3)[a]							M	BM			
Onsite Wells (1)									M		
C. F. Industries										M	
Nickajack/Chickamauga/ Watts Bar Reservoirs[a]											S

W - Weekly BW - Biweekly (every other week) BM - Bimonthly (every 2 weeks) M - Monthly (every 4 weeks)
Q - Quarterly S - Semiannually A - Annual

a. Part of Sequoyah Nuclear Plant sampling program.

Table 2

ENVIRONMENTAL MONITORING STATION LOCATIONS

WATTS BAR NUCLEAR PLANT

Sample Station	Approximate Distance and Direction from Plant		
Indicator Stations			
LM-1 WB	0.5 mile	(0.8 kilometers)	SSW
LM-2 WB	0.5 mile	(0.8 kilometers)	N
LM-3 WB	2.0 miles	(3.2 kilometers)	NNE
LM-4 WB	0.9 miles	(1.4 kilometers)	SE
PM-2 WB, Spring City, TN	7.0 miles	(11.3 kilometers)	NW
PM-3 WB, Cedine Camp	11.5 miles	(18.5 kilometers)	NNE
PM-4 WB, Ten Mile, TN	7.75 miles	(12.5 kilometers)	NE
PM-5 WB, Decatur, TN	6.25 miles	(10.1 kilometers)	S
Farm H	4.75 miles	(7.6 kilometers)	W
Farm L[a]	1.5 miles	(2.4 kilometers)	SSW
Farm Mo	4.5 miles	(7.2 kilometers)	NW
Farm Mu	3.8 miles	(6.1 kilometers)	ESE
Farm Bn	2.1 miles	(3.4 kilometers)	NE
Farm R	1.5 miles	(2.4 kilometers)	WSW
Control Stations			
Rm-2 WB, Dayton, TN (Identical with RM-2 SQ, Sequoyah Nuclear Plant)	15 miles	(24.1 kilometers)	SW
RM-3 WB, Alloway, TN	14.9 miles	(23.8 kilometers)	NNW
Farm S	19.5 miles	(31.4 kilometers)	SW
Farm B	15 miles	(24.1 kilometers)	E
Farm C	16 miles	(25.7 kilometers)	SSW

a. Considered as a control for well water.

Table 3

DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS

A. Specific Analyses

NOMINAL LOWER LIMIT OF DETECTION (LLD)*

	Air Particulates pCi/m^3	Charcoal pCi/m^3	Fallout mCi/Km^2	Water pCi/L	Vegetation and Grain pCi/g, Dry	Soil and Sediment pCi/g, Dry	Fish, Clam Flesh, Plankton, pCi/g, Dry	Clam Shells pCi/g, Dry	Foods, Meat, Poultry, pCi/Kg, Wet	Milk pCi/L
Gross α	0.005			2	0.05	0.35	0.1	0.7		
Gross β	0.01		0.05	2	0.20	0.70	0.1	0.7	25	
H-3				330						
I-131		0.01								0.5
Sr-89	0.005			10	0.25	1.5	0.5	5.0	40	10
Sr-90	0.001			2	0.05	0.15	0.1	1.0	8	2

* All LLD values for isotopic separations are calculated by the method developed by Pasternack and Harley as described in HASL-300. Factors such as sample size, decay time, chemical yield, and counting efficiency may vary for a given sample; these variations may change the LLD value for the given sample. The assumption is made that all samples are analyzed within one week of the collection date. Conversion factors: 1 pCi = 3.7×10^{-2} Bq; 1 mCi = 3.7×10^{7} Bq.

Table 3 (Continued)

DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS

B. Gamma Analyses

NOMINAL LOWER LIMIT OF DETECTION (LLD)

	Air particulates pCi/m^3 Ge(Li)*	Water and milk pCi/L Ge(Li)	Vegetation and grain pCi/g, dry Ge(Li)	Soil and sediment pCi/g, dry Ge(Li)	Fish pCi/g, dry Ge(Li)	Clam flesh and plankton pCi/g, dry Ge(Li)	Clam shells pCi/g, dry Ge(Li)	Foods, (tomatoes potatoes, etc.) pCi/Kg, wet Ge(Li)	Meat and poultry pCi/Kg, wet Ge(Li)
Ce-144	0.02	33	0.22	0.06	0.06	0.35	0.06	33	40
Cr-51	0.03	44	0.47	0.10	0.10	0.56	0.10	44	90
I-131	0.01	8	0.09	0.02	0.02	0.07	0.02	8	20
Ru-106	0.03	30	0.51	0.11	0.11	0.74	0.11	40	90
Cs-134	0.01	5	0.33	0.08	0.07	0.48	0.08	26	40
Cs-137	0.01	5	0.06	0.02	0.02	0.08	0.02	5	15
Zr-95	0.01	10	0.11	0.03	0.03	0.15	0.03	10	20
Nb-95	0.01	5	0.05	0.01	0.01	0.07	0.01	5	15
Co-58	0.01	5	0.05	0.01	0.01	0.07	0.01	5	15
Mn-54	0.01	5	0.05	0.01	0.01	0.08	0.01	5	15
Zn-65	0.01	9	0.11	0.02	0.02	0.17	0.02	9	20
Co-60	0.01	5	0.06	0.01	0.01	0.08	0.01	5	15
Fe-59		5			0.10				
Ba-140	0.02	25	0.34	0.07	0.07	0.30	0.07	25	50
La-140	0.01	7	0.08	0.02	0.02	0.10	0.02	7	15

* The Ge(Li) LLD values are calculated by the method developed by Pasternack and Harley as described in HASL-300. These LLD values are expected to vary depending on the activities of the components in the samples. These figures do not represent the LLD values achievable on given samples. Water is counted in either a 0.5-L or 3.5-L Marinelli beaker. Solid samples, such as soil, sediment, and clam shells, are counted in a 0.5-L Marinelli beaker as dry weight. The average dry weight is 400-500 grams. Air filters and very small volume samples are counted in petri dishes centered on the detector endcap. The counting system consists of a ND-6700 multichannel analyzer and germanium detector having an efficiency of 20 percent. The counting time is normally 4-15 hours. All spectral analyses are performed using the software program HYPERMET. The assumption is made that all samples are analyzed within one week of the collection date. Conversion factor: $1\ pCi = 3.7 \times 10^{-2}$ Bq.

TABLE 4

RESULTS OBTAINED IN INTERLABORATORY COMPARISON PROGRAM

A. Air Filter (pCi/Filter)

Date	Gross Alpha EPA value (±3σ)	Gross Alpha TVA Avg.	Gross Beta EPA value (±3σ)	Gross Beta TVA Avg.	Strontium-90 EPA value (±3σ)	Strontium-90 TVA Avg.	Cesium-137 EPA value (±3σ)	Cesium-137 TVA Avg.
4/86	15±9	14	47±9	51	18±3	13[a]	10±9	11
9/86	22±9	21	66±9	68	22±3	20	22±9	20

B. Radiochemical Analysis of Water (pCi/L)

Date	Gross Beta EPA value (±3σ)	Gross Beta TVA Avg.	Strontium-89 EPA value (±3σ)	Strontium-89 TVA Avg.	Strontium-90 EPA value (±3σ)	Strontium-90 TVA Avg.	Tritium EPA value (±3σ)	Tritium TVA Avg.	Iodine-131 EPA value (±3σ)	Iodine-131 TVA Avg.
11/85	13±9	14								
1/86	7±9	8								
2/86							5227±906	4643		
2/86									9±10	9
3/86	8±9	12								
4/86[b]	35±9	31	7±9	<10[c]	7±3	6				
4/86									9±10	8
5/86	15±9	16								
6/86							3125±624	2777		
7/86	18±9	22								
8/86									45±10	48
9/86	8+9	10								
10/86							5973±1034	5330		
10/86[b]	51±9	40[d]	10±9	16	4±3	3				
11/86	20±9	20								

C. Gamma-Spectral Analysis of Water (pCi/L)

Date	Chromium-51 EPA value (±3σ)	Chromium-51 TVA Avg.	Cobalt-60 EPA value (±3σ)	Cobalt-60 TVA Avg.	Zinc-65 EPA value (±3σ)	Zinc-65 TVA Avg.	Ruthenium-106 EPA value (±3σ)	Ruthenium-106 TVA Avg.	Cesium-134 EPA value (±3σ)	Cesium-134 TVA Avg.	Cesium-137 EPA value (±3σ)	Cesium-137 TVA Avg
2/86	38±9	<44[c]	18±9	19	40±9	37	0±9	40[c]	30±9	28	22±9	21
4/86[b]			10±9	10					5±9	6	5±9	5
6/86	0±9	<44[c]	66±9	66	86±9	83	50±9	48	49±9	46	10±9	11
10/86	59±9	58	31±9	31	85±9	78	74±9	73	28±9	26	44±9	43
10/86[b]			24±9	25					12±9	11	8±9	8

TABLE 4 (continued)

D. Food (pCi/Kg, Wet Weight)

Date	Strontium-89 EPA value (±3σ)	Strontium-89 TVA Avg.	Strontium-90 EPA value (±3σ)	Strontium-90 TVA Avg.	Iodine-131 EPA value (±3σ)	Iodine-131 TVA Avg.	Cesium-137 EPA value (±3σ)	Cesium-137 TVA Avg.	Potassium-40[e] EPA value (±3σ)	Potassium-40[e] TVA Avg.
1/86	25±9	16	10±3	12	20±10	17	15±9	17	950±248	1073
7/86	30±9	31	19±3	21	30±10	27	20±9	22	1150±100	1257[f]

E. Milk (pCi/L)

Date	Strontium-89 EPA value (±3σ)	Strontium-89 TVA Avg.	Strontium-90 EPA value (±3σ)	Strontium-90 TVA Avg.	Iodine-131 EPA value (±3σ)	Iodine-131 TVA Avg.	Cesium-137 EPA value (±3σ)	Cesium-137 TVA Avg.	Potassium-40[g] EPA value (±3σ)	Potassium-40[g] TVA Avg.
10/85	48±9	63[h]	26±3	26	42±10	41	56±9	55	1540±133	1533
6/86	0±9	<10[c]	16±3	16	41±10	42	31±9	34	1600±139	1677
11/86	9±9	13	0±3	< 2[c]	49±10	48	39±9	43	1565±135	1633

a. The low results for Sr-90 were associated with a poor chemical yield due to chemical separation problems.
b. Laboratory performance evaluation study.
c. Below LLD.
d. The cause of the low gross beta results could not be clearly identified. However, problems appear to exist with a large percentage of the other participating laboratories not being able to obtain agreement with the EPA method of calculating the known gross beta activity for LPES cross-checks.
e. Values reported as mg K/Kg.
f. Temperature variations can produce minor gain shifts in the detection systems. The low abundance and low counting efficiency for the 1460 KeV line used for identification of K-40 combined with a minor gain shift will produce results with a large bias.
g. Values reported as mg K/liter.
h. Results were investigated, but the source of the high result for Sr-89 could not be clearly identified.

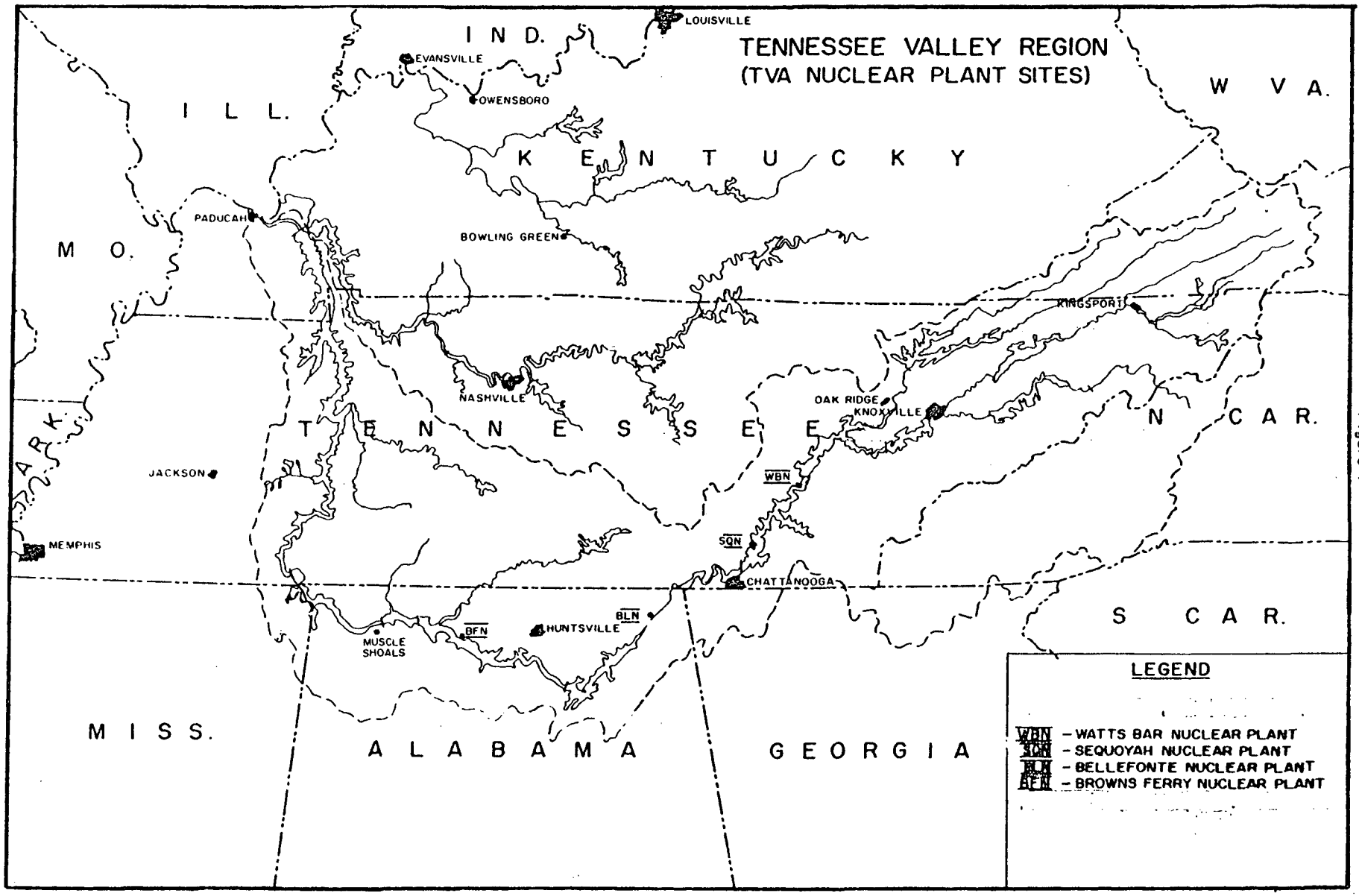

TENNESSEE VALLEY REGION
(TVA NUCLEAR PLANT SITES)
LOUISVILLE
IND.
EVANSVILLE
OWENSBORO
ILL.
W VA.
KENTUCKY
PADUCAH
BOWLING GREEN
MO.
KINGSPORT
NASHVILLE
OAK RIDGE
KNOXVILLE
ARK.
TENNESSEE
N CAR.
JACKSON
WBN
MEMPHIS
SQN
CHATTANOOGA
S CAR.
BLN
BFN
HUNTSVILLE
MUSCLE SHOALS
MISS.
ALABAMA
GEORGIA
LEGEND
WBN - WATTS BAR NUCLEAR PLANT
SQN - SEQUOYAH NUCLEAR PLANT
BLN - BELLEFONTE NUCLEAR PLANT
BFN - BROWNS FERRY NUCLEAR PLANT

Figure 1

Atmospheric Monitoring

The atmospheric monitoring network is divided into three subgroups; local monitors, perimeter monitors, and remote monitors. Four local monitoring stations are located within or near the plant boundary. Four perimeter monitoring stations are located at distances out to 11 miles (18 kilometers) from the plant in the towns of Spring City and Decatur and two other populated areas. One remote monitoring station is in Alloway, 14.9 miles (23.8 kilometers) NNW of the plant. The other remote monitoring station is located in Dayton, 15 miles (24 kilometers) SW of the plant. For location information see table 2 and figures 2 and 3.

Each monitoring station has air sampling filters, a collection tray and storage container to continuously collect rainwater, a horizontal platform covered with gummed acetate to catch and hold heavy particle fallout, and at selected stations (until December 22, 1986) a GM tube with a recorder to continuously monitor and record gamma radiation levels. Additionally, at two local and one remote monitoring station moisture is collected from the atmosphere and analyzed for H^3.

The air particulate and charcoal filter system uses a 1-7/8-inch diameter glass fiber particulate filter. The charcoal filter used to sample airborne radioiodine is a 2-1/4-inch diameter, 1-inch thick filter filled with TEDA-impregnated charcoal. The particulate and charcoal filter is contained in a round cone-shaped filter holder located on the outside of the monitoring station and protected from rain by a metal overhang housing the gum paper filter. Air is continuously drawn in through the particulate and charcoal filter by an air pump at a flow rate of approximately 2 CFM. The total flow through the system is measured with a domestic type gas meter.

Each of the local and perimeter air monitors was fitted with a GM tube that continuously monitored the gamma activity levels at the stations. The disintegration rate of the atmospheric radioactivity was continuously recorded at each station. The data from the four local monitors and from three perimeter monitors (PM-2, PM-4, and PM-5) were radiotelemetered into the plant control room. This system was deleted from the program December 22, 1986.

Table 5 presents the maximum permissible concentrations (MPC) specified in 10 CFR 20 for nonoccupational exposure.

Air Filters

Air filters were collected weekly and analyzed for gross beta activity. The samples were composited monthly and analyzed for specific gamma-emitting radionuclides and quarterly for Sr-89 and Sr-90 content. Adequate time is allowed for decay of radon daughters between collection and analysis. This time is typically 3 days. Due to potential fallout

from the Chernobyl nuclear reactor accident, one set of weekly air filters (one filter was not collected because of equipment problems) received a gamma scan for specific gamma-emitting radionuclides. I-131, Ru-103, and Cs-137 were identified in these samples. Analytical results are presented in table 6. During this reporting period, 15 weekly air filters were not collected because of equipment malfunction and one filter was destroyed during processing. Three other samples were destroyed before strontium analysis could be completed.

The annual averages of the gross beta activity in the air particulate filters at the indicator stations (local and perimeter monitors) and at the control stations (remote monitors) for the years 1977 through 1986 are presented in figure 4. Increased levels due to fallout from atmospheric nuclear weapons testing are evident, especially in 1977, 1978, and 1981. Increased levels from the accident at the Chernobyl nuclear power station are also in evidence. These fluctuations are consistent with data from monitoring programs conducted by TVA at other nuclear power plant sites.

Rainwater

Rainwater was collected monthly from each of the atmospheric monitoring stations and analyzed for specific gamma-emitting isotopes, Sr-89, and Sr-90. A gamma scan was performed on a 3.5-liter monthly sample. The strontium isotopes were separated chemically and counted in a low background system. In addition, extra samples collected during the Chernobyl accident fallout period were analyzed for gamma-emitting nuclides. I-131 was identified in samples from two locations. The highest level reported was 10.4 pCi/L. Analytical results are shown in table 7. During this report period, two samples were not available for analysis because of equipment malfunction.

Heavy Particle Fallout

The gummed acetate that was used to collect heavy particle fallout was changed monthly. The samples were ashed and counted for gross beta activity. The results are given in table 8. During this report period, one sample was destroyed before analysis could be completed.

Charcoal Filters

Charcoal filters were collected weekly and analyzed for radioiodine. The filter was counted in a single channel analyzer system. Samples collected following the accident at the Chernobyl nuclear power station exhibited increased levels of I-131. The highest level reported was 0.17 pCi/m^3. Analytical data are shown in table 9. During this reporting period, 15 samples were not collected because of equipment malfunction and one sample was destroyed inadvertently during processing.

Atmospheric Moisture

An atmospheric moisture collection device containing molecular sieve was located at two local monitors and at one remote monitor. Samples were taken every other week, the moisture driven off the molecular sieve, collected in a cold trap, distilled, and counted for H^3 content. The results are shown in table 10. During this reporting period, eight samples were not obtained because of equipment malfunction, two samples were destroyed during analysis, and nineteen samples contained insufficient volume for analysis.

Table 5

MAXIMUM PERMISSIBLE CONCENTRATIONS

FOR NONOCCUPATIONAL EXPOSURE

	MPC	
	In Water pCi/l*	In Air pCi/m^3*
Alpha	30	
Gross beta	3,000	100
H-3	3,000,000	200,000
Cs-137	20,000	500
Ru-103,-106	10,000	200
Ce-144	10,000	200
Zr-95 - NB-95	60,000	1,000
Ba-140 - La-140	20,000	1,000
I-131	300	100
Zn-65	100,000	2,000
Mn-54	100,000	1,000
Co-60	30,000	300
Sr-89	3,000	300
Sr-90	300	30
Cr-51	2,000,000	80,000
Cs-134	9,000	400
Co-58	90,000	2,000

*1 pCi = 3.7×10^{-2} Bq.

Source: 10 CFR, Part 20, Appendix B, Table II.

TABLE 6

RADIOACTIVITY IN AIR FILTER

PCI/M(3) - 0.037 BQ/M(3)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391

LOCATION OF FACILITY SHEA TENNESSEE — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA	1.00E-02	2.63E-02(404/ 405)	PM4 TEN MILE	2.79E-02(51/ 51)	2.53E-02(99/ 99)	
504		1.01E-02 - 1.71E-01	7.75 MILES NE	1.24E-02 - 1.37E-01	1.02E-02 - 1.35E-01	
GAMMA (GELI)						
139						
RU-103	NOT ESTAB	9.70E-03(21/ 111)	PM3 CEDINE BIBLE	1.75E-02(1/ 13)	8.67E-03(6/ 28)	
		1.00E-03 - 1.75E-02	CAMP 11.5 M. NNE	1.75E-02 - 1.75E-02	1.20E-03 - 1.70E-02	
CS-137	1.00E-02	1.47E-02(9/ 111)	LM2 N. WBSP GATE	1.66E-02(1/ 14)	1.44E-02(2/ 28)	
		1.13E-02 - 1.66E-02	0.5 MILES N	1.66E-02 - 1.66E-02	1.34E-02 - 1.54E-02	
K-40	NOT ESTAB	8.09E-03(20/ 111)	LM-4 WB	1.87E-02(5/ 14)	1.26E-02(2/ 28)	
		1.50E-03 - 2.27E-02	0.9 MILES SE	1.43E-02 - 2.27E-02	3.30E-03 - 2.18E-02	
I-131	1.00E-02	1.44E-02(6/ 111)	PM5 DECATUR	1.64E-02(1/ 14)	1.39E-02(2/ 28)	
		1.18E-02 - 1.64E-02	6.25 MILES S	1.64E-02 - 1.64E-02	1.33E-02 - 1.44E-02	
PB-212	NOT ESTAB	1.44E-03(18/ 111)	PM2 SPRING CITY	1.96E-02(1/ 14)	3.20E-03(5/ 28)	
		1.00E-04 - 1.96E-02	7.0 MILES NW	1.96E-02 - 1.96E-02	3.00E-04 - 1.00E-02	
BE-7	5.00E-02	1.03E-01(111/ 111)	LM2 N. WBSP GATE	1.12E-01(14/ 14)	1.04E-01(28/ 28)	
		6.29E-02 - 1.93E-01	0.5 MILES N	7.56E-02 - 1.93E-01	6.59E-02 - 1.53E-01	
TL-208	NOT ESTAB	1.21E-03(10/ 111)	PM2 SPRING CITY	8.10E-03(1/ 14)	2.10E-03(3/ 28)	
		1.00E-04 - 8.10E-03	7.0 MILES NW	8.10E-03 - 8.10E-03	2.00E-04 - 3.30E-03	
AC-228	NOT ESTAB	2.27E-03(4/ 111)	PM3 CEDINE BIBLE	2.90E-03(2/ 13)	5.54E-03(5/ 28)	
		1.40E-03 - 3.30E-03	CAMP 11.5 M. NNE	2.50E-03 - 3.30E-03	8.00E-04 - 1.76E-02	
PA-234M	NOT ESTAB	1.42E-01(2/ 111)	LM-3 WB	1.61E-01(1/ 14)	28 VALUES <LLD	
		1.22E-01 - 1.61E-01	2.1 MILES NNE	1.61E-01 - 1.61E-01		
SR 89	5.00E-03	29 VALUES <LLD			8 VALUES <LLD	
37		ANALYSIS PERFORMED				
SR 90	1.00E-03	29 VALUES <LLD			8 VALUES <LLD	
37		ANALYSIS PERFORMED				

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.

NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).

TABLE 7

RADIOACTIVITY [illegible]AINWATER

PCI/L - 0.037 BQ/L

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391

LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA (GELI)						
139						
K-40	NOT ESTAB	1.38E+01(8/ 111)	LM-4 WB	2.59E+01(2/ 13)	3.13E+01(3/ 28)	
		4.23E+00 - 2.93E+01	0.9 MILES SE	2.25E+01 - 2.93E+01	1.86E-01 - 9.21E+01	
I-131	8.00E+00	8.87E+00(1/ 111)	PM5 DECATUR	8.87E+00(1/ 14)	1.04E+01(1/ 28)	
		8.87E+00 - 8.87E+00	6.25 MILES S	8.87E+00 - 8.87E+00	1.04E+01 - 1.04E+01	
BI-214	NOT ESTAB	5.58E+00(52/ 111)	LM-3 WB	8.53E+00(7/ 14)	5.37E+00(12/ 28)	
		6.29E-01 - 3.20E+01	2.1 MILES NNE	1.35E+00 - 3.20E+01	7.73E-01 - 1.14E+01	
PB-214	NOT ESTAB	6.38E+00(24/ 111)	LM1 ENV DATA STA	1.15E+01(2/ 14)	4.49E+00(9/ 28)	
		6.80E-02 - 2.12E+01	0.5 MILES SSW	5.43E+00 - 1.75E+01	9.55E-01 - 1.62E+01	
PB-212	NOT ESTAB	3.36E+00(22/ 111)	LM-3 WB	6.21E+00(2/ 14)	2.95E+00(11/ 28)	
		3.39E-01 - 1.12E+01	2.1 MILES NNE	1.19E+00 - 1.12E+01	1.74E-01 - 7.44E+00	
BE-7	NOT ESTAB	4.76E+01(35/ 111)	PM3 CEDINE BIBLE	5.63E+01(7/ 15)	5.51E+01(14/ 28)	
		2.80E+01 - 7.96E+01	CAMP 11.5 M. NNE	4.06E+01 - 6.93E+01	3.72E+01 - 9.11E+01	
AC-228	1.50E+01	111 VALUES <LLD			2.16E+01(2/ 28)	
					2.16E+01 - 2.16E+01	
SR 89	1.00E+01	102 VALUES <LLD			26 VALUES <LLD	
128		ANALYSIS PERFORMED				
SR 90	2.00E+00	102 VALUES <LLD			26 VALUES <LLD	
128		ANALYSIS PERFORMED				

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.

NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).

TABLE 8

RADIOACTIVITY IN HEAVY PARTICLE FALLOUT

MCI/KM(2) - 37000000.00 BQ/KM(2)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD)	ALL INDICATOR LOCATIONS MEAN (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE	CONTROL LOCATIONS MEAN (F) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
	SEE NOTE 1	SEE NOTE 2		SEE NOTE 2	SEE NOTE 2	
GROSS BETA	5.00E-02	1.12E-01(91/ 103)	LM-3 WB	1.23E-01(10/ 13)	1.11E-01(25/ 26)	
129		5.12E-02 - 3.34E-01	2.1 MILES NNE	6.73E-02 - 3.03E-01	5.50E-02 - 3.14E-01	

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.
NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).

TABLE 9

RADIOACTIVITY IN [redacted]COAL FILTERS

PCI/M(3) - 0.037 BQ/M(3)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391

LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
IODINE-131	1.00E-02	1.46E-02(78/ 374)	PM4 TEN MILE	1.56E-02(12/ 47)	1.39E-02(12/ 91)	
465		1.00E-02 - 2.94E-02	7.75 MILES NE	1.03E-02 - 2.70E-02	1.01E-02 - 2.09E-02	
GAMMA (GELI) 39						
K-40	NOT ESTAB	5.14E-01(15/ 31)	PM3 CEDINE BIBLE	6.61E-01(3/ 3)	4.50E-01(4/ 8)	
		2.60E-01 - 7.06E-01	CAMP 11.5 M. NNE	6.32E-01 - 7.06E-01	3.97E-01 - 5.40E-01	
I-131	NOT ESTAB	1.07E-01(23/ 31)	PM3 CEDINE BIBLE	1.32E-01(2/ 3)	1.02E-01(6/ 8)	
		5.67E-02 - 1.70E-01	CAMP 11.5 M. NNE	1.04E-01 - 1.60E-01	6.13E-02 - 1.44E-01	
BI-214	NOT ESTAB	1.48E-02(12/ 31)	PM3 CEDINE BIBLE	2.80E-02(2/ 3)	1.11E-02(4/ 8)	
		3.90E-03 - 3.18E-02	CAMP 11.5 M. NNE	2.42E-02 - 3.18E-02	1.00E-03 - 1.57E-02	
PB-214	NOT ESTAB	1.56E-02(12/ 31)	PM3 CEDINE BIBLE	2.60E-02(2/ 3)	1.69E-02(2/ 8)	
		2.70E-03 - 3.27E-02	CAMP 11.5 M. NNE	1.92E-02 - 3.27E-02	9.30E-03 - 2.44E-02	
PB-212	NOT ESTAB	2.53E-03(9/ 31)	PM3 CEDINE BIBLE	3.65E-03(2/ 3)	8 VALUES <LLD	
		1.00E-04 - 7.20E-03	CAMP 11.5 M. NNE	1.00E-04 - 7.20E-03		
AC-228	NOT ESTAB	1.72E-02(3/ 31)	PM3 CEDINE BIBLE	1.92E-02(2/ 3)	8 VALUES <LLD	
		6.80E-03 - 3.16E-02	CAMP 11.5 M. NNE	6.80E-03 - 3.16E-02		

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.

NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).

TABLE 10

RADIOACTIVITY IN ATMOSPHERIC MOISTURE

PCI/M(3) - 0.037 BQ/M(3)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391

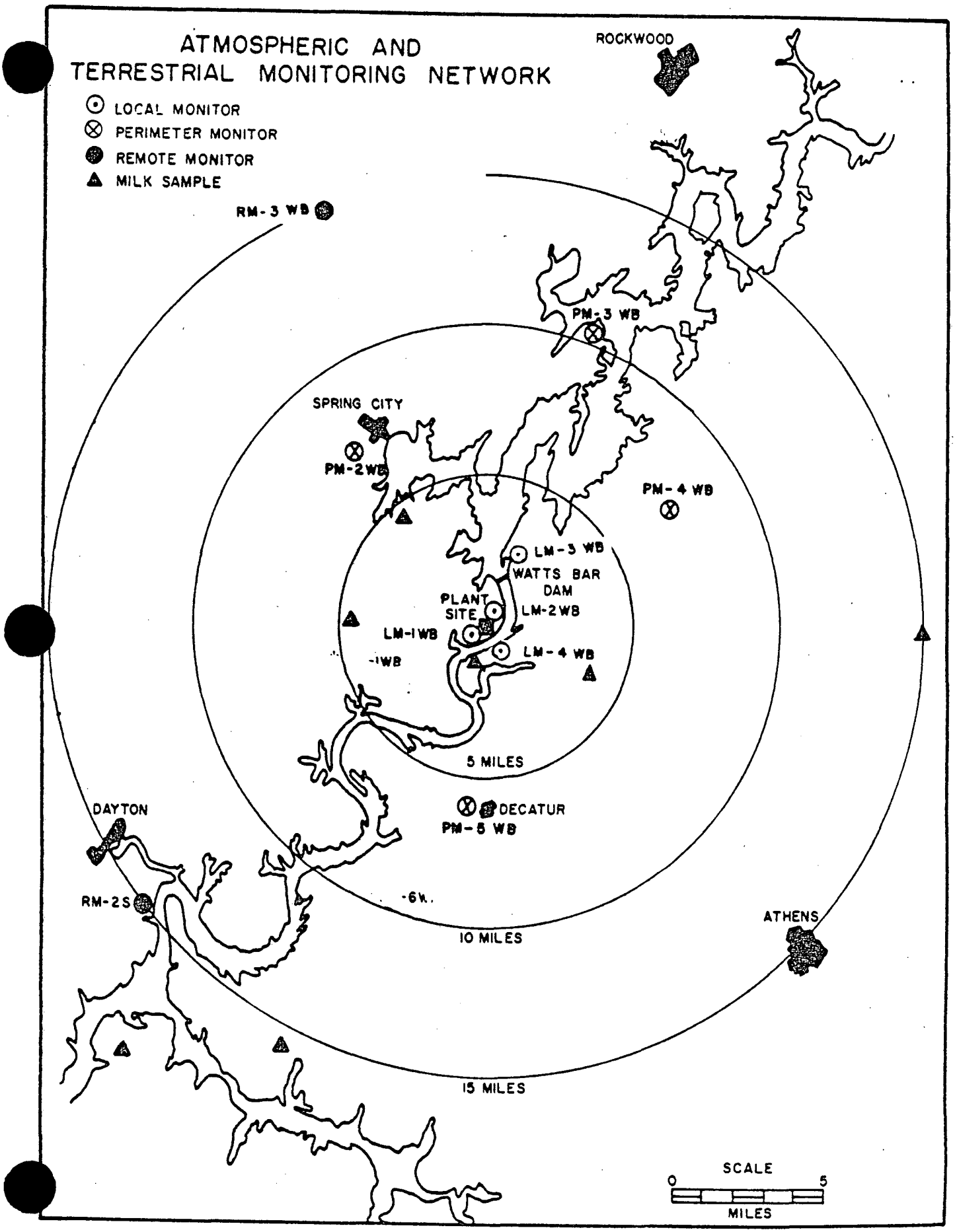
LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD)	ALL INDICATOR LOCATIONS MEAN (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE	CONTROL LOCATIONS MEAN (F) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
	SEE NOTE 1	SEE NOTE 2		SEE NOTE 2	SEE NOTE 2	
TRITIUM	NOT ESTAB	9.56E-01(23/ 35)	LM2 N. WBSP GATE	1.16E+00(13/ 21)	4.19E-01(9/ 14)	
49		6.11E-03 - 6.04E+00	0.5 MILES N	6.11E-03 - 6.04E+00	1.18E-02 - 9.17E-01	

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.

NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).

Figure 2



(1 mile - 1.6 kilometers)

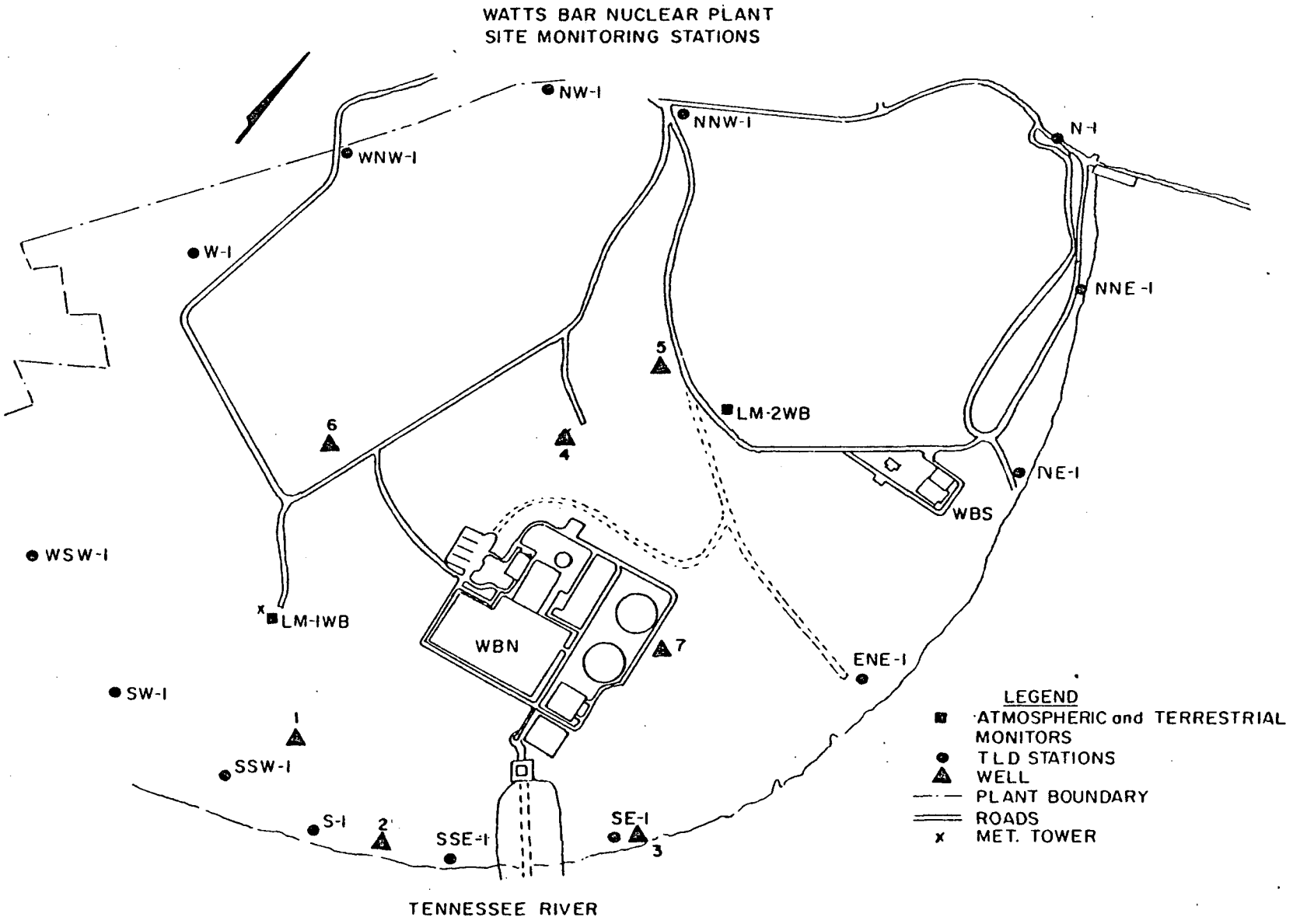
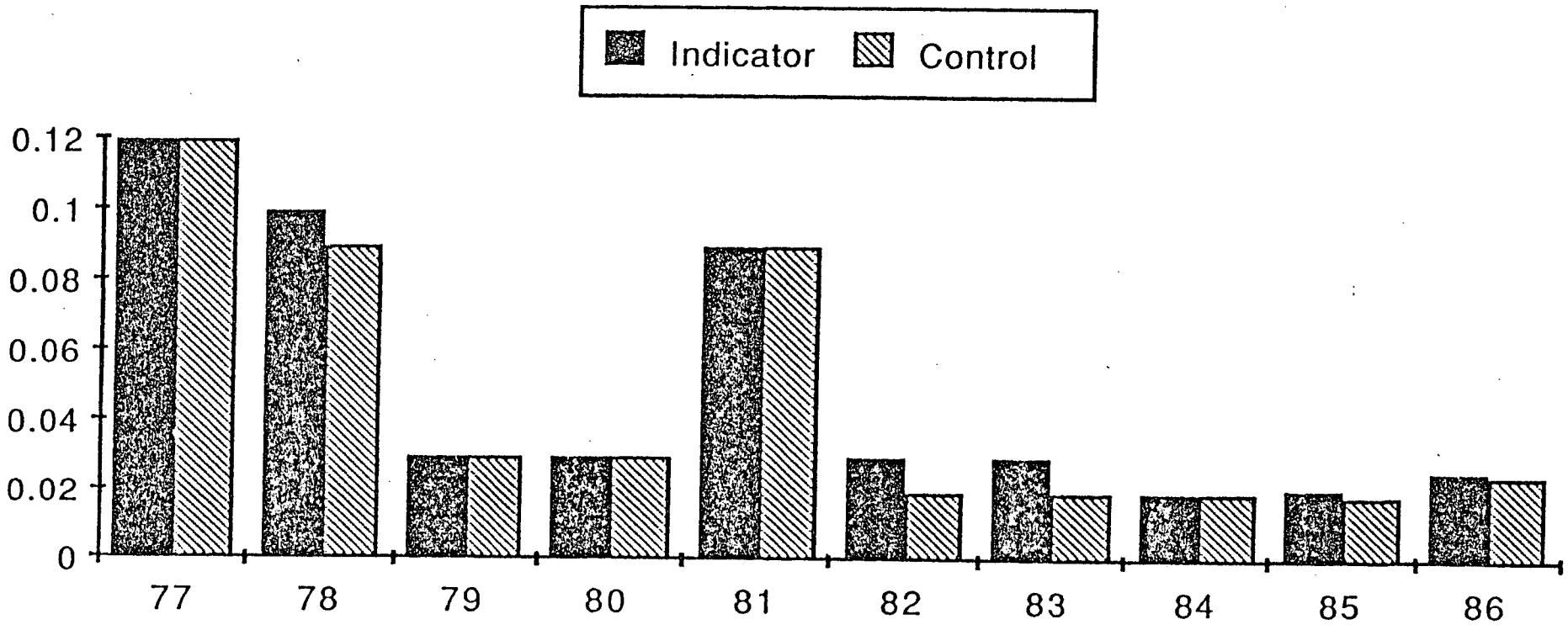

WATTS BAR NUCLEAR PLANT
SITE MONITORING STATIONS
NW-1
NNW-1
N-1
WNW-1
W-1
NNE-1
5
LM-2WB
6
4
NE-1
WBS
WSW-1
LM-1WB
WBN
7
ENE-1
SW-1
1
SSW-1
S-1
2
SSE-1
SE-1
3
TENNESSEE RIVER
LEGEND
ATMOSPHERIC and TERRESTRIAL MONITORS
TLD STATIONS
WELL
PLANT BOUNDARY
ROADS
MET. TOWER

Figure 3

Figure 4

Annual Average Gross Beta Activity
Air Filters (pCi/cubic meter)
Watts Bar Nuclear Plant



Terrestrial Monitoring

Terrestrial monitoring was accomplished by collecting samples of environmental media that provide a pathway to humans. Samples of milk, vegetation, soil, groundwater, public water, gamma radiation levels, and food products were taken on routine schedules at indicator stations (at or near the plant) and control stations (remote to the plant). Once each year, a land use survey is performed to determine census and location of milk-producing animals within a 5-mile radius of the plant. Significant changes identified by the survey may be reflected by modifying milk/vegetation sampling locations.

Land Use Survey

The annual land use survey was conducted during the summer of 1986. No new locations with milk-producing animals were identified. At one location from which vegetation was routinely collected, the milk-producing animal was disposed of, and sampling was discontinued at the end of the year.

Milk

Milk samples were collected routinely from four indicator dairies and from three control dairies. Raw milk was analyzed semimonthly for I-131 and gamma-emitting radioisotopes and monthly for Sr-89 and Sr-90 content. Increased levels of I-131 were identified in samples collected following the Chernobyl accident. The highest I-131 concentration measured was 32.2 pCi/L. Table 11 summarizes the results of laboratory analyses. During this report period, six samples were not available for collection and two samples spoiled before analysis for I-131 could be performed.

As has been noted in previous radiological monitoring reports, the levels of Sr-90 in milk samples from farms producing milk for private consumption only were up to six times the levels found in milk from commercial dairy farms. Samples of feed and water supplied to the animals were analyzed in 1979 in an effort to determine the source of the strontium. Analysis of dried hay samples indicated levels of Sr-90 slightly higher than those encountered in routine vegetation samples. Analysis of pond water indicated no significant strontium activity.

This phenomenon was observed during preoperational radiological monitoring near Sequoyah and Bellefonte Nuclear Plants at farms where only one or two cows were being milked for private consumption of the milk. A similar phenomenon has been observed at two small dairy farms near WBN. It is postulated that the feeding practices of these small farmers differ from those of the larger dairy farmers to the extent that fallout from atmospheric nuclear weapons testing may be more concentrated in these instances. Similarly, Hansen, et al., reported an inverse

relationship between the levels of Sr-90 in milk and the quality of fertilization and land management.[a]

Vegetation

Vegetation samples were collected monthly from ten air monitoring stations (semimonthly at one control location) and from nine dairies and farms (semimonthly from three control dairies). Approximately 1 to 2 kilograms of grass was broken or cut at ground level and returned for analysis. For samples taken at dairies and farms, efforts were made to collect vegetation that was representative of the pasturage where animals graze. Samples were analyzed monthly for I-131 and gamma-emitting nuclides and quarterly for Sr-89 and Sr-90 content. The results of laboratory analyses are summarized in table 12. During this report period, one sample spoiled before analysis could be performed, one sample was destroyed during analysis, and on one occasion sufficient quantities of sample were not obtained.

Soil

Soil samples were collected annually near each air monitoring station. An additional sample was collected from one control station which is also used in the Sequoyah monitoring program. Soil samples are taken to provide an indication of any long-term buildup of radioactivity in the environment. An auger or "cookie cutter" type of sampler was used to obtain samples of the top 2 inches (5 cm) of soil. All samples were analyzed for gamma-emitting radionuclides and for Sr-89 and Sr-90 content. The analytical results are given in table 13.

Groundwater

Well water samples were obtained monthly from one onsite well and from one offsite location. All samples were analyzed for gamma-emitting radionuclides and a quarterly composite was analyzed for H^3. The analytical results are summarized in table 14.

Public Water

Potable water supplies taken from the Tennessee River in the vicinity of WBN were sampled and analyzed monthly for gross beta and gamma-emitting radionuclides. Tritium, Sr-89, and Sr-90 concentrations were determined in quarterly composite samples. Two potable water sampling locations downstream from the plant are equipped with automatic samplers with composite samples analyzed monthly. In addition, the surface water sample collected by an automatic sampler upstream from the plant is included as a control for drinking water. Results of laboratory analysis are shown in table 15. During this reporting period, two samples contained insufficient volume for gross beta analysis.

---

[a]Hansen, W. G., et al., Farming Practices and Concentrations of Emission Products in Milk, U.S. Department of Health, Education, and Welfare; Public Health Service Publication No. 999R6, May 1964.

Figure 5 shows the trends in gross beta activity in drinking water from 1977 through 1986. The annual averages for the indicator stations reported herein are slightly higher than the levels reported in surface water samples (figure 6).

Environmental Gamma Radiation Levels

Bulb-type, Victoreen, manganese-activated, calcium fluoride (CaF_2: Mn), thermoluminescent dosimeters (TLDs) are placed at 16 stations around the plant near the site boundary, at the perimeter and remote air monitors, and at 22 additional stations approximately 5 miles from the site to determine the gamma exposure rates at these locations. The dosimeters, in energy compensating shields to correct energy dependence, are placed at approximately 1 meter above the ground, with three TLDs at each station. They are annealed and read with a Victoreen Model 2810 TLD reader. The values are corrected for gamma response, self-irradiation, and fading, with individual gamma response calibrations and self-irradiation factors determined for each TLD. The system meets or exceeds the performance specifications outlined in Regulatory Guide 4.13 for environmental applications of TLDs.

The TLDs are exchanged every 3 months. The quarterly gamma radiation levels determined from these TLDs are given in table 16, which indicates that average levels at onsite stations are approximately 2-4 mR/quarter higher than levels at offsite stations. This is consistent with levels reported in other preoperational radiological monitoring programs conducted by TVA where the average radiation levels onsite are generally 2-6 mR/quarter higher than levels offsite. The causes of these differences have not been completely isolated; however, it is postulated that the differences are probably attributable to combinations of influences, such as natural variations in environmental radiation levels, earth moving activities onsite, the mass of concrete employed in the construction of the plant, or other undetermined influences.

Figure 8 compares plots of the data from the onsite or site boundary stations with those from the offsite stations over the period from 1977 through 1986. To reduce the variations present in the data sets, a 4-quarter moving average was constructed for each set. Figure 9 presents a trend plot of the direct radiation levels as defined by the moving averages. The data follow the same general trend as the raw data, but the curves are smoothed considerably.

Food Products

Food products raised in the vicinity of WBN were sampled annually as they became available during the growing season. During this sampling period, samples of cabbage, corn, pears, potatoes, tomatoes, turnip greens were collected and analyzed for gross beta and specific gamma-emitting radionuclides. The results of laboratory analyses are summarized in tables 17 through 22.

TABLE

RADIOACTIV[redacted]IN MILK

PCI/L - 0.037 BQ/L

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391

LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
IODINE-131	5.00E-01	8.20E+00(13/ 102)	MULLINS FARM	1.11E+01(3/ 26)	4.45E+00(7/ 72)	
174		5.71E-01 - 2.85E+01	3.75 MILES ESE	2.02E+00 - 2.32E+01	6.41E-01 - 1.00E+01	
GAMMA (GELI)						
176						
CS-134	5.00E+00	8.36E+00(3/ 103)	MOFFETT FARM	9.04E+00(2/ 25)	73 VALUES <LLD	
		7.01E+00 - 1.06E+01	4.5 MILES NW	7.49E+00 - 1.06E+01		
CS-137	5.00E+00	9.19E+00(7/ 103)	MOFFETT FARM	1.29E+01(3/ 25)	7.11E+00(3/ 73)	
		5.08E+00 - 1.81E+01	4.5 MILES NW	9.13E+00 - 1.81E+01	5.15E+00 - 1.00E+01	
K-40	NOT ESTAB	1.30E+03(103/ 103)	MULLINS FARM	1.42E+03(26/ 26)	1.35E+03(73/ 73)	
		6.22E+02 - 1.77E+03	3.75 MILES ESE	1.20E+03 - 1.77E+03	7.21E+02 - 1.69E+03	
I-131	8.00E+00	1.90E+01(4/ 103)	MOFFETT FARM	3.22E+01(1/ 25)	1.15E+01(1/ 73)	
		1.10E+01 - 3.22E+01	4.5 MILES NW	3.22E+01 - 3.22E+01	1.15E+01 - 1.15E+01	
BI-214	NOT ESTAB	3.40E+01(41/ 103)	LAYMAN FARM	6.50E+01(17/ 26)	1.17E+01(36/ 73)	
		3.76E-01 - 2.74E+02	1.5 MILES SSW	5.26E-01 - 2.74E+02	4.12E-01 - 1.39E+02	
PB-214	NOT ESTAB	4.53E+01(27/ 103)	LAYMAN FARM	8.64E+01(12/ 26)	1.39E+01(24/ 73)	
		1.05E+00 - 2.70E+02	1.5 MILES SSW	7.58E+00 - 2.70E+02	4.10E-01 - 1.56E+02	
PB-212	NOT ESTAB	2.12E+00(29/ 103)	LAYMAN FARM	2.51E+00(4/ 26)	1.66E+00(23/ 73)	
		1.03E-01 - 5.17E+00	1.5 MILES SSW	5.03E-01 - 3.67E+00	1.34E-01 - 3.79E+00	
TL-208	NOT ESTAB	1.43E+00(11/ 103)	MULLINS FARM	2.34E+00(3/ 26)	1.78E+00(5/ 73)	
		1.87E-01 - 3.84E+00	3.75 MILES ESE	4.34E-01 - 3.84E+00	1.22E-01 - 5.23E+00	
AC-228	NOT ESTAB	1.09E+01(4/ 103)	MULLINS FARM	1.15E+01(1/ 26)	6.95E+00(9/ 73)	
		4.14E+00 - 1.67E+01	3.75 MILES ESE	1.15E+01 - 1.15E+01	2.88E+00 - 1.37E+01	
SR 89	1.00E+01	51 VALUES <LLD			37 VALUES <LLD	
88		ANALYSIS PERFORMED				
SR 90	2.00E+00	4.31E+00(35/ 51)	MOFFETT FARM	6.17E+00(12/ 12)	2.52E+00(8/ 37)	
88		2.02E+00 - 8.83E+00	4.5 MILES NW	2.23E+00 - 8.83E+00	2.17E+00 - 2.96E+00	

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.

NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).

TABLE 12

RADIOACTIVITY IN VEGETATION

PCI/G - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
IODINE-131	NOT ESTAB	5.30E-03(67/ 182)	PM2 SPRING CITY	1.00E-02(5/ 13)	1.34E-02(39/ 114)	
(SEE NOTE 3) 296		1.10E-05 - 4.91E-02	7.0 MILES NW	1.02E-04 - 4.91E-02	6.00E-06 - 1.11E-01	
GAMMA (GELI) 299						
RU-103	2.00E-01	2.86E-01(10/ 182)	PM2 SPRING CITY	6.30E-01(1/ 13)	3.53E-01(4/ 117)	
		2.20E-01 - 6.30E-01	7.0 MILES NW	6.30E-01 - 6.30E-01	2.42E-01 - 4.90E-01	
CS-137	6.00E-02	1.91E-01(47/ 182)	SHIRLEY REED FAR	2.96E-01(2/ 13)	1.88E-01(22/ 117)	
		6.34E-02 - 5.67E-01	1.5 MILES WSW	1.96E-01 - 3.96E-01	6.73E-02 - 6.49E-01	
K-40	NOT ESTAB	1.66E+01(182/ 182)	MULLINS FARM	2.14E+01(13/ 13)	1.81E+01(117/ 117)	
		1.91E+00 - 3.84E+01	3.75 MILES ESE	3.96E+00 - 3.84E+01	2.04E+00 - 4.08E+01	
I-131	9.00E-02	3.55E-01(3/ 182)	PM2 SPRING CITY	5.66E-01(1/ 13)	4.71E-01(7/ 117)	
		2.28E-01 - 5.66E-01	7.0 MILES NW	5.66E-01 - 5.66E-01	2.06E-01 - 8.49E-01	
BI-214	1.00E-01	2.12E-01(61/ 182)	MOFFETT FARM	3.67E-01(2/ 13)	1.90E-01(41/ 117)	
		1.07E-01 - 5.47E-01	4.5 MILES NW	2.14E-01 - 5.20E-01	1.01E-01 - 4.01E-01	
BI-212	NOT ESTAB	2.89E-01(1/ 182)	MULLINS FARM	2.89E-01(1/ 13)	117 VALUES <LLD	
		2.89E-01 - 2.89E-01	3.75 MILES ESE	2.89E-01 - 2.89E-01		
PB-214	NOT ESTAB	1.24E-01(135/ 182)	HOUSLEY FARM	1.90E-01(11/ 13)	1.10E-01(73/ 117)	
		2.80E-03 - 5.65E-01	4.75 MILES W	4.65E-02 - 3.61E-01	1.00E-04 - 4.28E-01	
PB-212	NOT ESTAB	4.92E-02(107/ 182)	HOUSLEY FARM	7.78E-02(8/ 13)	4.25E-02(69/ 117)	
		1.00E-04 - 2.28E-01	4.75 MILES W	8.60E-03 - 1.37E-01	7.00E-04 - 3.59E-01	
BE-7	NOT ESTAB	6.19E+00(181/ 182)	PM2 SPRING CITY	7.94E+00(13/ 13)	6.06E+00(117/ 117)	
		1.15E+00 - 2.03E+01	7.0 MILES NW	1.41E+00 - 1.35E+01	7.56E-01 - 1.65E+01	
TL-208	NOT ESTAB	3.06E-02(52/ 182)	PM3 CEDINE BIBLE	4.14E-02(5/ 13)	3.35E-02(25/ 117)	
		9.00E-04 - 8.37E-02	CAMP 11.5 M. NNE	1.22E-02 - 8.37E-02	7.00E-04 - 1.75E-01	
AC-228	NOT ESTAB	1.68E-01(47/ 182)	LM2 N. WBSP GATE	2.14E-01(4/ 13)	1.18E-01(25/ 117)	
		1.22E-02 - 3.07E-01	0.5 MILES N	1.12E-01 - 3.04E-01	1.46E-02 - 2.78E-01	
PA-234M	NOT ESTAB	5.37E+00(2/ 182)	LAYMAN FARM	6.49E+00(1/ 13)	117 VALUES <LLD	
		4.25E+00 - 6.49E+00	1.5 MILES SSW	6.49E+00 - 6.49E+00		
SR 89	2.50E-01	56 VALUES <LLD			36 VALUES <LLD	
92		ANALYSIS PERFORMED				
SR 90	5.00E-02	1.88E-01(45/ 56)	LM-3 WB	4.30E-01(4/ 4)	1.51E-01(30/ 36)	
92		5.64E-02 - 7.99E-01	2.1 MILES NNE	1.87E-01 - 7.99E-01	5.50E-02 - 5.89E-01	

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.
NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).
NOTE: 3. I-131 VALUES REPORTED AS PCI/G WET WEIGHT.

TABLE

RADIOACTIV IN SOIL

PCI/G - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA (GELI)						
11						
CS-137	2.00E-02	3.94E-01(8/ 8)	PM2 SPRING CITY	8.44E-01(1/ 1)	3.61E-01(3/ 3)	
		3.85E-02 - 8.44E-01	7.0 MILES NW	8.44E-01 - 8.44E-01	2.83E-01 - 4.42E-01	
K-40	2.50E-01	1.09E+01(8/ 8)	LM-4 WB	2.48E+01(1/ 1)	3.70E+00(3/ 3)	
		2.89E+00 - 2.48E+01	0.9 MILES SE	2.48E+01 - 2.48E+01	2.50E+00 - 5.33E+00	
BI-214	5.00E-02	9.17E-01(8/ 8)	LM-4 WB	1.09E+00(1/ 1)	7.42E-01(3/ 3)	
		7.87E-01 - 1.09E+00	0.9 MILES SE	1.09E+00 - 1.09E+00	6.84E-01 - 7.75E-01	
BI-212	1.00E-01	1.15E+00(8/ 8)	LM-4 WB	1.78E+00(1/ 1)	6.23E-01(3/ 3)	
		6.87E-01 - 1.78E+00	0.9 MILES SE	1.78E+00 - 1.78E+00	5.23E-01 - 7.65E-01	
PB-214	5.00E-02	9.88E-01(8/ 8)	LM-4 WB	1.15E+00(1/ 1)	8.17E-01(3/ 3)	
		8.02E-01 - 1.15E+00	0.9 MILES SE	1.15E+00 - 1.15E+00	7.28E-01 - 8.87E-01	
PB-212	NOT ESTAB	1.04E+00(8/ 8)	LM-4 WB	1.36E+00(1/ 1)	6.09E-01(3/ 3)	
		7.77E-01 - 1.36E+00	0.9 MILES SE	1.36E+00 - 1.36E+00	4.99E-01 - 7.64E-01	
RA-226	5.00E-02	9.17E-01(8/ 8)	LM-4 WB	1.09E+00(1/ 1)	7.42E-01(3/ 3)	
		7.87E-01 - 1.09E+00	0.9 MILES SE	1.09E+00 - 1.09E+00	6.84E-01 - 7.75E-01	
RA-224	NOT ESTAB	1.28E+00(4/ 8)	LM-4 WB	1.58E+00(1/ 1)	6.50E-01(2/ 3)	
		9.96E-01 - 1.58E+00	0.9 MILES SE	1.58E+00 - 1.58E+00	4.83E-01 - 8.17E-01	
TL-208	2.00E-02	3.63E-01(8/ 8)	LM-4 WB	5.12E-01(1/ 1)	2.14E-01(3/ 3)	
		2.85E-01 - 5.12E-01	0.9 MILES SE	5.12E-01 - 5.12E-01	1.85E-01 - 2.56E-01	
AC-228	6.00E-02	1.06E+00(8/ 8)	LM-4 WB	1.43E+00(1/ 1)	6.03E-01(3/ 3)	
		7.77E-01 - 1.43E+00	0.9 MILES SE	1.43E+00 - 1.43E+00	4.86E-01 - 7.78E-01	
PA-234M	NOT ESTAB	2.54E+00(2/ 8)	LM2 N. WBSP GATE	2.83E+00(1/ 1)	2.60E+00(2/ 3)	
		2.24E+00 - 2.83E+00	0.5 MILES N	2.83E+00 - 2.83E+00	2.06E+00 - 3.14E+00	
SR 89	1.50E+00	8 VALUES <LLD			1.99E+00(1/ 3)	
11					1.99E+00 - 1.99E+00	
SR 90	1.50E-01	2.52E-01(3/ 8)	PM2 SPRING CITY	3.53E-01(1/ 1)	3 VALUES <LLD	
11		1.83E-01 - 3.53E-01	7.0 MILES NW	3.53E-01 - 3.53E-01		

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.
NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).

TABLE 14

RADIOACTIVITY IN WELL WATER

PCI/L - 0.037 BQ/L

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY DECATUR TENNESSEE — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA (GELI) 26						
K-40	NOT ESTAB	9.32E+00(2/ 13) 5.46E+00 - 1.32E+01	WBN WELL #1 ONSITE S	9.32E+00(2/ 13) 5.46E+00 - 1.32E+01	13 VALUES <LLD	
BI-214	NOT ESTAB	2.17E+01(12/ 13) 4.36E+00 - 4.86E+01	WBN WELL #1 ONSITE S	2.17E+01(12/ 13) 4.36E+00 - 4.86E+01	3.72E+02(13/ 13) 1.02E+02 - 5.90E+02	
PB-214	NOT ESTAB	1.96E+01(12/ 13) 1.10E+00 - 4.73E+01	WBN WELL #1 ONSITE S	1.96E+01(12/ 13) 1.10E+00 - 4.73E+01	3.71E+02(13/ 13) 8.28E+01 - 5.96E+02	
PB-212	NOT ESTAB	1.33E+00(3/ 13) 8.51E-01 - 1.76E+00	WBN WELL #1 ONSITE S	1.33E+00(3/ 13) 8.51E-01 - 1.76E+00	5.91E+00(3/ 13) 1.99E+00 - 1.18E+01	
TL-208	NOT ESTAB	8.80E-01(2/ 13) 3.36E-01 - 1.42E+00	WBN WELL #1 ONSITE S	8.80E-01(2/ 13) 3.36E-01 - 1.42E+00	1.91E+00(1/ 13) 1.91E+00 - 1.91E+00	
AC-228	NOT ESTAB	1.17E+01(2/ 13) 9.99E+00 - 1.34E+01	WBN WELL #1 ONSITE S	1.17E+01(2/ 13) 9.99E+00 - 1.34E+01	1.58E+01(3/ 13) 4.80E+00 - 2.48E+01	
TRITIUM 8	3.30E+02	4 VALUES <LLD ANALYSIS PERFORMED			4 VALUES <LLD	

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.
NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).

TABLE

RADIOACTIVITY IN PUBLIC WATER SUPPLY

PCI/L - 0.037 BQ/L

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA	2.00E+00	3.53E+00(25/ 26)	CF INDUSTRIES	3.54E+00(12/ 13)	3.96E+00(9/ 11)	
37		2.14E+00 - 1.07E+01	TRM 473.0	2.24E+00 - 7.24E+00	2.21E+00 - 1.16E+01	
IODINE-131	NOT ESTAB	1.07E-01(5/ 26)	DAYTON, TN	1.25E-01(4/ 13)	1.10E-01(7/ 13)	
39		2.88E-04 - 4.45E-01	17.75 MILES NNE	2.88E-04 - 4.45E-01	9.55E-03 - 2.52E-01	
GAMMA (GELI)						
39						
K-40	NOT ESTAB	2.49E+01(1/ 26)	CF INDUSTRIES	2.49E+01(1/ 13)	13 VALUES <LLD	
		2.49E+01 - 2.49E+01	TRM 473.0	2.49E+01 - 2.49E+01		
BI-214	NOT ESTAB	5.49E+00(13/ 26)	DAYTON, TN	6.95E+00(6/ 13)	3.54E+00(5/ 13)	
		1.36E+00 - 1.61E+01	17.75 MILES NNE	1.65E+00 - 1.61E+01	2.62E+00 - 4.79E+00	
PB-214	NOT ESTAB	3.32E+00(7/ 26)	DAYTON, TN	9.25E+00(2/ 13)	5.95E+00(4/ 13)	
		4.14E-02 - 1.67E+01	17.75 MILES NNE	1.85E+00 - 1.67E+01	7.94E-01 - 1.70E+01	
PB-212	NOT ESTAB	2.23E+00(10/ 26)	CF INDUSTRIES	3.58E+00(4/ 13)	2.15E+00(3/ 13)	
		4.77E-01 - 6.57E+00	TRM 473.0	9.15E-01 - 6.57E+00	1.56E+00 - 2.93E+00	
TL-208	NOT ESTAB	1.66E+00(5/ 26)	DAYTON, TN	1.71E+00(2/ 13)	13 VALUES <LLD	
		2.66E-01 - 4.08E+00	17.75 MILES NNE	1.11E+00 - 2.30E+00		
AC-228	NOT ESTAB	26 VALUES <LLD			4.76E+00(1/ 13)	
					4.76E+00 - 4.76E+00	
SR 89	1.00E+01	8 VALUES <LLD			4 VALUES <LLD	
12		ANALYSIS PERFORMED				
SR 90	2.00E+00	8 VALUES <LLD			4 VALUES <LLD	
12		ANALYSIS PERFORMED				
TRITIUM	3.30E+02	8 VALUES <LLD			4 VALUES <LLD	
12		ANALYSIS PERFORMED				

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.
NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).

Table 16

ENVIRONMENTAL GAMMA RADIATION LEVELS

Average External Gamma Radiation Levels at Various Distances from Watts Bar Nuclear Plant for Each Quarter - 1986
mR/Quarter[a]

Distance Miles	Average External Gamma Radiation Levels[b]			
	1st Quarter (Dec 85-Feb 86)	2nd Quarter (Mar-May 86)	3rd Quarter (Jun-Aug 86)	4th Quarter (Sep-Nov 86)
0-1	20.6 ± 2.1	18.9 ± 3.7	19.9 ± 3.7	20.3 ± 1.9
1-2	20.8 ± 2.1	19.0 ± 2.8	22.5 ± 3.1	23.8 ± 6.3
2-4	18.1 ± 1.9	14.5 ± 0.0	14.3 ± 0.9	16.1 ± 1.1
4-6	18.6 ± 2.3	16.4 ± 3.1	18.3 ± 4.1	17.8 ± 1.6
>6	16.6 ± 3.1	15.1 ± 4.1	16.0 ± 4.7	21.7 ± 3.6
Average, 0-2 miles (Onsite)	20.7 ± 2.0	18.9 ± 3.3	20.9 ± 3.6	20.9 ± 3.1
Average >2 miles (Offsite)	17.8 ± 2.7	15.8 ± 3.4	17.2 ± 4.3	18.3 ± 6.5

a. Data normalized to one quarter (2190 hours).
b. Averages of the individual measurements in the set ±1 standard deviation of the set.

TABLE 17

RADIOACTIVITY IN CABBAGE

PCI/KG - 0.037 BQ/KG (WET WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY DAYTON TENNESSEE — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA	2.50E+01	4.26E+03(1/ 1)	2.0 MILES S	4.26E+03(1/ 1)	3.32E+03(1/ 1)	
2		4.26E+03 - 4.26E+03		4.26E+03 - 4.26E+03	3.32E+03 - 3.32E+03	
GAMMA (GELI)						
2						
K-40	NOT ESTAB	1.94E+03(1/ 1)	2.0 MILES S	1.94E+03(1/ 1)	1.51E+03(1/ 1)	
		1.94E+03 - 1.94E+03		1.94E+03 - 1.94E+03	1.51E+03 - 1.51E+03	
BI-214	NOT ESTAB	5.29E+00(1/ 1)	2.0 MILES S	5.29E+00(1/ 1)	6.34E+00(1/ 1)	
		5.29E+00 - 5.29E+00		5.29E+00 - 5.29E+00	6.34E+00 - 6.34E+00	
PB-214	NOT ESTAB	4.10E+00(1/ 1)	2.0 MILES S	4.10E+00(1/ 1)	4.34E+00(1/ 1)	
		4.10E+00 - 4.10E+00		4.10E+00 - 4.10E+00	4.34E+00 - 4.34E+00	
PB-212	NOT ESTAB	1 VALUES <LLD			1.84E+00(1/ 1)	
					1.84E+00 - 1.84E+00	

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.
NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).

TABLE 18

RADIOACTIVITY IN CORN

PCI/KG - 0.037 BQ/KG (WET WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391

LOCATION OF FACILITY DAYTON TENNESSEE — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA 2	2.50E+01	3.06E+03(1/ 1) 3.06E+03 - 3.06E+03	2.0 MILES S	3.06E+03(1/ 1) 3.06E+03 - 3.06E+03	4.27E+03(1/ 1) 4.27E+03 - 4.27E+03	
GAMMA (GELI) 2						
K-40	NOT ESTAB	1.82E+03(1/ 1) 1.82E+03 - 1.82E+03	2.0 MILES S	1.82E+03(1/ 1) 1.82E+03 - 1.82E+03	2.22E+03(1/ 1) 2.22E+03 - 2.22E+03	
BI-214	NOT ESTAB	2.20E+00(1/ 1) 2.20E+00 - 2.20E+00	2.0 MILES S	2.20E+00(1/ 1) 2.20E+00 - 2.20E+00	1 VALUES <LLD	

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.
NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).

TABLE 19

RADIOACTIVITY IN PEARS

PCI/KG - 0.037 BQ/KG (WET WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY DAYTON TENNESSEE — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA 2	2.50E+01	2.70E+03(1/ 1) 2.70E+03 - 2.70E+03	ORIS BENNETT FAR 2.1 MILES NE	2.70E+03(1/ 1) 2.70E+03 - 2.70E+03	1.85E+03(1/ 1) 1.85E+03 - 1.85E+03	
GAMMA (GELI) 2						
K-40	NOT ESTAB	9.49E+02(1/ 1) 9.49E+02 - 9.49E+02	ORIS BENNETT FAR 2.1 MILES NE	9.49E+02(1/ 1) 9.49E+02 - 9.49E+02	6.60E+02(1/ 1) 6.60E+02 - 6.60E+02	
BI-214	NOT ESTAB	5.92E+00(1/ 1) 5.92E+00 - 5.92E+00	ORIS BENNETT FAR 2.1 MILES NE	5.92E+00(1/ 1) 5.92E+00 - 5.92E+00	1 VALUES <LLD	
PB-214	NOT ESTAB	2.11E+00(1/ 1) 2.11E+00 - 2.11E+00	ORIS BENNETT FAR 2.1 MILES NE	2.11E+00(1/ 1) 2.11E+00 - 2.11E+00	1 VALUES <LLD	
PB-212	NOT ESTAB	6.28E+00(1/ 1) 6.28E+00 - 6.28E+00	ORIS BENNETT FAR 2.1 MILES NE	6.28E+00(1/ 1) 6.28E+00 - 6.28E+00	1 VALUES <LLD	

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.
NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).

TABLE 20

RADIOACTIVITY IN POTATOES

PCI/KG - 0.037 BQ/KG (WET WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA 2	2.50E+01	8.73E+03(1/ 1) 8.73E+03 - 8.73E+03	LAYMAN FARM 1.5 MILES SSW	8.73E+03(1/ 1) 8.73E+03 - 8.73E+03	6.25E+03(1/ 1) 6.25E+03 - 6.25E+03	
GAMMA (GELI) 2						
K-40	NOT ESTAB	3.91E+03(1/ 1) 3.91E+03 - 3.91E+03	LAYMAN FARM 1.5 MILES SSW	3.91E+03(1/ 1) 3.91E+03 - 3.91E+03	3.31E+03(1/ 1) 3.31E+03 - 3.31E+03	
BI-214	NOT ESTAB	1.61E+01(1/ 1) 1.61E+01 - 1.61E+01	LAYMAN FARM 1.5 MILES SSW	1.61E+01(1/ 1) 1.61E+01 - 1.61E+01	1 VALUES <LLD	
PB-214	NOT ESTAB	1.69E+00(1/ 1) 1.69E+00 - 1.69E+00	LAYMAN FARM 1.5 MILES SSW	1.69E+00(1/ 1) 1.69E+00 - 1.69E+00	1 VALUES <LLD	
PB-212	NOT ESTAB	4.91E+00(1/ 1) 4.91E+00 - 4.91E+00	LAYMAN FARM 1.5 MILES SSW	4.91E+00(1/ 1) 4.91E+00 - 4.91E+00	1 VALUES <LLD	

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.
NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).

TABLE

RADIOACTIVITY TOMATOES

PCI/KG - 0.037 BQ/KG (WET WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA 2	2.50E+01	3.24E+03(1/ 1) 3.24E+03 - 3.24E+03	2.0 MILES S	3.24E+03(1/ 1) 3.24E+03 - 3.24E+03	4.68E+03(1/ 1) 4.68E+03 - 4.68E+03	
GAMMA (GELI) 2						
K-40	NOT ESTAB	2.44E+03(1/ 1) 2.44E+03 - 2.44E+03	2.0 MILES S	2.44E+03(1/ 1) 2.44E+03 - 2.44E+03	1.94E+03(1/ 1) 1.94E+03 - 1.94E+03	
BI-214	NOT ESTAB	1 VALUES <LLD			7.16E-01(1/ 1) 7.16E-01 - 7.16E-01	
PB-212	NOT ESTAB	1 VALUES <LLD			4.32E+00(1/ 1) 4.32E+00 - 4.32E+00	

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.
NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).

TABLE 22

RADIOACTIVITY IN TURNIP GREENS

PCI/KG - 0.037 BQ/KG (WET WEIGHT)

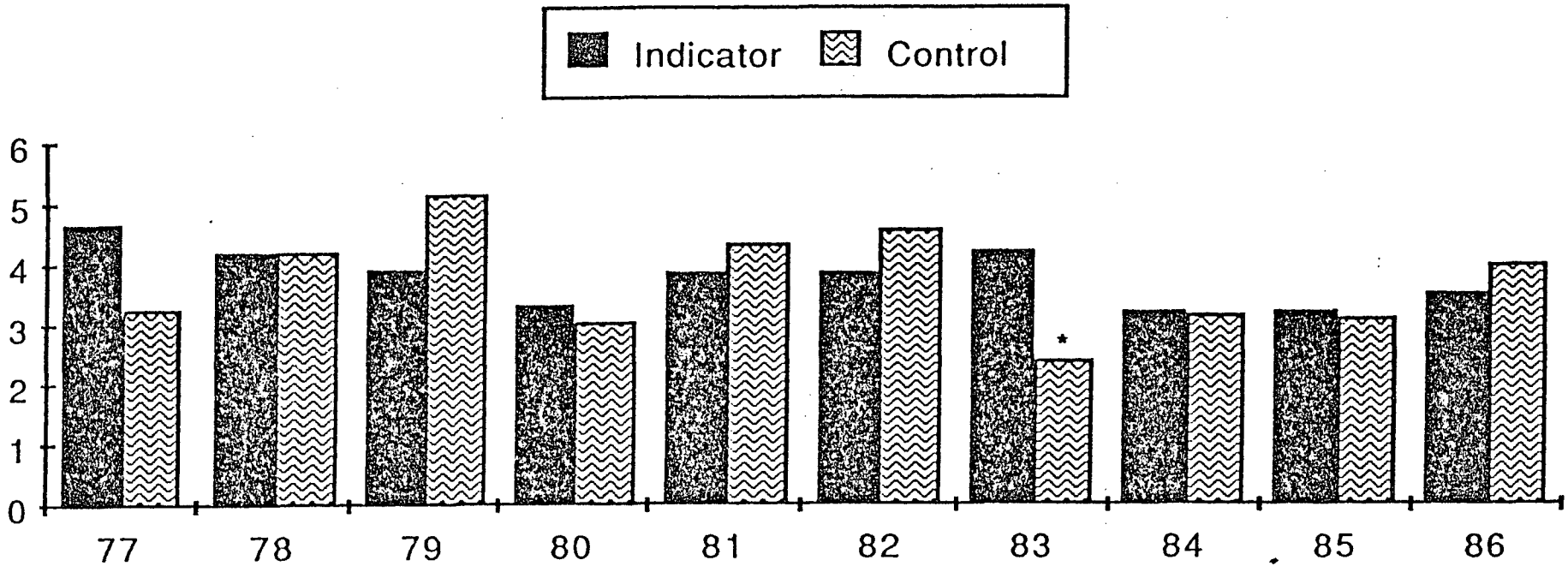
NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA 2	2.50E+01	3.24E+03(1/ 1) 3.24E+03 - 3.24E+03	ORIS BENNETT FAR 2.1 MILES NE	3.24E+03(1/ 1) 3.24E+03 - 3.24E+03	3.63E+03(1/ 1) 3.63E+03 - 3.63E+03	
GAMMA (GELI) 2						
K-40	NOT ESTAB	1.30E+03(1/ 1) 1.30E+03 - 1.30E+03	ORIS BENNETT FAR 2.1 MILES NE	1.30E+03(1/ 1) 1.30E+03 - 1.30E+03	1.30E+03(1/ 1) 1.30E+03 - 1.30E+03	
BI-214	NOT ESTAB	3.73E+00(1/ 1) 3.78E+00 - 3.78E+00	ORIS BENNETT FAR 2.1 MILES NE	3.78E+00(1/ 1) 3.78E+00 - 3.78E+00	1 VALUES <LLD	
PB-212	NOT ESTAB	4.20E+00(1/ 1) 4.20E+00 - 4.20E+00	ORIS BENNETT FAR 2.1 MILES NE	4.20E+00(1/ 1) 4.20E+00 - 4.20E+00	6.39E+00(1/ 1) 6.39E+00 - 6.39E+00	
BE-7	NOT ESTAB	8.74E+01(1/ 1) 8.74E+01 - 8.74E+01	ORIS BENNETT FAR 2.1 MILES NE	8.74E+01(1/ 1) 8.74E+01 - 8.74E+01	1 VALUES <LLD	
TL-208	NOT ESTAB	1.66E+00(1/ 1) 1.66E+00 - 1.66E+00	ORIS BENNETT FAR 2.1 MILES NE	1.66E+00(1/ 1) 1.66E+00 - 1.66E+00	1 VALUES <LLD	
AC-228	NOT ESTAB	1.11E+01(1/ 1) 1.11E+01 - 1.11E+01	ORIS BENNETT FAR 2.1 MILES NE	1.11E+01(1/ 1) 1.11E+01 - 1.11E+01	1.56E+01(1/ 1) 1.56E+01 - 1.56E+01	

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.
NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).

Figu

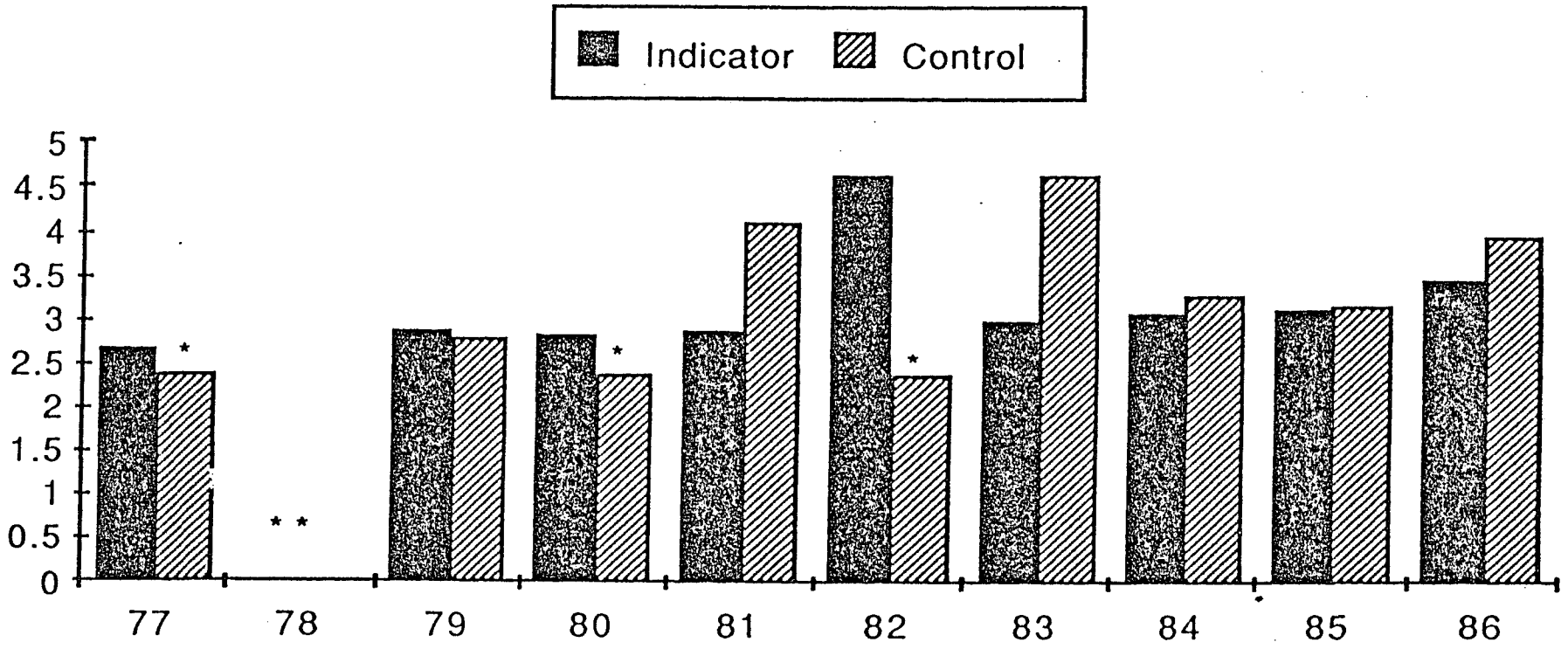
Annual Average Gross Beta Activity
Drinking Water (pCi/liter)
Watts Bar Nuclear Plant



* Less than LLD (2.4 pCi/L)

Figure 6

Annual Average Gross Beta Activity
Surface Water (pCi/liter)
Watts Bar Nuclear Plant



* Less than LLD (2.4 pCi/L)

** No gross beta measurements were made in 1978.

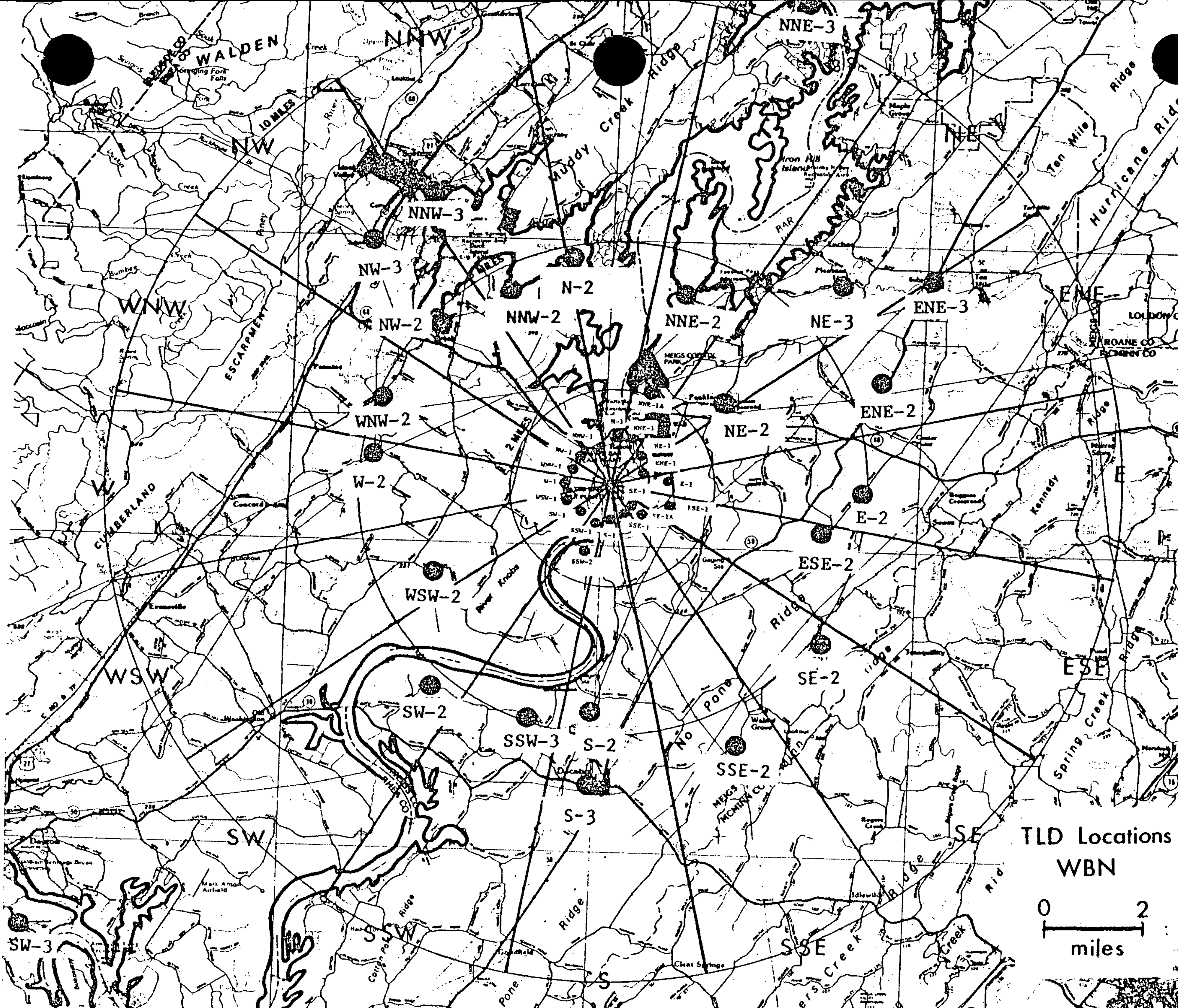


Figure 7

TLD LOCATIONS - WBN.

Figure 8

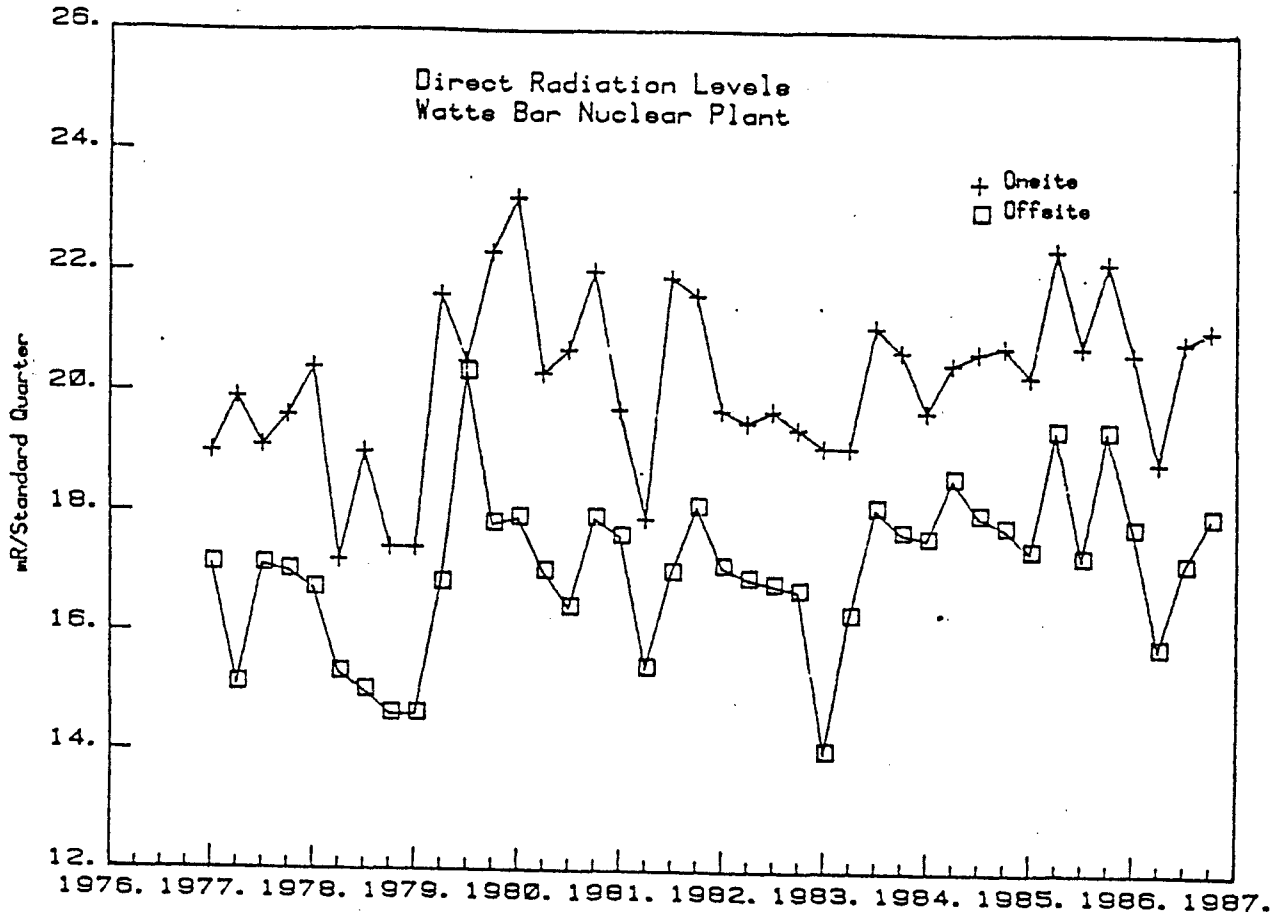
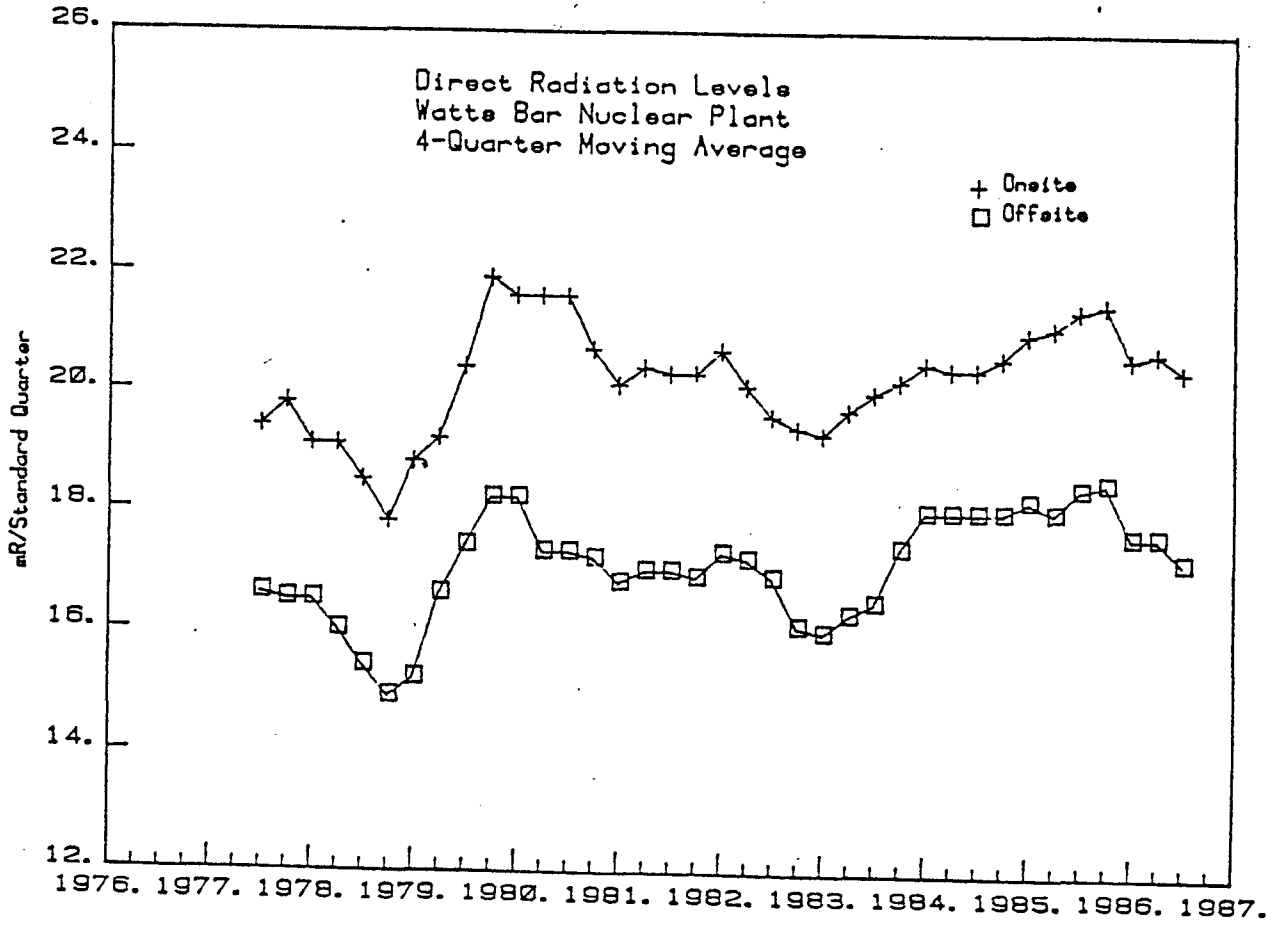


Figure 9



Reservoir Monitoring

Samples of water and aquatic media were collected along the Tennessee River in Chickamauga and Watts Bar Reservoirs. One station is also a part of the Sequoyah Nuclear Plant monitoring program. In conjunction with that program, additional analyses are conducted on some samples. Samples collected for radiological analyses include sediment, and Asiatic clams from three stations; water from three stations; and fish from Watts Bar, Chickamauga and Nickajak Reservoirs (see table 23). The locations of these stations are shown on the accompanying map (figure 10) and conform to sediment ranges established and surveyed by TVA.

Water

Water samples were collected automatically by sequential type sampling devices at three locations on the Tennessee River (one upstream from the plant discharge area, one immediately downstream from the plant discharge, and one approximately 9 miles downstream). The samples are collected monthly and analyzed for gross beta and for gamma-emitting radionuclides. These monthly samples are composited quarterly for Sr-89, Sr-90, and tritium determination. Analytical results are summarized in table 24. During this report period, two samples were not analyzed because of insufficient volume.

Figure 6 presents a plot of the gross beta activity in surface water from 1977 through 1986. Indicator stations were those located downstream from the plant and controls were located upstream. The levels reported were consistent with gross beta levels measured in surface water samples taken from the Tennessee River in preoperational radiological monitoring programs conducted by TVA at other sites.

Fish

Radiological monitoring for fish was accomplished by analyses of composite samples of adult fish taken semiannually from each of three contiguous reservoirs--Watts Bar, Chickamauga, and Nickajack. No permanent sampling stations have been established within each reservoir; this reflects the movement of fish species within reservoirs as determined by TVA data from the Browns Ferry Nuclear Plant preoperational monitoring program. Three species, white crappie, channel catfish, and smallmouth buffalo, were collected representing both commercial and game species. Sufficient fish are collected in each reservoir to yield 250 or 300 grams oven-dry weight for analytical purposes. The composite samples contained approximately the same quantity of flesh from each fish. For each composite, a subsample of material was drawn for counting. Samples were analyzed for gamma-emitting radionuclides. Analytical results are given in tables 25 through 28.

Sediment

Sediment samples were collected semiannually at three locations on the Tennessee River by dredge hauls made for bottom fauna. Each sample was a composite obtained by combining equal volumes of sediment from each of three dredge hauls. Samples were analyzed for gamma-emitting radionuclides and Sr-89 and Sr-90 content. Analytical results are summarized in table 30. During this report period, Sr-89 and Sr-90 content was not determined in samples taken at Tennessee River Mile 496.5. One sample was not collected because of personnel error.

Shoreline sediment samples were collected semiannually at two recreation-use areas (one downstream from the plant and one upstream) in the vicinity of WBN. Samples collected were analyzed for gamma-emitting radionuclides, Sr-89, and Sr-90. Results are summarized in table 31.

Figures 11 and 12 respectively present the trends in cesium-137 and cobalt-60 levels in sediment during the operation of the monitoring program. The upstream (control) station is located above Watts Bar Dam.

Asiatic Clams

Samples of Asiatic clams were collected with a Ponar dredge semiannually from three stations. Clam flesh was analyzed only for gamma-emitting radionuclides. During this report period, on three occasions, clams were not available. Results of samples analyzed are summarized in tables 32 and 33.

Table 23

SAMPLING SCHEDULE - RESERVOIR MONITORING

Tennessee River Mile	Biological Samples				
	Asiatic Clams	Sediment	Shoreline Sediment	Fish[a]	Surface Water
Indicator Stations					
496.5	X	X			
531.0			X		
517.9					X
523.1					X
527.4	X	X			
Control Stations					
529.3					X
529.9					
530.2			X		
532.1	X	X			

a. Fish samples taken from Watts Bar, Chickamauga, and Nickajack Reservoirs.

TABLE 2

RADIOACTIVITY IN SURFACE WATER TOTAL

PCI/L - 0.037 BQ/L

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391

LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA	2.00E+00	3.47E+00(24/ 26)	TRM 517.9	3.79E+00(11/ 13)	3.96E+00(9/ 11)	
37		2.07E+00 - 7.58E+00	10.3 MILE DOWNST	2.21E+00 - 7.58E+00	2.21E+00 - 1.16E+01	
IODINE-131	NOT ESTAB				1.10E-01(7/ 13)	
13					9.55E-03 - 2.52E-01	
GAMMA (GELI)						
39						
K-40	NOT ESTAB	1.99E+01(3/ 26)	TRM 517.9	2.25E+01(2/ 13)	13 VALUES <LLD	
		1.46E+01 - 2.77E+01	10.3 MILE DOWNST	1.74E+01 - 2.77E+01		
BI-214	NOT ESTAB	8.14E+00(12/ 26)	TRM 523.1	1.15E+01(4/ 13)	3.54E+00(5/ 13)	
		1.17E+00 - 2.35E+01	5.2 MILE DOWNSTR	3.28E+00 - 2.28E+01	2.62E+00 - 4.79E+00	
PB-214	NOT ESTAB	6.36E+00(6/ 26)	TRM 523.1	7.82E+00(3/ 13)	5.95E+00(4/ 13)	
		2.70E+00 - 1.06E+01	5.2 MILE DOWNSTR	4.38E+00 - 1.06E+01	7.94E-01 - 1.70E+01	
PB-212	NOT ESTAB	2.25E+00(6/ 26)	TRM 523.1	2.87E+00(2/ 13)	2.15E+00(3/ 13)	
		6.67E-01 - 4.25E+00	5.2 MILE DOWNSTR	1.72E+00 - 4.03E+00	1.56E+00 - 2.93E+00	
SR 89	1.00E+01	8 VALUES <LLD			4 VALUES <LLD	
12		ANALYSIS PERFORMED				
SR 90	2.00E+00	8 VALUES <LLD			4 VALUES <LLD	
12		ANALYSIS PERFORMED				
TRITIUM	3.30E+02	8 VALUES <LLD			4 VALUES <LLD	
12		ANALYSIS PERFORMED				

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.

NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).

TABLE 25

RADIOACTIVITY IN CHANNEL CATFISH (FLESH)

PCI/G - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA (GELI) 6						
CS-137	2.00E-02	6.00E-02(3/ 4) 4.25E-02 - 7.59E-02	NICKAJACK RES TRM 425-471	7.59E-02(1/ 2) 7.59E-02 - 7.59E-02	4.10E-02(2/ 2) 3.86E-02 - 4.34E-02	
K-40	NOT ESTAB	1.16E+01(4/ 4) 1.03E+01 - 1.46E+01	NICKAJACK RES TRM 425-471	1.28E+01(2/ 2) 1.09E+01 - 1.46E+01	1.06E+01(2/ 2) 9.27E+00 - 1.20E+01	
BI-214	2.00E-02	1.53E-01(1/ 4) 1.53E-01 - 1.53E-01	CHICKAMAUGA RES TRM 471-530	1.53E-01(1/ 2) 1.53E-01 - 1.53E-01	2 VALUES <LLD	
PB-214	NOT ESTAB	6.70E-03(1/ 4) 6.70E-03 - 6.70E-03	NICKAJACK RES TRM 425-471	6.70E-03(1/ 2) 6.70E-03 - 6.70E-03	2 VALUES <LLD	
PB-212	NOT ESTAB	4 VALUES <LLD			1.00E-04(1/ 2) 1.00E-04 - 1.00E-04	

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.
NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).

TABLE 26

RADIOACTIVITY IN WHI[illegible]APPIE (FLESH)

PCI/G - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391

LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA (GELI) 6						
CS-137	2.00E-02	9.90E-02(4/ 4) 4.12E-02 - 1.39E-01	NICKAJACK RES TRM 425-471	1.08E-01(2/ 2) 8.29E-02 - 1.34E-01	1.08E-01(2/ 2) 1.08E-01 - 1.09E-01	
K-40	NOT ESTAB	1.71E+01(4/ 4) 1.61E+01 - 1.84E+01	CHICKAMAUGA RES TRM 471-530	1.74E+01(2/ 2) 1.65E+01 - 1.84E+01	1.79E+01(2/ 2) 1.70E+01 - 1.88E+01	
BI-214	2.00E-02	3.69E-02(1/ 4) 3.69E-02 - 3.69E-02	CHICKAMAUGA RES TRM 471-530	3.69E-02(1/ 2) 3.69E-02 - 3.69E-02	1.01E-01(1/ 2) 1.01E-01 - 1.01E-01	
PB-214	NOT ESTAB	2.83E-02(2/ 4) 1.50E-02 - 4.16E-02	CHICKAMAUGA RES TRM 471-530	4.16E-02(1/ 2) 4.16E-02 - 4.16E-02	4.83E-02(1/ 2) 4.83E-02 - 4.83E-02	
PB-212	NOT ESTAB	4 VALUES <LLD			7.50E-03(1/ 2) 7.50E-03 - 7.50E-03	

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.

NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).

TABLE 27

RADIOACTIVITY IN SMALLMOUTH BUFFALO (FLESH)

PCI/G - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA (GELI) 6						
CS-137	2.00E-02	3.83E-02(3/ 4) 3.32E-02 - 4.44E-02	CHICKAMAUGA RES TRM 471-530	4.44E-02(1/ 2) 4.44E-02 - 4.44E-02	8.62E-02(1/ 2) 8.62E-02 - 8.62E-02	
K-40	NOT ESTAB	1.07E+01(4/ 4) 9.30E+00 - 1.46E+01	NICKAJACK RES TRM 425-471	1.20E+01(2/ 2) 9.42E+00 - 1.46E+01	1.30E+01(2/ 2) 1.24E+01 - 1.36E+01	
PB-214	NOT ESTAB	3.73E-02(1/ 4) 3.73E-02 - 3.73E-02	NICKAJACK RES TRM 425-471	3.73E-02(1/ 2) 3.73E-02 - 3.73E-02	1.63E-02(1/ 2) 1.63E-02 - 1.63E-02	
PB-212	NOT ESTAB	3.80E-03(1/ 4) 3.80E-03 - 3.80E-03	NICKAJACK RES TRM 425-471	3.80E-03(1/ 2) 3.80E-03 - 3.80E-03	2.80E-03(1/ 2) 2.80E-03 - 2.80E-03	

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.
NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).

TABLE 2[illegible]

RADIOACTIVITY IN SMALL[illegible]H BUFFALO (WHOLE)

PCI/G - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY DAYTON TENNESSEE — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA (GELI) 6						
CS-137	2.00E-02	2.45E-02(3/ 4) 2.10E-02 - 2.93E-02	CHICKAMAUGA RES TRM 471-530	2.52E-02(2/ 2) 2.10E-02 - 2.93E-02	2 VALUES <LLD	
K-40	NOT ESTAB	6.22E+00(4/ 4) 5.27E+00 - 6.82E+00	NICKAJACK RES TRM 425-471	6.59E+00(2/ 2) 6.36E+00 - 6.82E+00	5.82E+00(2/ 2) 5.02E+00 - 6.62E+00	
BI-214	2.00E-02	3.74E-02(2/ 4) 2.06E-02 - 5.41E-02	NICKAJACK RES TRM 425-471	3.74E-02(2/ 2) 2.06E-02 - 5.41E-02	2 VALUES <LLD	
PB-214	NOT ESTAB	2.34E-02(1/ 4) 2.34E-02 - 2.34E-02	NICKAJACK RES TRM 425-471	2.34E-02(1/ 2) 2.34E-02 - 2.34E-02	6.40E-03(1/ 2) 6.40E-03 - 6.40E-03	
PB-212	NOT ESTAB	6.40E-03(1/ 4) 6.40E-03 - 6.40E-03	NICKAJACK RES TRM 425-471	6.40E-03(1/ 2) 6.40E-03 - 6.40E-03	3.80E-03(1/ 2) 3.80E-03 - 3.80E-03	

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.
NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).

TABLE 29

RADIOACTIVITY IN SEDIMENT

PCI/G - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA (GELI)						
5						
CO-60	1.00E-02	1.22E-01(2/ 4)	TRM 496.50	1.22E-01(2/ 2)	2.33E-01(1/ 1)	
		1.21E-01 - 1.22E-01		1.21E-01 - 1.22E-01	2.33E-01 - 2.33E-01	
CS-137	2.00E-02	1.50E+00(2/ 4)	TRM 496.50	1.50E+00(2/ 2)	3.18E+00(1/ 1)	
		1.28E+00 - 1.72E+00		1.28E+00 - 1.72E+00	3.18E+00 - 3.18E+00	
K-40	NOT ESTAB	1.46E+01(4/ 4)	TRM 496.50	1.59E+01(2/ 2)	1.79E+01(1/ 1)	
		1.31E+01 - 1.62E+01		1.56E+01 - 1.62E+01	1.79E+01 - 1.79E+01	
BI-214	2.00E-02	1.03E+00(4/ 4)	TRM 496.50	1.25E+00(2/ 2)	1.60E+00(1/ 1)	
		7.92E-01 - 1.26E+00		1.25E+00 - 1.26E+00	1.60E+00 - 1.60E+00	
BI-212	1.00E-01	1.40E+00(4/ 4)	TRM 496.50	1.54E+00(2/ 2)	2.19E+00(1/ 1)	
		1.21E+00 - 1.60E+00		1.48E+00 - 1.60E+00	2.19E+00 - 2.19E+00	
PB-214	NOT ESTAB	1.10E+00(4/ 4)	TRM 496.50	1.31E+00(2/ 2)	1.76E+00(1/ 1)	
		8.31E-01 - 1.34E+00		1.29E+00 - 1.34E+00	1.76E+00 - 1.76E+00	
PB-212	NOT ESTAB	1.29E+00(4/ 4)	TRM 496.50	1.50E+00(2/ 2)	1.94E+00(1/ 1)	
		1.05E+00 - 1.51E+00		1.50E+00 - 1.51E+00	1.94E+00 - 1.94E+00	
RA-226	NOT ESTAB	1.03E+00(4/ 4)	TRM 496.50	1.25E+00(2/ 2)	1.60E+00(1/ 1)	
		7.92E-01 - 1.26E+00		1.25E+00 - 1.26E+00	1.60E+00 - 1.60E+00	
RA-224	NOT ESTAB	1.44E+00(3/ 4)	TRM 496.50	1.53E+00(2/ 2)	1 VALUES <LLD	
		1.26E+00 - 1.57E+00		1.49E+00 - 1.57E+00		
TL-208	2.00E-02	4.32E-01(4/ 4)	TRM 496.50	5.06E-01(2/ 2)	6.99E-01(1/ 1)	
		3.51E-01 - 5.18E-01		4.93E-01 - 5.18E-01	6.99E-01 - 6.99E-01	
AC-228	6.00E-02	1.34E+00(4/ 4)	TRM 496.50	1.54E+00(2/ 2)	1.93E+00(1/ 1)	
		1.11E+00 - 1.57E+00		1.51E+00 - 1.57E+00	1.93E+00 - 1.93E+00	
PA-234M	NOT ESTAB	3.36E+00(1/ 4)	TRM 527.4	3.36E+00(1/ 2)	1 VALUES <LLD	
		3.36E+00 - 3.36E+00		3.36E+00 - 3.36E+00		
SR 89	1.50E+00	1.70E+00(1/ 2)	TRM 527.4	1.70E+00(1/ 2)	1 VALUES <LLD	
3		1.70E+00 - 1.70E+00		1.70E+00 - 1.70E+00		
SR 90	1.50E-01	2 VALUES <LLD			1 VALUES <LLD	
3		ANALYSIS PERFORMED				

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.
NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).

TABLE 3[illegible]

RADIOACTIVITY [illegible]HORE LINE SEDIMENT

PCI/G - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391

LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA (GELI) 4						
CS-137	2.00E-02	7.73E-02(2/ 2) 2.18E-02 - 1.33E-01	COTTON PORT MARI TRM 513	7.73E-02(2/ 2) 2.18E-02 - 1.33E-01	2.07E-02(1/ 2) 2.07E-02 - 2.07E-02	
K-40	NOT ESTAB	2.42E+01(2/ 2) 2.14E+01 - 2.70E+01	COTTON PORT MARI TRM 513	2.42E+01(2/ 2) 2.14E+01 - 2.70E+01	8.25E-01(2/ 2) 7.32E-01 - 9.18E-01	
BI-214	2.00E-02	7.78E-01(2/ 2) 7.08E-01 - 8.47E-01	COTTON PORT MARI TRM 513	7.78E-01(2/ 2) 7.08E-01 - 8.47E-01	1.74E-01(2/ 2) 1.51E-01 - 1.98E-01	
BI-212	1.00E-01	1.73E+00(2/ 2) 1.52E+00 - 1.95E+00	COTTON PORT MARI TRM 513	1.73E+00(2/ 2) 1.52E+00 - 1.95E+00	2.49E-01(2/ 2) 2.43E-01 - 2.56E-01	
PB-214	NOT ESTAB	8.37E-01(2/ 2) 7.17E-01 - 9.57E-01	COTTON PORT MARI TRM 513	8.37E-01(2/ 2) 7.17E-01 - 9.57E-01	1.98E-01(2/ 2) 1.66E-01 - 2.30E-01	
PB-212	2.00E-02	1.54E+00(2/ 2) 1.35E+00 - 1.74E+00	COTTON PORT MARI TRM 513	1.54E+00(2/ 2) 1.35E+00 - 1.74E+00	2.02E-01(2/ 2) 1.72E-01 - 2.33E-01	
RA-226	NOT ESTAB	8.47E-01(1/ 2) 8.47E-01 - 8.47E-01	COTTON PORT MARI TRM 513	8.47E-01(1/ 2) 8.47E-01 - 8.47E-01	1.74E-01(2/ 2) 1.51E-01 - 1.93E-01	
RA-224	NOT ESTAB	1.86E+00(1/ 2) 1.86E+00 - 1.86E+00	COTTON PORT MARI TRM 513	1.86E+00(1/ 2) 1.86E+00 - 1.86E+00	2 VALUES <LLD	
BE-7	2.00E-02	2 VALUES <LLD			1.50E-01(1/ 2) 1.50E-01 - 1.50E-01	
TL-208	2.00E-02	5.34E-01(2/ 2) 4.63E-01 - 6.04E-01	COTTON PORT MARI TRM 513	5.34E-01(2/ 2) 4.63E-01 - 6.04E-01	6.48E-02(2/ 2) 5.92E-02 - 7.04E-02	
AC-228	6.00E-02	1.56E+00(2/ 2) 1.42E+00 - 1.70E+00	COTTON PORT MARI TRM 513	1.56E+00(2/ 2) 1.42E+00 - 1.70E+00	2.05E-01(2/ 2) 1.87E-01 - 2.22E-01	
SR 89 4	1.50E+00	2 VALUES <LLD ANALYSIS PERFORMED			2 VALUES <LLD	
SR 90 4	1.50E-01	2 VALUES <LLD			1.61E-01(1/ 2) 1.61E-01 - 1.61E-01	

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.

NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).

TABLE 31

RADIOACTIVITY IN CLAM FLESH

PCI/G - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY DECATUR TENNESSEE — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA (GELI) 4						
BI-214	NOT ESTAB	1.90E-01(3/ 4) 5.78E-02 - 3.20E-01	TRM 496.50	2.56E-01(2/ 2) 1.92E-01 - 3.20E-01		
PB-214	NOT ESTAB	1.97E-01(2/ 4) 1.92E-01 - 2.02E-01	TRM 527.4	2.02E-01(1/ 2) 2.02E-01 - 2.02E-01		
PB-212	NOT ESTAB	2.08E-01(1/ 4) 2.08E-01 - 2.08E-01	TRM 496.50	2.08E-01(1/ 2) 2.08E-01 - 2.08E-01		
TL-208	NOT ESTAB	1.60E-01(1/ 4) 1.60E-01 - 1.60E-01	TRM 496.50	1.60E-01(1/ 2) 1.60E-01 - 1.60E-01		

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.
NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).

Figure 10

RESERVOIR MONITORING NETWORK

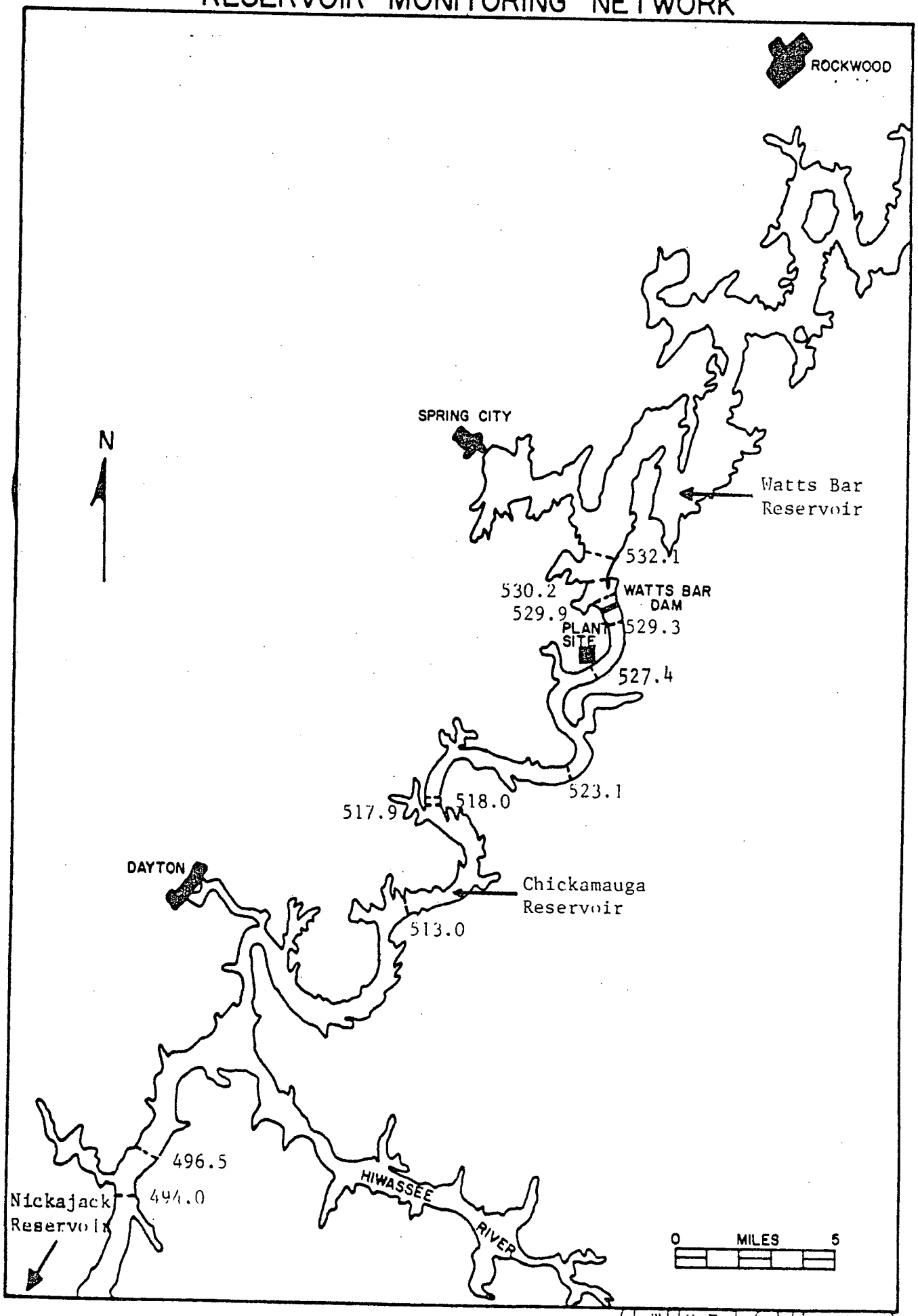


Figure 11

Annual Average Cs-137 Activity
Sediment (pCi/g dry weight)
Watts Bar Nuclear Plant

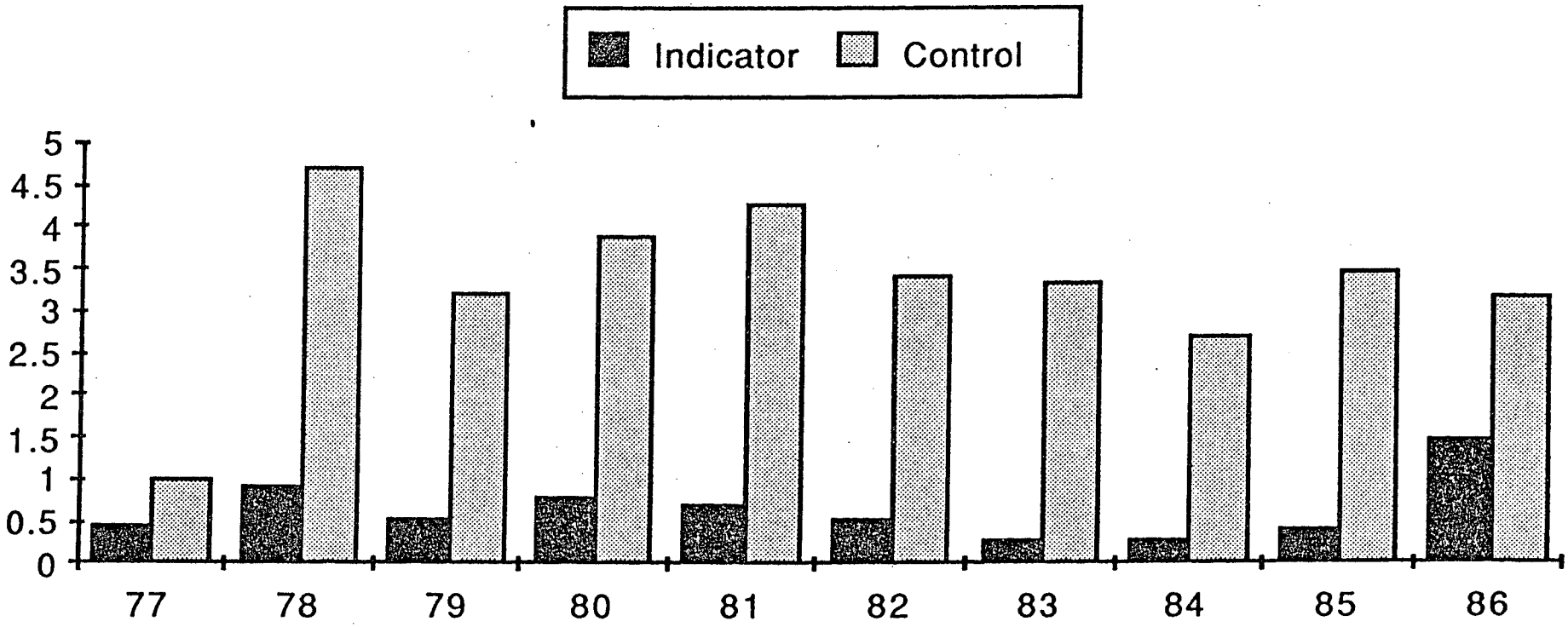
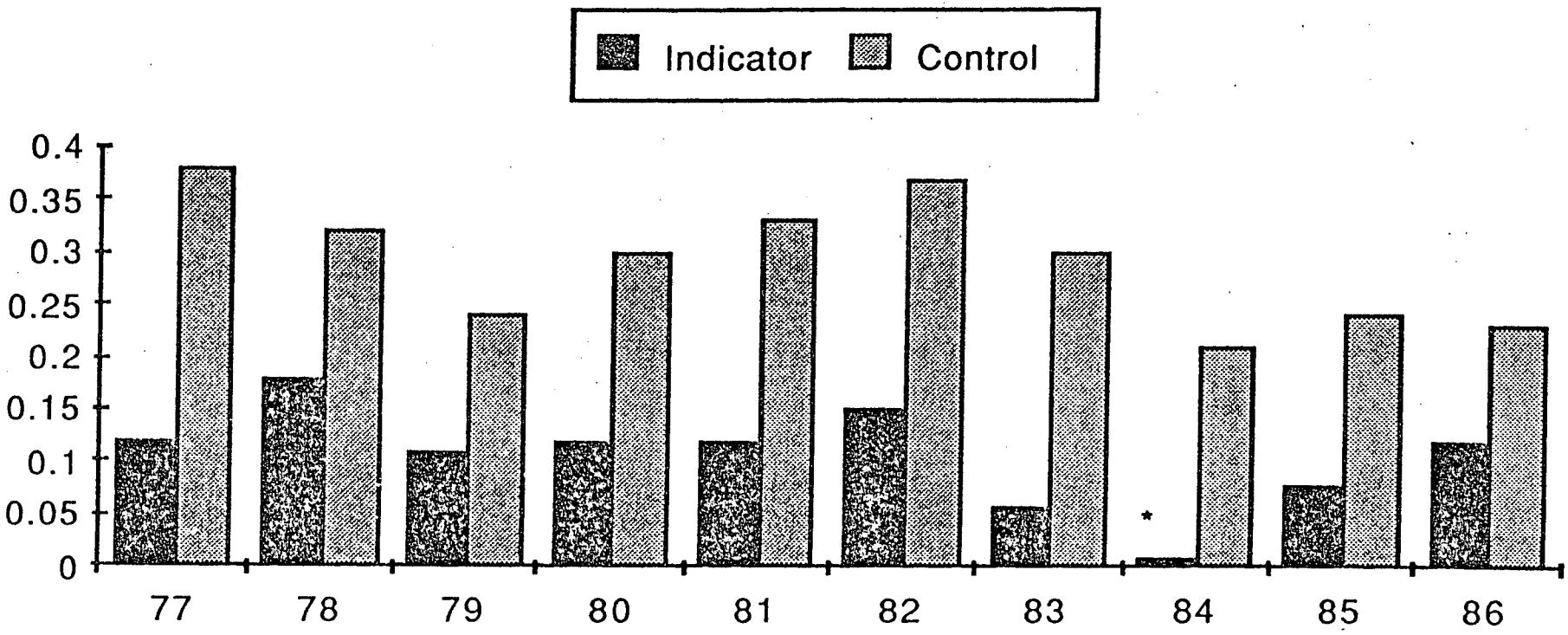


Figure 12

Annual Average Co-60 Activity
Sediment (pCi/g dry weight)
Watts Bar Nuclear Plant



* Less than LLD (0.01 pCi/g)

Quality Control

A quality control program has been established with the Tennessee Department of Public Health Radiological Laboratory and the Eastern Environmental Radiation Facility, Environmental Protection Agency, Montgomery, Alabama. Samples of air, water, milk, fish, and soil collected around nuclear plants are forwarded to these laboratories for analysis, and results are exchanged for comparison.

Conclusions

Since WBN has not achieved criticality, there has been no contribution of radioactivity from the plant to the environment. The levels of radioactivity being reported in this document are due to natural background radiation, fallout from nuclear weapons testing, fallout from the Chernobyl nuclear power station accident, or other nuclear operations in the area.

TENNESSEE VALLEY AUTHORITY

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT
SEQUOYAH NUCLEAR PLANT
1986

RADIOLOGICAL CONTROL