TENNESSEE VALLEY AUTHORITY

ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT
WATTS BAR NUCLEAR PLANT
1985

RADIOLOGICAL HEALTH

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1985

TENNESSEE VALLEY AUTHORITY
DIVISION OF NUCLEAR SERVICES
RADIOLOGICAL HEALTH

May 1986

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ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT

WATTS BAR NUCLEAR PLANT

1985

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 1987.

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 1985.

Radiological Health (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. A Nuclear Data (ND) Model 6700 system, in conjunction with germanium detection systems was used to analyze the samples for specific gamma-emitting radionuclides. Specific analysis for ^{131}I in charcoal filters are routinely counted with NaI(Tℓ) detection systems. TVA-fabricated beta-gamma coincidence counting systems are utilized for the determination of ^{131}I concentrations in milk. Tritium determinations are made with Packard Tri-carb 3255 or 4000 series liquid scintillation counting systems.

Data were entered in 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 ^{7}Be, ^{40}K, ^{212}Bi, ^{214}Bi, ^{212}Pb, ^{214}Pb, ^{226}Ra, 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 radionuclide 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 1985 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[a]	Vegetation	Milk	Well Water	Public Water	Aquatic Life and Sediment
Site SSW	W	W	M	M	BW	S	M[b]				
Site SE	W	W	M	M		S	M[b]				
Site N	W	W	M	M	BW	S	M[b]				
Site NNE	W	W	M	M		S	M[b]				
Spring City	W	W	M	M		S	M[b]			M[c]	
Cedine	W	W	M	M		S	M[b]				
Ten Mile	W	W	M	M		S	M[b]				
Decatur	W	W	M	M		S	M[b]				
Dayton[g]	W	W	M	M	BW	S	M[b]			M	
Alloway	W	W	M	M		S	M[b]				
Farm Bn							Q[d]				
Farm R							Q[d]				
Farm H							Q[d]	M[e]			
Farm L							Q[d]	M[e]	M		
Farm Mo							Q[d]	M[e]			
Farm Mu[f]							M	BM			
Control Farms[g]							Q[d]	M[e]			
Onsite Wells (6)[h]									M		
Watts Bar Reservation[c]										M	
C. F. Industries[g]										M	
Nickajack/Chickamauga/Watts Bar Reservoirs[g]											S

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

a. Collection changed to annually in June 1985.
b. Added to sampling program in June 1985.
c. Discontinued in June 1985.
d. Collection changed to monthly in June 1985.
e. Collection changed to bimonthly in June 1985.
f. Added to sampling program in November 1985.
g. Part of Sequoyah Nuclear Plant sampling program.
h. Five of six onsite wells discontinued in June 1985.

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 controls 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

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 = 3.7×10^{-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.	EPA value (±3σ)	TVA Avg.	EPA value (±3σ)	TVA Avg.	EPA value (±3σ)	TVA Avg.
11/84	15±9	15	52±9	61	21±3	21	10±9	10
3/85	10±9	11	36±9	40	15±3	16	6±9	6
8/85	13±9	12	44±9	45	18±3	16	8±9	9

B. Tritium in Urine (pCi/L)

Date	EPA value (±3σ)	TVA Avg.
4/85	3056±622	2687
7/85	2444±610	2280

C. Radiochemical Analysis of Water (pCi/L)

Date	Gross Alpha		Gross Beta		Strontium-89		Stronium-90		Tritium		Iodine-131	
	EPA value (±3σ)	TVA Avg.	EPA value (±3σ)	TVA Avg.	EPA value (±3σ)	TVA Avg.	EPA value (±3σ)	TVA Avg.	EPA value (±3σ)	TVA Avg.	EPA value (±3σ)	TVA Avg.
4/84[a]					23±9	22[b]	26±3	26				
1/85	5±9	4	15±9	19	3±9	10	30±3	29				
2/85									3796±634	3817		
3/85	6±9	6	15±9	17								
4/85									3559±630	3347	7.5±1.4	7.3
4/85[c]			72±9	69	10±9	9[d]	15±3	16				
5/85	12±9	9	11±9	14	39±9	49	15±3	13				
6/85									2416±608	2257		
7/85	11±9	12	8±9	11								
8/85									4480±776	4127	33 ±10	29
9/85	8±9	8	8±9	12	20±9	26	7±3	5				
10/85									1974±598	1880		

Table 4

RESULTS OBTAINED IN INTERLABORATORY COMPARISON PROGRAM (Continued)

D. 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.
4/84[a]			30±9	30					30±9	27	26±9	27
2/85	48±9	45	20±9	20	55±5	53	25±9	40[b]	35±9	32	25±9	25
4/85[c]			15±9	16					15±9	15	12±9	13
6/85	44±9	40[d]	14±9	14	47±9	48	62±9	53	35±9	34	20±9	19
10/85	21±9	40[d]	20±9	21	19±9	20	20±9	25	20±9	18	20±9	20

E. 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.
1/85	34±9	37	26±3	37[f]	35±10	33	29±9	28	1382±208	1270
7/85	33±9	34	26±3	34	35±10	36	29±9	31	1514±132	1567

F. 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.
3/85					9±1.6	11[h]				
6/85	11±9	13	11±3	11	11±10	11	11±9	12	1525±132	1680[i]

a. Laboratory performance evaluation study. Results received from EPA in April 1985.
b. Below LLD.
c. Laboratory performance evaluation study.
d. The analysis was reviewed. Cause for high results could not be identified.
e. Values reported as mg K/kg.
f. Possible error due to nonhomogeneity of sample. EPA used dog food containing bone meal in the preparation of the food cross-check.
g. Values reported as mg K/L.
h. Results were investigated. No source of error was determined.
i. High bias on result due to broadening of the peak used for identifying K-40. The low abundance and low counting efficiency for the 1460 kev line inflated the small positive bias caused by temperature variations.

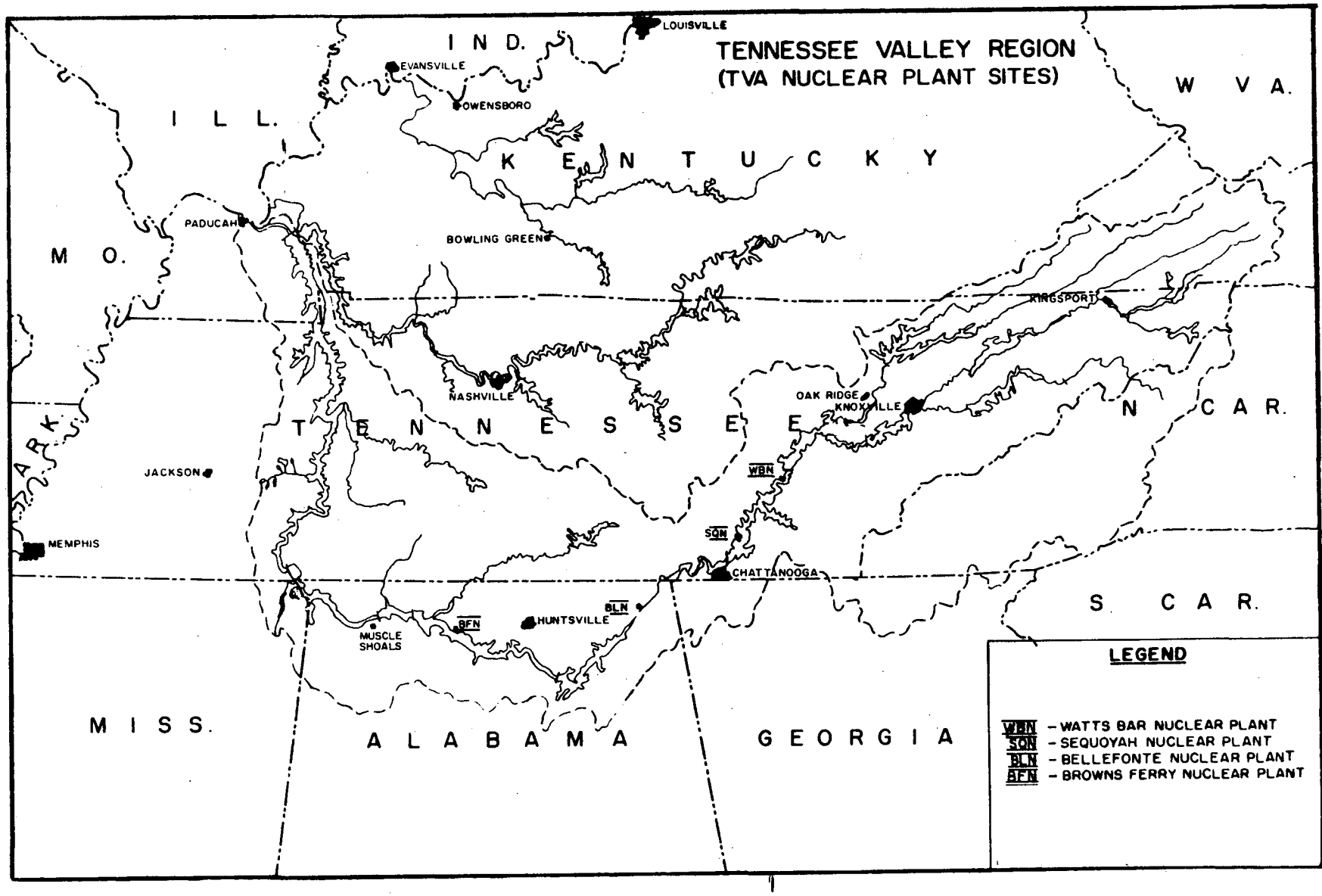

TENNESSEE VALLEY REGION
(TVA NUCLEAR PLANT SITES)
LOUISVILLE
IND.
EVANSVILLE
OWENSBORO
ILL.
W VA.
KENTUCKY
PADUCAH
BOWLING GREEN
MO.
KINGSPORT
NASHVILLE
OAK RIDGE
KNOXVILLE
N CAR.
ARK.
TENNESSEE
JACKSON
WBN
SQN
MEMPHIS
CHATTANOOGA
S CAR.
BLN
BFN
HUNTSVILLE
MUSCLE SHOALS
MISS.
ALABAMA
GEORGIA
LEGEND
WBN - 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 monitors are located within or near the plant boundary. Four perimeter monitors 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 monitor is in Alloway, 14.9 miles (23.8 kilometers) NNW of the plant. The other remote monitor 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 a GM tube with a recorder to continuously monitor and record gamma radiation levels. Additionally, at two local and one remote monitors moisture is collected from the atmosphere and analyzed for ^{3}H.

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

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 ^{89}Sr and ^{90}Sr content. Adequate time is allowed for decay of radon daughters between collection and analysis. This time is typically three days. Analytical results

are presented in table 6. During this reporting period, thirteen weekly air filters were not collected because of equipment malfunction. Three filters were off or damaged and unusable.

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 1985 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.

Rainwater

Rainwater was collected and analyzed monthly 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 (SQN) monitoring program, were until mid-June, analyzed for gross beta and ^{3}H activity. After June analysis for gross beta and for ^{3}H was deleted from the program. For the gross beta analysis, a maximum of 500 ml of the sample was boiled to dryness and counted. 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. The results are shown in table 7. During this report period two samples were not available for analysis because of equipment malfunction. One sample was not collected because of personnel error.

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.

Charcoal Filters

Charcoal filters were collected weekly and analyzed for radioiodine. The filter was counted in a single channel analyzer system. The data are shown in table 9. During this reporting period, thirteen samples were not collected because of equipment malfunction, three filters were damaged and unusable, and another 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 ^{3}H content. The results are shown in table 10. During this reporting period, seven samples were not obtained because of equipment malfunction, one sample was destroyed during analysis, eighteen samples contained insufficient volume for analysis, and two samples were not available through personnel errors.

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
^{3}H	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.

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 1985

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 504	1.0CE-02	2.14E-02(384/ 400) 1.01E-02 - 4.00E-02	PM2 SPRING CITY 7.0 MILES NW	2.27E-02(50/ 52) 1.18E-02 - 4.00E-02	1.88E-02(100/ 104) 1.00E-02 - 3.30E-02	
GAMMA (GELI) 130						
K-40	NOT ESTAB	1.33E-02(23/ 104) 2.40E-03 - 5.84E-02	PM4 TEN MILE 7.75 MILES NE	5.84E-02(1/ 13) 5.84E-02 - 5.84E-02	1.69E-02(7/ 26) 1.30E-02 - 2.23E-02	
BI-212	NOT ESTAB	8.90E-03(1/ 104) 8.90E-03 - 8.90E-03	LM-4 W8 0.9 MILES SE	8.90E-03(1/ 13) 8.90E-03 - 8.90E-03	26 VALUES <LLD	
PB-212	NOT ESTAB	3.47E-04(19/ 104) 1.00E-04 - 8.00E-04	PM2 SPRING CITY 7.0 MILES NW	7.00E-04(1/ 13) 7.00E-04 - 7.00E-04	3.20E-04(5/ 26) 2.00E-04 - 4.00E-04	
BE-7	5.00E-02	9.47E-02(95/ 104) 5.54E-02 - 1.85E-01	PM3 CEDINE BIBLE CAMP 11.5 M. NNE	1.02E-01(10/ 13) 5.54E-02 - 1.85E-01	9.30E-02(22/ 26) 5.55E-02 - 1.27E-01	
TL-208	NOT ESTAB	3.12E-04(8/ 104) 1.00E-04 - 1.00E-03	LM1 ENV DATA STA 0.5 MILES SSW	4.67E-04(3/ 13) 2.00E-04 - 1.00E-03	26 VALUES <LLD	
AC-228	NOT ESTAB	1.45E-03(8/ 104) 3.00E-04 - 3.90E-03	PM2 SPRING CITY 7.0 MILES NW	3.90E-03(1/ 13) 3.90E-03 - 3.90E-03	3.50E-04(2/ 26) 1.00E-04 - 6.00E-04	
SR 89 40	5.00E-03	32 VALUES <LLD ANALYSIS PERFORMED			8 VALUES <LLD	
SR 90 40	1.00E-03	32 VALUES <LLD ANALYSIS PERFORMED			8 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 7

RADIOACTIVITY IN RAINWATER

PCI/L - 0.037 BQ/L

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1985

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 5	2.00				3.97(5/ 5) 2.16 - 6.63	
GAMMA (GELI) 127						
K-40	NOT ESTAB	22.97(7/ 103) 1.98 - 48.50	LM1 ENV DATA STA 0.5 MILES SSW	48.50(1/ 13) 48.50 - 48.50	36.82(2/ 24) 9.84 - 63.81	
BI-214	NOT ESTAB	4.37(58/ 103) 0.02 - 13.19	LM-3 WB 2.1 MILES NNE	5.44(7/ 13) 0.54 - 11.52	5.93(16/ 24) 0.36 - 49.51	
PB-214	NOT ESTAB	3.51(24/ 103) 0.11 - 10.39	PM3 CEDINE BIBLE CAMP 11.5 M. NNE	4.98(2/ 13) 4.93 - 5.03	6.92(6/ 24) 2.22 - 24.85	
PB-212	NOT ESTAB	1.79(24/ 103) 0.04 - 5.16	PM5 DECATUR 6.25 MILES S	3.90(2/ 13) 3.84 - 3.97	2.19(6/ 24) 0.63 - 4.31	
BE-7	NOT ESTAB	56.99(43/ 103) 21.31 - 141.32	PM2 SPRING CITY 7.0 MILES NW	91.00(4/ 13) 67.92 - 128.11	50.45(13/ 24) 22.75 - 93.45	
SR 89 127	10.00	103 VALUES <LLD ANALYSIS PERFORMED			24 VALUES <LLD	
SR 90 127	2.00	103 VALUES <LLD ANALYSIS PERFORMED			24 VALUES <LLD	
TRITIUM 5	330.00	0 VALUES <LLD ANALYSIS PERFORMED			5 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 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 DECATUR TENNESSEE — REPORTING PERIOD 1985

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	0.05	0.13(90/ 104)	LM2 N. WBSP GATE	0.25(13/ 13)	0.11(24/ 26)	
130		0.05 - 0.74	0.5 MILES N	0.10 - 0.74	0.05 - 0.18	

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 CHARCOAL 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 1985

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	0.01	0.02(75/ 399)	PM5 DECATUR	0.02(9/ 51)	0.01(17/ 104)	
503		0.01 - 0.05	6.25 MILES S	0.01 - 0.05	0.01 - 0.03	

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 10

RADIOACTIVITY IN ATMOSPHERIC MOISTURE

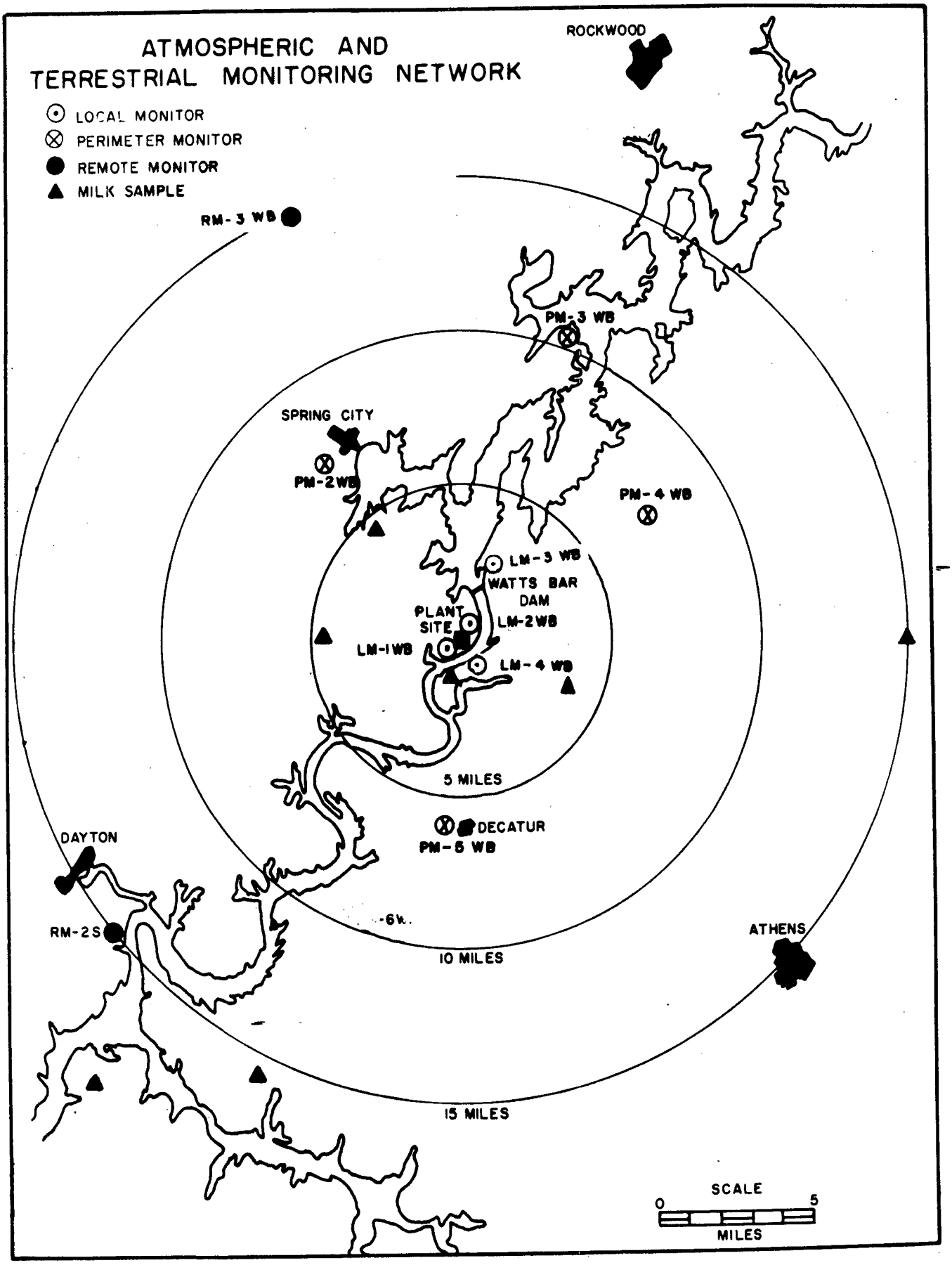
PCI/M(3) - 0.037 BQ/M(3)

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1985

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
TRITIUM	NOT ESTAB	1.28(26/ 36)	LM2 N. WBSP GATE	1.31(11/ 17)	1.11(13/ 14)	
50		0.22 - 2.62	0.5 MILES N	0.28 - 2.56	0.01 - 3.44	

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)

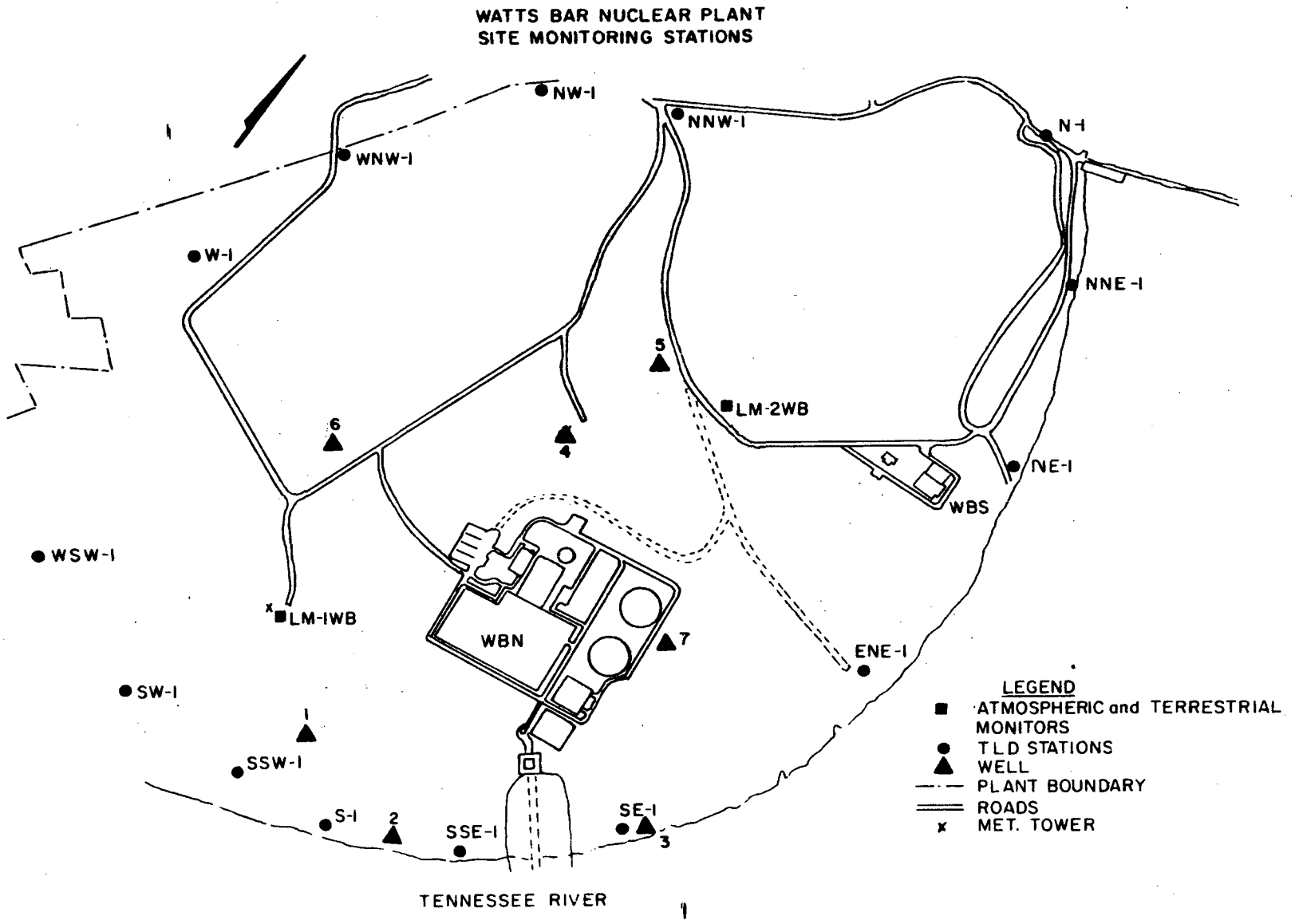

WATTS BAR NUCLEAR PLANT
SITE MONITORING STATIONS
NW-1
NNW-1
N-1
WNW-1
W-1
NNE-1
5
LM-2WB
6
4
NE-1
WBS
WSW-1
LM-1WB
WBN
7
ENE-1
SW-1
1
SSW-1
S-1
2
SSE-1
SE-1
3
TENNESSEE RIVER
LEGEND
ATMOSPHERIC and TERRESTRIAL MONITORS
T.L.D STATIONS
WELL
PLANT BOUNDARY
ROADS
MET. TOWER

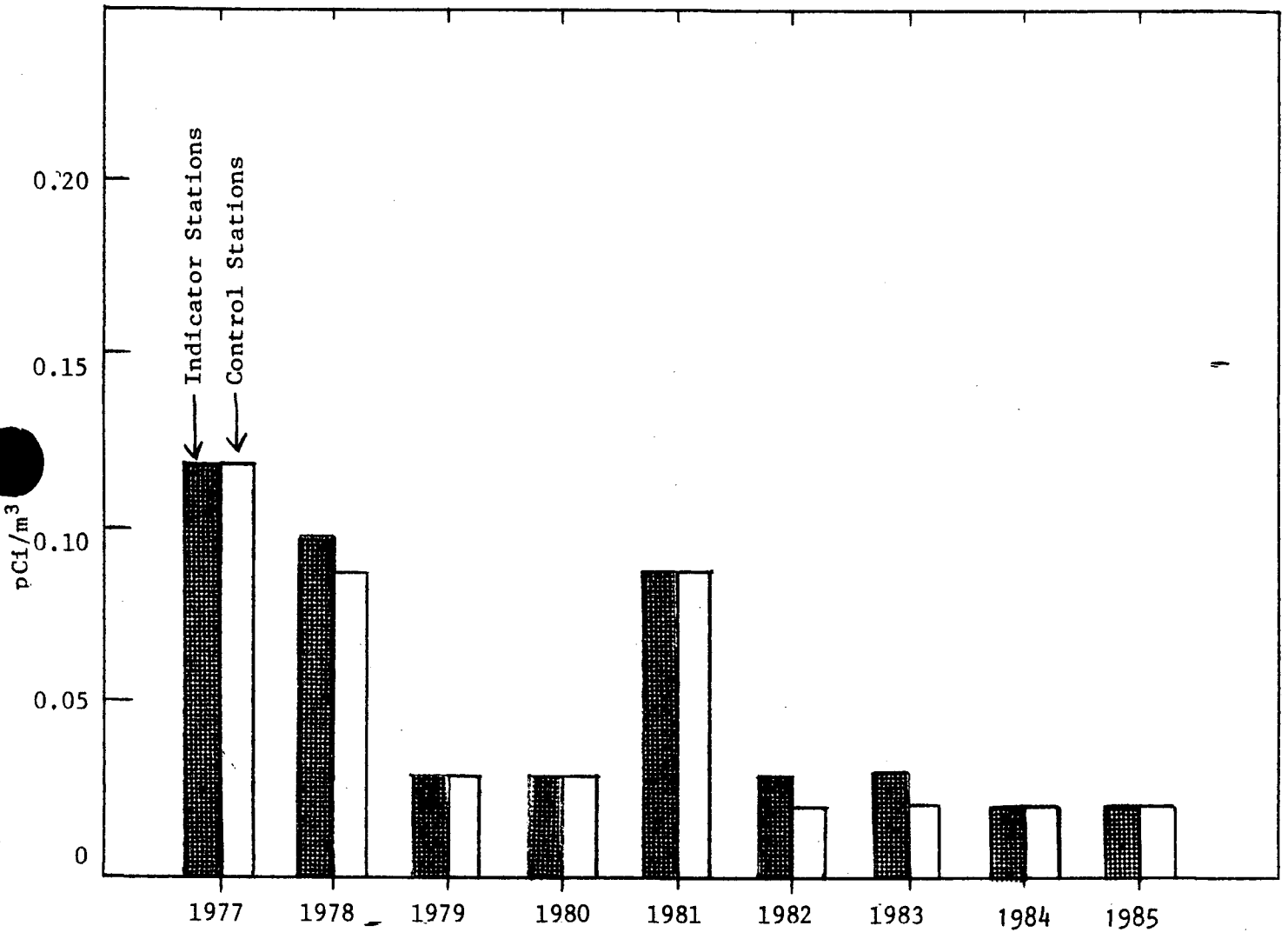
Figure 3

Figure 4

Annual Average

Gross Beta Activity in Air (Particulate Filters)

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 five-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 1985. This land use survey identified two locations with milk producing animals which produced projected doses in the range of those being calculated for existing sampling locations. Efforts were made to add these two locations to the sampling schedule. The owner of the animals at the location with the highest projected annual thyroid dose (ESE, 5150 meters from WBN) moved the milk producing animals out of state before sampling could be arranged. The other location (ESE, 5995 meters from WBN) was added to the environmental sampling program for milk and vegetation samples.

Milk

From January to mid-June milk samples were collected monthly from three indicator stations. Weekly samples were taken at three control stations (these control stations are part of an ongoing SQN sampling program). All monthly and weekly samples were analyzed for gamma-emitting radionuclides and iodine-131. Monthly samples were also analyzed for strontium. Beginning in mid-June the collection frequency was changed to semimonthly (every two weeks). The dairy identified by the 1985 land use survey was added to the sampling program as an additional indicator location with the first sample scheduled for late November 1985. Analysis for iodine-131 and for gamma-emitting radionuclides was conducted on all collected samples with analysis for Sr-89,-90 content done once per month (every fourth week). Table 11 summarizes the results of laboratory analyses. During this reporting period, three samples were not available for pickup and one sample spoiled before analysis for iodine-131 could be performed.

As has been noted in previous radiological monitoring reports, the levels of ^{90}Sr 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 ^{90}Sr 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 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 the Watts Bar Nuclear Plant. 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 ^{90}Sr in milk and the quality of fertilization and land management.[a]

Vegetation

From January to June 1985, vegetation was collected monthly from three control dairies and two indicator farms and quarterly from three indicator dairies. The control samples were analyzed monthly for gamma-emitting radionuclides and quarterly for Sr-89,-90 content. The samples collected from the two indicator farms were analyzed monthly for gamma-emitting radionuclides and Sr-89,-90 content. Samples were also collected quarterly from three indicator dairies and analyzed for gamma-emitting radionuclides and for Sr-89,-90.

During June 1985, the vegetation sampling program was expanded to include the ten air monitoring stations. In addition, the sampling frequency was changed to monthly collection. The samples were analyzed monthly for ^{131}I and for gamma-emitting radionuclides and quarterly for Sr-89,-90. The three control dairies and one control air monitoring stations were also part of the SQN sampling program. The change in sampling frequency resulted in these locations being sampled every two weeks. This additional data is reported herein. Approximately 1-2 kilograms of grass was broken or cut at ground level and returned for analysis. Where appropriate, efforts were made to sample vegetation that was representative of the pasturage where cattle graze. Table 12 summarizes the results obtained from the laboratory analyses.

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[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.

Soil

Soil samples were collected annually near each air monitoring station and from one control station 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 two inches (5 cm) of soil. All samples were analyzed for gross beta activity, gamma-emitting radionuclides, ^{89}Sr, and ^{90}Sr content. The analytical results are given in table 13.

Groundwater

Between January and June well water samples were obtained monthly from six onsite wells and from three farms in the area. All samples were analyzed for gamma-emitting radionuclides and a quarterly composite was analyzed for ^{3}H. Beginning in June collection from five of the six onsite wells and two of the three farms were discontinued. Analytical requirements remained unchanged at the two remaining stations. 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. Sample collection at two locations (Spring City and Watts Bar Reservation) was discontinued during June 1985. Tritium, ^{89}Sr, and ^{90}Sr 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, one sample was not collected because of equipment malfunction.

Figure 5 shows the trends in gross beta activity in drinking water from 1977 through 1985. 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 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 2-3 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 1985. 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.

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 apples, cabbage, corn, green beans, potatoes, and tomatoes were collected and analyzed for gross beta and specific gamma-emitting radionuclides. Samples of cabbage, green beans, and potatoes were inadvertently destroyed before the gross beta activity could be determined. The results of laboratory analyses are given in tables 17 through 22.

TABLE 11

RADIOACTIVITY IN MILK

PCI/L - 0.037 BQ/L

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY DAYTON TENNESSEE — REPORTING PERIOD 1285

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-131 173	0.50	60 VALUES <LLD ANALYSIS PERFORMED			113 VALUES <LLD	
GAMMA (GELI) 174						
K-40	NOT ESTAB	1239.25(60/ 60) 516.26 - 1569.68	MULLINS FARM 3.75 MILES ESE	1399.81(2/ 2) 1398.15 - 1401.46	1208.25(114/ 114) 743.59 - 1656.20	
BI-214	NOT ESTAB	32.47(32/ 60) 0.02 - 253.43	LAYMAN FARM 1.5 MILES SSW	74.02(12/ 19) 1.67 - 253.43	41.38(73/ 114) 0.37 - 160.91	
PB-214	NOT ESTAB	42.95(23/ 60) 0.53 - 245.56	LAYMAN FARM 1.5 MILES SSW	108.30(8/ 19) 3.78 - 245.56	48.78(61/ 114) 0.12 - 156.76	
PB-212	NOT ESTAB	1.37(14/ 60) 0.29 - 3.04	HOUSLEY FARM 4.75 MILES W	1.64(6/ 20) 0.29 - 3.04	2.16(22/ 114) 0.02 - 5.38	
TL-208	NOT ESTAB	2.39(7/ 60) 1.22 - 3.14	HOUSLEY FARM 4.75 MILES W	2.70(3/ 20) 2.15 - 3.14	0.78(20/ 114) 0.03 - 3.88	
AC-228	NOT ESTAB	2.50(2/ 60) 2.11 - 2.90	MOFFETT FARM 4.5 MILES NW	2.90(1/ 19) 2.90 - 2.90	5.68(12/ 114) 0.36 - 9.30	
SR 89 77	10.00	38 VALUES <LLD ANALYSIS PERFORMED			59 VALUES <LLD	
SR 90 77	2.00	5.82(32/ 38) 2.17 - 9.26	MOFFETT FARM 4.5 MILES NW	7.10(12/ 12) 3.08 - 9.26	2.73(19/ 39) 2.06 - 3.95	

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 1985

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	0.00(26/ 93)	LAYMAN FARM	0.00(1/ 7)	0.00(36/ 63)	
156		0.00 - 0.00	1.5 MILES SSW	0.00 - 0.00	0.00 - 0.00	
GAMMA (GELI)						
192						
CS-137	0.06	0.15(9/ 111)	PM5 DECATUR	0.25(1/ 7)	81 VALUES <LLD	
		0.09 - 0.25	6.25 MILES S	0.25 - 0.25		
K-40	NOT ESTAB	18.46(111/ 111)	MULLINS FARM	32.65(2/ 2)	23.52(81/ 81)	
		3.25 - 44.73	3.75 MILES ESE	30.81 - 34.50	3.42 - 45.27	
BI-214	0.10	0.19(41/ 111)	PM3 CEDINE BIBLE	0.36(4/ 7)	0.25(21/ 81)	
		0.10 - 0.48	CAMP 11.5 M. NNE	0.14 - 0.46	0.11 - 1.25	
PB-214	NOT ESTAB	0.12(86/ 111)	PM3 CEDINE BIBLE	0.26(7/ 7)	0.11(63/ 81)	
		0.00 - 0.57	CAMP 11.5 M. NNE	0.08 - 0.53	0.01 - 1.06	
PB-212	NOT ESTAB	0.07(63/ 111)	PM3 CEDINE BIBLE	0.15(6/ 7)	0.03(43/ 81)	
		0.00 - 0.42	CAMP 11.5 M. NNE	0.01 - 0.38	0.00 - 0.16	
BE-7	NOT ESTAB	7.05(111/ 111)	PM2 SPRING CITY	9.75(7/ 7)	6.84(80/ 81)	
		1.50 - 16.72	7.0 MILES NW	5.00 - 15.53	1.87 - 17.45	
TL-208	NOT ESTAB	0.04(33/ 111)	LM1 ENV DATA STA	0.12(2/ 7)	0.02(17/ 81)	
		0.00 - 0.20	0.5 MILES SSW	0.04 - 0.20	0.00 - 0.07	
AC-228	NOT ESTAB	0.23(41/ 111)	SHIRLEY REED FAR	0.36(7/ 13)	0.13(19/ 81)	
		0.03 - 1.69	1.5 MILES WSW	0.03 - 1.69	0.02 - 0.32	
SR 89	0.25	45 VALUES <LLD			24 VALUES <LLD	
69		ANALYSIS PERFORMED				
SR 90	0.05	0.27(43/ 45)	LM-3 WB	0.50(2/ 2)	0.17(20/ 24)	
69		0.06 - 1.35	2.1 MILES NNE	0.48 - 0.52	0.06 - 0.93	

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 13

RADIOACTIVITY IN SOIL

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

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

LOCATION OF FACILITY SPRA TENNESSEE — REPORTING PERIOD 1985

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	0.70	26.92(8/ 8)	LM-4 WB	41.26(1/ 1)	13.22(2/ 2)	
10		15.14 - 41.26	0.9 MILES SE	41.26 - 41.26	13.01 - 13.43	
GAMMA (GELI)						
10						
CS-137	0.02	0.40(8/ 8)	PM5 DECATUR	0.92(1/ 1)	0.39(2/ 2)	
		0.06 - 0.92	6.25 MILES S	0.92 - 0.92	0.31 - 0.47	
K-40	0.25	9.67(8/ 8)	LM-4 WB	19.36(1/ 1)	3.17(2/ 2)	
		3.26 - 19.36	0.9 MILES SE	19.36 - 19.36	2.42 - 3.91	
BI-214	0.05	0.89(8/ 8)	LM1 ENV DATA STA	1.09(1/ 1)	0.65(2/ 2)	
		0.69 - 1.09	0.5 MILES SSW	1.09 - 1.09	0.65 - 0.66	
BI-212	0.10	1.13(8/ 8)	LM1 ENV DATA STA	1.48(1/ 1)	0.68(2/ 2)	
		0.84 - 1.48	0.5 MILES SSW	1.48 - 1.48	0.62 - 0.75	
PB-214	0.05	0.99(8/ 8)	LM1 ENV DATA STA	1.21(1/ 1)	0.71(2/ 2)	
		0.77 - 1.21	0.5 MILES SSW	1.21 - 1.21	0.71 - 0.72	
PB-212	NOT ESTAB	1.02(8/ 8)	LM2 N. WBSP GATE	1.27(1/ 1)	0.54(2/ 2)	
		0.75 - 1.27	0.5 MILES N	1.27 - 1.27	0.50 - 0.59	
RA-226	0.05	0.89(8/ 8)	LM1 ENV DATA STA	1.09(1/ 1)	0.65(2/ 2)	
		0.69 - 1.09	0.5 MILES SSW	1.09 - 1.09	0.65 - 0.66	
RA-224	NOT ESTAB	1.22(7/ 8)	LM-4 WB	1.51(1/ 1)	0.57(2/ 2)	
		0.90 - 1.51	0.9 MILES SE	1.51 - 1.51	0.53 - 0.61	
TL-208	0.02	0.36(8/ 8)	LM1 ENV DATA STA	0.47(1/ 1)	0.18(2/ 2)	
		0.25 - 0.47	0.5 MILES SSW	0.47 - 0.47	0.16 - 0.20	
AC-228	0.06	1.06(8/ 8)	LM-4 WB	1.39(1/ 1)	0.56(2/ 2)	
		0.75 - 1.39	0.9 MILES SE	1.39 - 1.39	0.54 - 0.57	
PA-234M	NOT ESTAB	2.46(4/ 8)	PM3 CEDINE BIBLE	3.44(1/ 1)	2 VALUES <LLD	
		1.74 - 3.44	CAMP 11.5 M. NNE	3.44 - 3.44		
SR 89	1.50	8 VALUES <LLD			2 VALUES <LLD	
10		ANALYSIS PERFORMED				
SR 90	0.15	0.21(3/ 8)	PM5 DECATUR	0.21(1/ 1)	2 VALUES <LLD	
10		0.21 - 0.21	6.25 MILES S	0.21 - 0.21		

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 RHEA TENNESSEE — REPORTING PERIOD 1985

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) 68						
K-40	NOT ESTAB	25.98(8/ 43) 11.84 - 40.76	WBN WELL #2 ONSITE SSE	37.24(2/ 6) 34.49 - 40.00	14.41(7/ 25) 0.91 - 36.20	
BI-214	NOT ESTAB	10.32(31/ 43) 1.01 - 35.04	WBN WELL #5 ONSITE N	18.83(5/ 6) 12.22 - 25.17	169.29(25/ 25) 31.60 - 525.59	
PB-214	NOT ESTAB	10.69(25/ 43) 1.16 - 29.15	WBN WELL #6 ONSITE WSW	17.19(5/ 6) 10.41 - 28.62	169.52(25/ 25) 35.72 - 511.80	
PB-212	NOT ESTAB	1.64(5/ 43) 0.84 - 3.52	WBN WELL #1 ONSITE S	1.94(3/ 13) 0.87 - 3.52	1.22(5/ 25) 0.03 - 2.93	
TL-208	NOT ESTAB	1.46(6/ 43) 0.10 - 2.83	WBN WELL #1 ONSITE S	1.82(3/ 13) 0.10 - 2.83	2.32(2/ 25) 1.75 - 2.90	
AC-228	NOT ESTAB	6.21(4/ 43) 0.42 - 11.49	WBN WELL #1 ONSITE S	9.69(2/ 13) 7.89 - 11.49	25 VALUES <LLD	
TRITIUM 22	330.00	335.47(1/ 14) 335.47 - 335.47	WBN WELL #1 ONSITE S	335.47(1/ 4) 335.47 - 335.47	8 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 15

RADIOACTIVITY IN PUBLIC WATER SUPPLY

PCI/L - 0.037 BQ/L

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY SHEA TENNESSEE — REPORTING PERIOD 1985

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	2.00	3.21(22/ 26)	CF INDUSTRIES	3.25(9/ 13)	3.12(13/ 24)	
50		2.17 - 4.55	TRM 473.0	2.17 - 4.55	2.24 - 4.98	
IODINE-131	NOT ESTAB	0.18(3/ 14)	CF INDUSTRIES	0.18(3/ 7)	0.12(4/ 7)	
21		0.00 - 0.40	TRM 473.0	0.00 - 0.40	0.06 - 0.30	
GAMMA (GELI)						
50						
K-40	NOT ESTAB	7.84(1/ 26)	DAYTON, TN	7.84(1/ 13)	1.56(2/ 24)	
		7.84 - 7.84	17.75 MILES NNE	7.84 - 7.84	1.48 - 1.64	
BI-214	NOT ESTAB	5.39(13/ 26)	DAYTON, TN	6.83(6/ 13)	7.95(18/ 24)	
		0.05 - 21.32	17.75 MILES NNE	1.14 - 21.32	0.54 - 23.19	
PB-214	NOT ESTAB	2.13(5/ 26)	DAYTON, TN	2.40(3/ 13)	7.93(13/ 24)	
		1.14 - 4.01	17.75 MILES NNE	1.58 - 4.01	0.98 - 24.65	
PB-212	NOT ESTAB	1.93(9/ 26)	DAYTON, TN	2.14(6/ 13)	1.60(5/ 24)	
		0.05 - 5.12	17.75 MILES NNE	0.05 - 5.12	0.25 - 4.34	
TL-208	NOT ESTAB	0.99(4/ 26)	DAYTON, TN	0.99(4/ 13)	0.43(1/ 24)	
		0.29 - 2.47	17.75 MILES NNE	0.29 - 2.47	0.43 - 0.43	
AC-228	NOT ESTAB	4.29(6/ 26)	DAYTON, TN	4.49(5/ 13)	15.00(1/ 24)	
		2.43 - 6.09	17.75 MILES NNE	2.43 - 6.09	15.00 - 15.00	
SR 89	10.00	8 VALUES <LLD			8 VALUES <LLD	
16		ANALYSIS PERFORMED				
SR 90	2.00	8 VALUES <LLD			8 VALUES <LLD	
16		ANALYSIS PERFORMED				
TRITIUM	330.00	8 VALUES <LLD			396.01(1/ 8)	
16					396.01 - 396.01	

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 16

ENVIRONMENTAL GAMMA RADIATION LEVELS

Average External Gamma Radiation Levels at Various Distances from Watts Bar Nuclear Plant for Each Quarter - 1985
mR/Quarter[a]

Distance miles	Average External Gamma Radiation Levels[b]			
	1st Quarter (Dec 84-Feb 85)	2nd Quarter (Mar-May 85)	3rd Quarter (Jun-Aug 85)	4th Quarter (Sep-Nov 85)
0-1	20.3 ± 2.3	22.2 ± 3.2	20.8 ± 2.6	22.1 ± 2.1
1-2	20.3 ± 1.6	22.8 ± 2.0	20.9 ± 1.5	22.3 ± 1.7
2-4	16.8 ± 1.4	18.2 ± 2.0	17.1 ± 1.1	19.0 ± 0.8
4-6	18.1 ± 2.6	20.2 ± 3.0	18.4 ± 3.1	20.2 ± 2.4
>6	16.3 ± 2.8	18.2 ± 3.5	15.5 ± 4.2	18.3 ± 3.0
Average, 0-2 miles (Onsite)	20.3 ± 2.0	22.4 ± 2.8	20.8 ± 2.2	22.2 ± 1.9
Average, >2 miles (Offsite)	17.4 ± 2.6	19.4 ± 3.2	17.3 ± 3.6	19.4 ± 2.6

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

TABLE 17

RADIOACTIVITY IN APPLES

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

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1985

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	25.00	2473.74(1/ 1)	2.0 MILES S	2473.74(1/ 1)	789.25(1/ 1)	
2		2473.74 - 2473.74		2473.74 - 2473.74	789.25 - 789.25	
GAMMA (GELI)						
2						
K-40	NOT ESTAB	1189.47(1/ 1)	2.0 MILES S	1189.47(1/ 1)	671.59(1/ 1)	
		1189.47 - 1189.47		1189.47 - 1189.47	671.59 - 671.59	
BI-214	NOT ESTAB	3.28(1/ 1)	2.0 MILES S	3.28(1/ 1)	1 VALUES <LLD	
		3.28 - 3.28		3.28 - 3.28		
PB-214	NOT ESTAB	3.76(1/ 1)	2.0 MILES S	3.76(1/ 1)	1 VALUES <LLD	
		3.76 - 3.76		3.76 - 3.76		

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 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 1985

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	25.00	3887.27(1/ 1)	ORIS BENNETT FAR	3887.27(1/ 1)		
1		3887.27 - 3887.27	2.1 MILES NE	3887.27 - 3887.27		
GAMMA (GELI)						
2						
K-40	NOT ESTAB	1791.22(1/ 1)	ORIS BENNETT FAR	1791.22(1/ 1)	1737.57(1/ 1)	
		1791.22 - 1791.22	2.1 MILES NE	1791.22 - 1791.22	1737.57 - 1737.57	
PB-212	NOT ESTAB	1 VALUES <LLD			0.25(1/ 1)	
					0.25 - 0.25	

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 CORN

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

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY ROANE TENNESSEE — REPORTING PERIOD 1985

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	25.00	5572.35(1/ 1) 5572.35 - 5572.35	SHIRLEY REED FAR 1.5 MILES WSW	5572.35(1/ 1) 5572.35 - 5572.35	3971.36(1/ 1) 3971.36 - 3971.36	
GAMMA (GELI) 2						
K-40	NOT ESTAB	2056.95(1/ 1) 2056.95 - 2056.95	SHIRLEY REED FAR 1.5 MILES WSW	2056.95(1/ 1) 2056.95 - 2056.95	2475.67(1/ 1) 2475.67 - 2475.67	
BI-214	NOT ESTAB	10.26(1/ 1) 10.26 - 10.26	SHIRLEY REED FAR 1.5 MILES WSW	10.26(1/ 1) 10.26 - 10.26	1 VALUES <LLD	
PB-214	NOT ESTAB	3.02(1/ 1) 3.02 - 3.02	SHIRLEY REED FAR 1.5 MILES WSW	3.02(1/ 1) 3.02 - 3.02	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 GREEN BEANS

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 1985

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	25.00	4308.27(1/ 1)	SHIRLEY REED FAR	4308.27(1/ 1)		
1		4308.27 - 4308.27	1.5 MILES WSW	4308.27 - 4308.27		
GAMMA (GELI)						
2						
K-40	NOT ESTAB	2148.08(1/ 1)	SHIRLEY REED FAR	2148.08(1/ 1)	1538.56(1/ 1)	
		2148.08 - 2148.08	1.5 MILES WSW	2148.08 - 2148.08	1538.56 - 1538.56	
BI-214	NOT ESTAB	13.01(1/ 1)	SHIRLEY REED FAR	13.01(1/ 1)	1 VALUES <LLD	
		13.01 - 13.01	1.5 MILES WSW	13.01 - 13.01		
PB-212	NOT ESTAB	1.89(1/ 1)	SHIRLEY REED FAR	1.89(1/ 1)	1 VALUES <LLD	
		1.89 - 1.89	1.5 MILES WSW	1.89 - 1.89		

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 21

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 1985

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	25.00	6067.49(1/ 1) 6067.49 - 6067.49	2.0 MILES S	6067.49(1/ 1) 6067.49 - 6067.49		
GAMMA (GELI) 2						
K-40	NOT ESTAB	3912.12(1/ 1) 3912.12 - 3912.12	2.0 MILES S	3912.12(1/ 1) 3912.12 - 3912.12	2725.72(1/ 1) 2725.72 - 2725.72	
PB-212	NOT ESTAB	0.39(1/ 1) 0.39 - 0.39	2.0 MILES S	0.39(1/ 1) 0.39 - 0.39	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 22

RADIOACTIVITY IN 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 1985

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	25.00	3657.48(1/ 1)	SHIRLEY REED FAR	3657.48(1/ 1)	6591.92(1/ 1)	
2		3657.48 - 3657.48	1.5 MILES WSW	3657.48 - 3657.48	6591.92 - 6591.92	
GAMMA (GELI)						
2						
K-40	NOT ESTAB	2444.07(1/ 1)	SHIRLEY REED FAR	2444.07(1/ 1)	4296.08(1/ 1)	
		2444.07 - 2444.07	1.5 MILES WSW	2444.07 - 2444.07	4296.08 - 4296.08	
BI-214	NOT ESTAB	8.59(1/ 1)	SHIRLEY REED FAR	8.59(1/ 1)	11.08(1/ 1)	
		8.59 - 8.59	1.5 MILES WSW	8.59 - 8.59	11.08 - 11.08	
PB-214	NOT ESTAB	1 VALUES <LLD			9.18(1/ 1)	
					9.18 - 9.18	

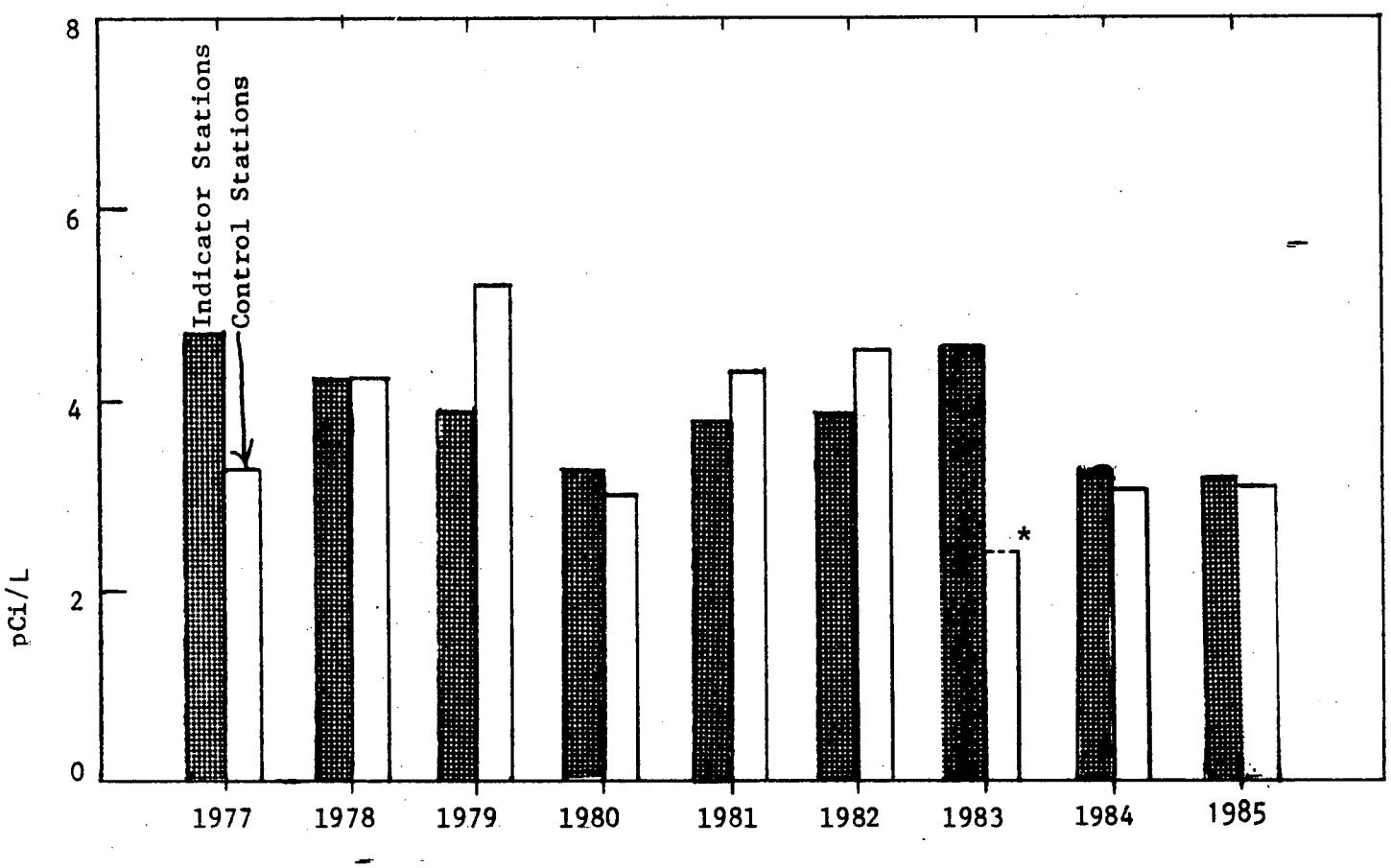
NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE 3.
NOTE: 2. MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES (F).

Figure 5

Annual Average

Gross Beta Activity in Drinking Water

Watts Bar Nuclear Plant



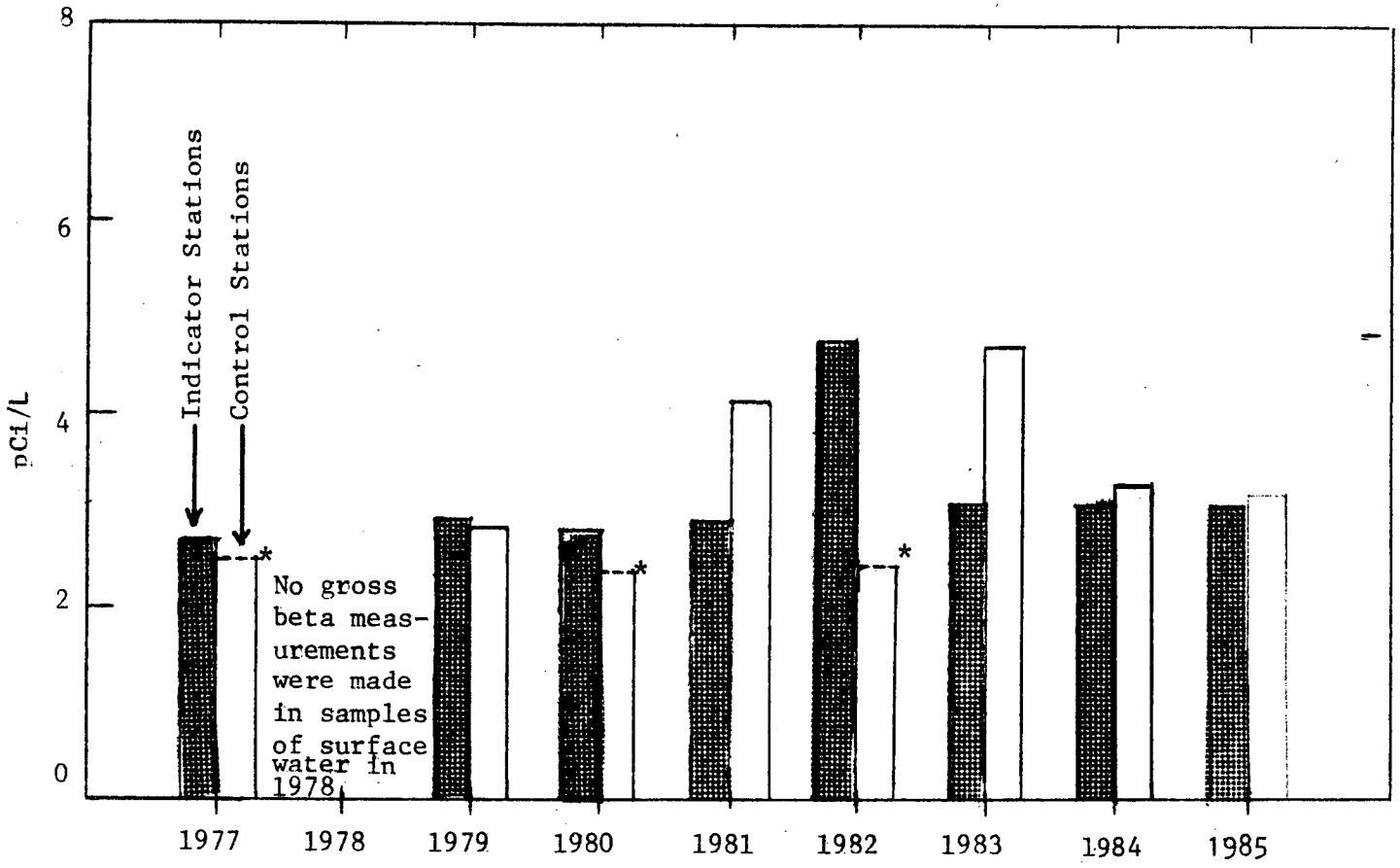
*Less than LLD (2.4 pCi/L).

Figure 6

Annual Average

Gross Beta Activity in Surface Water

Watts Bar Nuclear Plant



*Less than LLD (2.4 pCi/L).

Figure 7

TLD LOCATIONS - WBN

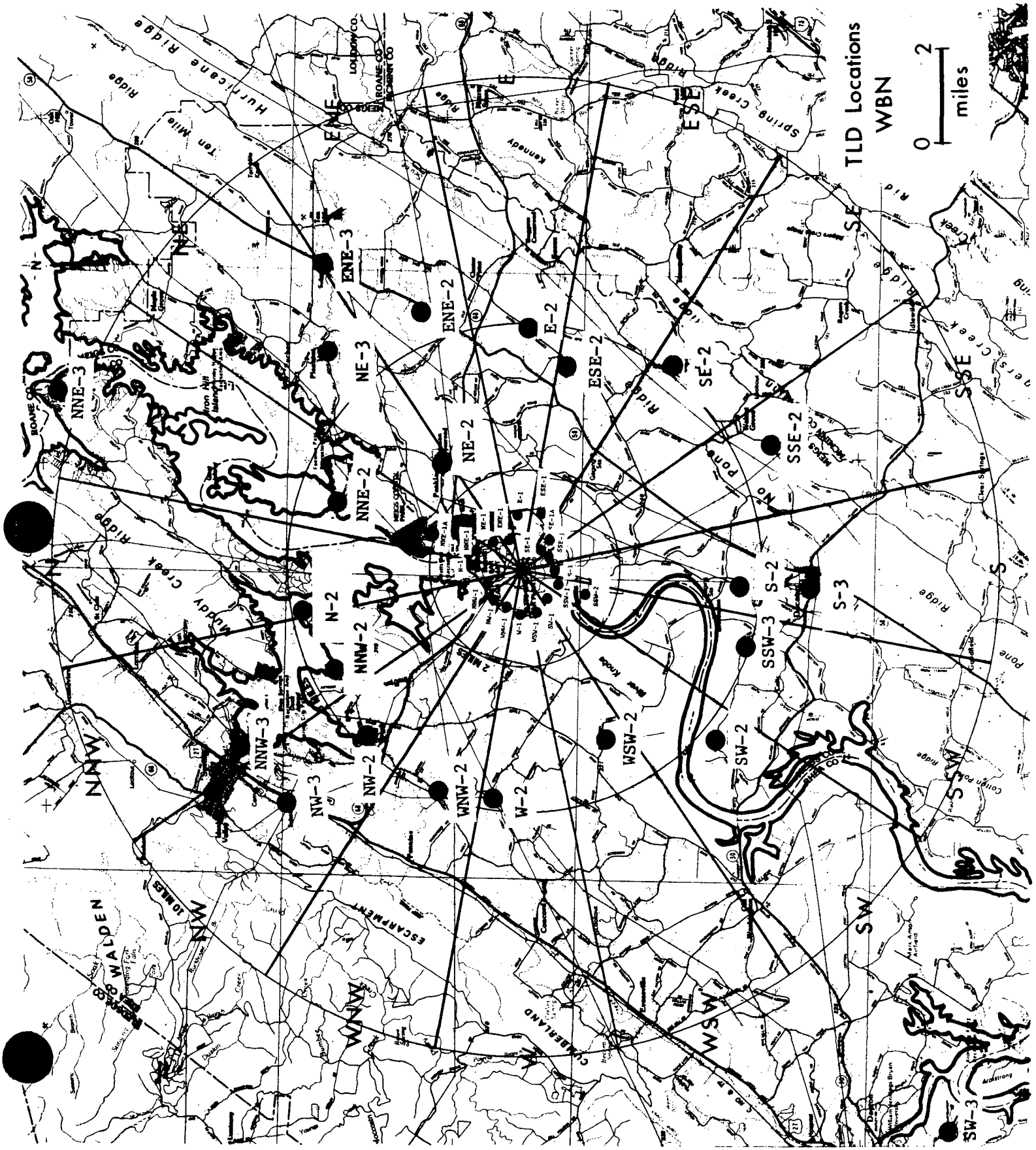


Figure 8

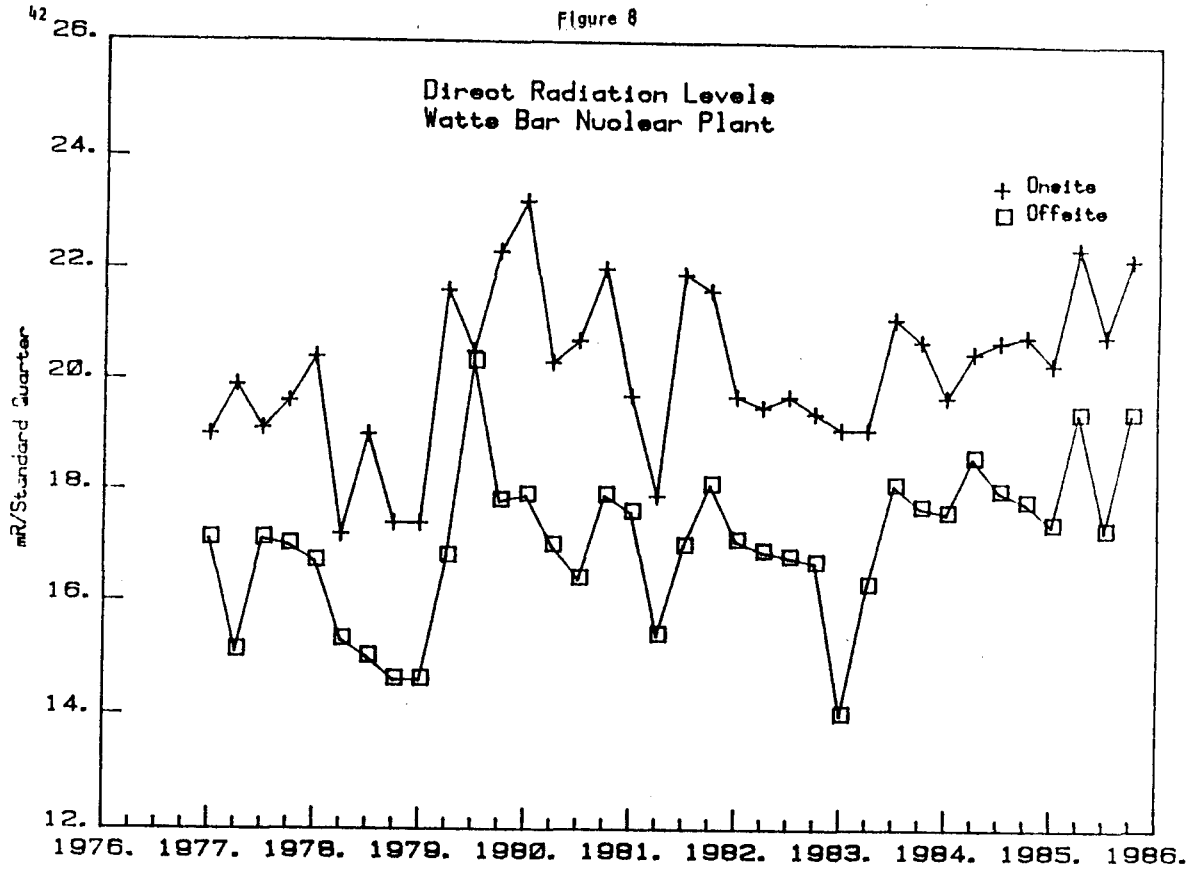
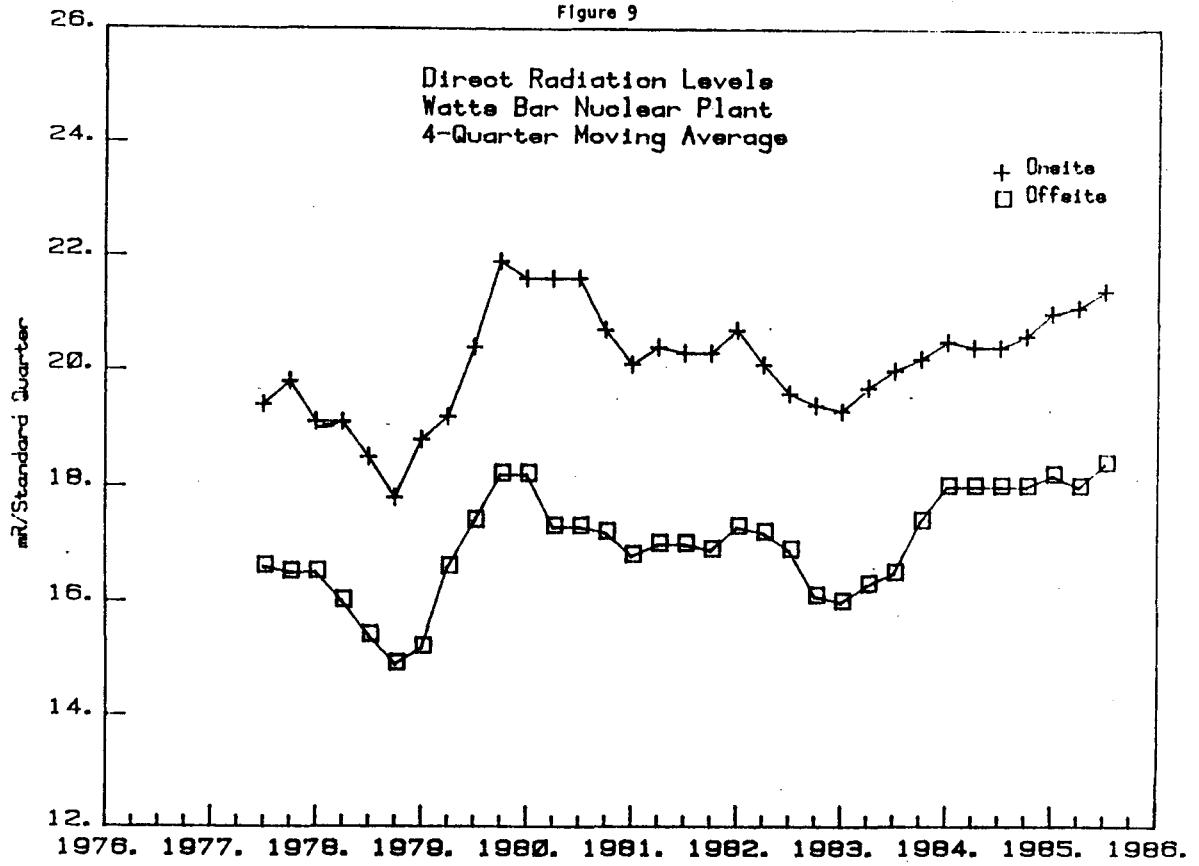


Figure 9



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, plankton, and Asiatic clams from four stations; water from three stations; and fish from Watts Bar, Chickamauga and Nickajack 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 nine miles downstream). The samples are collected monthly and analyzed for gross beta and for gamma-emitting radionuclides. These monthly samples are composited quarterly for strontium and tritium determination. Analytical results are summarized in table 24. During this report period one sample was not collected because of equipment problems.

Figure 6 presents a plot of the gross beta activity in surface water from 1977 through 1985. 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. Prior to June 1985 all samples collected were analyzed for gross alpha, gross beta, gamma-emitting radionuclides, and strontium content. After June samples were analyzed only for gamma-emitting radionuclides. Analytical results are given in tables 25 through 28.

Plankton

As indicated in table 23, net plankton was collected quarterly 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. Collection of such amounts is usually practical only during the period April to September because of seasonal variability in plankton abundance. All samples collected were analyzed for gross beta activity. When quantities collected were sufficient, analyses for gamma-emitting radionuclides and strontium were performed. Analytical results of collected samples are given in table 29. During this reporting period, samples collected contained insufficient volume of material for analysis resulting in 2 gross beta, 4 gamma-emitting radionuclides identification, and 8 strontium determinations not being done. Sampling of this medium was discontinued in June 1985.

Sediment

Sediment samples were collected from dredge hauls made for bottom fauna. Each sample was a composite obtained by combining equal volumes of sediment from each of three dredge hauls at each of four cross sections of the river. Between January and June 1985, sample collection was quarterly from three stations and semiannually from one station. Gross beta, gamma activity, and ^{89}Sr,^{90}Sr content was determined in all samples collected. In addition, gross alpha activity was determined in samples from Tennessee River Mile (TRM) 496.5. During June 1985, one station was deleted from the sampling program. The collection frequency for the remaining locations was changed to semiannual collection. All samples collected, including three additional samples were analyzed for gamma-emitting radionuclides and ^{89}Sr,^{90}Sr content. Analytical results are summarized in table 30.

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 collected were analyzed for gross beta, gamma-emitting radionuclides, ^{89}Sr, and ^{90}Sr. Results are given in table 31. During June 1985 gross beta analyses were deleted and one of the downstream stations was discontinued.

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 quarterly from three stations and semiannually from one station 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. At the same time clam shells were no longer analyzed. Clam flesh was analyzed only for gamma-emitting radionuclides. In June 1985 one station at TRM 518.0 was deleted from the sampling program. During this report period, on one occassion clams were not available while one sample contained insufficient volume for analysis. Results of samples analyzed are summarized in tables 32 and 33.

Table 23

Sampling Schedule - Reservoir Monitoring

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

a. Discontinued in June 1985.
b. Fish samples taken from Watts Bar, Chickamauga, and Nickajack Reservoirs.

TABLE 24

RADIOACTIVITY IN SURFACE WATER TOTAL

PCI/L - 0.037 BQ/L

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY DAYTON TENNESSEE — REPORTING PERIOD 1985

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	2.00	3.13(26/ 26)	TRM 523.1	3.23(13/ 13)	3.19(12/ 12)	
38		2.14 - 4.23	5.2 MILE DOWNSTR	2.14 - 4.23	2.24 - 4.98	
IODINE-131	NOT ESTAB				0.12(4/ 7)	
7					0.06 - 0.30	
GAMMA (GELI)						
38						
K-40	NOT ESTAB	3.11(2/ 26)	TRM 523.1	5.19(1/ 13)	1.48(1/ 12)	
		1.03 - 5.19	5.2 MILE DOWNSTR	5.19 - 5.19	1.48 - 1.48	
BI-214	NOT ESTAB	7.92(12/ 26)	TRM 523.1	10.18(6/ 13)	4.14(8/ 12)	
		0.84 - 16.45	5.2 MILE DOWNSTR	2.30 - 16.45	0.54 - 10.67	
PB-214	NOT ESTAB	6.68(7/ 26)	TRM 523.1	6.83(5/ 13)	4.43(4/ 12)	
		2.08 - 10.93	5.2 MILE DOWNSTR	2.08 - 10.93	1.31 - 7.89	
PB-212	NOT ESTAB	1.88(6/ 26)	TRM 517.9	2.32(3/ 13)	1.92(3/ 12)	
		0.20 - 4.80	10.3 MILE DOWNST	0.20 - 4.80	0.25 - 4.34	
AC-228	15.00	16.37(1/ 26)	TRM 517.9	16.37(1/ 13)	12 VALUES <LLD	
		16.37 - 16.37	10.3 MILE DOWNST	16.37 - 16.37		
SR 89	10.00	8 VALUES <LLD			4 VALUES <LLD	
12		ANALYSIS PERFORMED				
SR 90	2.00	8 VALUES <LLD			4 VALUES <LLD	
12		ANALYSIS PERFORMED				
TRITIUM	330.00	343.09(2/ 8)	TRM 523.1	351.22(1/ 4)	396.01(1/ 4)	
12		334.95 - 351.22	5.2 MILE DOWNSTR	351.22 - 351.22	396.01 - 396.01	

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 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 1985

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 ALPHA	0.10	0.12(1/ 2)	CHICKAMAUGA RES	0.12(1/ 1)	0.21(1/ 1)	
3		0.12 - 0.12	TRM 471-530	0.12 - 0.12	0.21 - 0.21	
GROSS BETA	0.10	23.79(2/ 2)	CHICKAMAUGA RES	25.96(1/ 1)	43.69(1/ 1)	
3		21.62 - 25.96	TRM 471-530	25.96 - 25.96	43.69 - 43.69	
GAMMA (GELI)						
6						
CS-137	0.02	0.09(4/ 4)	CHICKAMAUGA RES	0.10(2/ 2)	0.06(2/ 2)	
		0.05 - 0.14	TRM 471-530	0.07 - 0.14	0.06 - 0.07	
K-40	NOT ESTAB	11.65(4/ 4)	NICKAJACK RES	12.09(2/ 2)	11.91(2/ 2)	
		9.08 - 13.32	TRM 425-471	11.45 - 12.74	9.16 - 14.66	
PB-214	NOT ESTAB	0.03(1/ 4)	NICKAJACK RES	0.03(1/ 2)	2 VALUES <LLD	
		0.03 - 0.03	TRM 425-471	0.03 - 0.03		
SR 89	0.50	2 VALUES <LLD			1 VALUES <LLD	
3		ANALYSIS PERFORMED				
SR 90	0.10	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 26

RADIOACTIVITY IN WHITE CRAPPIE (FLESH)

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

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

LOCATION OF FACILITY SHEA TENNESSEE — REPORTING PERIOD 1982

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 ALPHA 3	0.10	2 VALUES <LLD ANALYSIS PERFORMED			1 VALUES <LLD	
GROSS BETA 3	0.10	19.20(2/ 2) 12.00 - 26.41	CHICKAMAUGA RES TRM 471-530	26.41(1/ 1) 26.41 - 26.41	25.43(1/ 1) 25.43 - 25.43	
GAMMA (GELI) 6						
CS-137	0.02	0.09(4/ 4) 0.04 - 0.13	NICKAJACK RES TRM 425-471	0.12(2/ 2) 0.11 - 0.13	0.12(2/ 2) 0.10 - 0.14	
K-40	NOT ESTAB	16.59(4/ 4) 14.28 - 19.25	CHICKAMAUGA RES TRM 471-530	16.77(2/ 2) 14.28 - 19.25	16.46(2/ 2) 16.40 - 16.49	
BI-214	0.02	0.05(1/ 4) 0.05 - 0.05	NICKAJACK RES TRM 425-471	0.05(1/ 2) 0.05 - 0.05	0.04(1/ 2) 0.04 - 0.04	
PB-214	NOT ESTAB	0.03(1/ 4) 0.03 - 0.03	NICKAJACK RES TRM 425-471	0.03(1/ 2) 0.03 - 0.03	0.02(2/ 2) 0.01 - 0.03	
SR 89 3	0.50	2 VALUES <LLD ANALYSIS PERFORMED			1 VALUES <LLD	
SR 90 3	0.10	2 VALUES <LLD ANALYSIS PERFORMED			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 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 1985

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 ALPHA	0.10	0.11(1/ 2)	NICKAJACK RES	0.11(1/ 1)	0.10(1/ 1)	
3		0.11 - 0.11	TRM 425-471	0.11 - 0.11	0.10 - 0.10	
GROSS BETA	0.10	25.58(2/ 2)	NICKAJACK RES	26.55(1/ 1)	22.48(1/ 1)	
3		24.61 - 26.55	TRM 425-471	26.55 - 26.55	22.48 - 22.48	
GAMMA (GELI)						
6						
CS-137	0.02	0.05(4/ 4)	CHICKAMAUGA RES	0.07(2/ 2)	0.06(2/ 2)	
		0.03 - 0.08	TRM 471-530	0.06 - 0.08	0.04 - 0.09	
K-40	NOT ESTAB	11.70(4/ 4)	NICKAJACK RES	12.35(2/ 2)	10.93(2/ 2)	
		9.14 - 15.56	TRM 425-471	9.14 - 15.56	10.72 - 11.13	
BI-214	0.02	0.05(3/ 4)	CHICKAMAUGA RES	0.06(1/ 2)	0.14(1/ 2)	
		0.02 - 0.06	TRM 471-530	0.06 - 0.06	0.14 - 0.14	
PB-214	NOT ESTAB	0.03(3/ 4)	CHICKAMAUGA RES	0.04(1/ 2)	0.11(1/ 2)	
		0.01 - 0.04	TRM 471-530	0.04 - 0.04	0.11 - 0.11	
SR 89	0.50	2 VALUES <LLD			1 VALUES <LLD	
3		ANALYSIS PERFORMED				
SR 90	0.10	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 28

RADIOACTIVITY IN SMALLMOUTH BUFFALO (WHOLE)

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 1985

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 ALPHA 3	0.10	2 VALUES <LLD ANALYSIS PERFORMED			1 VALUES <LLD	
GROSS BETA 3	0.10	18.28(2/ 2) 16.79 - 19.78	NICKAJACK RES TRM 425-471	19.78(1/ 1) 19.78 - 19.78	22.07(1/ 1) 22.07 - 22.07	
GAMMA (GELI) 6						
CS-137	0.02	0.03(2/ 4) 0.03 - 0.04	NICKAJACK RES TRM 425-471	0.04(1/ 2) 0.04 - 0.04	2 VALUES <LLD	
K-40	NOT ESTAB	6.20(4/ 4) 5.50 - 7.30	NICKAJACK RES TRM 425-471	6.65(2/ 2) 6.00 - 7.30	8.50(2/ 2) 7.82 - 9.19	
BI-214	0.02	0.03(2/ 4) 0.02 - 0.03	CHICKAMAUGA RES TRM 471-530	0.03(1/ 2) 0.03 - 0.03	0.05(2/ 2) 0.03 - 0.07	
PB-214	NOT ESTAB	0.03(3/ 4) 0.01 - 0.04	CHICKAMAUGA RES TRM 471-530	0.03(2/ 2) 0.03 - 0.04	0.03(2/ 2) 0.01 - 0.06	
PB-212	NOT ESTAB	4 VALUES <LLD			0.01(2/ 2) 0.01 - 0.02	
SR 89 3	0.50	0.69(1/ 2) 0.69 - 0.69	NICKAJACK RES TRM 425-471	0.69(1/ 1) 0.69 - 0.69	1 VALUES <LLD	
SR 90 3	0.10	2 VALUES <LLD ANALYSIS PERFORMED			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 29

RADIOACTIVITY IN PLANKTON

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 1985

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 10	0.10	39.96(7/ 7) 17.79 - 56.02	TRM 518.0	42.20(3/ 3) 33.40 - 55.59	14.43(3/ 3) 10.27 - 19.00	
GAMMA (GELI) 8						
CS-137	0.08	0.94(1/ 6) 0.94 - 0.94	TRM 518.0	0.94(1/ 3) 0.94 - 0.94	2 VALUES <LLD	
K-40	NOT ESTAB	23.23(3/ 6) 11.06 - 41.83	TRM 518.0	26.44(2/ 3) 11.06 - 41.83	2 VALUES <LLD	
BI-214	NOT ESTAB	4.14(5/ 6) 0.73 - 12.03	TRM 527.4	5.18(3/ 3) 1.52 - 12.03	4.94(2/ 2) 0.69 - 9.19	
PB-214	NOT ESTAB	4.54(5/ 6) 1.10 - 10.70	TRM 527.4	6.88(2/ 3) 3.07 - 10.70	5.91(2/ 2) 0.75 - 11.07	
PB-212	NOT ESTAB	0.86(4/ 6) 0.12 - 2.48	TRM 527.4	1.40(2/ 3) 0.33 - 2.48	2 VALUES <LLD	
TL-208	NOT ESTAB	1.87(1/ 6) 1.87 - 1.87	TRM 518.0	1.87(1/ 3) 1.87 - 1.87	2 VALUES <LLD	
AC-228	NOT ESTAB	0.40(1/ 6) 0.40 - 0.40	TRM 518.0	0.40(1/ 3) 0.40 - 0.40	2 VALUES <LLD	
SR 89 3	0.50	2 VALUES <LLD ANALYSIS PERFORMED			1 VALUES <LLD	
SR 90 3	0.10	2 VALUES <LLD ANALYSIS PERFORMED			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 30

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 1985

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 ALPHA 1	0.35	3.12(1/ 1) 3.12 - 3.12	TRM 496.50	3.12(1/ 1) 3.12 - 3.12		
GROSS BETA 7	0.70	31.92(5/ 5) 25.75 - 37.32	TRM 518.0	34.79(2/ 2) 32.26 - 37.32	38.69(2/ 2) 30.16 - 47.22	
GAMMA (GELI) 13						
CO-60	0.01	0.08(3/ 9) 0.02 - 0.11	TRM 496.50	0.08(3/ 3) 0.02 - 0.11	0.24(4/ 4) 0.11 - 0.30	
CS-137	0.02	0.43(9/ 9) 0.04 - 1.85	TRM 496.50	1.13(3/ 3) 0.17 - 1.85	3.50(4/ 4) 1.29 - 4.78	
K-40	NOT ESTAB	14.82(9/ 9) 12.24 - 16.21	TRM 496.50	15.69(3/ 3) 14.97 - 16.21	17.10(4/ 4) 13.95 - 18.28	
MN-54	0.01	9 VALUES <LLD			0.04(1/ 4) 0.04 - 0.04	
BI-214	0.02	1.00(9/ 9) 0.73 - 1.15	TRM 496.50	1.08(3/ 3) 0.99 - 1.15	1.50(4/ 4) 0.83 - 1.87	
BI-212	0.10	1.47(9/ 9) 1.16 - 1.75	TRM 527.4	1.58(4/ 4) 1.16 - 1.75	1.99(4/ 4) 1.09 - 2.83	
PB-214	NOT ESTAB	1.09(9/ 9) 0.80 - 1.25	TRM 496.50	1.17(3/ 3) 1.07 - 1.25	1.60(4/ 4) 0.90 - 1.98	
PB-212	NOT ESTAB	1.25(9/ 9) 0.96 - 1.57	TRM 527.4	1.30(4/ 4) 0.96 - 1.57	1.81(4/ 4) 1.01 - 2.19	
RA-226	NOT ESTAB	1.00(9/ 9) 0.73 - 1.15	TRM 496.50	1.08(3/ 3) 0.99 - 1.15	1.19(2/ 4) 0.83 - 1.56	
RA-224	NOT ESTAB	1.38(9/ 9) 1.03 - 1.88	TRM 527.4	1.52(4/ 4) 1.03 - 1.88	1.13(1/ 4) 1.13 - 1.13	
BE-7	NOT ESTAB	0.36(1/ 9) 0.36 - 0.36	TRM 496.50	0.36(1/ 3) 0.36 - 0.36	4 VALUES <LLD	
TL-208	0.02	0.43(9/ 9) 0.33 - 0.55	TRM 527.4	0.45(4/ 4) 0.33 - 0.55	0.62(4/ 4) 0.32 - 0.75	
AC-228	0.06	1.30(9/ 9) 1.04 - 1.57	TRM 527.4	1.35(4/ 4) 1.04 - 1.57	1.74(4/ 4) 0.94 - 2.21	
PA-234M	NOT ESTAB	2.91(1/ 9) 2.91 - 2.91	TRM 496.50	2.91(1/ 3) 2.91 - 2.91	3.22(1/ 4) 3.22 - 3.22	
SR 89 12	1.50	8 VALUES <LLD ANALYSIS PERFORMED			4 VALUES <LLD	
SR 90 12	0.15	0.18(1/ 8) 0.18 - 0.18	TRM 527.4	0.18(1/ 4) 0.18 - 0.18	0.27(1/ 4) 0.27 - 0.27	

NOTE: 1. NOMINAL LOWER LIMIT OF DETECTION (LLD) AS DESCRIBED IN TABLE B.
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 SHORE 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 1985

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 3	0.70	28.45(2/ 2) 22.88 - 34.01	COTTON PORT MARI TRM 513	34.01(1/ 1) 34.01 - 34.01	11.14(1/ 1) 11.14 - 11.14	
GAMMA (GELI) 5						
CS-137	0.02	0.10(3/ 3) 0.03 - 0.23	COTTON PORT MARI TRM 513	0.13(2/ 2) 0.03 - 0.23	0.23(1/ 2) 0.23 - 0.23	
K-40	NOT ESTAB	17.84(3/ 3) 8.77 - 27.73	COTTON PORT MARI TRM 513	22.37(2/ 2) 17.01 - 27.73	2.13(2/ 2) 1.28 - 2.98	
BI-214	0.02	0.77(3/ 3) 0.61 - 0.88	GRASSHOPPER CREE TRM 494	0.88(1/ 1) 0.88 - 0.88	0.43(2/ 2) 0.35 - 0.51	
BI-212	0.10	1.43(3/ 3) 1.38 - 1.49	COTTON PORT MARI TRM 513	1.45(2/ 2) 1.42 - 1.49	0.67(2/ 2) 0.57 - 0.77	
PB-214	NOT ESTAB	0.86(3/ 3) 0.68 - 0.99	GRASSHOPPER CREE TRM 494	0.99(1/ 1) 0.99 - 0.99	0.47(2/ 2) 0.39 - 0.54	
PB-212	0.02	1.28(3/ 3) 1.26 - 1.31	COTTON PORT MARI TRM 513	1.29(2/ 2) 1.27 - 1.31	0.54(2/ 2) 0.42 - 0.67	
RA-226	NOT ESTAB	0.77(3/ 3) 0.61 - 0.88	GRASSHOPPER CREE TRM 494	0.88(1/ 1) 0.88 - 0.88	0.43(2/ 2) 0.35 - 0.51	
RA-224	NOT ESTAB	1.51(3/ 3) 1.22 - 1.87	COTTON PORT MARI TRM 513	1.65(2/ 2) 1.44 - 1.87	0.63(2/ 2) 0.48 - 0.78	
TL-208	0.02	0.44(3/ 3) 0.41 - 0.47	COTTON PORT MARI TRM 513	0.46(2/ 2) 0.45 - 0.47	0.20(2/ 2) 0.16 - 0.25	
AC-228	0.06	1.35(3/ 3) 1.31 - 1.39	COTTON PORT MARI TRM 513	1.37(2/ 2) 1.36 - 1.39	0.58(2/ 2) 0.44 - 0.72	
SR 89	1.50	1.83(1/ 3) 1.83 - 1.83	COTTON PORT MARI TRM 513	1.83(1/ 2) 1.83 - 1.83	2 VALUES <LLD	
SR 90 5	0.15	3 VALUES <LLD ANALYSIS PERFORMED			2 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 32

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 1985

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 ALPHA 2	0.10	0.61(2/ 2) 0.36 - 0.86	TRM 496.5D	0.61(2/ 2) 0.36 - 0.86		
GROSS BETA 2	0.10	6.58(2/ 2) 4.35 - 8.81	TRM 496.5D	6.58(2/ 2) 4.35 - 8.81		
GAMMA (GELI) 12						
CS-137	0.08	0.12(2/ 10) 0.08 - 0.17	TRM 496.5D	0.17(1/ 3) 0.17 - 0.17	0.13(1/ 2) 0.13 - 0.13	
K-40	NOT ESTAB	2.52(4/ 10) 0.56 - 5.71	TRM 496.5D	4.24(2/ 3) 2.77 - 5.71	2.74(1/ 2) 2.74 - 2.74	
BI-214	NOT ESTAB	0.70(9/ 10) 0.00 - 1.75	TRM 496.5D	1.44(2/ 3) 1.12 - 1.75	0.16(2/ 2) 0.09 - 0.23	
PB-214	NOT ESTAB	0.85(9/ 10) 0.36 - 1.78	TRM 496.5D	1.29(3/ 3) 0.85 - 1.78	0.31(1/ 2) 0.31 - 0.31	
PB-212	NOT ESTAB	0.15(4/ 10) 0.01 - 0.42	TRM 496.5D	0.42(1/ 3) 0.42 - 0.42	2 VALUES <LLD	
AC-228	NOT ESTAB	0.48(1/ 10) 0.48 - 0.48	TRM 527.4	0.48(1/ 4) 0.48 - 0.48	0.16(1/ 2) 0.16 - 0.16	

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 33

RADIOACTIVITY IN CLAM SHELL

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

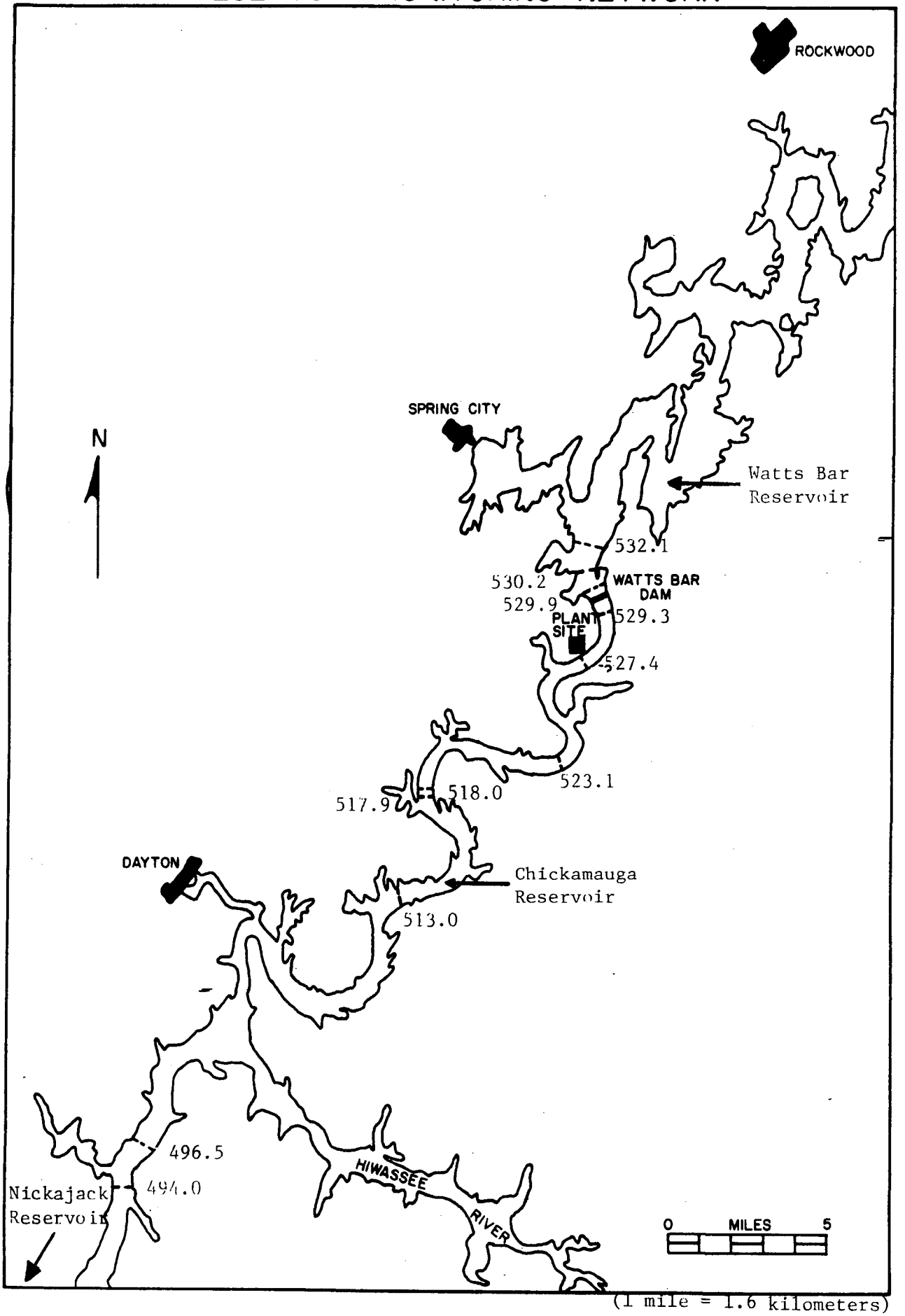
NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1995

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 ALPHA 2	0.70	0.75(1/ 2) 0.75 - 0.75	TRM 496.5C	0.75(1/ 2) 0.75 - 0.75		
GROSS BETA 2	0.70	5.23(2/ 2) 4.87 - 5.58	TRM 496.50	5.23(2/ 2) 4.87 - 5.58		
GAMMA (GELI) 11						
CO-60	0.01	0.01(2/ 8) 0.01 - 0.02	TRM 496.50	0.02(1/ 2) 0.02 - 0.02	3 VALUES <LLD	
CS-137	0.02	0.04(1/ 8) 0.04 - 0.04	TRM 496.50	0.04(1/ 2) 0.04 - 0.04	3 VALUES <LLD	
K-40	NOT ESTAB	0.15(5/ 8) 0.04 - 0.23	TRM 496.50	0.22(2/ 2) 0.22 - 0.23	0.95(3/ 3) 0.16 - 1.72	
BI-214	0.05	0.18(8/ 8) 0.07 - 0.40	TRM 496.50	0.25(2/ 2) 0.21 - 0.29	0.40(3/ 3) 0.05 - 1.02	
BI-212	0.10	0.17(4/ 8) 0.12 - 0.23	TRM 518.0	0.18(1/ 3) 0.18 - 0.18	3 VALUES <LLD	
PB-214	0.05	0.20(8/ 8) 0.09 - 0.42	TRM 496.50	0.26(2/ 2) 0.21 - 0.31	0.47(3/ 3) 0.08 - 1.18	
PB-212	NOT ESTAB	0.11(8/ 8) 0.04 - 0.18	TRM 496.50	0.17(2/ 2) 0.16 - 0.18	0.05(3/ 3) 0.01 - 0.08	
RA-226	0.05	0.15(7/ 8) 0.07 - 0.29	TRM 496.50	0.25(2/ 2) 0.21 - 0.29	0.10(2/ 3) 0.05 - 0.14	
RA-224	NOT ESTAB	0.20(1/ 8) 0.20 - 0.20	TRM 518.0	0.20(1/ 3) 0.20 - 0.20	3 VALUES <LLD	
TL-208	0.02	0.05(6/ 8) 0.02 - 0.11	TRM 518.0	0.05(3/ 3) 0.02 - 0.11	0.02(1/ 3) 0.02 - 0.02	
AC-228	0.06	0.23(8/ 8) 0.09 - 0.49	TRM 518.0	0.28(3/ 3) 0.14 - 0.49	0.12(3/ 3) 0.08 - 0.21	
SR 89 2	5.00	2 VALUES <LLD ANALYSIS PERFORMED			0 VALUES <LLD	
SR 90 2	1.00	1.10(1/ 2) 1.10 - 1.10	TRM 496.50	1.10(1/ 2) 1.10 - 1.10		

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



(1 mile = 1.6 kilometers)

Figure 11

Annual Average

Cesium-137 in Sediment

Watts Bar Nuclear Plant

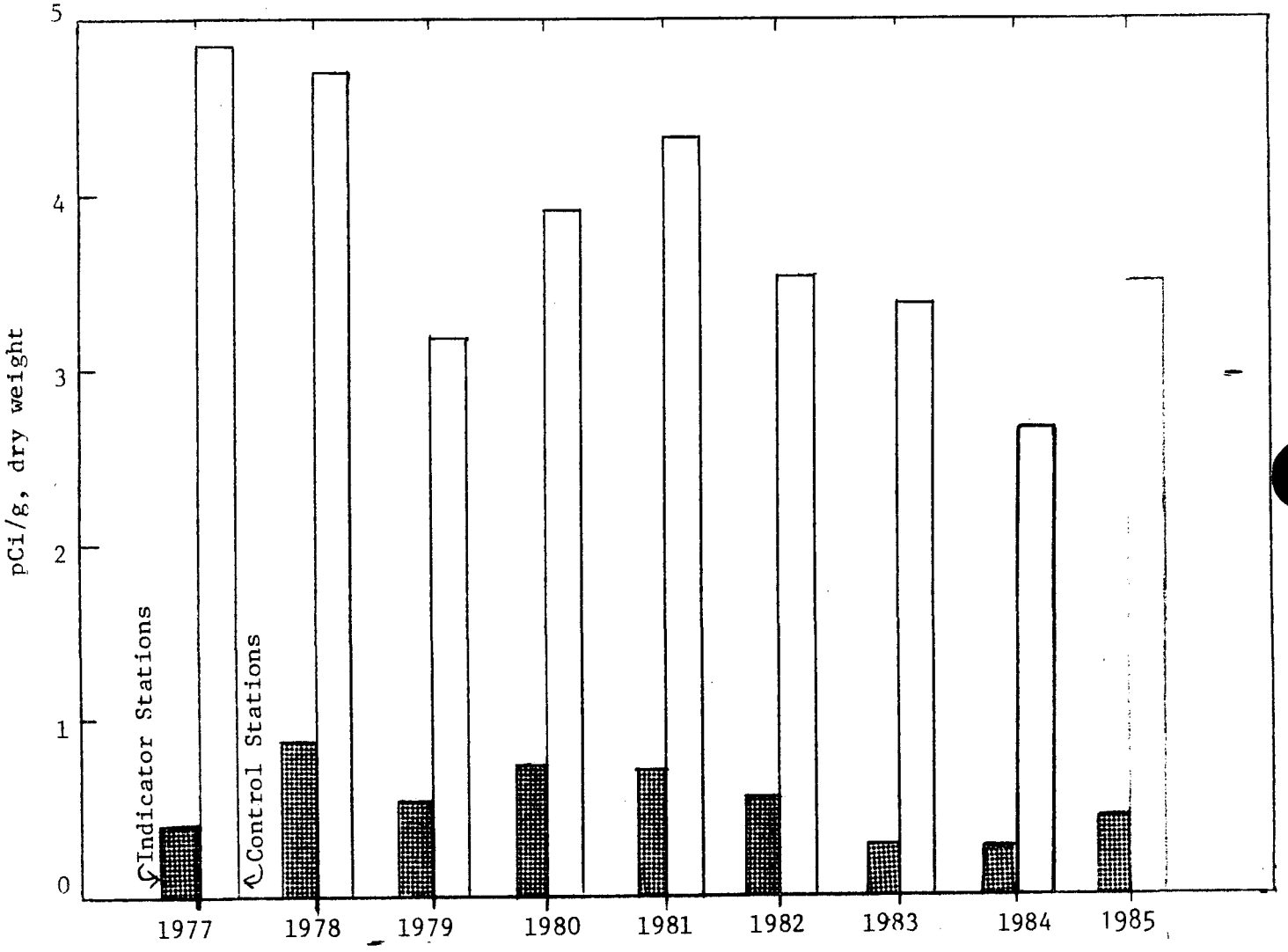
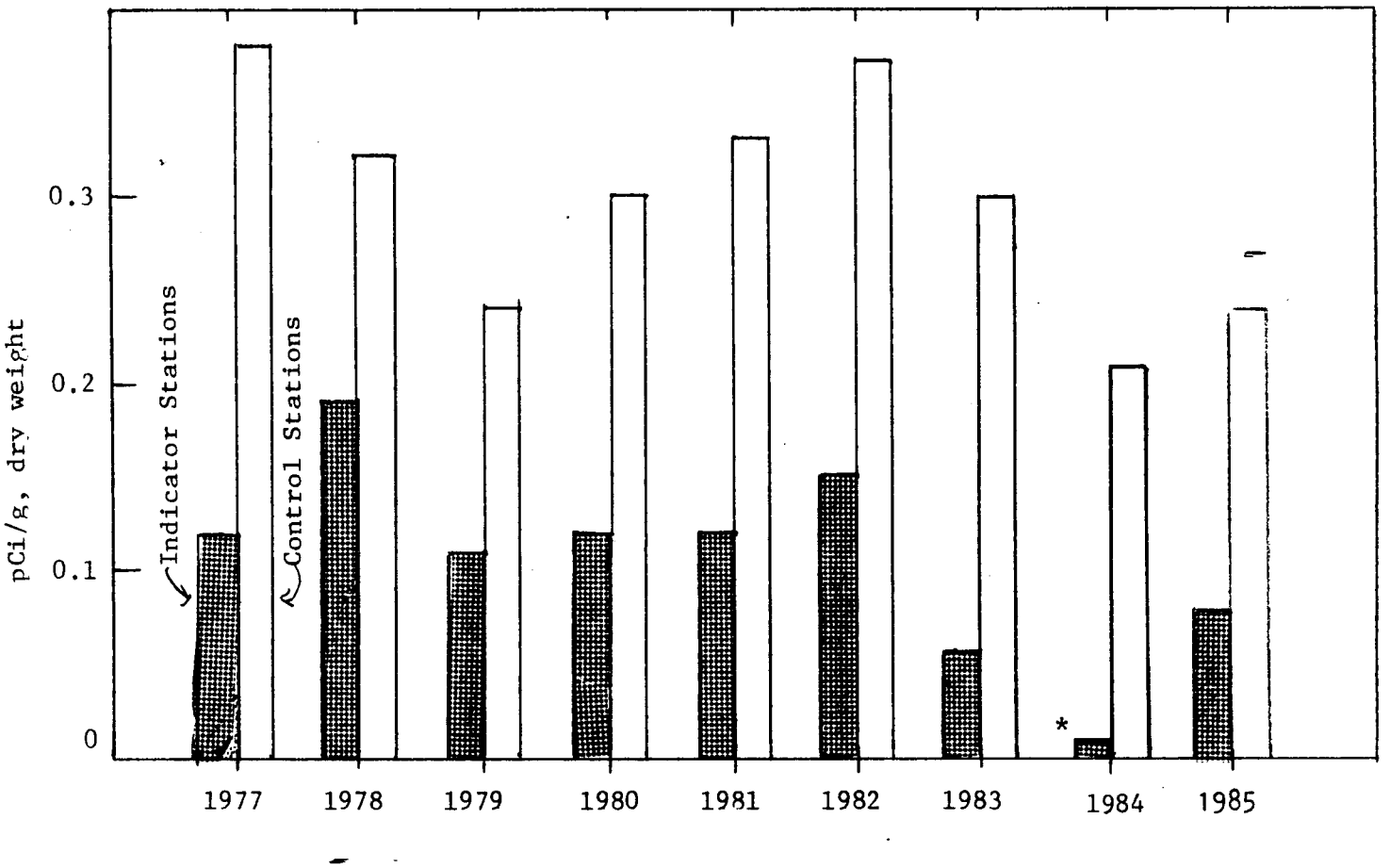


Figure 12

Annual Average

Cobalt-60 in Sediment

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, or other nuclear operations in the area.