TENNESSEE VALLEY AUTHORITY

DIVISION OF OCCUPATIONAL HEALTH AND SAFETY

8207020186 820624
PDR ADOCK 05000390
R PDR

ENVIRONMENTAL RADIOACTIVITY LEVELS
WATTS BAR NUCLEAR PLANT
Annual Report 1981
TVA/OMS/OHS-82/9

May 1982

CONTENTS

	Page
List of Tables	iii
List of Figures	iv
Introduction	1
Atmospheric Monitoring	11
Terrestrial Monitoring	23
Reservoir Monitoring	41
Quality Control	57
Conclusions	57

LIST OF TABLES

	Page
Table 1 - Environmental Radioactivity Sampling Schedule	3
Table 2 - Environmental Monitoring Stations 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 Permissable Concentrations for Nonoccupational Exposure	13
Table 6 - Radioactivity in Air Filter	14
Table 7 - Radioactivity in Rainwater	15
Table 8 - Radioactivity in Heavy Particle Fallout	16
Table 9 - Radioactivity in Charcoal Filters	17
Table 10 - Radioactivity in Atmospheric Moisture	18
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 Food Crops	32
Table 18 - Radioactivity in Beef	36
Table 19 - Sampling Schedule - Reservoir Monitoring	43
Table 20 - Radioactivity in Surface Water	44
Table 21 - Radioactivity in Channel Catfish (Flesh)	45
Table 22 - Radioactivity in White Crappie (Flesh)	46
Table 23 - Radioactivity in Smallmouth Buffalo (Flesh)	47
Table 24 - Radioactivity in Smallmouth Buffalo (Whole)	48
Table 25 - Radioactivity in Plankton	49
Table 26 - Radioactivity in Sediment	50
Table 27 - Radioactivity in Shoreline Sediment	51
Table 28 - Radioactivity in Clam Flesh	52
Table 29 - Radioactivity in Clam Shell	53

LIST OF FIGURES

		Page
Figure 1	- Tennessee Valley Region	10
Figure 2	- Atmospheric and Terrestrial Monitoring Network	19
Figure 3	- Watts Bar Nuclear Plant Site Monitoring Stations	20
Figure 4	- Annual Average Gross Beta Activity in Air (Particulate Filters) - WBN	21
Figure 5	- Annual Average Gross Beta Activity in Drinking Water - WBN	37
Figure 6	- Annual Average Gross Beta Activity in Surface Water - WBN	37
Figure 7	- TLD Locations WBN	38
Figure 8	- Direct Radiation Levels - WBN	39
Figure 9	- Direct Radiation Levels - WBN, 4-Quarter Moving Average	39
Figure 10	- Reservoir Monitoring Network	54
Figure 11	- Annual Average Cesium-137 in Sediment - WBN	55
Figure 12	- Annual Average Cobalt-60 in Sediment - WBN	55

ENVIRONMENTAL RADIOACTIVITY LEVELS

WATTS BAR NUCLEAR PLANT

1981

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. Fuel load in unit 1 is scheduled for 1983.

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 man-made radioactivity in the environment near the plant site. This report presents the results obtained from that program during 1981.

Staffs in the Division of Occupational Health and Safety and the Office of Natural Resources carried out the sampling program outlined in tables 1 and 19. 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, and Eastern Area Radiological Laboratory (EARL) at Vonore, Tennessee, with EARL being the primary laboratory for samples from WBN. Alpha and beta analyses were performed on Beckman Low Beta II, Beckman Wide Beta II, and Tennelec LB5100 low-background proportional counters. Nuclear Data (ND) Model 100 multichannel analyzer systems employing sodium iodide, NaI(Tℓ), detectors and ND Model 4420 Systems in conjunction with germanium, Ge(Li), detection systems were used to analyze the samples for specific gamma-emitting radionuclides. At EARL, an ND Model 6620 system is used with both types of detectors. Samples of water, vegetation, air particulates, food crops, and charcoal (specific analysis for ^{131}I) are routinely counted with NaI(Tℓ) detection systems. If significant concentrations of radioisotopes are identified, or if there is a reasonable expectation of increased radioactivity levels (such as during periods of increased fallout), these samples are counted on the Ge(Li) system. Identification of gamma-emitting radionuclides in all other types of samples is routinely performed by analysis on the Ge(Li) system. TVA-fabricated and Tennelec beta-gamma coincidence counting systems are utilized for the determination of ^{131}I concentrations in milk. Tritium determinations are made with Beckman LS150, Beckman LS100C, and Packard Model 3250 liquid scintillation counting systems.

Data were entered in computer storage for processing specific to the analysis conducted. A computer, employing an ALPHA-M least-squares code, using multimatrix techniques was used to estimate the activities of the gamma-emitting nuclides analyzed by NaI(Tℓ). The data obtained by Ge(Li) detectors were resolved by the appropriate analyzer software and the metric minimization routine HYPERMET.

The detection capabilities for environmental sample analysis given as the nominal lower limits of detection (LLD) are listed in table 3. Samples processed by NaI(Tℓ) gamma spectroscopy were analyzed for 14 specific gamma-emitting radionuclides and radionuclide combinations[a]. For these analyses, radionuclide combinations such as ^{103,106}Ru and ^{95}Zr-Nb are analyzed as one radionuclide. All photopeaks found in Ge(Li) spectra were identified and quantified. Many of the isotopes identified by Ge(Li) spectral analysis are naturally occurring or naturally produced radioisotopes, such as ^{7}Be, ^{40}K, ^{212}Bi, ^{214}Bi, ^{212}Pb, ^{214}Pb, ^{226}Ra, etc. LLDs for the analysis of the radionuclides listed below[a] are given in table 3B. LLDs for additional radionuclides identified by Ge(Li) analysis were calculated for each analysis and nominal values are listed in the appropriate data tables. In the instance where an LLD has not been established, an LLD value of zero was assumed. 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 radioanalytical laboratories participate in the Environmental Radioactivity Laboratory Intercomparison Studies Program conducted by EPA-Las Vegas. This program provides periodic cross-check samples of the type and radionuclide composition normally analyzed in an environmental monitoring program. Routine sample handling and analysis procedures were employed in the evaluation of these samples. The results received during calendar year 1981 are shown in table 4. The ±3σ limits based on one measurement were divided by the square root of 3 to correct for triplicate determinations.

---

[a]The following radionuclides and radionuclide combinations are quantified by the ALPHA-M least-squares computer code: ^{141,144}Ce; ^{51}Cr; ^{131}I; ^{103,106}Ru; ^{134}Cs; ^{137}Cs; ^{95}Zr-Nb; ^{58}Co; ^{54}Mn; ^{65}Zn; ^{59}Fe; ^{60}Co; ^{40}K; and ^{140}Ba-La.

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	S					
Site N	W	W	M	M	BW	S					
Petty Farm	W	W	M	M		S	Q		M		
Spring City	W	W	M	M		S				M	
Cedine	W	W	M	M		S					
Ten Mile	W	W	M	M		S					
Decatur	W	W	M	M		S					
Goodfield	W	W	M	M		S					
Rockwood	W	W	M	M		S					
Dayton	W	W	M	M	BW	S				M	
Farm L							Q	M	M		
Control Farms							Q	M			
Onsite Wells (7)									M		
Watts Bar Reservation										M	
C. F. Industries										M	
Chickamauga/Watts Bar Reservoir											Q

W - Weekly BW - Biweekly M - Monthly (every 4 weeks) Q - Quarterly S - Semiannually

Table 2

ENVIRONMENTAL MONITORING STATION LOCATIONS

WATTS BAR NUCLEAR PLANT

Sample Station	Approximate Distance and Direction from Plant		
Indicator Stations			
LM-1 WB	1/2 mile	(3/4 kilometers)	SSW
LM-2 WB	1/2 mile	(3/4 kilometers)	N
PM-1 WB, Smith Bend (Petty Farm)	3-1/2 miles	(5-1/2 kilometers)	SW
PM-2 WB, Spring City, TN	7 miles	(11-1/4 kilometers)	NW
PM-3 WB, Cedine Camp	11-1/2 miles	(18-1/2 kilometers)	NNE
PM-4 WB, Ten Mile, TN	7-3/4 miles	(12-1/2 kilometers)	NE
PM-5 WB, Decatur, TN	6-1/4 miles	(10 kilometers)	S
PM-6 WB, Goodfield, TN	9 miles	(14-1/2 kilometers)	SSW
Farm L	1-1/2 miles	(2 kilometers)	SSW
Control Stations			
RM-1 WB, Rockwood, TN	17-1/4 miles	(27-3/4 kilometers)	NNE
RM-2 WB, Dayton, TN (Identical with RM-2S, Sequoyah Nuclear Plant)	15 miles	(24-1/4 kilometers)	SW
Farm S	19-1/2 miles	(31-1/3 kilometers)	SW
Farm B	15 miles	(24-1/4 kilometers)	E
Farm C	16 miles	(25-3/4 kilometers)	SSW

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
Total α			-	0.4	0.01				1.5	
Gross α	0.005			2.0	0.05	0.35	0.1	0.7		
Gross β	0.01		0.05	2.4	0.20	0.70	0.1	0.7	25	
^{3}H				330						
^{131}I		0.02								0.5
^{89}Sr	0.005			10	0.25	1.5	0.5	5.0	40	10
^{90}Sr	0.001			2	0.05	0.3	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

DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS

B. Gamma Analyses

NOMINAL LOWER LIMIT OF DETECTION (LLD)

	Air particulates pCi/m³		Water and milk pCi/l		Vegetation and grain pCi/g, dry		Soil and sediment pCi/g, dry		Fish pCi/g, dry		Clam flesh and plankton pCi/g, dry		Clam shells pCi/g, dry		Foods, (tomatoes potatoes, etc.) pCi/kg, wet		Meat and poultry pCi/kg, wet	
	NaI*	Ge(Li)**	NaI	Ge(Li)	NaI	Ge(Li)	NaI	Ge(Li)	NaI	Ge(Li)	NaI	Ge(Li)	NaI	Ge(Li)	NaI	Ge(Li)	NaI	Ge(Li)
^{141,144}Ce	0.03		38		0.55		0.35		0.35				0.35		38		90	
^{144}Ce		0.02		33		0.22		0.06		0.06		0.35		0.06		33		40
^{51}Cr	0.07	0.03	60	44	1.10	0.47	0.60	0.10	0.60	0.10		0.56	0.60	0.10	60	44	200	90
^{131}I	0.01	0.01	15	8	0.35	0.09	0.20	0.02	0.20	0.02		0.07	0.20	0.02	15	8	50	20
^{103,106}Ru	0.04		40		0.65		0.45		0.45				0.45		40		150	
^{106}Ru		0.03		40		0.51		0.11		0.11		0.74		0.11		40		90
^{134}Cs	0.01	0.02	10	26	0.20	0.33	0.12	0.08	0.12	0.08		0.48	0.12	0.08	10	26	40	50
^{137}Cs	0.01	0.01	10	5	0.20	0.06	0.12	0.02	0.12	0.02		0.08	0.12	0.02	10	5	40	15
^{95}Zr-Nb	0.01		10		0.20		0.12		0.12				0.12		10		40	
^{95}Zr		0.01		10		0.11		0.03		0.03		0.15		0.03		10		20
^{95}Nb		0.01		5		0.05		0.01		0.01		0.07		0.01		5		15
^{58}Co	0.02	0.01	15	5	0.23	0.05	0.20	0.01	0.20	0.01		0.07	0.20	0.01	15	5	55	15
^{54}Mn	0.02	0.01	10	5	0.20	0.05	0.15	0.01	0.15	0.01		0.08	0.15	0.01	10	5	40	15
^{65}Zn	0.02	0.01	15	9	0.25	0.11	0.23	0.02	0.23	0.02		0.17	0.23	0.02	15	9	70	20
^{60}Co	0.01	0.01	10	5	0.17	0.06	0.11	0.01	0.11	0.01		0.08	0.11	0.01	10	5	30	15
^{40}K	0.10		150		2.50		0.90		0.90				0.90		150		400	
^{140}Ba-La	0.02		15		0.68		0.15		0.15				0.15		15		50	
^{140}Ba		0.02		25		0.34		0.07		0.07		0.30		0.07		25		50
^{140}La		0.01		7		0.08		0.02		0.02		0.10		0.02		7		15

*The NaI(Tl) LLD values are calculated by the method developed by Pasternack and Harley as described in HASL-300 and Nucl. Instr. Methods 91, 533-40 (1971). 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 a given sample. Water is counted in a 3.5-L Marinelli beaker. Vegetation, fish, soil, and sediment are counted in a 1-pint container as dry weight. The average dry weight is 120 grams for vegetation and 400-500 grams for soil sediment and fish. Meat and poultry are counted in a 1-pint container as dry weight, then corrected to wet weight using an average moisture content of 70%. Average dry weight is 250 grams. Air particulates are counted in a well crystal. The counting system consists of a multichannel analyzer and either a 4" x 4" solid or 4" x 5" well NaI(Tl) crystal. The counting time is 4000 seconds. All calculations are performed by the least-squares computer program ALPHA-M. The assumption is made that all samples are analyzed within one week of the collection date.

**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 petrie dishes centered on the detector endcap. The counting system consists of a ND-4420 multichannel analyzer and either a 25%, 14%, 16%, or 29% Ge(Li) detector. The counting time is normally 8 hours. All spectral analysis is performed using the software provided with the ND-4420. The assumption is made that all samples are analyzed within one week of the collection date.
Conversion factor: 1 pCi = 3.7×10^{-2} Bq.

Table 4

Results Obtained in Interlaboratory Comparison Program

A. Air Filter (pCi/filter)

Date	Gross Alpha			Gross Beta			Strontium-90			Cesium-137		
	EPA value (±3σ)	TVA AVG. WARL[a]	EARL[b]	EPA value (±3σ)	TVA AVG. WARL	EARL	EPA value (±3σ)	TVA AVG. WARL	EARL	EPA value (±3σ)	TVA AVG. WARL	EARL
12/80	21±9	22	23	19±9	24	26	0	2	<2	19±9	20	22
3/81	30±13	31	31	50±9	55	49	18±2.6	18	15[c]	14±9	15	14
6/81	28±12	29	32	54±9	62	59	19±2.6	19	23[c]	16±9	17	18
9/81	25±11	26	25	51±9	61[c]	54	16±2.6	16	19[c]	19±9	21	20

B. Tritium in Urine (pCi/L)

Date	EPA Value (±3σ)	TVA AVERAGE	
		WARL	EARL
3/81	810±549	713	390
6/81	1600±585	1637	1830[d]
9/81	2050±599	2103	-[e]
11/81	2700±615	2573	2623

a. Western Area Radiological Laboratory, Muscle Shoals, Alabama
b. Eastern Area Radiological Laboratory, Vonore, Tennessee
c. Efficiency curves were checked and known spikes were run. Everything found was within acceptable limits. We are awaiting the next cross-check for further investigation.
d. Results were mailed to EPA but not reported by them.
e. Sample was lost in analysis. There was insufficient time to obtain another sample from EPA and reanalyze.

Table 4 (Contd)

Results Obtained in Interlaboratory Comparison Program

E. Milk (pCi/L)[k]

Date	Strontium - 89			Strontium - 90			Iodine - 131			Cesium - 137			Barium - 140			Potassium			Cobalt - 60		
	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL
1/81	0	<10[e]	<10	20±5.2	21[e]	20	26±17	24	21	43±16	40	41	0	<25	<15	1550±232	1490	1453			
4/81	25±9		28	11±2.6		13	26±10	21	29	22±9	21	24	0	<15	<15	1559±135	1513	1674			
7/81	25±9	23	30	17±2.6	14[m]	16	.01±	<15	<15	31±9	32	32	0	<15	<15	1600±139	1623	1620			
10/81	23±9	25	28	18±2.6	17	16	52±10	49[n]	47	25±9	27	27				1530±133	1620	1500			

F. Foods (pCi/kg, Wet Weight)[o]

3/81	47±9	42	44	29±2.8	38[p]	21[p]	119±21	126	121[q]	53±9	56	55[q]	0	<15	<15	2640±229	2857	2917			
7/81	44±9	53	51	31±2.8	31	32	82±14	80	106[q]	45±9	43	54[q]	0	<25	<25	2640±229	2870	3437			
11/81	38±9	49[p]	54[p]	23±2.6	25	22	None			33±9	29	35	0	<15	<25	2730±237	2820[r]	2720	30±9	25	32

k. Values for potassium are reported as mg/liter of sample.
m. Results were marginally out of limits. Efficiency curves were checked with no conclusive findings. Subsequent results have been satisfactory.
n. Only two results were sent to EPA. Results were not included in their analysis.
o. Values for potassium are reported as mg/kg sample.
p. Investigation of this problem was initiated but no satisfactory conclusions have been reached. We suspect difficulties arising from sample inhomogeniety.
q. An incorrect weight was obtained in the gamma analysis of this sample. Further analysis destroyed the sample so that the correct weight could not be determined.
r. Investigation was conducted. No satisfactory explanation was found. Other cross-checks on this isotope in different media are satisfactory.

Table 4 (Contd)

Results Obtained in Interlaboratory Comparison Program

C. Radiochemical Analyses of Water (pCi/L)

Date	Gross Alpha			Gross Beta			Strontium - 89			Strontium - 90			Tritium			Iodine - 131[f]		
	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL
1/81	9±9	10	9	44±9	49	49	16±9	11	14	34±3.1	38[g]	28[h]						
2/81													1760±591	1917	1753			
3/81	25±10	23	15[i]	25±9	26	29												
4/81													2710±615	2467	2723	30±10	32	28
5/81	21±9	21	14	14±9	14	16	36±9	40	33	22±2.6	21	22						
6/81													1950±596	1990	1947			
7/81	22±10	20	22	15±9	15	18												
8/81													2630±613	2623	2713	73±13	79	73
9/81	33±14	29	18[i]	28±9	29	26	23±9	26	23	11±2.6	11	10						
10/81													2210±603	2263	2197			
11/81	21±9	21	13	23±9	18	24												
12/81													2700±615	2717	2807	76±13	65	56[j]

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

Date	Chromium - 51			Cobalt - 60			Zinc - 65			Ruthenium - 106			Cesium - 134			Cesium - 137		
	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL	EPA value (±3σ)	TVA WARL	AVG. EARL
2/81	0	<60	<60	25±9	25	25	85±9	84	83	0	<40	<40	36±9	39	35	4±9	6	10
6/81	0	<60	<60	17±9	18	17	0	<15	<15	15±9	<40	<40	21±9	23	21	31±9	27	30
10/81	34±9	<60	<60	22±9	25	22	24±9	26	21	0	<40	<40	21±9	21	24	32±9	35	32

f. Specific analysis for ^{131}I to test the procedures used for the analysis of milk.
g. Investigations of the analytical procedure were conducted and new efficiency curves were determined. Results have been satisfactory since that time.
h. New efficiency curves were determined subsequent to this analysis. Subsequent results were satisfactory.
i. Excess humidity in counting room and a change in the amount of solid introduced into the sample by EPA are suspected in the difficulty with this sample type. Steps have been taken to correct or compensate for these items.
j. Results are possibly due to an incorrect chemical form of the precipitate counted in this procedure. Investigations continue.

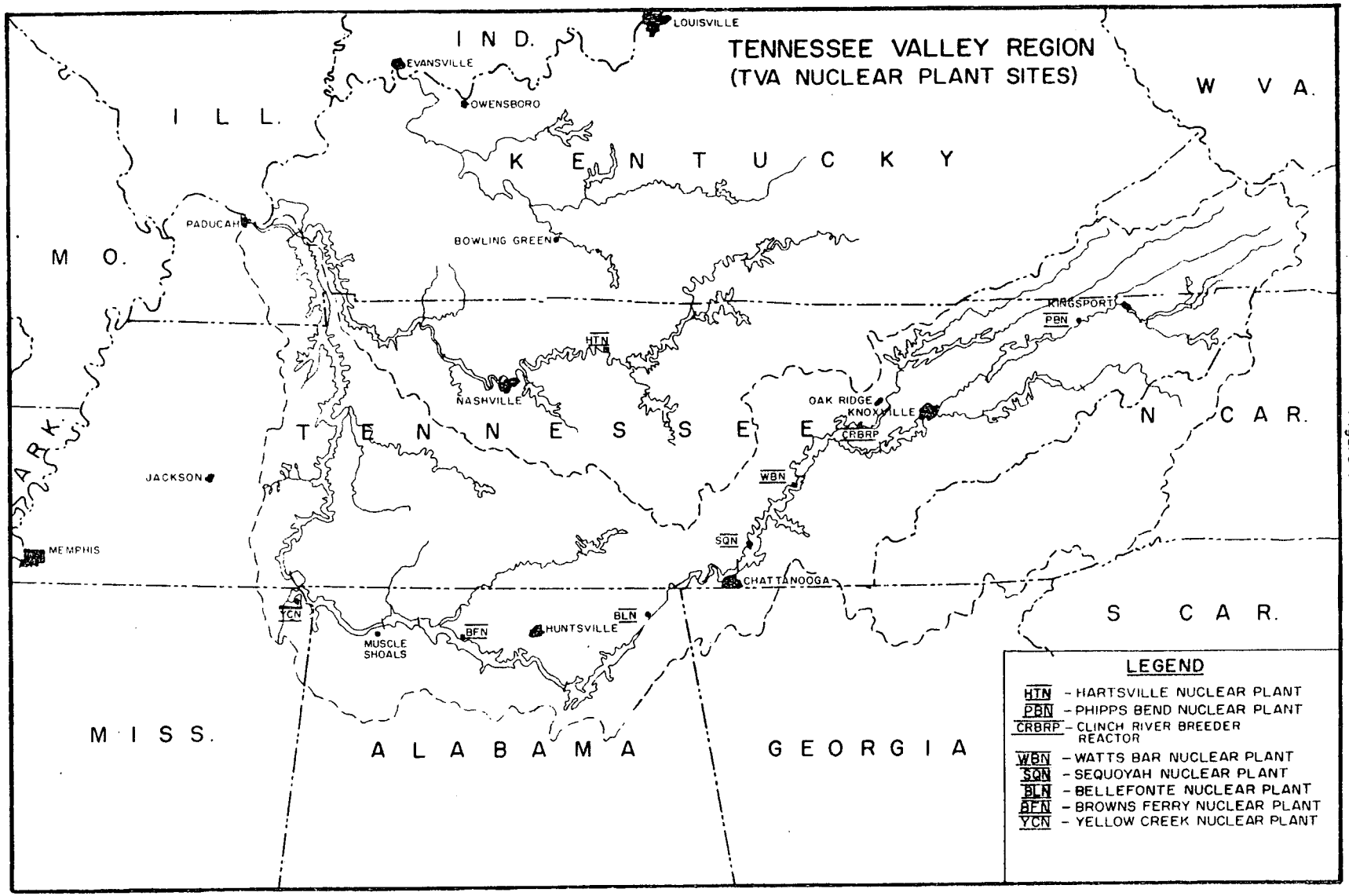

TENNESSEE VALLEY REGION
(TVA NUCLEAR PLANT SITES)
LOUISVILLE
IND.
EVANSVILLE
OWENSBORO
ILL.
W VA.
KENTUCKY
PADUCAH
BOWLING GREEN
MO.
KINGSPORT
PBN
HTN
NASHVILLE
OAK RIDGE
KNOXVILLE
CRBRP
ARK.
TENNESSEE
N CAR.
JACKSON
WBN
MEMPHIS
SQN
CHATTANOOGA
YCN
BLN
BFN
HUNTSVILLE
MUSCLE SHOALS
S CAR.
MISS.
ALABAMA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

Figure 1

Atmospheric Monitoring

The atmospheric monitoring network is divided into three subgroups. Two local air monitors are located within the plant boundary. Six perimeter air monitors are located at distances out to 11 miles (18 kilometers) from the plant in the towns of Spring City and Decatur, and four other populated areas. The remote air monitors are located at distances out to 17 miles (27 kilometers) from the plant in the towns of Dayton and Rockwood. See table 2 and figures 2, 3, and 7.

At each monitor, air is continuously pulled through a Hollingsworth and Vose LB 5211 glass fiber filter at a regulated flow of 3 ft^3/min (0.085 m^3/min). In series with, but downstream of, the particulate filter, is a charcoal filter used to collect iodine. Each monitor has a collection tray and storage container to collect rainwater on a continuous basis, and a horizontal platform covered with gummed acetate to catch and hold heavy particle fallout. Moisture is collected from the atmosphere at each local monitor and at one remote monitor and analyzed for tritium.

Each of the local and perimeter air monitors is fitted with a GM tube that continuously scans the particulate filter. The disintegration rate of the atmospheric radioactivity is continuously recorded at each station. The data from the two local monitors and from perimeter monitors (PM) 1, 2, 4, and 5 are radiotelemetered into the plant control room.

Air filters are collected weekly and analyzed for gross beta activity. During this period, five samples were not obtained because of equipment malfunction. No analyses are performed until three days after sample collection. The samples are composited monthly for analysis of specific gamma-emitting radionuclides and quarterly for ^{89}Sr, ^{90}Sr analysis. The results are presented in table 6.

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 1981 are presented in figure 4. Increased levels due to fallout from atmospheric nuclear weapons testing are evident, especially in 1977, 1978, and 1981. These fluctuations are consistent with data from monitoring programs conducted by TVA at other nuclear power plant sites.

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

Rainwater is collected and analyzed for specific gamma-emitting isotopes and strontium. In addition, samples from one of the control stations, which is also a part of the Sequoyah Nuclear Plant monitoring program, were analyzed for gross beta and tritium activity. During this period, three samples contained insufficient volume for any analyses. For the gross beta analysis, a maximum of 500 ml of the sample is boiled to dryness and counted. A gamma scan is performed on a 3.5-liter monthly sample. The strontium isotopes are separated chemically and counted in a low background system. The results are shown in table 7.

The gummed acetate that is used to collect heavy particle fallout is changed monthly. The samples are ashed and counted for gross beta activity. The results are given in table 8. During this reporting period, one sample was damaged to the extent that no analysis could be conducted.

Charcoal filters are collected and analyzed for radioiodine. During this period, six samples were not obtained because of equipment malfunction. The filter is counted in a single channel analyzer system. The data are shown in table 9.

An atmospheric moisture collection device containing molecular sieve is located at each local monitor and at one remote monitor. Samples are taken every other week, the moisture driven off the molecular sieve, collected in a cold trap, distilled, and counted for tritium content. The results are shown in table 10. During this reporting period, twelve samples were not obtained because of equipment malfunction, and four samples were lost during analysis.

In late September the levels of tritium measured in the atmosphere increased from 6-10 pCi/m^3 up to 100-400 pCi/m^3. Efforts were made to determine the cause of the increases but without success. From November 17, 1981 through the end of the year, samples were collected weekly at each station. The levels remained somewhat elevated but decreased to around 20 pCi/m^3 by the end of the year. The highest concentration measured is only 0.2 percent of the MPC for tritium in air as shown in table 5.

Table 5

MAXIMUM PERMISSIBLE CONCENTRATIONS

FOR NONOCCUPATIONAL EXPOSURE

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

*1 pCi = 3.7×10^{-2} Bq.

TABLE 6

RADIOACTIVITY IN AIR FILTER

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

NAME OF FACILITY WATTS BAR
LOCATION OF FACILITY RHEA TENNESSEE

DOCKET NO. TVA/OMS/OHS-82/9
REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN: NAME, DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA 515	0.010	0.09(411/ 411) 0.01- 0.38	PM1 PETTY FARM 3.75 MILES WSW	0.10(52/ 52) 0.02- 0.38	0.09(104/ 104) 0.01- 0.34	
GAMMA (GELI) 130						
CE-141	0.010	0.01(15/ 104) 0.01- 0.02	LM2 N. WBSP GATE 0.5 MILES N	0.01(2/ 13) 0.01- 0.02	0.01(3/ 26) 0.01- 0.01	
CE-144	0.020	0.03(21/ 104) 0.02- 0.05	PM4 TEN MILE 7.75 MILES NE	0.04(2/ 13) 0.03- 0.04	0.03(6/ 26) 0.02- 0.04	
RU-103	NOT ESTAB	0.01(46/ 104) 0.00- 0.03	PM6 GOODFIELD 9.0 MILES SSW	0.02(5/ 13) 0.01- 0.03	0.01(11/ 26) 0.00- 0.02	
CS-137	NOT ESTAB	0.00(1/ 104) 0.00- 0.00	LM2 N. WBSP GATE 0.5 MILES N	0.00(1/ 13) 0.00- 0.00	0.00(1/ 26) 0.00- 0.00	
ZR-95	0.010	0.03(46/ 104) 0.01- 0.06	PM3 CEDINE BIBLE CAMP 11.5 M. NNE	0.03(6/ 13) 0.01- 0.06	0.02(13/ 26) 0.01- 0.05	
NB-95	0.010	0.04(55/ 104) 0.01- 0.11	PM6 GOODFIELD 9.0 MILES SSW	0.05(7/ 13) 0.01- 0.11	0.04(14/ 26) 0.01- 0.09	
K-40	NOT ESTAB	0.02(67/ 104) 0.00- 0.07	PM5 DECATUR 6.25 MILES S	0.03(10/ 13) 0.01- 0.05	0.02(10/ 26) 0.00- 0.05	
BI-214	0.020	0.03(20/ 104) 0.02- 0.05	PM2 SPRING CITY 7.0 MILES NW	0.04(3/ 13) 0.02- 0.05	0.03(6/ 26) 0.02- 0.04	
PB-214	0.020	0.03(19/ 104) 0.02- 0.04	PM3 CEDINE BIBLE CAMP 11.5 M. NNE	0.04(1/ 13) 0.04- 0.04	0.02(4/ 26) 0.02- 0.03	
PB-212	NOT ESTAB	0.00(31/ 104) 0.00- 0.00	PM2 SPRING CITY 7.0 MILES NW	0.00(4/ 13) 0.00- 0.00	0.00(9/ 26) 0.00- 0.00	
BE-7	0.050	0.06(67/ 104) 0.05- 0.09	PM3 CEDINE BIBLE CAMP 11.5 M. NNE	0.07(7/ 13) 0.05- 0.08	0.06(15/ 26) 0.05- 0.09	
TL-208	NOT ESTAB	0.00(37/ 104) 0.00- 0.00	LM1 ENV DATA STA 0.5 MILES SSW	0.00(4/ 13) 0.00- 0.00	0.00(9/ 26) 0.00- 0.00	
AC-228	NOT ESTAB	0.00(11/ 104) 0.00- 0.01	LM2 N. WBSP GATE 0.5 MILES N	0.01(1/ 13) 0.01- 0.01	0.01(2/ 26) 0.00- 0.01	
PA-234M	NOT ESTAB	0.60(1/ 104) 0.60- 0.60	PM2 SPRING CITY 7.0 MILES NW	0.60(1/ 13) 0.60- 0.60	0.73(1/ 26) 0.73- 0.73	
SR 89 40	NOT ESTAB	0.00(32/ 32) 0.00- 0.01	PM3 CEDINE BIBLE CAMP 11.5 M. NNE	0.01(4/ 4) 0.00- 0.01	0.00(8/ 8) 0.00- 0.01	
SR 90 40	0.001	0.00(8/ 32) 0.00- 0.00	PM2 SPRING CITY 7.0 MILES NW	0.00(1/ 4) 0.00- 0.00	0.00(1/ 8) 0.00- 0.00	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements of specified locations is indicated in parentheses (F).

TABLE 7

RADIOACTIVITY IN RAINWATER

PCI/L - 0.037 BQ/L

NAME OF FACILITY WATTS BAR
LOCATION OF FACILITY RHEA TENNESSEE

DOCKET NO. IVA/OMS/OHS-82/9
REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN: NAME, DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA	2.400				20.01(10/ 12)	
12					5.83- 42.28	
GAMMA (NAI)						
78						
CS-137	NOT ESTAB	4.11(23/ 63)	PM5 DECATUR	5.00(1/ 5)	3.98(6/ 15)	
		2.40- 7.40	6.25 MILES S	5.00- 5.00	2.90- 5.70	
MN-54	NOT ESTAB	1.64(16/ 63)	PM1 PETTY FARM	2.30(1/ 8)	2.30(3/ 15)	
		0.20- 4.20	3.75 MILES WSW	2.30- 2.30	0.90- 3.10	
FE-59	NOT ESTAB	5.02(19/ 63)	PM2 SPRING CITY	9.20(1/ 7)	3.19(9/ 15)	
		1.50- 9.20	7.0 MILES NW	9.20- 9.20	0.60- 6.30	
BE-7	NOT ESTAB	56.23(50/ 63)	PM4 TEN MILE	61.73(7/ 8)	51.15(11/ 15)	
		14.30- 101.60	7.75 MILES NE	19.60- 101.60	18.40- 97.90	
GAMMA (GELI)						
49						
RU-103	NOT ESTAB	6.42(10/ 40)	PM1 PETTY FARM	10.65(1/ 5)	9.32(4/ 9)	
		3.22- 10.93	3.75 MILES WSW	10.65- 10.65	4.42- 14.41	
ZR-95	10.000	11.26(4/ 40)	PM2 SPRING CITY	11.61(2/ 6)	17.03(2/ 9)	
		10.66- 12.43	7.0 MILES NW	10.79- 12.43	14.19- 19.87	
NB-95	5.000	7.85(10/ 40)	PM1 PETTY FARM	12.31(1/ 5)	15.88(3/ 9)	
		5.40- 12.31	3.75 MILES WSW	12.31- 12.31	6.51- 32.74	
K-40	NOT ESTAB	23.70(16/ 40)	LM2 N. WBSP GATE	45.29(2/ 4)	18.28(3/ 9)	
		3.21- 85.47	0.5 MILES N	5.11- 85.47	4.64- 33.08	
BI-214	NOT ESTAB	6.94(17/ 40)	PM1 PETTY FARM	14.29(2/ 5)	13.65(7/ 9)	
		0.02- 20.17	3.75 MILES WSW	12.04- 16.54	1.73- 32.33	
PB-214	NOT ESTAB	9.00(6/ 40)	PM4 TEN MILE	14.33(1/ 5)	8.23(3/ 9)	
		2.66- 14.33	7.75 MILES NE	14.33- 14.33	0.31- 17.37	
PB-212	NOT ESTAB	2.26(14/ 40)	LM2 N. WBSP GATE	9.46(1/ 4)	0.03(1/ 9)	
		0.02- 9.46	0.5 MILES N	9.46- 9.46	0.03- 0.03	
BE-7	NOT ESTAB	44.77(15/ 40)	PM4 TEN MILE	50.58(2/ 5)	42.15(4/ 9)	
		25.86- 66.16	7.75 MILES NE	41.68- 59.48	34.05- 46.98	
SR 89	10.000	12.40(24/ 103)	PM3 CEDINE BIBLE	13.23(2/ 13)	13.23(5/ 24)	
127		10.21- 15.49	CAMP 11.5 M. NNE	12.95- 13.51	10.66- 16.65	
SR 90	2.000	103 VALUES <LLD			24 VALUES <LLD	
127		ANALYSIS PERFORMED				
TRITIUM	330.000				375.14(1/ 12)	
12					375.14- 375.14	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements of 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
LOCATION OF FACILITY RHEA TENNESSEE

DOCKET NO. IVA/OMS/OHS-82/9
REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN: NAME, DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA 129	0.050	0.82(103/ 103) 0.06- 2.97	LM2 N. WBSP GATE 0.5 MILES N	1.10(13/ 13) 0.10- 2.97	0.90(26/ 26) 0.09- 2.71	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements of specified locations is indicated in parentheses (F).

TABLE 9

RADIOACTIVITY IN CHARCOAL FILTERS

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

NAME OF FACILITY WATTS BAR — DOCKET NO. IVA/OMS/OHS-82/3

LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN: NAME, DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
IODINE IN AIR	0.020	0.03(33/ 410)	PM3 CEDINF BIBLE	0.03(3/ 52)	0.03(3/ 104)	
514		0.02- 0.04	CAMP 11.5 M. NNE	0.02- 0.04	0.02- 0.04	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements of specified locations is indicated in parentheses (F).

TABLE 10

RADIOACTIVITY IN ATMOSPHERIC MOISTURE

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

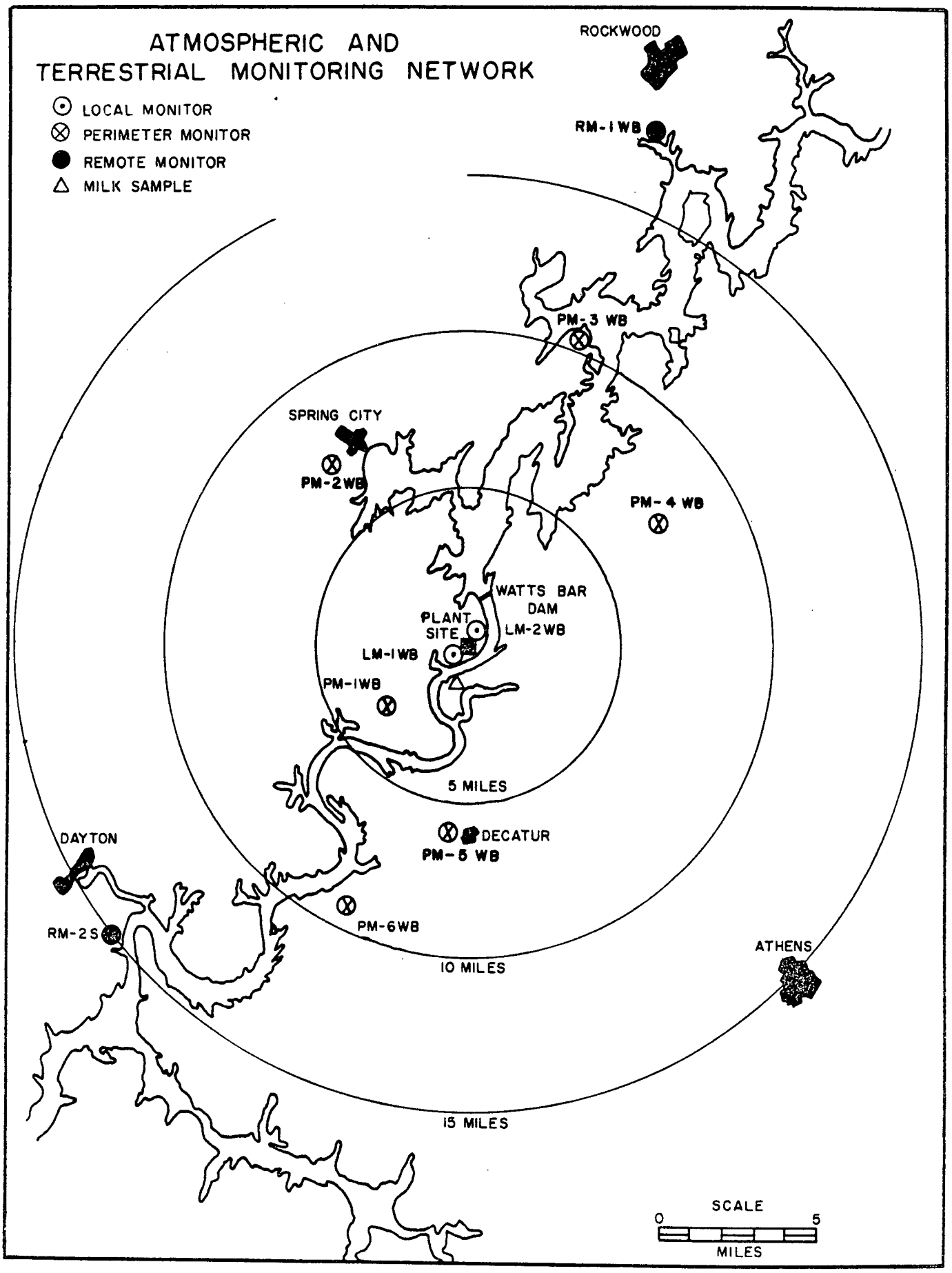
NAME OF FACILITY WATTS BAR
LOCATION OF FACILITY RHEA TENNESSEE

DOCKET NO. TVA/OMS/OHS-82/9
REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN: NAME, DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS[b] MEAN (F) RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
TRITIUM 71	NOT ESTAB	17.21(51/ 51) 0.03- 128.29	LM2 N. ABSP GATE 0.5 MILES N	20.09(24/ 24) 0.87- 80.64	41.21(20/ 20) 0.16- 409.43	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements of specified locations is indicated in parentheses (F).

Figure 2



(1 mile - 1.6 kilometers)

Figure 3

WATTS BAR NUCLEAR PLANT
SITE MONITORING STATIONS

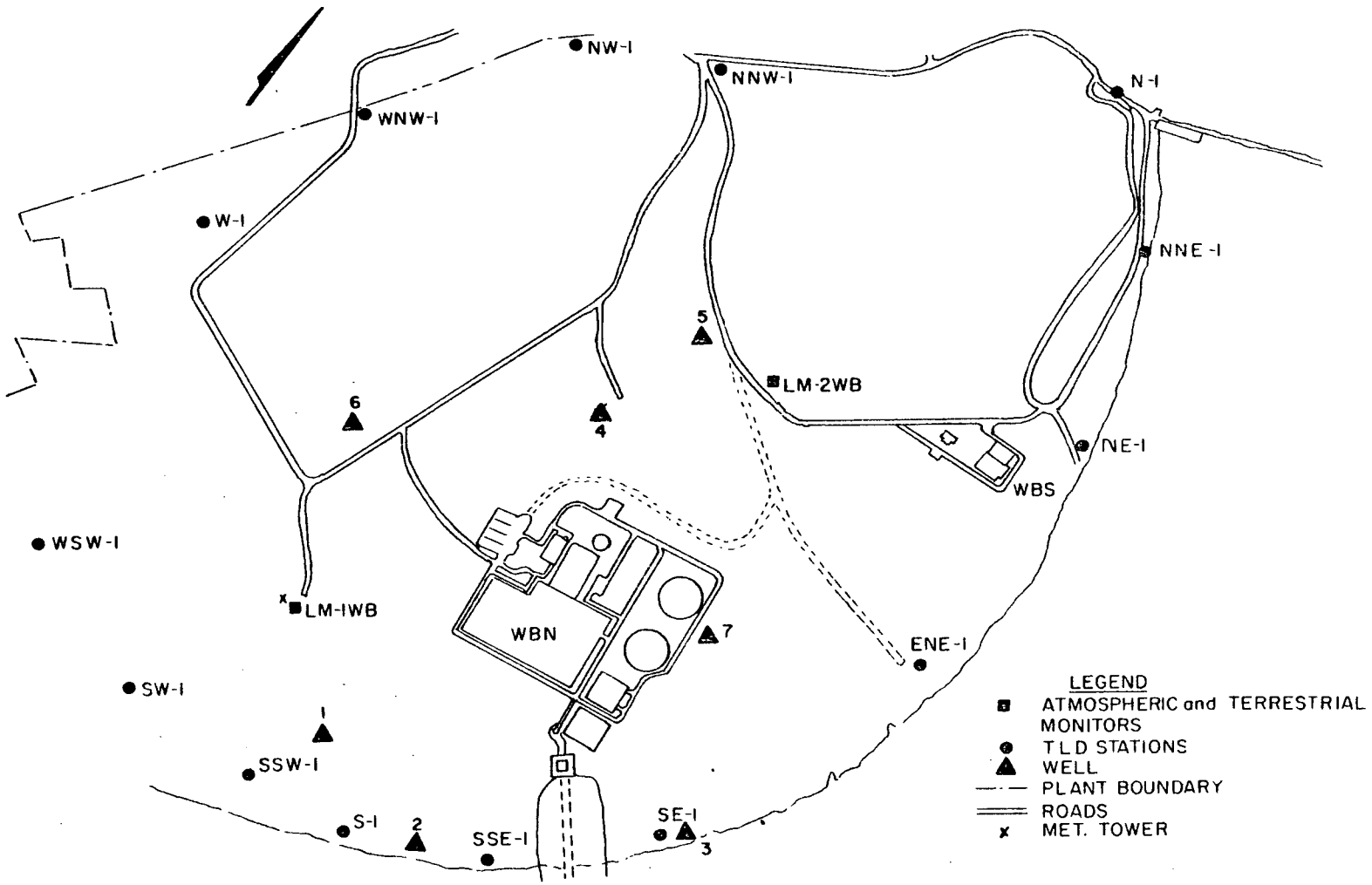
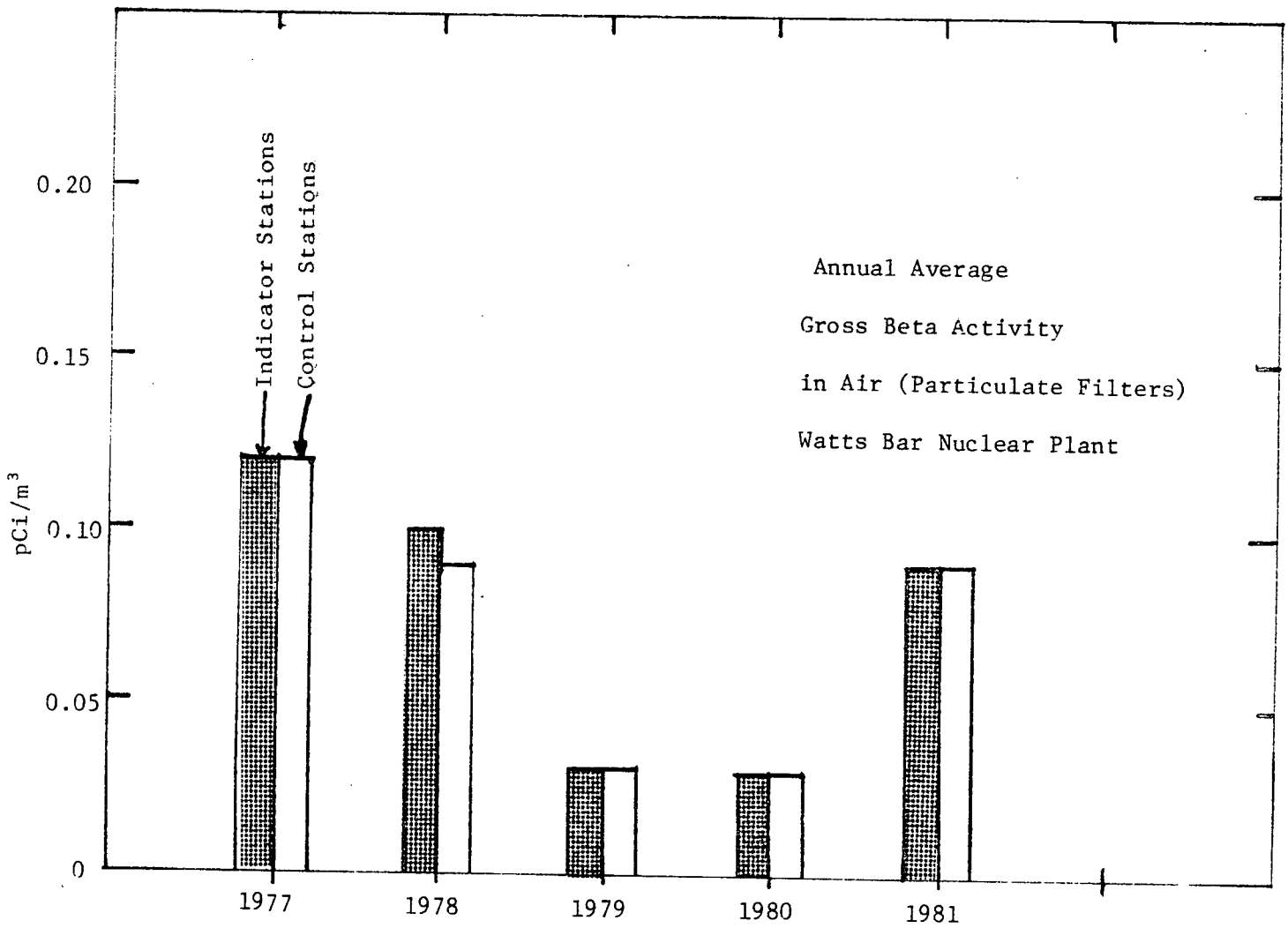


Figure 4


Indicator Stations
Control Stations
Annual Average
Gross Beta Activity
in Air (Particulate Filters)
Watts Bar Nuclear Plant
pCi/m³
0.20
0.15
0.10
0.05
0
1977
1978
1979
1980
1981

Terrestrial Monitoring

Milk

Milk was collected monthly from one dairy farm within a five-mile radius of the plant (figure 2), and from at least one of three control dairy farms. The three control farms are also controls for Sequoyah Nuclear Plant (SQN). Since this plant is operating, milk samples are collected weekly for ^{131}I analysis with monthly analyses for gamma-emitting radionuclides and strontium. The results are shown in table 11.

Vegetation

Vegetation samples were collected quarterly from the farms from which milk was collected and analyzed for gamma-emitting radionuclides, ^{89}Sr, and ^{90}Sr content. In June 1981 sampling frequency was increased to monthly at the three control stations in support of the SQN monitoring program. In addition, gross alpha and gross beta analyses were performed on samples from the dairy farm near the plant. Approximately 1-2 kilograms of grass was broken or cut at ground level and returned for analysis. Efforts were made to sample vegetation that was representative of the pasturage where cattle graze. Table 12 gives the results obtained from the laboratory analyses.

Soil

Soil samples were collected semiannually near each monitoring station to provide an indication of any long-term buildup of radioactivity in the environment. One additional sample was taken at the control station used in the SQN monitoring program. An auger or "cookie cutter" type sampler was used to obtain samples of the top two inches (5 cm) of soil. These samples were analyzed for gamma-emitting radionuclides, ^{89}Sr, and ^{90}Sr. In addition, one sample from each station and two samples from the SQN control station were analyzed for gross beta. The results are given in table 13.

Ground Water

Well water was obtained monthly from two farms in the area and from six onsite wells. All samples were analyzed for gamma-emitting radionuclides and a quarterly composite was analyzed for tritium. The results are shown in table 14. During this reporting period, two samples were not taken because the stations were inaccessible, and one sample was not available for tritium analysis.

An automatic sequential-type sampling device was installed on a seventh well located downgradient from WBN, and sampling was begun in June 1981.

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, ^{89}Sr, and ^{90}Sr concentrations are determined in quarterly composite samples. One potable water supply downstream from the plant is equipped with an automatic sampler with composite samples analyzed monthly. Three additional water supplies are sampled monthly by the collection of grab samples. An automatic sampler was installed on the other downstream water supply in May 1981. Grab sampling was discontinued and automatic sampling begun the first week of June 1981. The results are shown in table 15.

Figure 5 shows the trends in gross beta activity in drinking water from 1977 through 1981. The annual averages 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 one 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 TLDs are exchanged every three 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 2-5 mR/quarter higher than levels at offsite stations. This is consistent with levels reported in other preoperational 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 1981. To reduce the variations present in the data sets, a four-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.

Poultry, and Food Crops

Food crops and beef raised in the vicinity of WBN are sampled annually as they become available during the growing season. During this sampling period, samples of apples, cabbage, corn, green beans, potatoes, tomatoes, turnip greens, and beef were collected and analyzed for gross beta and specific gamma-emitting radionuclides. The results are given in tables 17, and 18. No sample of beef was taken from a control location.

TABLE 11

RADIOACTIVITY IN MILK

PCI/L - 0.037 BQ/L

NAME OF FACILITY WATTS BAR
LOCATION OF FACILITY RHEA TENNESSEE

DOCKET NO. TVA/OMS/OHS-82/9
REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN: NAME DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA (NAI) 50						
K-40	150.000	1303.47(13/ 13) 1178.10- 1375.60	LAYMAN FARM 1.5 MILES SSW	1303.47(13/ 13) 1178.10- 1375.60	1283.73(37/ 37) 1107.10- 1420.80	
IODINE IN MILK 169	0.500	13 VALUES <LLD ANALYSIS PERFORMED			156 VALUES <LLD	
GAMMA (GELI) 2						
K-40	NOT ESTAB				1315.59(2/ 2) 1290.04- 1341.13	
PB-212	NOT ESTAB				0.71(2/ 2) 0.56- 0.86	
TL-208	NOT ESTAB				0.00(1/ 2) 0.00- 0.00	
SR 89	10.000	13 VALUES <LLD ANALYSIS PERFORMED			39 VALUES <LLD	
SR 90 52	2.000	2.91(10/ 13) 2.28- 3.88	LAYMAN FARM 1.5 MILES SSW	2.91(10/ 13) 2.28- 3.88	2.98(29/ 39) 2.03- 4.15	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements of 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. TVA/OMS/OHS-82/9

LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN: NAME, DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS ALPHA 4	0.050				7.67(4/ 4) 3.67- 9.36	
GROSS BETA 4	0.200				42.66(4/ 4) 24.81- 64.44	
GAMMA (GELI) 34						
CE-141	0.200	0.98(4/ 6) 0.21- 1.98	PM1 PETTY FARM 3.75 MILES WSW	1.10(2/ 2) 0.21- 1.98	0.53(7/ 28) 0.21- 1.39	
CE-144	0.220	1.47(6/ 6) 0.41- 2.98	PM1 PETTY FARM 3.75 MILES WSW	2.21(2/ 2) 1.44- 2.98	1.06(20/ 28) 0.32- 2.76	
PR-144	NOT ESTAB	6 VALUES <LLD			4.14(1/ 28) 4.14- 4.14	
RU-103	0.200	0.76(4/ 6) 0.21- 1.42	PM1 PETTY FARM 3.75 MILES WSW	0.82(2/ 2) 0.21- 1.42	0.51(5/ 28) 0.20- 1.22	
RU-106	0.510	0.73(1/ 6) 0.73- 0.73	PM1 PETTY FARM 3.75 MILES WSW	0.73(1/ 2) 0.73- 0.73	0.53(1/ 28) 0.53- 0.53	
CS-137	0.060	0.12(6/ 6) 0.08- 0.18	PM1 PETTY FARM 3.75 MILES WSW	0.14(2/ 2) 0.11- 0.18	0.11(12/ 28) 0.06- 0.28	
ZR-95	0.110	1.70(4/ 6) 0.77- 3.04	PM1 PETTY FARM 3.75 MILES WSW	1.91(2/ 2) 0.77- 3.04	0.75(14/ 28) 0.12- 2.74	
NB-95	0.050	2.18(6/ 6) 0.14- 5.51	PM1 PETTY FARM 3.75 MILES WSW	3.52(2/ 2) 1.53- 5.51	0.92(22/ 28) 0.06- 4.76	
K-40	NOT ESTAB	23.33(6/ 6) 4.22- 42.70	LAYMAN FARM 1.5 MILES SSW	27.16(4/ 4) 14.70- 42.70	18.58(28/ 28) 2.90- 43.53	
MN-54	0.050	0.06(1/ 6) 0.06- 0.06	LAYMAN FARM 1.5 MILES SSW	0.06(1/ 4) 0.06- 0.06	0.06(2/ 28) 0.05- 0.07	
BI-214	0.100	0.17(3/ 6) 0.10- 0.28	PM1 PETTY FARM 3.75 MILES WSW	0.28(1/ 2) 0.28- 0.28	0.22(11/ 28) 0.10- 0.53	
PB-214	NOT ESTAB	0.08(2/ 6) 0.02- 0.14	LAYMAN FARM 1.5 MILES SSW	0.08(2/ 4) 0.02- 0.14	0.11(18/ 28) 0.02- 0.37	
PB-212	NOT ESTAB	0.05(5/ 6) 0.01- 0.11	LAYMAN FARM 1.5 MILES SSW	0.06(3/ 4) 0.03- 0.11	0.05(19/ 28) 0.00- 0.32	
BE-7	NOT ESTAB	4.52(6/ 6) 0.41- 10.77	PM1 PETTY FARM 3.75 MILES WSW	7.11(2/ 2) 3.45- 10.77	4.20(28/ 28) 1.21- 9.13	
TL-208	NOT ESTAB	0.02(4/ 6) 0.01- 0.04	LAYMAN FARM 1.5 MILES SSW	0.02(3/ 4) 0.01- 0.04	0.02(18/ 28) 0.00- 0.12	
AC-228	NOT ESTAB	0.10(4/ 6) 0.03- 0.19	LAYMAN FARM 1.5 MILES SSW	0.12(3/ 4) 0.08- 0.19	0.12(12/ 28) 0.03- 0.35	
SR 89 16	0.250	1.64(3/ 6) 0.43- 2.52	PM1 PETTY FARM 3.75 MILES WSW	2.52(1/ 2) 2.52- 2.52	0.97(5/ 10) 0.39- 2.03	
SR 90 16	0.050	0.23(6/ 6) 0.13- 0.34	PM1 PETTY FARM 3.75 MILES WSW	0.30(2/ 2) 0.27- 0.34	0.15(10/ 10) 0.06- 0.25	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.

b. Mean and range based upon detectable measurements only. Fraction of detectable measurements of specified locations is indicated in parentheses (F).

TABLE 13

RADIOACTIVITY IN SOIL

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

NAME OF FACILITY WATTS BAR
LOCATION OF FACILITY AREA TENNESSEE

DOCKET NO. IVA/OMS/OMS-82/9
REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]		LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]		CONTROL LOCATIONS MEAN (F)[b] RANGE[b]		NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA 12	0.700	22.97(8/ 8)		PM2 SPRING CITY	43.02(	1/ 1)	11.22(	4/ 4)	
		13.51-	43.02	7.0 MILES NW	43.02-	43.02	9.01-	16.24	
GAMMA (GELI) 21									
CE-144	0.060	0.15(	3/ 16)	LM1 ENV DATA STA	0.17(	1/ 2)	0.12(	1/ 5)	
		0.13-	0.17	0.5 MILES SSW	0.17-	0.17	0.12-	0.12	
RU-103	NOT ESTAB	0.04(	1/ 16)	PM3 CEDINE BIBLE	0.04(	1/ 2)	5 VALUES <LLD		
		0.04-	0.04	CAMP 11.5 M. NNE	0.04-	0.04			
CS-137	NOT ESTAB	0.65(	16/ 16)	PM2 SPRING CITY	1.65(	2/ 2)	0.35(	5/ 5)	
		0.17-	2.44	7.0 MILES NW	0.86-	2.44	0.16-	0.59	
ZR-95	0.030	0.11(	5/ 16)	PM2 SPRING CITY	0.14(	1/ 2)	0.04(	3/ 5)	
		0.07-	0.14	7.0 MILES NW	0.14-	0.14	0.03-	0.07	
NB-95	0.010	0.12(	10/ 16)	PM3 CEDINE BIBLE	0.24(	1/ 2)	0.07(	4/ 5)	
		0.02-	0.24	CAMP 11.5 M. NNE	0.24-	0.24	0.02-	0.12	
K-40	0.250	7.91(	16/ 16)	PM2 SPRING CITY	14.91(	2/ 2)	3.35(	5/ 5)	
		2.65-	20.42	7.0 MILES NW	9.40-	20.42	2.36-	5.69	
MN-54	0.010	0.02(	2/ 16)	PM3 CEDINE BIBLE	0.02(	1/ 2)	0.02(	1/ 5)	
		0.02-	0.02	CAMP 11.5 M. NNE	0.02-	0.02	0.02-	0.02	
BI-214	0.050	0.82(	16/ 16)	PM1 PETTY FARM	0.97(	2/ 2)	0.80(	5/ 5)	
		0.56-	1.52	3.75 MILES WSW	0.92-	1.02	0.66-	1.11	
BI-212	NOT ESTAB	1.23(	16/ 16)	PM5 DECATUR	1.49(	2/ 2)	0.75(	5/ 5)	
		0.72-	1.58	6.25 MILES S	1.44-	1.53	0.57-	1.02	
PB-214	0.050	0.91(	16/ 16)	PM1 PETTY FARM	1.05(	2/ 2)	0.86(	5/ 5)	
		0.64-	1.58	3.75 MILES WSW	1.02-	1.08	0.71-	1.20	
PB-212	NOT ESTAB	1.11(	16/ 16)	PM5 DECATUR	1.34(	2/ 2)	0.66(	5/ 5)	
		0.69-	1.45	6.25 MILES S	1.23-	1.45	0.54-	0.87	
RA-226	0.050	0.82(	16/ 16)	PM1 PETTY FARM	0.97(	2/ 2)	0.80(	5/ 5)	
		0.56-	1.52	3.75 MILES WSW	0.92-	1.02	0.66-	1.11	
RA-224	NOT ESTAB	1.14(	15/ 16)	PM5 DECATUR	1.53(	1/ 2)	0.87(	4/ 5)	
		0.69-	1.53	6.25 MILES S	1.53-	1.53	0.65-	1.18	
BE-7	0.160	0.30(	2/ 16)	PM3 CEDINE BIBLE	0.33(	1/ 2)	0.16(	1/ 5)	
		0.26-	0.33	CAMP 11.5 M. NNE	0.33-	0.33	0.16-	0.16	
TL-208	NOT ESTAB	0.34(	16/ 16)	PM1 PETTY FARM	0.39(	2/ 2)	0.21(	5/ 5)	
		0.21-	0.43	3.75 MILES WSW	0.38-	0.40	0.16-	0.27	
AC-228	NOT ESTAB	1.04(	16/ 16)	LM1 ENV DATA STA	1.27(	2/ 2)	0.62(	5/ 5)	
		0.62-	1.37	0.5 MILES SSW	1.17-	1.37	0.51-	0.72	
PA-234M	NOT ESTAB	2.76(	11/ 16)	PM4 TEN MILE	3.69(	2/ 2)	2.80(	3/ 5)	
		1.65-	4.31	7.75 MILES NE	3.07-	4.31	1.89-	4.23	
SR-89	NOT ESTAB	1.04(	16/ 16)	PM5 DECATUR	1.82(	2/ 2)	0.49(	5/ 5)	
		0.07-	2.90	6.25 MILES S	0.73-	2.90	0.18-	0.84	
SR-90 21	0.300	0.32(	1/ 16)	PM2 SPRING CITY	0.32(	1/ 2)	0.32(	1/ 5)	
		0.32-	0.32	7.0 MILES NW	0.32-	0.32	0.32-	0.32	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements of specified locations is indicated in parentheses (F).

TABLE 14

RADIOACTIVITY IN WELL WATER

PCI/L - 0.037 BQ/L

NAME OF FACILITY WATTS BAR
LOCATION OF FACILITY RHEA TENNESSEE

DOCKET NO. TVA/OMS/OHS-82/9
REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PEREORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN: NAME / DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA (NAI) 80						
FE-59	NOT ESTAB	5.67(20/ 62) 2.40- 9.60	WBN WELL #1 ONSITE S	8.60(3/ 10) 7.20- 9.60	5.46(8/ 18) 1.60- 7.80	
GAMMA (GELI) 28						
K-40	NOT ESTAB	16.17(10/ 22) 2.39- 35.01	WBN WELL #5 ONSITE N	31.48(2/ 3) 27.94- 35.01	4.35(2/ 6) 0.24- 8.46	
BI-214	NOT ESTAB	8.85(9/ 22) 1.58- 19.80	WBN WELL #1 ONSITE S	16.77(3/ 3) 12.96- 19.80	17.24(5/ 6) 0.20- 35.42	
PB-214	NOT ESTAB	9.18(5/ 22) 2.84- 14.47	WBN WELL #1 ONSITE S	13.26(3/ 3) 12.07- 14.47	15.90(4/ 6) 4.29- 30.89	
PB-212	NOT ESTAB	1.92(5/ 22) 0.26- 4.63	WBN WELL #3 ONSITE SE	4.63(1/ 3) 4.63- 4.63	6 VALUES <LLD	
TL-208	NOT ESTAB	3.82(6/ 22) 1.65- 6.11	WBN WELL #6 ONSITE WSW	6.11(1/ 4) 6.11- 6.11	0.54(2/ 6) 0.04- 1.03	
AC-228	NOT ESTAB	1.06(1/ 22) 1.06- 1.06	WBN WELL #4 ONSITE NNW	1.06(1/ 3) 1.06- 1.06	2.05(1/ 6) 2.05- 2.05	
TRITIUM 33	330.000	25 VALUES <LLD ANALYSIS PERFORMED			8 VALUES <LLD	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements of specified locations is indicated in parentheses (F).

TABLE 15

RADIOACTIVITY IN PUBLIC WATER SUPPLY

PCI/L - 0.037 BQ/L

NAME OF FACILITY WATTS BAR — DOCKET NO. TVA/OMS/OHS-82/9

LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN: NAME, DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS[b] MEAN (F) RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA	2.000	3.86(24/ 26)	DAYTON, TN	4.43(12/ 13)	4.32(4/ 26)	
52		2.41- 8.68	15.0 MILES SW	2.41- 8.68	2.48- 6.04	
GAMMA (NAI)						
38						
RU-103,106	NOT ESTAB	17.63(3/ 18)	CF INDUSTRIES	17.63(3/ 10)	29.13(3/ 20)	
		10.80- 24.00	TRM 473.0	10.80- 24.00	24.10- 37.00	
K-40	NOT ESTAB	67.35(2/ 18)	CF INDUSTRIES	67.35(2/ 10)	63.63(3/ 20)	
		61.50- 73.20	TRM 473.0	61.50- 73.20	48.10- 83.80	
FE-59	NOT ESTAB	4.71(9/ 18)	DAYTON, TN	4.88(4/ 8)	8.10(3/ 20)	
		3.60- 8.80	15.0 MILES SW	3.80- 7.00	7.60- 8.40	
GAMMA (GELI)						
14						
K-40	NOT ESTAB	10.07(2/ 8)	CF INDUSTRIES	10.07(2/ 3)	10.00(3/ 6)	
		7.02- 13.12	TRM 473.0	7.02- 13.12	7.77- 13.11	
BI-214	NOT ESTAB	7.22(7/ 8)	DAYTON, TN	8.71(5/ 5)	16.75(6/ 6)	
		1.88- 19.42	15.0 MILES SW	1.88- 19.42	0.58- 43.70	
PB-214	NOT ESTAB	6.15(4/ 8)	DAYTON, TN	7.16(3/ 5)	30.11(3/ 6)	
		3.14- 10.41	15.0 MILES SW	3.54- 10.41	22.67- 40.25	
PB-212	NOT ESTAB	2.44(2/ 8)	DAYTON, TN	2.93(1/ 5)	0.06(1/ 6)	
		1.95- 2.93	15.0 MILES SW	2.93- 2.93	0.06- 0.06	
TL-208	NOT ESTAB	2.02(1/ 8)	CF INDUSTRIES	2.02(1/ 3)	1.36(3/ 6)	
		2.02- 2.02	TRM 473.0	2.02- 2.02	0.47- 2.48	
AC-228	NOT ESTAB	8 VALUES <LLD			0.75(1/ 6)	
					0.75- 0.75	
SR 89	10.000	8 VALUES <LLD			8 VALUES <LLD	
16		ANALYSIS PERFORMED				
SR 90	NOT ESTAB	0.35(8/ 8)	DAYTON, TN	0.43(4/ 4)	0.42(8/ 8)	
16		0.02- 1.14	15.0 MILES SW	0.06- 1.14	0.12- 0.91	
TRITIUM	330.000	333.07(1/ 8)	DAYTON, TN	333.07(1/ 4)	8 VALUES <LLD	
16		333.07- 333.07	15.0 MILES SW	333.07- 333.07		

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements of 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 - 1981
mR/Quarter[a]

Distance miles	Average External Gamma Radiation Levels[b]			
	1st Quarter (Dec 80-Feb 81)	2nd Quarter (Mar-May 81)	3rd Quarter (Jun-Aug 81)	4th Quarter (Sep-Nov 81)
0-1	19.8 ± 1.4	18.1 ± 1.6	21.5 ± 3.4	21.4 ± 2.6
1-2	19.5 ± 1.6	17.5 ± 1.2	22.8 ± 1.5	22.3 ± 1.0
2-4	16.5 ± 2.1	14.4 ± 0.3	16.7 ± 0.4	17.4 ± 0.4
4-6	19.0 ± 2.6	16.1 ± 1.7	18.3 ± 3.7	19.3 ± 2.6
>6	15.6 ± 2.9	14.5 ± 2.2	15.2 ± 4.5	16.6 ± 2.8
Average, 0-2 miles (Onsite)	19.7 ± 1.4	17.9 ± 1.5	21.9 ± 3.0	21.6 ± 2.2
Average, >2 miles (Offsite)	17.6 ± 3.1	15.4 ± 2. 0	17.0 ± 4.1	18.1 ± 2.8

a. Data normalized to one quarter (2190 hours).
b. All averages reported ±1σ (68 percent confidence level).

TABLE 17

RADIOACTIVITY IN FOOD CROPS

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

NAME OF FACILITY WATTS BAR — DOCKET NO. TVA/OMS/OHS-82/9
LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE	LOCATION WITH HIGHEST ANNUAL MEAN: NAME, DISTANCE AND DIRECTION	MEAN (F)[b] RANGE	CONTROL LOCATIONS MEAN (F)[b] RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
RADIOACTIVITY IN APPLES						
GROSS BETA	NOT ESTAB	2035.66(1/ 1) 2035.66- 2035.66	2.0 MILES W	2035.66(1/ 1) 2035.66- 2035.66	1302.45(1/ 1) 1302.45- 1302.45	
GAMMA (GELI)[2]						
K-40	NOT ESTAB	961.42(1/ 1) 961.42- 961.42	2.0 MILES W	961.42(1/ 1) 961.42- 961.42	764.07(1/ 1) 764.07- 764.07	
BI-214	NOT ESTAB	0.82(1/ 1) 0.82- 0.82	2.0 MILES W	0.82(1/ 1) 0.82- 0.82	15.05(1/ 1) 15.05- 15.05	
PB-214	NOT ESTAB	1 VALUES <LLD			7.95(1/ 1) 7.95- 7.95	
PB-212	NOT ESTAB	1.01(1/ 1) 1.01- 1.01	2.0 MILES W	1.01(1/ 1) 1.01- 1.01	1 VALUES <LLD	
TL-208	NOT ESTAB	0.62(1/ 1) 0.62- 0.62	2.0 MILES W	0.62(1/ 1) 0.62- 0.62	1.68(1/ 1) 1.68- 1.68	
RADIOACTIVITY IN CABBAGE						
GROSS BETA	25.000	4370.46(1/ 1) 4370.46- 4370.46	3.5 MILES SW	4370.46(1/ 1) 4370.46- 4370.46	3805.38(1/ 1) 3805.38- 3805.38	
GAMMA (GELI)[2]						
K-40	NOT ESTAB	2193.85(1/ 1) 2193.85- 2193.85	3.5 MILES SW	2193.85(1/ 1) 2193.85- 2193.85	1805.53(1/ 1) 1805.53- 1805.53	
BI-214	NOT ESTAB	4.48(1/ 1) 4.48- 4.48	3.5 MILES SW	4.48(1/ 1) 4.48- 4.48	6.45(1/ 1) 6.45- 6.45	
PB-214	NOT ESTAB	1 VALUES <LLD			6.78(1/ 1) 6.78- 6.78	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements of specified locations is indicated in parentheses (F).

TABLE 17 (CONTD)

RADIOACTIVITY IN FOOD CROPS

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

NAME OF FACILITY WATTS BAR
LOCATION OF FACILITY RHEA TENNESSEE

DOCKET NO. TVA/OMS/OHS-82/9
REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN: NAME, DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
RADIOACTIVITY IN CORN						
GROSS BETA	25.000	3830.76(1/ 1) 3830.76- 3830.76	2.0 MILES W	3830.76(1/ 1) 3830.76- 3830.76	3650.05(1/ 1) 3650.05- 3650.05	
GAMMA (GELI)[2]						
CS-137	5.000	1 VALUES <LLD			6.05(1/ 1) 6.05- 6.05	
K-40	NOT ESTAB	1892.72(1/ 1) 1892.72- 1892.72	2.0 MILES W	1892.72(1/ 1) 1892.72- 1892.72	2033.71(1/ 1) 2033.71- 2033.71	
BI-214	NOT ESTAB	6.16(1/ 1) 6.16- 6.16	2.0 MILES W	6.16(1/ 1) 6.16- 6.16	12.03(1/ 1) 12.03- 12.03	
PB-214	NOT ESTAB	6.03(1/ 1) 6.03- 6.03	2.0 MILES W	6.03(1/ 1) 6.03- 6.03	7.59(1/ 1) 7.59- 7.59	
TL-208	NOT ESTAB	1.62(1/ 1) 1.62- 1.62	2.0 MILES W	1.62(1/ 1) 1.62- 1.62	1 VALUES <LLD	
RADIOACTIVITY IN GREEN BEANS						
GROSS BETA	25.000	4127.66(1/ 1) 4127.66- 4127.66	3.5 MILES SW	4127.66(1/ 1) 4127.66- 4127.66	5560.41(1/ 1) 5560.41- 5560.41	
GAMMA (GELI)[2]						
K-40	NOT ESTAB	2442.27(1/ 1) 2442.27- 2442.27	3.5 MILES SW	2442.27(1/ 1) 2442.27- 2442.27	2558.47(1/ 1) 2558.47- 2558.47	
BI-214	NOT ESTAB	1 VALUES <LLD			17.84(1/ 1) 17.84- 17.84	
PB-214	NOT ESTAB	1 VALUES <LLD			15.79(1/ 1) 15.79- 15.79	
PB-212	NOT ESTAB	4.32(1/ 1) 4.32- 4.32	3.5 MILES SW	4.32(1/ 1) 4.32- 4.32	0.33(1/ 1) 0.33- 0.33	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements of specified locations is indicated in parentheses (F).

TABLE 17 (CONTD)

RADIOACTIVITY IN FOOD CROPS

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

NAME OF FACILITY WATTS BAR
LOCATION OF FACILITY RHEA TENNESSEE

DOCKET NO. TVA/OMS/OHS-82/9
REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) [a]	ALL INDICATOR LOCATIONS MEAN (F) [b] RANGE [b]	LOCATION WITH HIGHEST ANNUAL MEAN: NAME DISTANCE AND DIRECTION	MEAN (F) [b] RANGE [b]	CONTROL LOCATIONS MEAN (F) [b] RANGE [b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
RADIOACTIVITY IN POTATOES						
GROSS BETA	25.000	7842.98(1/ 1) 7842.98- 7842.98	3.5 MILES SW	7842.98(1/ 1) 7842.98- 7842.98	6204.73(1/ 1) 6204.73- 6204.73	
GAMMA (GELI) [2]						
CS-137	NOT ESTAB	1 VALUES <LLD			13.99(1/ 1) 13.99- 13.99	
K-40	NOT ESTAB	3777.78(1/ 1) 3777.78- 3777.78	3.5 MILES SW	3777.78(1/ 1) 3777.78- 3777.78	2864.60(1/ 1) 2864.60- 2864.60	
BI-214	NOT ESTAB	1 VALUES <LLD			0.12(1/ 1) 0.12- 0.12	
RADIOACTIVITY IN TOMATOES						
GROSS BETA	25.000	2082.92(1/ 1) 2082.92- 2082.92	2.0 MILES W	2082.92(1/ 1) 2082.92- 2082.92	3263.63(1/ 1) 3263.63- 3263.63	
GAMMA (GELI) [2]						
K-40	NOT ESTAB	1471.50(1/ 1) 1471.50- 1471.50	2.0 MILES W	1471.50(1/ 1) 1471.50- 1471.50	1835.24(1/ 1) 1835.24- 1835.24	
BI-214	NOT ESTAB	1 VALUES <LLD			4.44(1/ 1) 4.44- 4.44	
PB-214	NOT ESTAB	1 VALUES <LLD			3.78(1/ 1) 3.78- 3.78	
PB-212	NOT ESTAB	1.78(1/ 1) 1.78- 1.78	2.0 MILES W	1.78(1/ 1) 1.78- 1.78	1 VALUES <LLD	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements of specified locations is indicated in parentheses (F).

TABLE 17 (CONTD)

RADIOACTIVITY IN FOOD CROPS

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

NAME OF FACILITY WATTS BAR — DOCKET NO. TVA/OMS/OHS-82/9

LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION [a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F) [b] RANGE [b]	LOCATION WITH HIGHEST ANNUAL MEAN: NAME, DISTANCE AND DIRECTION	MEAN (F) [b] RANGE [b]	CONTROL LOCATIONS MEAN (F) [b] RANGE [b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
RADIOACTIVITY IN TURNIP GREENS						
GROSS BETA	25.000	4223.54(1/ 1) 4223.54- 4223.54	PM1 PETTY FARM 3.75 MILES WSW	4223.54(1/ 1) 4223.54- 4223.54	5642.29(1/ 1) 5642.29- 5642.29	
GAMMA (GELI) [2]						
K-40	NOT ESTAB	2747.57(1/ 1) 2747.57- 2747.57	PM1 PETTY FARM 3.75 MILES WSW	2747.57(1/ 1) 2747.57- 2747.57	2444.09(1/ 1) 2444.09- 2444.09	
BI-214	NOT ESTAB	2.69(1/ 1) 2.69- 2.69	PM1 PETTY FARM 3.75 MILES WSW	2.69(1/ 1) 2.69- 2.69	9.90(1/ 1) 9.90- 9.90	
BI-212	NOT ESTAB	124.76(1/ 1) 124.76- 124.76	PM1 PETTY FARM 3.75 MILES WSW	124.76(1/ 1) 124.76- 124.76	1 VALUES <LLD	
PB-214	NOT ESTAB	1 VALUES <LLD			8.66(1/ 1) 8.66- 8.66	
PB-212	NOT ESTAB	107.21(1/ 1) 107.21- 107.21	PM1 PETTY FARM 3.75 MILES WSW	107.21(1/ 1) 107.21- 107.21	7.65(1/ 1) 7.65- 7.65	
BE-7	NOT ESTAB	1 VALUES <LLD			47.30(1/ 1) 47.30- 47.30	
TL-208	NOT ESTAB	35.82(1/ 1) 35.82- 35.82	PM1 PETTY FARM 3.75 MILES WSW	35.82(1/ 1) 35.82- 35.82	2.15(1/ 1) 2.15- 2.15	
AC-228	NOT ESTAB	1 VALUES <LLD			25.49(1/ 1) 25.49- 25.49	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements of specified locations is indicated in parentheses (F).

TABLE 18

RADIOACTIVITY IN BEEF

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

NAME OF FACILITY WATTS BAR — DOCKET NO. TVA/OMS/OHS-82/9

LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN: NAME, DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA (GELI)[1]						
K-40	NOT ESTAB	6.08(1/ 1) 6.08- 6.08	LAYMAN FARM 1.5 MILES SSW	6.08(1/ 1) 6.08- 6.08		
BI-214	NOT ESTAB	0.09(1/ 1) 0.09- 0.09	LAYMAN FARM 1.5 MILES SSW	0.09(1/ 1) 0.09- 0.09		
PB-214	NOT ESTAB	0.06(1/ 1) 0.06- 0.06	LAYMAN FARM 1.5 MILES SSW	0.06(1/ 1) 0.06- 0.06		
TL-208	NOT ESTAB	0.01(1/ 1) 0.01- 0.01	LAYMAN FARM 1.5 MILES SSW	0.01(1/ 1) 0.01- 0.01		

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements of specified locations is indicated in parentheses (F).

Figure 5

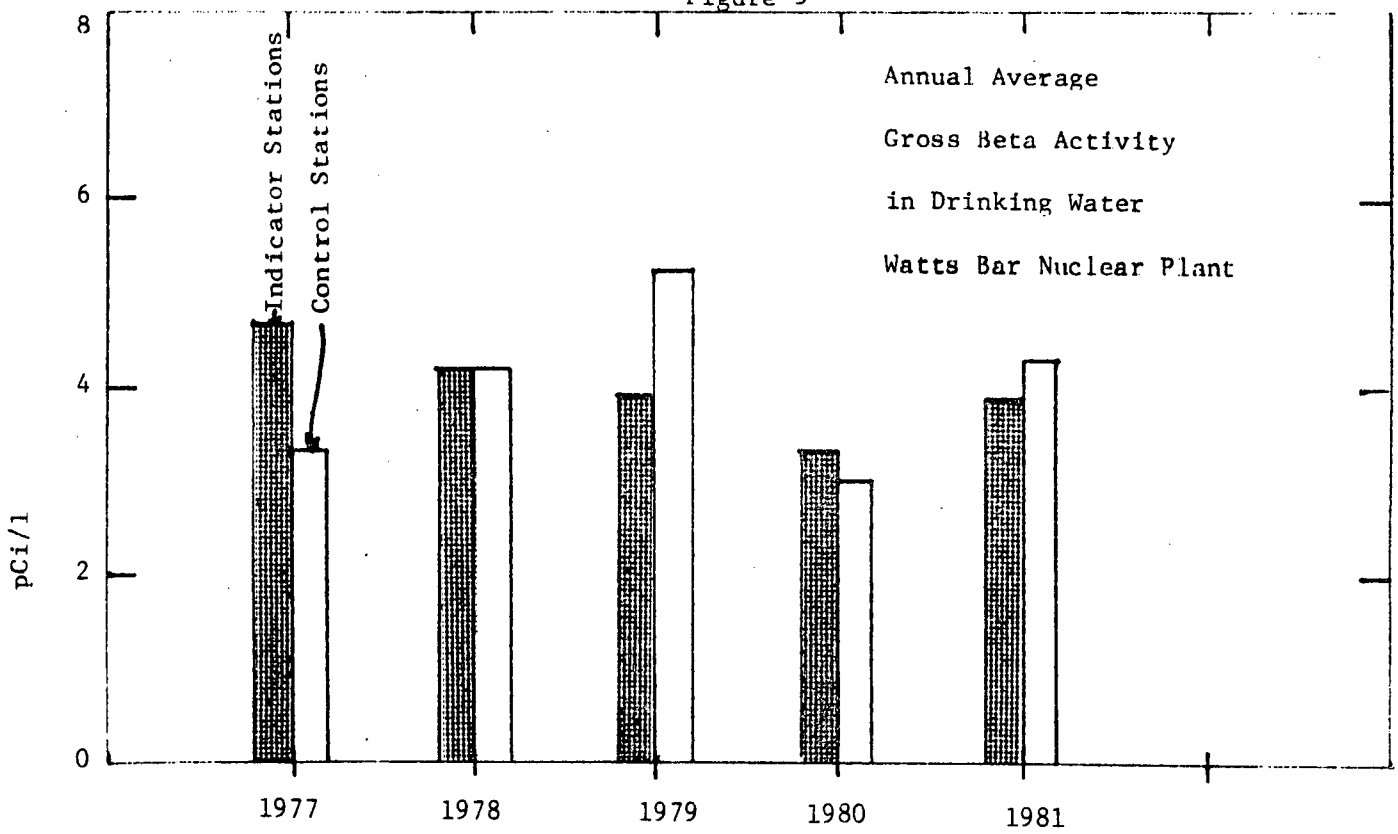


Figure 6

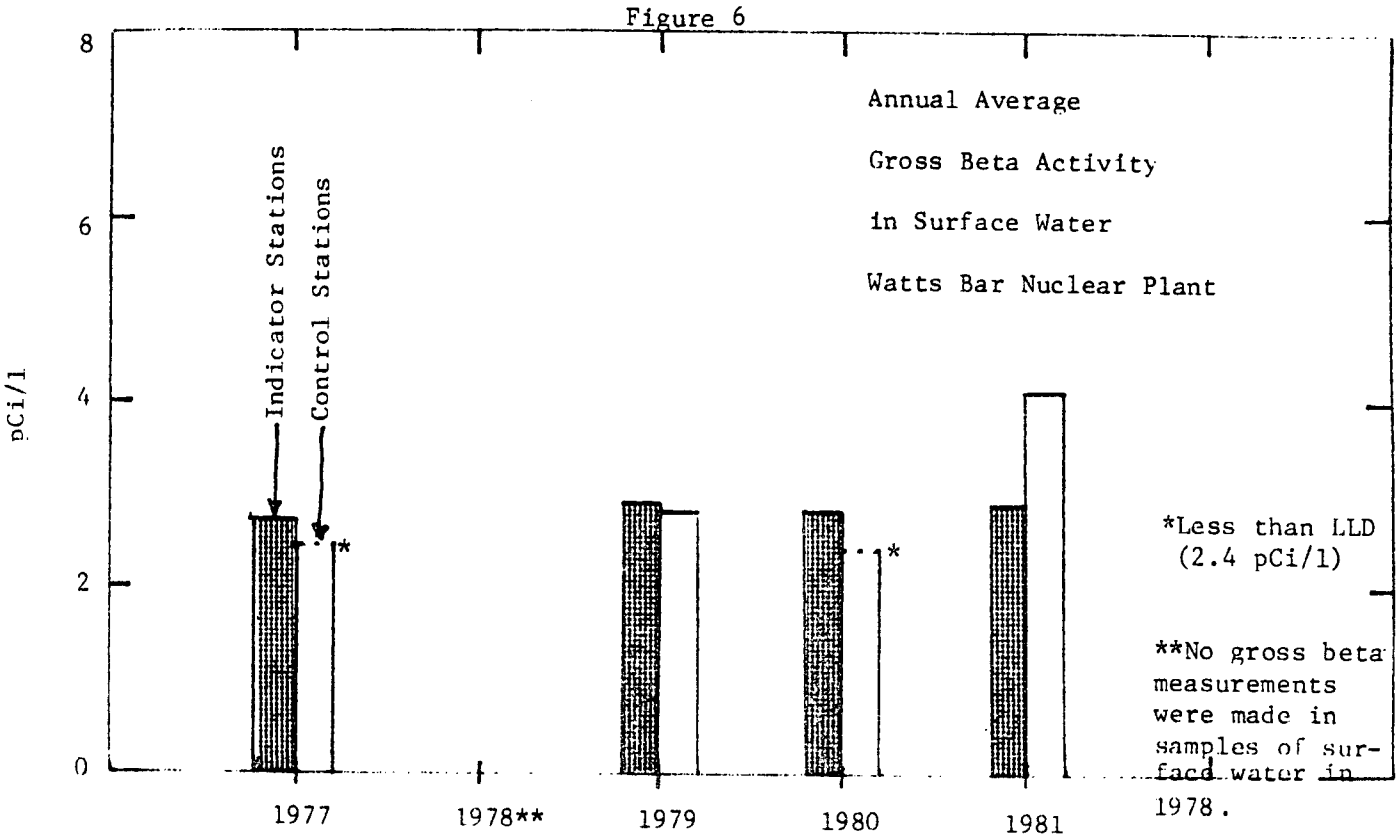


Figure 7

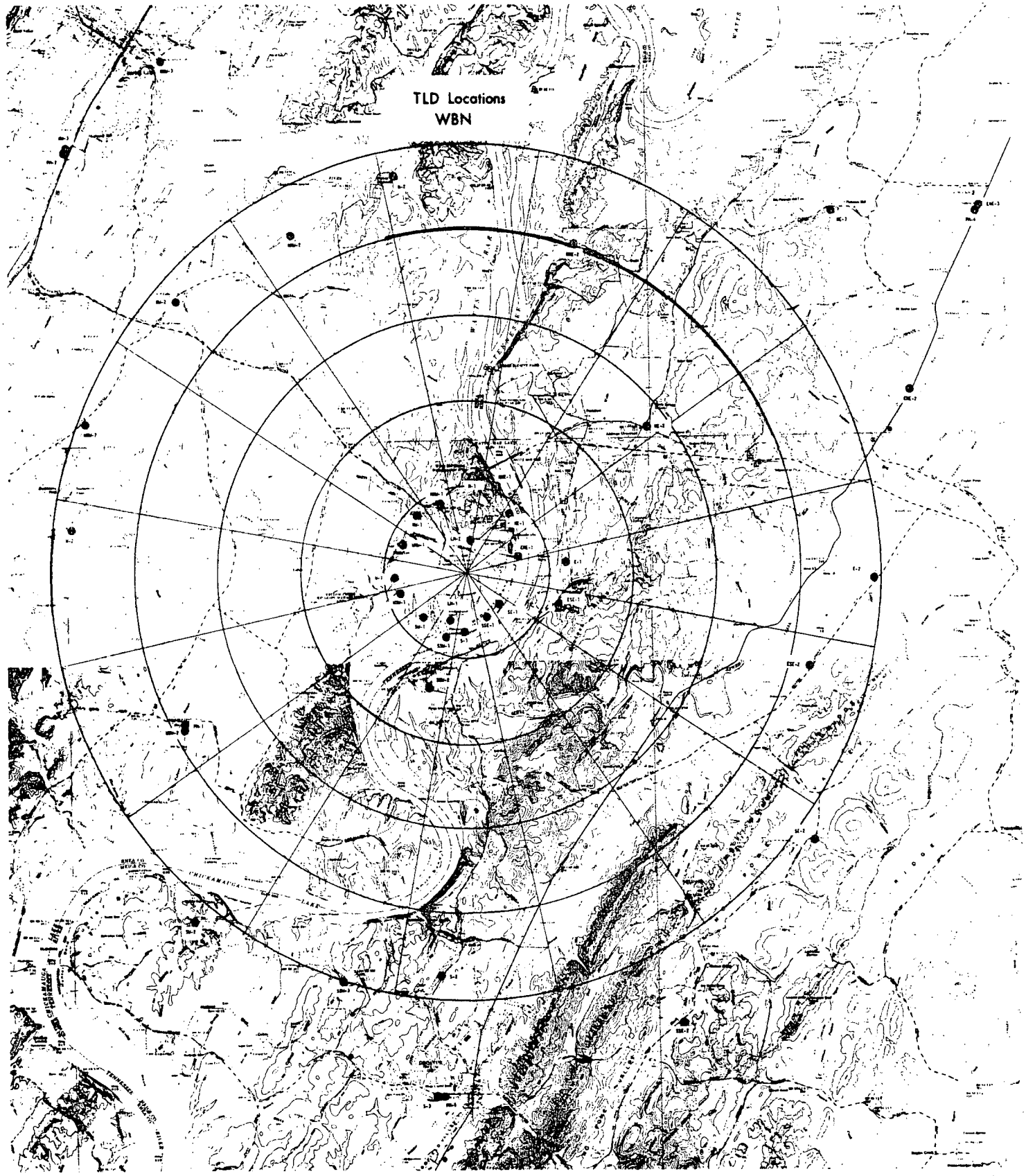


Figure 8

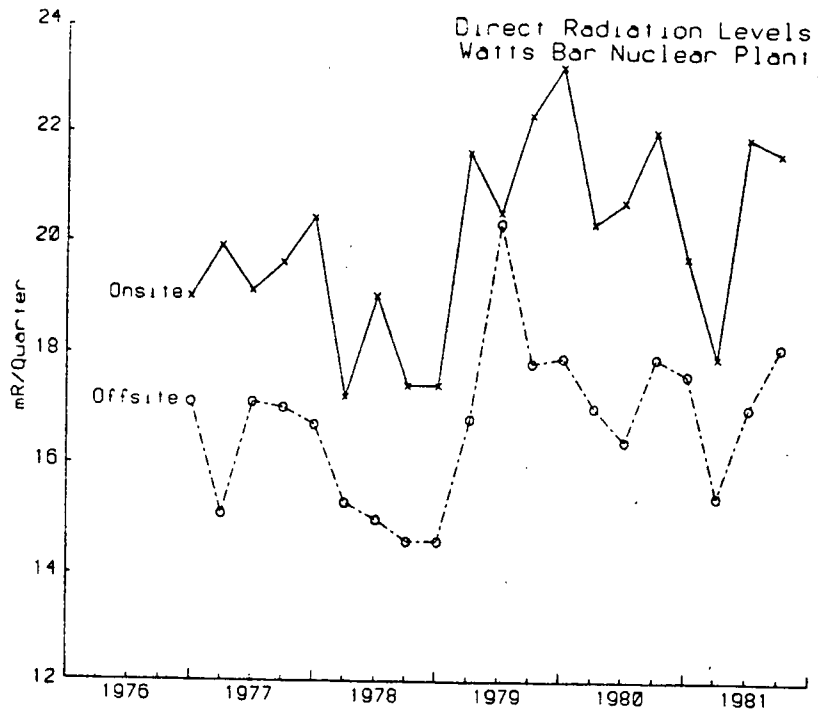
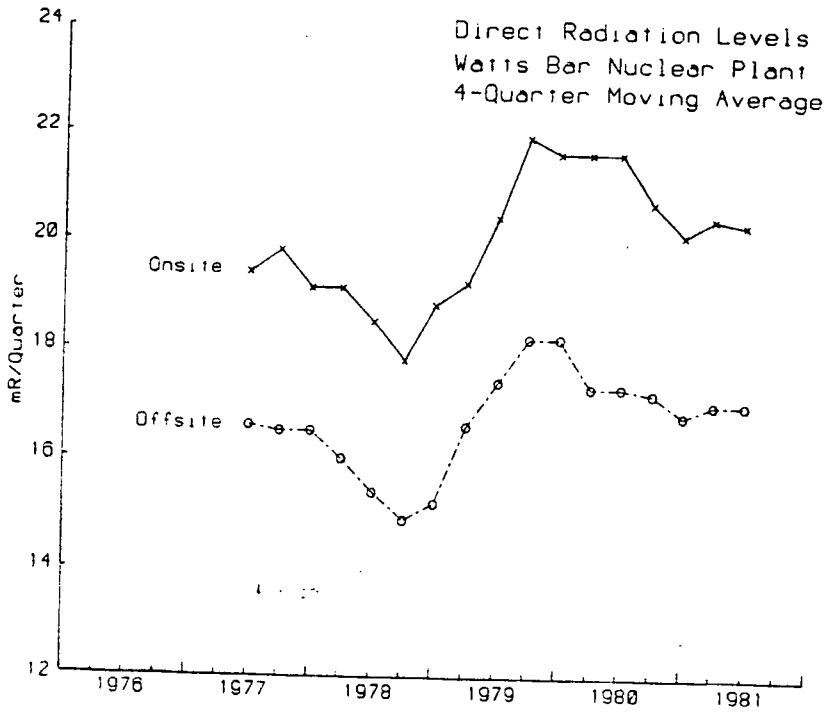


Figure 9



Reservoir Monitoring

Samples of water and aquatic media are collected quarterly along five river stations in Chickamauga and Watts Bar Reservoirs--at Tennessee River miles (TRM) 496.5, 518.0, 527.4. 529.9, and 532.1. The station at TRM 496.5 is also a part of the Sequoyah Nuclear Plant monitoring. In conjunction with that program, additional analyses are conducted on some samples. Samples collected for radiological analyses include sediment, plankton, and Asiatic clams from four stations; water from three stations; and fish from Watts Bar, Chickamauga and Nickajack Reservoirs (see table 19). The locations of these stations are shown on the accompanying map (figure 10) and conform to sediment ranges established and surveyed by TVA.

Samples of water, net plankton, sediment, and Asiatic clams were collected quarterly and analyzed for radioactivity. In addition, samples of the flesh of two commercial and one game species of fish and the whole body of one commercial fish species were collected and analyzed semiannually.

Water

Grab water samples were collected quarterly from three locations in the Tennessee River; one upstream from the plant discharge area, one immediately downstream from the discharge area, and one approximately nine miles downstream. The samples were analyzed for gamma-emitting radionuclides, ^{89}Sr, ^{90}Sr, and ^{3}H. Results are displayed in table 20.

Figure 6 presents a plot of the gross beta activity in surface water from 1977 through 1981. Indicator stations are those located downstream from the plant and controls are located upstream. The levels reported are consistent with gross beta levels measured in surface water samples taken from the Tennessee River in preoperational 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, are 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. All samples were analyzed for gamma, gross alpha, and gross beta activity. In addition, two samples of each species were analyzed for ^{89}Sr and ^{90}Sr. The composite samples contained approximately the same quantity of flesh from each

fish. For each composite a subsample of material was drawn for counting. Results are given in tables 21, 22, 23, and 24. During this reporting period, an insufficient sample of each species (four samples) was available for analysis in the first sampling period.

Plankton

As indicated in table 19, net plankton was collected for radiological analyses at four stations by vertical tows with a one-half meter, 100 micro-mesh net. For analytical accuracy, at least 50 grams (wet weight) of material is required; and collection of such amounts will probably be practical only during the period April to September because of seasonal variability in plankton abundance. All samples were analyzed for gross beta activity. Quantities of the samples were not sufficient for the analysis of specific gamma-emitting radionuclides, ^{89}Sr and ^{90}Sr. Sample results are given in table 25.

Sediment

Sediment samples were collected from dredge hauls made for bottom fauna. Gamma activity, ^{89}Sr, and ^{90}Sr content were determined in samples collected from points in four cross sections. In addition, gross alpha and gross beta activity was determined in samples from TRM 496.5, and gross beta activity was determined in two samples from each of the three remaining stations. Each sample was a composite obtained by combining equal volumes of sediment from each of three dredge hauls at a point in the cross section. Results are given in table 26.

Shoreline sediment samples were collected semiannually at three recreation-use areas (two downstream from the plant and one upstream) in the vicinity of WBN. Samples were analyzed for gross beta, gamma-emitting radionuclides, ^{89}Sr, and ^{90}Sr. Results are given in table 27.

Figures 11 and 12 respectively present the trends in ^{137}Cs and ^{60}Co 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 from four stations and analyzed for gamma activity. Gross alpha and gross beta analyses were also conducted on samples from TRM 496.5 and strontium activity was determined in samples of clam shells taken at that location. Results are given in tables 28 and 29.

Table 19

Sampling Schedule - Reservoir Monitoring

Tennessee River (Mile	Biological Samples				Water Samples	
	Plankton	Benthic Fauna	Sediment	Fish*	Distance from Left Bank, %	Depths (Meters)
Indicator Stations						
496.5	X	X	X			
518.0	X	X	X		67	0
527.4	X	X	X		67	1
Control Stations						
529.9					90	1
532.1	X	X	X			

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

TABLE 20

RADIOACTIVITY IN SURFACE WATER TOTAL

PCI/L - 0.037 BQ/L

NAME OF FACILITY WATTS BAR DOCKET NO. IVA/OMS/OHS-82/9
LOCATION OF FACILITY RHEA TENNESSEE REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD)[a]	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN: NAME, DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA 12	2.400	2.88(3/ 8) 2.54- 3.40	TRM 527.4-67-1	3.40(1/ 4) 3.40- 3.40	4.12(4/ 4) 3.12- 5.40	
GAMMA (NAI) 8						
FE-59	NOT ESTAB	6.90(2/ 5) 4.30- 9.50	TRM 527.4-67-1	9.50(1/ 3) 9.50- 9.50	3 VALUES <LLD	
GAMMA (GELI) 4						
BI-214	NOT ESTAB	8.99(1/ 3) 8.99- 8.99	TRM 527.4-67-1	8.99(1/ 1) 8.99- 8.99	4.25(1/ 1) 4.25- 4.25	
PB-212	NOT ESTAB	0.77(1/ 3) 0.77- 0.77	TRM 518.0-67-0	0.77(1/ 2) 0.77- 0.77	1 VALUES <LLD	
SR 89 12	10.000	8 VALUES <LLD ANALYSIS PERFORMED			4 VALUES <LLD	
SR 90 12	2.000	8 VALUES <LLD ANALYSIS PERFORMED			4 VALUES <LLD	
TRITIUM 12	330.000	504.83(4/ 8) 398.01- 629.37	TRM 518.0-67-0	513.69(2/ 4) 398.01- 629.37	444.00(2/ 4) 439.54- 448.46	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements of specified locations is indicated in parentheses (F).

TABLE 21

RADIOACTIVITY IN CHANNEL CATFISH (FLESH)

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

NAME OF FACILITY WATTS BAR — DOCKET NO. TVA/OMS/OHS-82/9

LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN: NAME, DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS ALPHA 5	0.100	2.24(3/ 3) 1.62- 3.36	NICKAJACK RES TRM 425-471	3.36(1/ 1) 3.36- 3.36)	2.99(2/ 2) 2.68- 3.30	
GROSS BETA 5	0.100	21.40(3/ 3) 15.50- 25.06	NICKAJACK RES TRM 425-471	23.64(1/ 1) 23.64- 23.64	25.47(2/ 2) 24.35- 26.58	
GAMMA (GELI) 5						
CS-137	0.020	0.07(3/ 3) 0.05- 0.08)	NICKAJACK RES TRM 425-471	0.07(1/ 1) 0.07- 0.07	0.05(2/ 2) 0.03- 0.07	
K-40	NOT ESTAB	11.51(3/ 3) 10.07- 13.24	CHICKAMAUGA RES TRM 471-530	11.66(2/ 2) 10.07- 13.24	12.83(2/ 2) 10.44- 15.22	
BI-214	0.020	3 VALUES <LLD			0.02(1/ 2) 0.02- 0.02	
PB-214	NOT ESTAB	0.02(1/ 3) 0.02- 0.02	CHICKAMAUGA RES TRM 471-530	0.02(1/ 2) 0.02- 0.02	0.02(2/ 2) 0.01- 0.02	
PB-212	NOT ESTAB	0.00(1/ 3) 0.00- 0.00	CHICKAMAUGA RES TRM 471-530	0.00(1/ 2) 0.00- 0.00	0.00(2/ 2) 0.00- 0.00	
TL-208	NOT ESTAB	0.00(1/ 3) 0.00- 0.00	CHICKAMAUGA RES TRM 471-530	0.00(1/ 2) 0.00- 0.00	1 VALUE <LLD	
SR 89 2	0.500	ANALYSIS PERFORMED 1 VALUE <LLD			1 VALUE <LLD	
SR 90 2	0.100	ANALYSIS PERFORMED 1 VALUE <LLD			1 VALUE <LLD	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements of specified locations is indicated in parentheses (F).

TABLE 22

RADIOACTIVITY IN WHITE CRAPPIE (FLESH)

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

NAME OF FACILITY WATTS BAR
LOCATION OF FACILITY RHEA TENNESSEE
DOCKET NO. IVA/OMS/OHS-82/9
REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN: NAME DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS ALPHA 5	0.100	2.97(3/ 3) 2.50- 3.27	CHICKAMAUGA RES TRM 471-530	2.97(2/ 2) 2.66- 3.27	3.73(2/ 2) 2.73- 4.73	
GROSS BETA 5	0.100	29.13(3/ 3) 25.39- 34.64	CHICKAMAUGA RES TRM 471-530	30.02(2/ 2) 25.39- 34.64	37.86(2/ 2) 35.17- 40.55	
GAMMA (GELI) 5						
CS-137	0.020	0.12(3/ 3) 0.09- 0.15	CHICKAMAUGA RES TRM 471-530	0.14(2/ 2) 0.12- 0.15	0.18(2/ 2) 0.17- 0.18	
K-40	NOT ESTAB	15.46(3/ 3) 13.97- 18.23	CHICKAMAUGA RES TRM 471-530	16.10(2/ 2) 13.97- 18.23	15.93(2/ 2) 15.40- 16.46	
BI-214	0.020	0.03(3/ 3) 0.01- 0.03	NICKAJACK RES TRM 425-471	0.03(1/ 1) 0.03- 0.03	2 VALUES <LLD	
PB-214	NOT ESTAB	0.03(1/ 3) 0.03- 0.03	CHICKAMAUGA RES TRM 471-530	0.03(1/ 2) 0.03- 0.03	2 VALUES <LLD	
PB-212	NOT ESTAB	0.01(2/ 3) 0.01- 0.01	CHICKAMAUGA RES TRM 471-530	0.01(2/ 2) 0.01- 0.01	2 VALUES <LLD	
TL-208	NOT ESTAB	0.01(1/ 3) 0.01- 0.01	CHICKAMAUGA RES TRM 471-530	0.01(1/ 2) 0.01- 0.01	0.01(1/ 2) 0.01- 0.01	
SR 89 2	0.500	1.41(1/ 1) 1.41- 1.41	CHICKAMAUGA RES TRM 471-530	1.41(1/ 1) 1.41- 1.41	0.86(1/ 1) 0.86- 0.86	
SR 90 2	0.100	ANALYSIS PERFORMED 1 VALUE <LLD			1 VALUES <LLD	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements of specified locations is indicated in parentheses (F).

TABLE 23

RADIOACTIVITY IN SMALLMOUTH BUFFALO (FLESH)

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

NAME OF FACILITY WATTS BAR — DOCKET NO. TVA/OMS/OHS-82/9

LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN: NAME, DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS ALPHA 5	0.100	2.25(3/ 3) 1.94- 2.67	CHICKAMAUGA RES TRM 471-530	2.31(2/ 2) 1.94- 2.67	2.58(2/ 2) 2.63- 4.53	
GROSS BETA 5	0.100	18.91(3/ 3) 17.46- 20.33	CHICKAMAUGA RES TRM 471-530	19.63(2/ 2) 18.93- 20.33	34.87(2/ 2) 25.38- 44.36	
GAMMA (GELI) 5						
CO-60	0.010	0.02(1/ 3) 0.02- 0.02	CHICKAMAUGA RES TRM 471-530	0.02(1/ 2) 0.02- 0.02	1 VALUE <LLD	
CS-137	0.020	0.06(3/ 3) 0.04- 0.08	CHICKAMAUGA RES TRM 471-530	0.06(2/ 2) 0.64- 0.08	0.08(2/ 2) 0.05- 0.11	
K-40	NOT ESTAB	9.65(3/ 3) 8.65- 10.75	CHICKAMAUGA RES TRM 471-530	9.70(2/ 2) 8.65- 10.75	12.69(2/ 2) 11.88- 13.50	
BI-214	0.020	0.01(2/ 3) 0.00- 0.01	CHICKAMAUGA RES TRM 471-530	0.01(1/ 2) 0.01- 0.01	0.04(2/ 2) 0.04- 0.04	
PB-214	NOT ESTAB	0.01(1/ 3) 0.01- 0.01	NICKAJACK RES TRM 425-471	0.01(1/ 1) 0.01- 0.01	0.02(2/ 2) 0.02- 0.03	
AC-228	NOT ESTAB	1 VALUE <LLD			0.03(1/ 2) 0.03- 0.03	
SR 89 2	0.500	ANALYSIS PERFORMED 1 VALUE <LLD			1.91(1/ 1) 1.91- 1.91	
SR 90 2	0.100	ANALYSIS PERFORMED 1 VALUE <LLD			1 VALUE <LLD	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements of specified locations is indicated in parentheses (F).

TABLE 24

RADIOACTIVITY IN SMALLMOUTH BUFFALO (WHOLE)

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

NAME OF FACILITY WATTS BAR
LOCATION OF FACILITY RHEA TENNESSEE

DOCKET NO. TVA/OMS/OHS-82/9
REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) [a]	ALL INDICATOR LOCATIONS MEAN (F) [b] RANGE [b]	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) [b] RANGE [b]	CONTROL LOCATIONS MEAN (F) [b] RANGE [b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS ALPHA 5	0.100	1.96(3/ 3) 0.83- 3.06	CHICKAMAUGA RES TRM 471-530	3.06(1/ 1) 3.06- 3.06	1.45(2/ 2) 1.45- 1.45	
GROSS BETA 5	0.100	13.06(3/ 3 10.62- 14.35	CHICKAMAUGA RES TRM 471-530	14.14(1/ 1) 14.14- 14.14	13.99(2/ 2) 13.04- 14.93	
GAMMA (GELI) 5						
CO-60	0.010	3 VALUES <LLD			0.02(2/ 2) 0.02- 0.02	
CS-137	0.020	0.04(2/ 3) 0.03- 0.04	NICKAJACK RES TRM 425-471	0.04(2/ 2) 0.03- 0.04	0.06(2/ 2) 0.06- 0.06	
K-40	NOT ESTAB	5.50(3/ 3) 5.11- 5.84	CHICKAMAUGA RES TRM 471-530	5.55(1/ 1) 5.55- 5.55	6.24(2/ 2) 5.70- 6.77	
BI-214	0.020	0.01(2/ 3) 0.01- 0.02	NICKAJACK RES TRM 425-471	0.02(1/ 2) 0.02- 0.02	0.01(1/ 2) 0.01- 0.01	
PB-214	NOT ESTAB	0.02(2/ 3) 0.02- 0.02	CHICKAMAUGA RES TRM 471-530	0.02(1/ 1) 0.02- 0.02	0.02(2/ 2) 0.02- 0.02	
PB-212	NOT ESTAB	0.02(2/ 3) 0.02- 0.02	CHICKAMAUGA RES TRM 471-530	0.02(1/ 1) 0.02- 0.02	0.01(2/ 2) 0.00- 0.01	
TL-208	NOT ESTAB	0.01(1/ 3) 0.01- 0.01	CHICKAMAUGA RES TRM 471-530	0.01(1/ 1) 0.01- 0.01	0.01(1/ 2) 0.01- 0.01	
SR 89 2	0.500	ANALYSIS PERFORMED 1 VALUE <LLD			1.56(1/ 1) 1.56- 1.56	
SR 90 2	0.100	0.29(1/ 1) 0.29- 0.29	NICKAJACK RES TRM 425-471	0.29(1/ 1) 0.29- 0.29	0.19(1/ 1) 0.19- 0.19	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements of specified locations is indicated in parentheses (F).

TABLE 25

RADIOACTIVITY IN PLANKTON

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

NAME OF FACILITY WATTS BAR — DOCKET NO. TVA/OMS/OHS-82/9

LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION [a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F) [b] RANGE [b]	LOCATION WITH HIGHEST ANNUAL MEAN: NAME, DISTANCE AND DIRECTION	MEAN (F) [b] RANGE [b]	CONTROL LOCATIONS MEAN (F) [b] RANGE [b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA	0.100	28.02(12/ 12)	TRM 527.4	35.39(4/ 4)	21.43(4/ 4)	
16		13.97- 42.12		28.06- 42.12	15.17- 34.16	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.

b. Mean and range based upon detectable measurements only. Fraction of detectable measurements of specified locations is indicated in parentheses (F).

TABLE 26

RADIOACTIVITY IN SEDIMENT

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

NAME OF FACILITY WATTS BAR
LOCATION OF FACILITY RHEA TENNESSEE

DOCKET NO. TVA/OMS/OHS-82/9
REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION [a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F) [b] RANGE [b]	LOCATION WITH HIGHEST ANNUAL MEAN: NAME, DISTANCE AND DIRECTION	MEAN (F) [b] RANGE [b]	CONTROL LOCATIONS MEAN (F) [b] RANGE [b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS ALPHA 4	0.350	3.48(4/ 4) 2.31- 4.68	TRM 496.50	3.48(4/ 4) 2.31- 4.68		
GROSS BETA 10	0.700	27.30(8/ 8) 23.36- 35.53	TRM 496.50	29.40(4/ 4) 23.36- 35.53	34.26(2/ 2) 32.25- 36.28	
GAMMA (GELI) 16						
CE-144	0.060	0.20(4/ 12) 0.12- 0.40	TRM 518.0	0.26(2/ 4) 0.12- 0.40	4 VALUES <LLD	
CO-60	0.010	0.12(9/ 12) 0.02- 0.28	TRM 496.50	0.19(4/ 4) 0.12- 0.28	0.33(4/ 4) 0.24- 0.44	
RU-103	NOT ESTAB	0.11(1/ 12) 0.11- 0.11	TRM 518.0	0.11(1/ 4) 0.11- 0.11	4 VALUES <LLD	
CS-137	0.020	0.71(12/ 12) 0.03- 2.68	TRM 496.50	1.81(4/ 4) 1.05- 2.68	4.30(4/ 4) 3.32- 4.94	
ZR-95	0.030	0.20(2/ 12) 0.06- 0.34	TRM 518.0	0.34(1/ 4) 0.34- 0.34	4 VALUES <LLD	
NB-95	0.010	0.19(6/ 12) 0.04- 0.64	TRM 518.0	0.26(3/ 4) 0.04- 0.64	4 VALUES <LLD	
K-40	NOT ESTAB	15.60(12/ 12) 12.45- 17.74	TRM 518.0	16.14(4/ 4) 13.40- 17.59	18.52(4/ 4) 16.47- 20.91	
MN-54	0.010	0.01(1/ 12) 0.01- 0.01	TRM 496.50	0.01(1/ 4) 0.01- 0.01	4 VALUES <LLD	
BI-214	0.020	1.00(12/ 12) 0.76- 1.34	TRM 496.50	1.03(4/ 4) 0.81- 1.34	1.41(4/ 4) 1.14- 1.68	
BI-212	0.100	1.55(12/ 12) 1.23- 1.97	TRM 527.4	1.64(4/ 4) 1.53- 1.80	2.23(4/ 4) 2.04- 2.44	
PB-214	NOT ESTAB	1.12(12/ 12) 0.80- 1.48	TRM 527.4	1.19(4/ 4) 1.07- 1.27	1.56(4/ 4) 1.24- 1.90	
PB-212	NOT ESTAB	1.40(12/ 12) 1.00- 1.89	TRM 527.4	1.50(4/ 4) 1.31- 1.61	2.08(4/ 4) 1.74- 2.54	
RA-226	NOT ESTAB	1.00(12/ 12) 0.76- 1.34	TRM 496.50	1.03(4/ 4) 0.81- 1.34	1.41(4/ 4) 1.14- 1.68	
RA-224	NOT ESTAB	1.47(12/ 12) 0.98- 2.01	TRM 527.4	1.58(4/ 4) 1.26- 1.77	2.43(4/ 4) 2.03- 2.97	
BE-7	NOT ESTAB	0.52(1/ 12) 0.52- 0.52	TRM 518.0	0.52(1/ 4) 0.52- 0.52	4 VALUES <LLD	
TL-208	0.020	0.41(12/ 12) 0.30- 0.57	TRM 527.4	0.44(4/ 4) 0.39- 0.46	0.60(4/ 4) 0.52- 0.67	
AC-228	0.060	1.35(12/ 12) 1.06- 1.95	TRM 527.4	1.41(4/ 4) 1.35- 1.49	1.95(4/ 4) 1.62- 2.42	
PA-234M	NOT ESTAB	3.92(3/ 12) 3.43- 4.64	TRM 496.50	4.16(2/ 4) 3.69- 4.64	4 VALUES <LLD	
SR 89 16	1.500	3.06(3/ 12) 2.29- 3.64	TRM 518.0	3.64(1/ 4) 3.64- 3.64	3.06(1/ 4) 3.06- 3.06	
SR 90 16	0.300	12 VALUES <LLD ANALYSIS PERFORMED			4 VALUES <LLD	

a Nominal Lower Limit of Detection (LLD) as described in Table 2

TABLE 27

RADIOACTIVITY IN SHORE LINE SEDIMENT

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

NAME OF FACILITY WATTS BAR — DOCKET NO. IVA/OMS/OHS-82/9

LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN: NAME DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA	0.700	21.52(4/ 4) 6.45- 33.90	COTTON PORT MARI TRM 513	32.41(2/ 2) 30.93- 33.90	9.24(2/ 2) 5.19- 13.30	
GAMMA (GELI)						
CO-60	0.010	0.07(1/ 4) 0.07- 0.07	COTTON PORT MARI TRM 513	0.07(1/ 2) 0.07- 0.07	2 VALUES <LLD	
CS-137	0.020	0.23(3/ 4) 0.03- 0.47	COTTON PORT MARI TRM 513	0.33(2/ 2) 0.19- 0.47	0.08(1/ 2) 0.08- 0.08	
NB-95	0.010	0.03(1/ 4) 0.03- 0.03	COTTON PORT MARI TRM 513	0.03(1/ 2) 0.03- 0.03	0.03(1/ 2) 0.03- 0.03	
K-40	NOT ESTAB	11.69(4/ 4) 3.32- 19.93	COTTON PORT MARI TRM 513	18.81(2/ 2) 17.69- 19.93	3.49(2/ 2) 0.92- 6.07	
BI-214	0.020	0.82(4/ 4) 0.33- 1.02	COTTON PORT MARI TRM 513	0.98(2/ 2) 0.95- 1.02	0.54(2/ 2) 0.46- 0.63	
BI-212	0.100	1.28(4/ 4) 0.40- 1.86	COTTON PORT MARI TRM 513	1.80(2/ 2) 1.74- 1.86	0.86(2/ 2) 0.62- 1.10	
PB-214	NOT ESTAB	0.88(4/ 4) 0.39- 1.08	COTTON PORT MARI TRM 513	1.02(2/ 2) 1.01- 1.03	0.60(2/ 2) 0.52- 0.67	
PB-212	0.020	1.16(4/ 4) 0.30- 1.65	COTTON PORT MARI TRM 513	1.60(2/ 2) 1.55- 1.65	0.77(2/ 2) 0.48- 1.07	
RA-226	NOT ESTAB	0.82(4/ 4) 0.33- 1.02	COTTON PORT MARI TRM 513	0.98(2/ 2) 0.95- 1.02	0.54(2/ 2) 0.46- 0.63	
RA-224	NOT ESTAB	1.66(3/ 4) 1.32- 1.85	COTTON PORT MARI TRM 513	1.83(2/ 2) 1.82- 1.85	0.90(2/ 2) 0.61- 1.20	
TL-208	0.020	0.35(4/ 4) 0.09- 0.48	COTTON PORT MARI TRM 513	0.48(2/ 2) 0.48- 0.48	0.22(2/ 2) 0.15- 0.29	
AC-228	0.060	1.15(4/ 4) 0.34- 1.60	COTTON PORT MARI TRM 513	1.55(2/ 2) 1.50- 1.60	0.73(2/ 2) 0.50- 0.95	
PA-234M	NOT ESTAB	2.90(1/ 4) 2.90- 2.90	COTTON PORT MARI TRM 513	2.90(1/ 2) 2.90- 2.90	2 VALUES <LLD	
SR 89	1.500	4 VALUES <LLD ANALYSIS PERFORMED			2 VALUES <LLD	
SR 90	0.300	4 VALUES <LLD ANALYSIS PERFORMED			2 VALUES <LLD	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements of specified locations is indicated in parentheses (F).

TABLE 28

RADIOACTIVITY IN CLAM FLESH

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

NAME OF FACILITY WATTS BAR — DOCKET NO. IVA/OMS/OHS-82/9
LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN: NAME, DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS ALPHA 4	0.100	3.52(4/ 4) 2.21- 5.49	TRM 496.50	3.52(4/ 4) 2.21- 5.49		
GROSS BETA 4	0.100	7.79(4/ 4) 5.68- 12.12	TRM 496.50	7.79(4/ 4) 5.68- 12.12		
GAMMA (GELI) 16						
CO-60	0.080	0.22(3/ 12) 0.14- 0.28	TRM 527.4	0.28(1/ 4) 0.28- 0.28	0.18(1/ 4) 0.18- 0.18	
CS-137	0.080	0.14(1/ 12) 0.14- 0.14	TRM 496.50	0.14(1/ 4) 0.14- 0.14	0.14(1/ 4) 0.14- 0.14	
NB-95	0.070	0.32(1/ 12) 0.32- 0.32	TRM 496.50	0.32(1/ 4) 0.32- 0.32	0.27(1/ 4) 0.27- 0.27	
K-40	NOT ESTAB	2.32(12/ 12) 0.52- 4.12	TRM 527.4	2.71(4/ 4) 0.91- 4.12	2.37(4/ 4) 1.79- 3.14	
BI-214	NOT ESTAB	0.60(12/ 12) 0.09- 2.47	TRM 496.50	1.25(4/ 4) 0.42- 2.47	0.57(4/ 4) 0.39- 0.75	
PB-214	NOT ESTAB	0.48(12/ 12) 0.03- 1.22	TRM 496.50	0.71(4/ 4) 0.39- 1.12	0.50(4/ 4) 0.36- 0.77	
PB-212	NOT ESTAB	0.12(5/ 12) 0.07- 0.17	TRM 496.50	0.13(4/ 4) 0.09- 0.17	0.04(2/ 4) 0.02- 0.06	
TL-208	NOT ESTAB	0.05(6/ 12) 0.01- 0.09	TRM 527.4	0.05(2/ 4) 0.04- 0.06	0.02(3/ 4) 0.01- 0.02	
AC-228	NOT ESTAB	0.49(1/ 12) 0.49- 0.49	TRM 496.50	0.49(1/ 4) 0.49- 0.49	0.18(2/ 4) 0.16- 0.20	

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements of specified locations is indicated in parentheses (F).

TABLE 29

RADIOACTIVITY IN CLAM SHELL

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

NAME OF FACILITY WATTS BAR — DOCKET NO. TVA/OMS/OHS-82/9

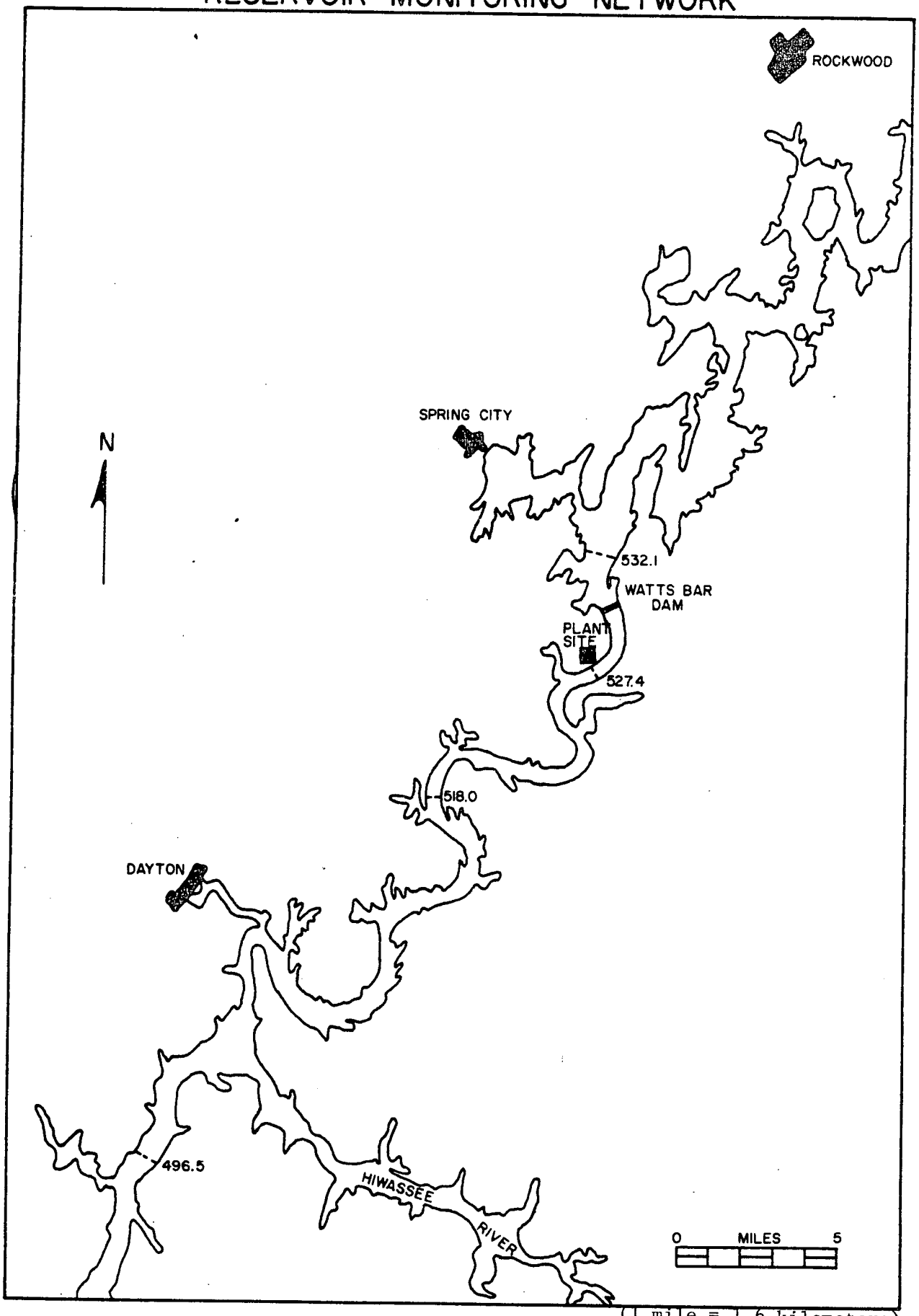
LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1981

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION[a] (LLD)	ALL INDICATOR LOCATIONS MEAN (F)[b] RANGE[b]	LOCATION WITH HIGHEST ANNUAL MEAN: NAME DISTANCE AND DIRECTION	MEAN (F)[b] RANGE[b]	CONTROL LOCATIONS MEAN (F)[b] RANGE[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS ALPHA 4	0.700	4 VALUES <LLD ANALYSIS PERFORMED			0 VALUES <LLD	
GROSS BETA 4	0.700	4.24(4/ 4) 3.81- 4.58	TRM 496.50	4.24(4/ 4) 3.81- 4.58		
GAMMA (GELI) 15						
CO-60	0.010	0.02(10/ 12) 0.01- 0.02	TRM 496.50	0.02(3/ 4) 0.01- 0.02	0.02(3/ 3) 0.01- 0.03	
CS-137	0.020	12 VALUES <LLD			0.04(1/ 3) 0.04- 0.04	
K-40	NOT ESTAB	0.11(11/ 12) 0.05- 0.22	TRM 518.0	0.14(4/ 4) 0.11- 0.16	0.14(2/ 3) 0.13- 0.15	
BI-214	0.050	0.13(11/ 12) 0.07- 0.18	TRM 518.0	0.14(4/ 4) 0.10- 0.18	0.11(3/ 3) 0.05- 0.20	
BI-212	0.100	0.21(8/ 12) 0.15- 0.31	TRM 527.4	0.22(2/ 4) 0.19- 0.26	0.23(2/ 3) 0.20- 0.26	
PB-214	0.050	0.14(11/ 12) 0.07- 0.21	TRM 518.0	0.15(4/ 4) 0.12- 0.21	0.14(3/ 3) 0.06- 0.28	
PB-212	NOT ESTAB	0.10(12/ 12) 0.03- 0.18	TRM 518.0	0.11(4/ 4) 0.08- 0.18	0.12(3/ 3) 0.03- 0.26	
RA-226	0.050	0.13(9/ 12) 0.09- 0.18	TRM 527.4	0.16(2/ 4) 0.14- 0.18	0.20(1/ 3) 0.20- 0.20	
RA-224	NOT ESTAB	12 VALUES <LLD			0.35(1/ 3) 0.35- 0.35	
TL-208	0.020	0.03(9/ 12) 0.02- 0.06	TRM 496.50	0.04(3/ 4) 0.02- 0.05	0.05(2/ 3) 0.02- 0.08	
AC-228	0.060	0.18(11/ 12) 0.08- 0.26	TRM 518.0	0.19(4/ 4) 0.15- 0.26	0.22(2/ 3) 0.08- 0.36	
PA-234M	NOT ESTAB	1.28(1/ 12) 1.28- 1.28	TRM 496.50	1.28(1/ 4) 1.28- 1.28	3 VALUES <LLD	
SR 89 4	5.000	5.21(1/ 4) 5.21- 5.21	TRM 496.50	5.21(1/ 4) 5.21- 5.21		
SR 90 4	1.000	1.54(3/ 4) 1.09- 1.97	TRM 496.50	1.54(3/ 4) 1.09- 1.97		

a. Nominal Lower Limit of Detection (LLD) as described in Table 3.
b. Mean and range based upon detectable measurements only. Fraction of detectable measurements of specified locations is indicated in parentheses (F).

Figure 10

RESERVOIR MONITORING NETWORK



(1 mile = 1.6 kilometers)

Figure 11

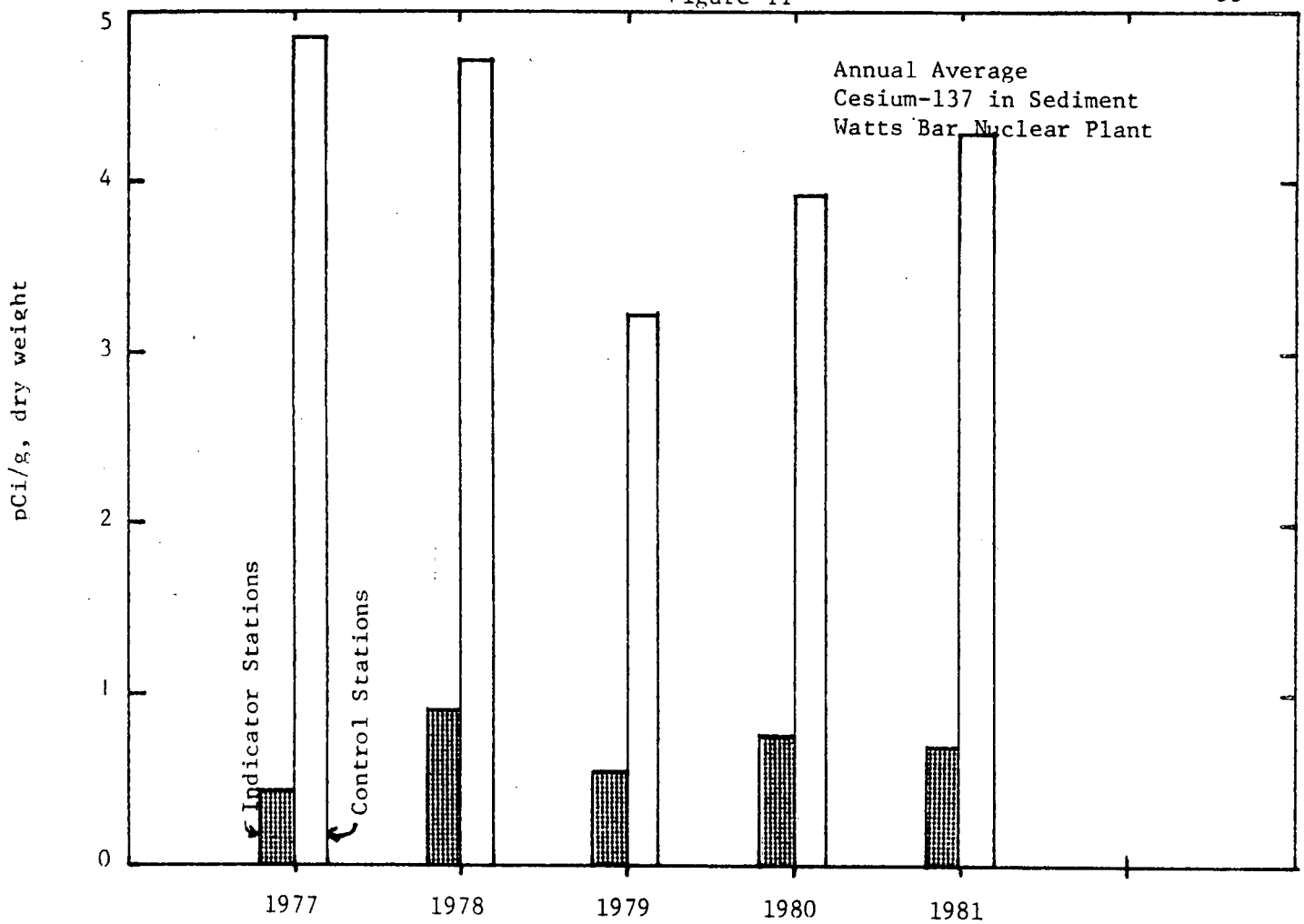
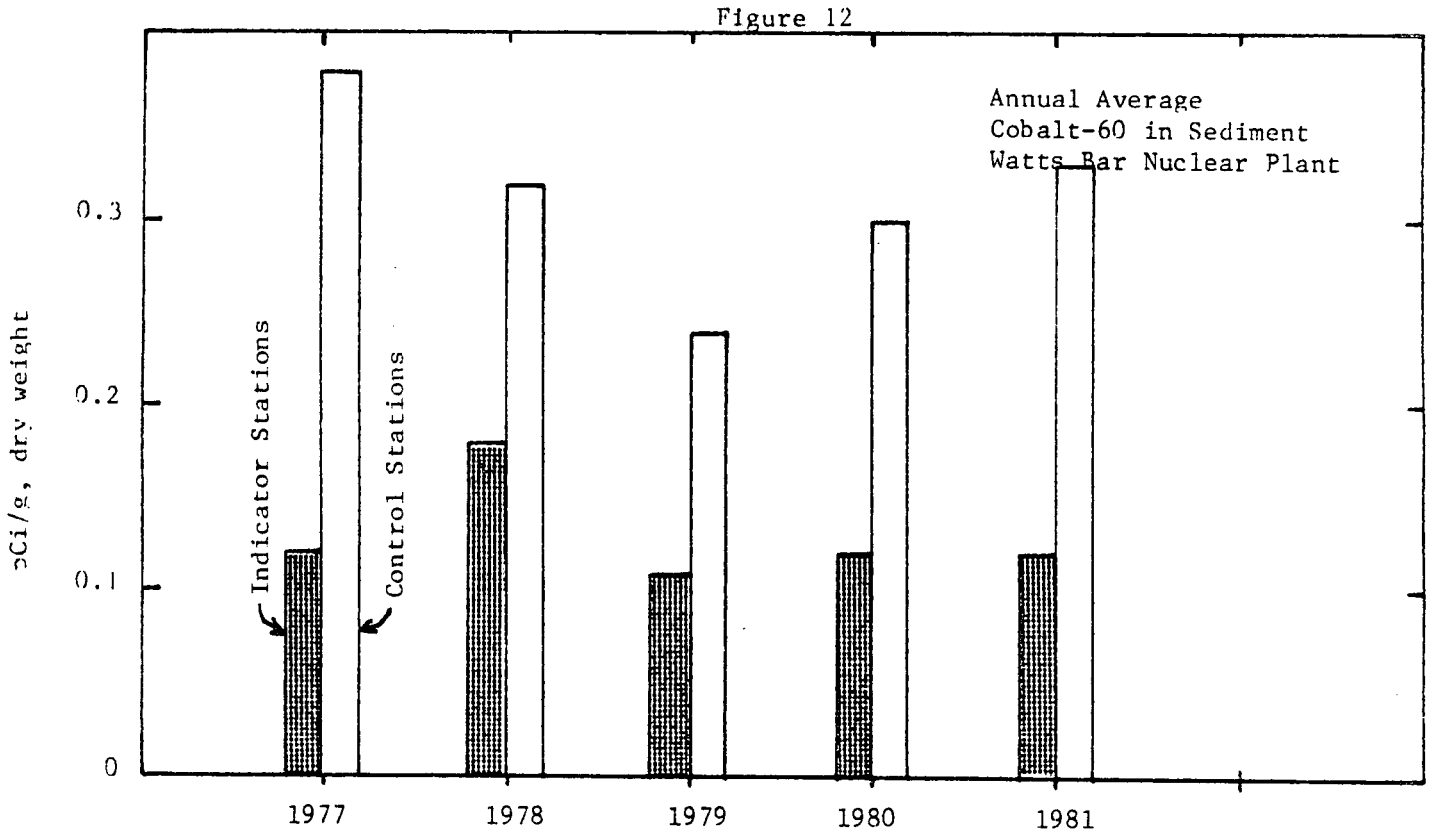


Figure 12



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, or other nuclear operations in the area.

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, or other nuclear operations in the area.