TENNESSEE VALLEY AUTHORITY

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ENVIRONMENTAL RADIOACTIVITY LEVELS
WATTS BAR NUCLEAR PLANT
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ENVIRONMENTAL RADIOACTIVITY LEVELS

WATTS BAR NUCLEAR PLANT

1982

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 1982.

The Radiological Health Staff (Office of Power) and the Office of Natural Resources carried out the sampling program outlined in tables 1 and 27. 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) systems. 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 1982 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.

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[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					
Smith Bend	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 H							Q	M	M[a]		
Farm L							Q	M	M[a]		
Farm Mo							Q	M	M[a]		
Control Farms							Q	M[b]	M[b]		
Onsite Wells (7)									M		
Watts Bar Reservation									M	M	
C. F. Industries										M	
Chickamauga/Watts Bar Reservoirs											Q[c]

W - Weekly BW - Biweekly M - Monthly (every 4 weeks) Q - Quarterly S - Semiannually a. Considered as controls for well water. b. Control farms are also part of SQN program and some locations are sampled weekly. c. Some control samples are part of the SQN program and are collected 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	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 H[a]	4-3/4 miles	(7-3/4 kilometers)	W
Farm L[a]	1-1/2 miles	(2 kilometers)	SSW
Farm Mo[a]	4-1/2 miles	(7-1/4 kilometers)	NW
Control Stations			
RM-1 WB, Rockwood, TN	17-1/4 miles	(27-3/4 kilometers)	NNE
RM-2 WB, Dayton, TN (Identical with RM-2 SQ, 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

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/m³	Charcoal pCi/m³	Fallout mCi/km²	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.[illegible]0	0.1	0.7	25	
^{3}H				330						0.5
^{131}I		0.02								
^{89}Sr	0.005			10	0.25	[illegible]	0.5	5.0	40	10
^{90}Sr	0.001			2	0.05	0.[illegible]	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]	TVA AVG. EARL[b]	EPA value (±3σ)	TVA AVG. WARL	TVA AVG. EARL	EPA value (±3σ)	TVA AVG. WARL	TVA AVG. EARL	EPA value (±3σ)	TVA AVG. WARL	TVA AVG. EARL
3/82	27±12	23	28	55±9	63	56	16±2.6	16	15	23±9	24	24
9/82	32±14	28	28	67±9	57[c]	52[c]	20±2.6	17[d,g]	14[g]	27±9	22	22

B. Tritium in Urine (pCi/L)

Date	EPA Value (±3σ)	TVA AVERAGE WARL	TVA AVERAGE EARL
5/82	1300±575	1793	1650[e]
12/82	3830±641	3510	4023

Table 4 (Continued)

Results Obtained in Interlaboratory Comparison Program

C. Radiochemical Analysis of Water (pCi/L)

Date	Gross Alpha			Gross Beta			Strontium - 89			Strontium - 90			Tritium			Iodine -131		
	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
1/82	24±10	20	19	32±9	33	28	21±9	20	22	12±2.6	13	12				8.4±2.6[h]	8.7	7.3
2/82													1820±592	2007	1793			
3/82	19±9	19	20	19±9	19	20												
4/82													2860±624	2907	2923	62±11	61	61
5/82	27.5±12	27	38.3	29±9	26	33	22±9	24	22	13±2.6	11	8[g]						
6/82													1830±589	1620	1810	4.4±1.2[h]	5.3	3.6
7/82	16±9	13	32[f]	23±9	20	21												
8/82													2890±624	2903	2793			
9/82	29±13	26	--[f]	40±9	38	--[f]	24.5±9	30	21	14.5±2.6	13.8	14.8				87±15	93	79
10/82													2560±606	2690	2510			
11/82	19±9	19	15[f]	24±9	22	23												
12/82													1990±598	1943	1993	37±10	37	39

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
2/82	0	<44	<35	20±9	21	22	15±9	16	16	20±9	<40	<30	22±9	21	19	23±9	24	22
6/82	23±9	<44	<35	29±9	32	34	26±9	29	26	0	<40	<30	35±9	31	32	25±9	24	27
10/82	51±9	55[d]	<35[i]	20±9	18[d]	21	24±9	25[d]	25	30±9	39[d]	<36	19±9	19[d]	17	20±9	20[d]	22

Table 4 (Continued)

Results Obtained in Interlaboratory Comparison Program

E. Milk (pCi/L)

Date	Strontium - 89			Strontium - 90			Iodine - 131			Cesium - 137			Barium - 140			Potassium[j]			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
4/82	25±9	29	28	16±2.6	16	13[k]				28±9	31	30	0	<25	<15	1500±130	1590	1413	30±6	32	29
7/82							5.4±1.4[h]	6.7	5.1												
10/82	0	<10	<10	18.6±2.6	19.5	19.2[k]	42±10	43	42	34±9	34	35	0	<25	<20	1560±135	1563	1639			

F. Foods (pCi/kg, Wet Weight)

Date	Strontium - 89			Strontium - 90			Iodine - 131			Cesium 137			Barium - 140			Potassium[j]		
	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
7/82	26±9	30	28	20±2.6	26[g,k]	27[k]	94±15	98	98	20±9	24	26	0	<25	<14	2400±208	2810[g]	2733[g]
11/82	0	<10	<40[d]	27.8±2.6	30.6[k]	24[d,k]	25±10	20	29	27±9	28	27	0	<25	<14	2780±242	2670	2903

[a] Western Area Radiological Laboratory, Muscle Shoals, Alabama

[b] Eastern Area Radiological Laboratory, Vonore, Tennessee

[c] No known explanation. Investigation underway.

[d] Analysis completed after report date

[e] Equipment malfunction, analysis completed after report date

[f] Poor analysis. Equipment taken out of service for recalibration. Further results satisfactory.

[g] Previous and Subsequent results satisfactory. No known explanation.

[h] NRC/EPA Low-level ^{131}I study.

[i] Experimental detection limit is being reviewed.

[j] Potassium values are mg/l or mg/kg.

[k] Review of procedure is in progress.

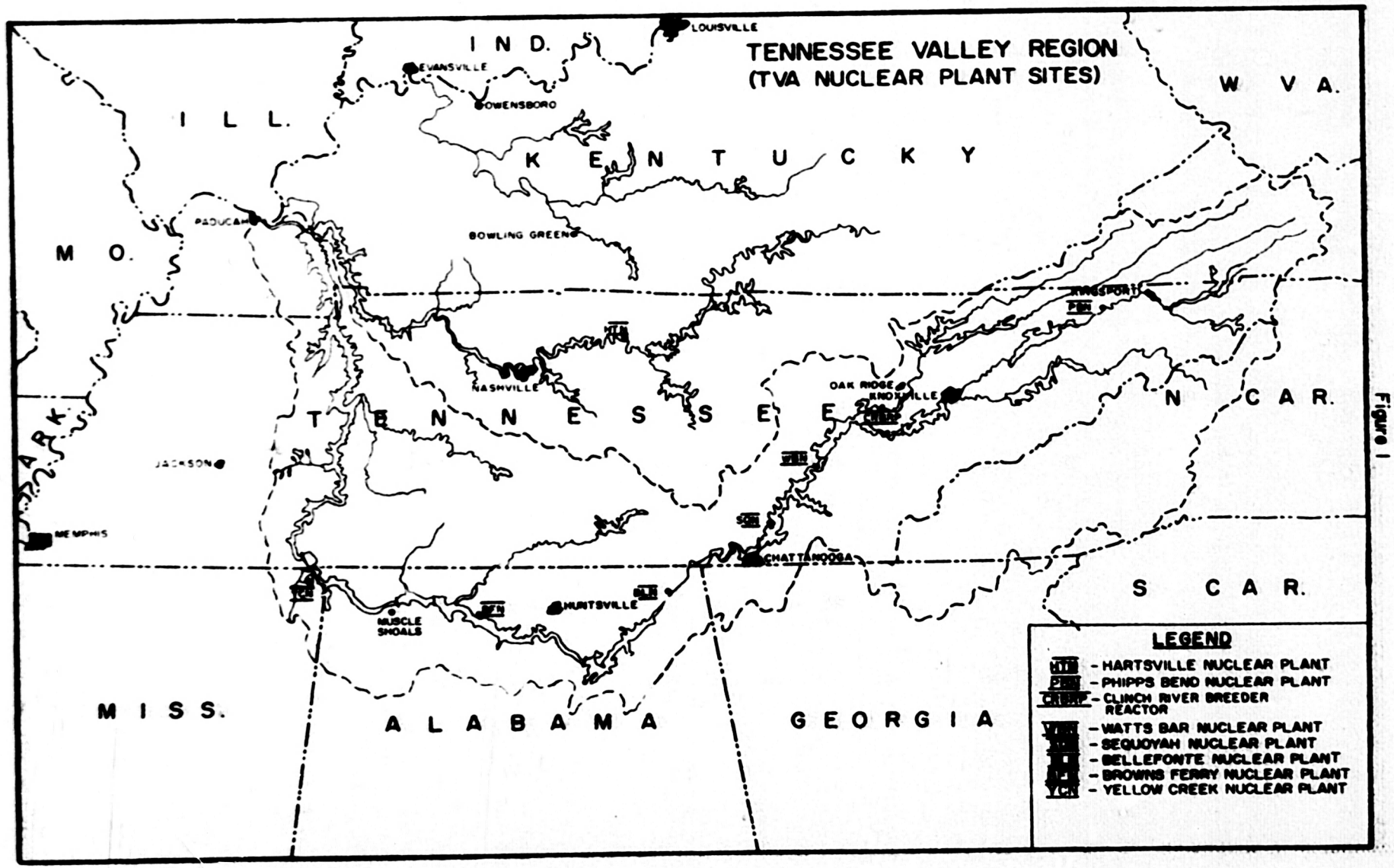

TENNESSEE VALLEY REGION
(TVA NUCLEAR PLANT SITES)
LOUISVILLE
EVANSVILLE
OWENSBORO
IND.
ILL.
KENTUCKY
W VA.
PADUCAH
BOWLING GREEN
MO.
KINGSPORT
NASHVILLE
OAK RIDGE
KNOXVILLE
TENNESSEE
N CAR.
ARK.
JACKSON
MEMPHIS
CHATTANOOGA
S CAR.
MUSCLE SHOALS
HUNTSVILLE
MISS.
ALABAMA
GEORGIA
LEGEND
- HARTSVILLE NUCLEAR PLANT
- PHIPPS BEND NUCLEAR PLANT
- CLINCH RIVER BREEDER REACTOR
- WATTS BAR NUCLEAR PLANT
- SEQUOYAH NUCLEAR PLANT
- BELLEFONTE NUCLEAR PLANT
- 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 in 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 flow rate 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, six 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. Five samples were lost or destroyed during strontium 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 1982 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) specified in 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 (SQN) monitoring program, were analyzed for gross beta and tritium activity. During this period, one sample contained insufficient volume for any analyses. Another sample was missed due to equipment malfunction. 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.

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, four samples were not obtained because of equipment malfunction, one sample was lost during analysis, and one sample contained insufficient volume for analysis.

Table 5

MAXIMUM PERMISSIBLE CONCENTRATIONS

FOR NONOCCUPATIONAL EXPOSURE

	MPC	
	In Water pCi/l*	In Air pCi/m^3*
Alpha	30	
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
^{59}Fe	50,000	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. 50-390,391
REPORTING PERIOD 1982

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 514	0.010	0.03(407/ 411) 0.01- 0.14	PM1 PETTY FARM 3.75 MILES WSW	0.04(51/ 51) 0.01- 0.14	0.02(100/ 103) 0.01- 0.07	
GAMMA (GELI) 130						
K-40	NOT ESTAB	0.02(93/ 104) 0.00- 0.07	PM5 DECATUR 6.25 MILES S	0.02(11/ 13) 0.01- 0.05	0.02(25/ 26) 0.00- 0.07	
BI-214	0.020	0.03(9/ 104) 0.02- 0.04	PM6 GOODFIELD 9.0 MILES SSW	0.03(2/ 13) 0.03- 0.03	0.03(3/ 26) 0.02- 0.05	
PB-214	0.020	0.03(8/ 104) 0.02- 0.04	PM4 TEN MILE 7.75 MILES NE	0.04(1/ 13) 0.04- 0.04	0.03(3/ 26) 0.02- 0.04	
PB-212	NOT ESTAB	0.00(56/ 104) 0.00- 0.00	PM4 TEN MILE 7.75 MILES NE	0.00(10/ 13) 0.00- 0.00	0.00(16/ 26) 0.00- 0.00	
BE-7	0.050	0.06(59/ 104) 0.05- 0.08	PM6 GOODFIELD 9.0 MILES SSW	0.07(8/ 13) 0.06- 0.08	0.06(15/ 26) 0.05- 0.07	
TL-208	NOT ESTAB	0.00(50/ 104) 0.00- 0.00	PM2 SPRING CITY 7.0 MILES NW	0.00(5/ 13) 0.00- 0.00	0.00(11/ 26) 0.00- 0.00	
AC-228	NOT ESTAB	0.00(25/ 104) 0.00- 0.01	PM6 GOODFIELD 9.0 MILES SSW	0.00(4/ 13) 0.00- 0.01	0.00(2/ 26) 0.00- 0.00	
PA-234M	NOT ESTAB	104 VALUES <LLD			0.35(2/ 26) 0.18- 0.53	
SR 89 35	0.005	31 VALUES <LLD ANALYSIS PERFORMED			4 VALUES <LLD	
SR 90 35	0.001	31 VALUES <LLD ANALYSIS PERFORMED			4 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 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 1982

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				3.75(8/ 12)	
12					2.75- 7.53	
GAMMA (GELI)						
128						
K-40	NOT ESTAB	16.71(49/ 103)	PM3 CEDINE BIBLE	31.12(9/ 13)	17.92(16/ 25)	
		0.01- 51.99	CAMP 11.5 M. NNE	16.48- 43.47	1.88- 44.54	
BI-214	NOT ESTAB	6.69(48/ 103)	PM1 PETTY FARM	10.12(4/ 13)	4.63(13/ 25)	
		0.00- 18.35	3.75 MILES WSW	2.79- 14.61	0.52- 23.16	
PB-214	NOT ESTAB	4.46(32/ 103)	PM2 SPRING CITY	6.95(2/ 13)	4.55(4/ 25)	
		0.26- 13.65	7.0 MILES NW	0.26- 13.65	0.77- 11.60	
PB-212	NOT ESTAB	2.05(30/ 103)	LM2 N. WBSP GATE	2.92(4/ 13)	2.08(14/ 25)	
		0.02- 6.65	0.5 MILES N	0.25- 6.32	0.11- 4.70	
BE-7	NOT ESTAB	48.21(39/ 103)	PM6 GOODFIELD	58.72(6/ 13)	45.27(14/ 25)	
		35.13- 119.20	9.0 MILES SSW	42.37- 119.20	30.48- 73.46	
SR 89	10.000	103 VALUES <LLD			25 VALUES <LLD	
128		ANALYSIS PERFORMED				
SR 90	2.000	2.79(1/ 103)	PM3 CEDINE BIBLE	2.79(1/ 13)	3.49(1/ 25)	
128		2.79- 2.79	CAMP 11.5 M. NNE	2.79- 2.79	3.49- 3.49	
TRITIUM	330.000	0 VALUES <LLD			12 VALUES <LLD	
12		ANALYSIS PERFORMED				

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 at specified locations is indicated in parentheses (F).

TABLE 8

RADIOACTIVITY IN HEAVY PARTICLE FALLOUT

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

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

LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1982

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 130	0.050	0.14(101/ 104) 0.05- 0.48	LM2 N. WBSP GATE 0.5 MILES N	0.33(13/ 13) 0.20- 0.48	0.11(26/ 26) 0.06- 0.22	

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 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 1982

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	0.02(97/ 411)	PM5 DECATUR	0.02(2/ 51)	0.02(4/ 103)	
514		0.02- 0.02	6.25 MILES S	0.02- 0.02	0.02- 0.02	

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 at specified locations is indicated in parentheses (F).

TABLE 10

RADIOACTIVITY IN ATMOSPHERIC MOISTURE

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

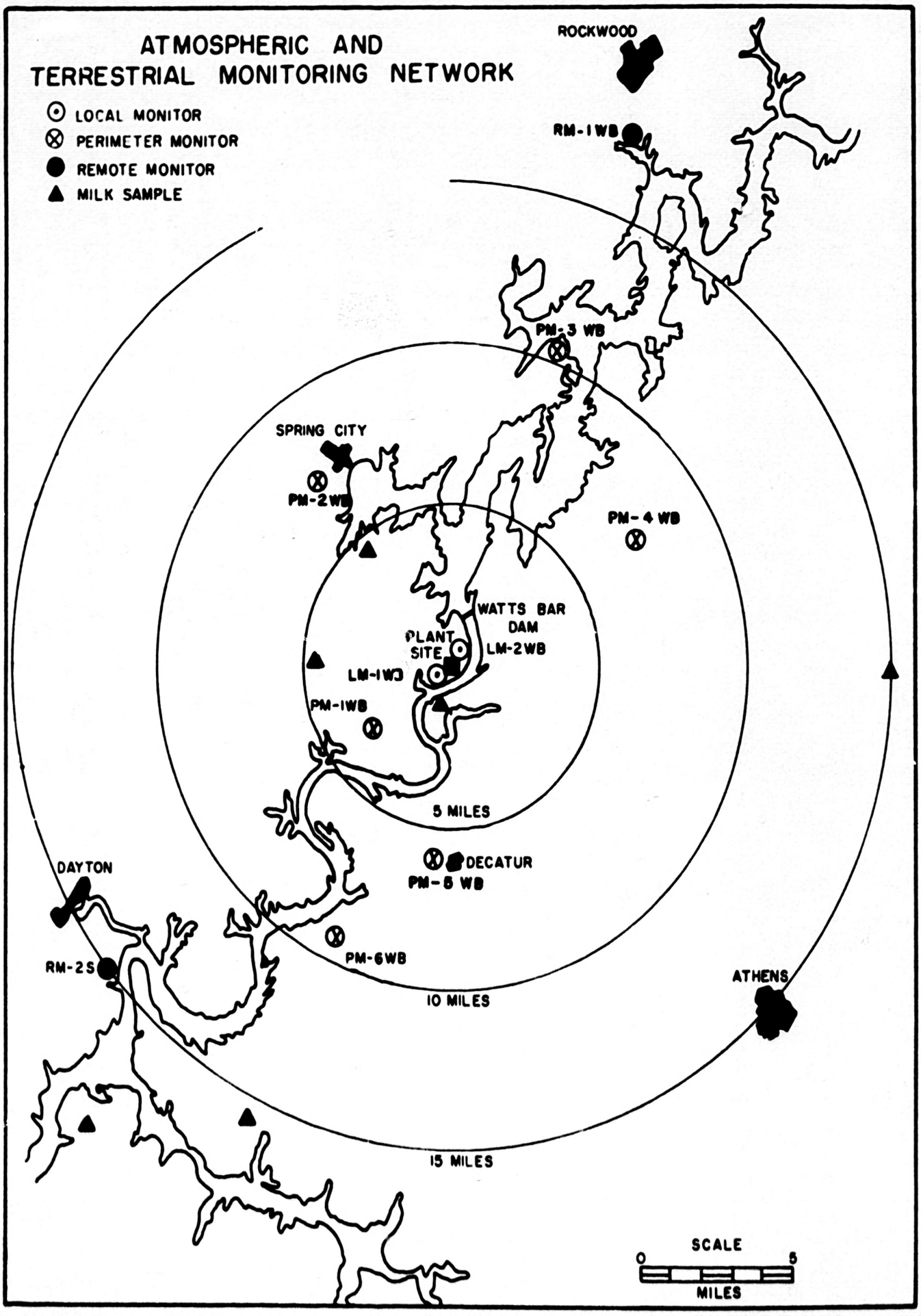
NAME OF FACILITY WATTS BAR
LOCATION OF FACILITY RHEA TENNESSEE

DOCKET NO. 50-390,391
REPORTING PERIOD 1982

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
TRITIUM 72	NOT ESTAB	5.82(46/ 46) 1.02- 16.88	LM2 N. WBSP GATE 0.5 MILES N	5.88(23/ 23) 1.02- 16.88	7.28(26/ 26) 1.33- 20.32	

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 at specified locations is indicated in parentheses (F).

Figure 2



(1 mile - 1.6 kilometers)

Figure 3

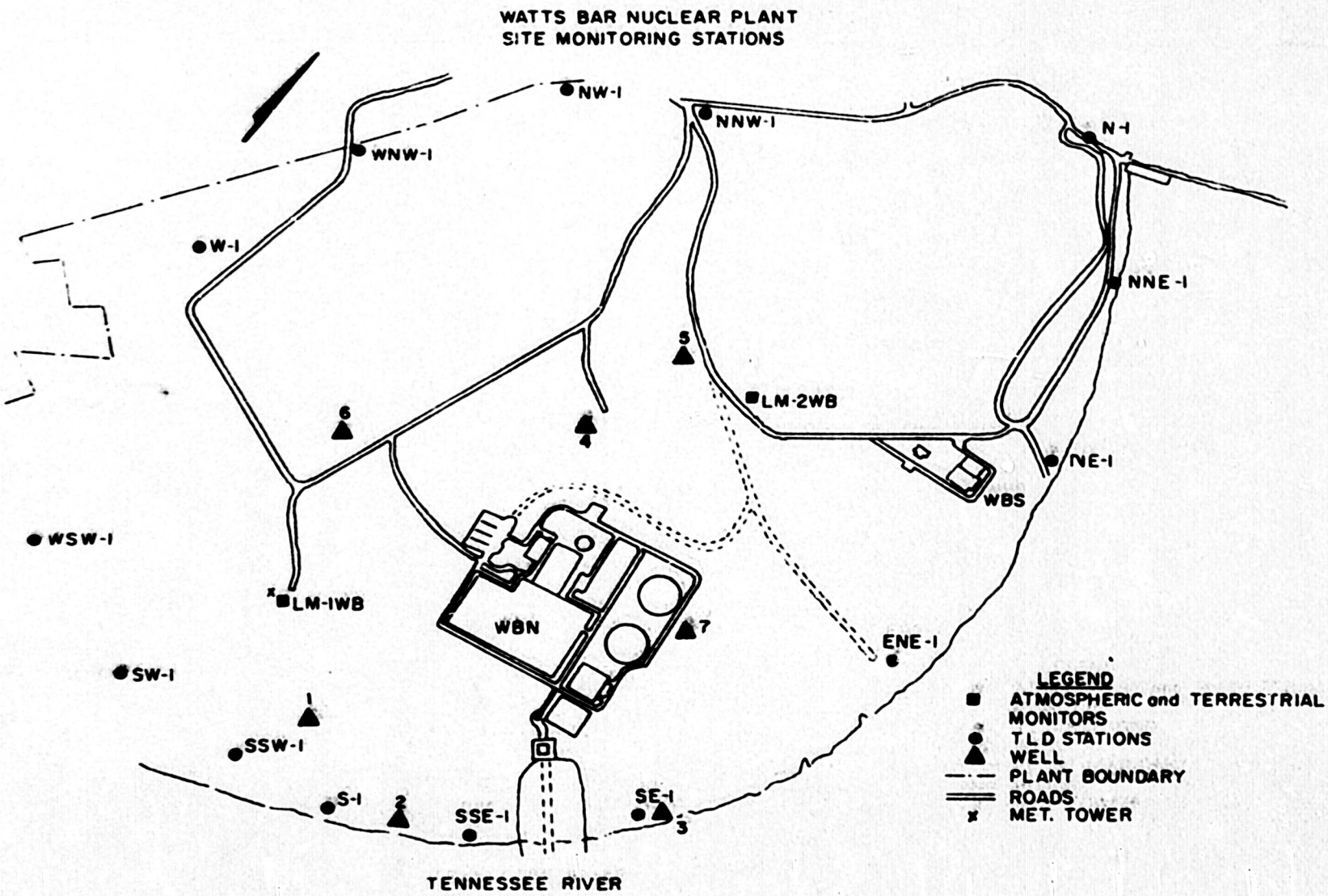
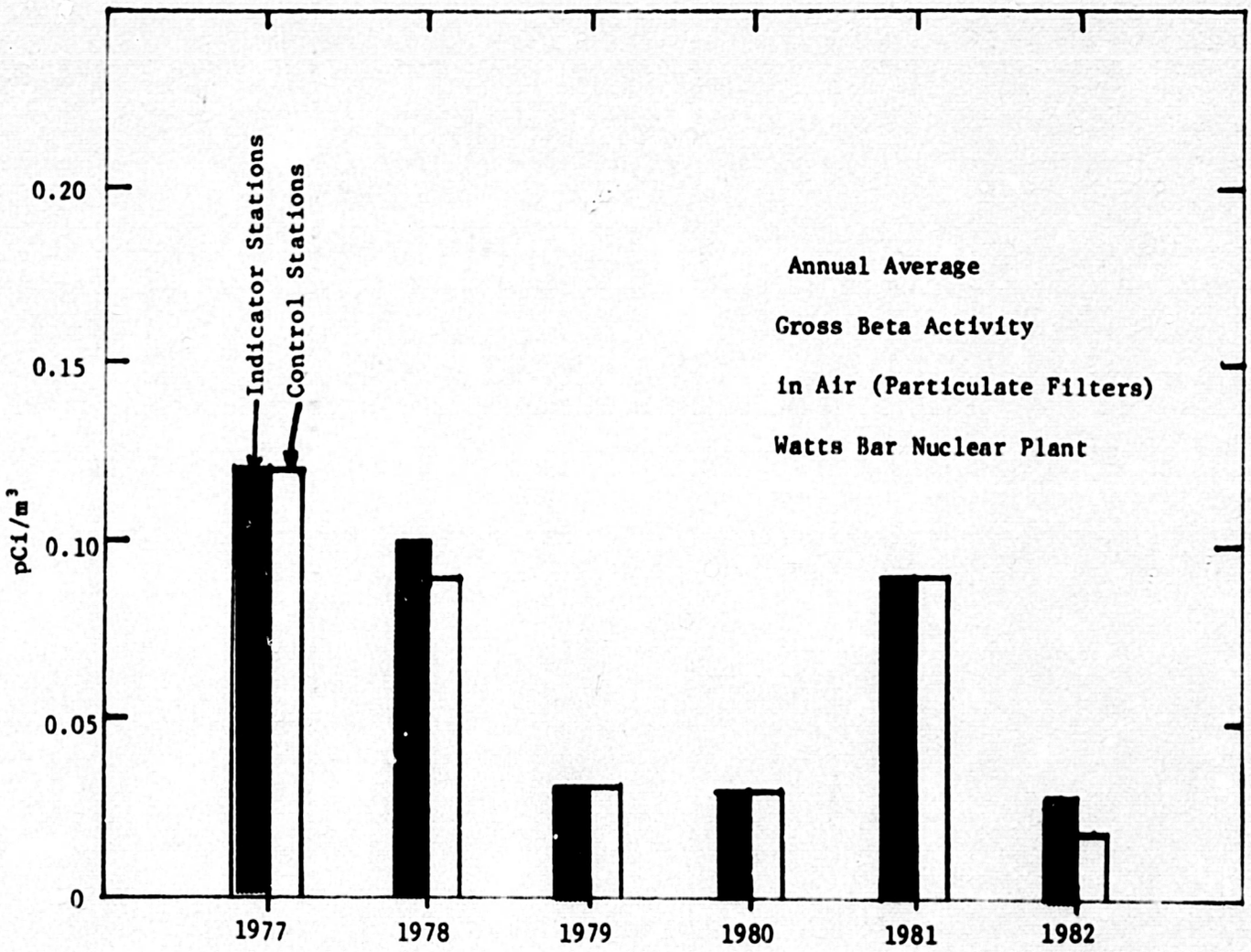

WATTS BAR NUCLEAR PLANT
SITE MONITORING STATIONS
NW-1
NNW-1
N-1
WNW-1
W-1
NNE-1
5
LM-2WB
6
4
NE-1
WBS
WSW-1
LM-1WB
WBN
7
ENE-1
SW-1
1
SSW-1
S-1
2
SSE-1
SE-1
3
TENNESSEE RIVER
LEGEND
ATMOSPHERIC and TERRESTRIAL MONITORS
TLD STATIONS
WELL
PLANT BOUNDARY
ROADS
MET. TOWER

Figure 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
1982

Terrestrial Monitoring

Milk

Milk samples were collected monthly from one indicator station until February 1982, when two additional stations were added. Weekly samples were taken at three control stations (these control stations are part of an ongoing SQN sampling program). All monthly and weekly samples and composites are analyzed for I-131. Monthly samples are also analyzed for gamma-emitting radionuclides and strontium. Only four samples for I-131 analysis were lost or destroyed; therefore, results for these samples are not available. Table 11 gives the results of laboratory analysis.

As has been noted in the Sequoyah and Bellefonte Nuclear Plants monitoring reports, the levels of ^{90}Sr in milk samples from farms producing milk for private consumption only are 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 preoperation 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 was observed at a small dairy farm 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

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. The sampling frequency was monthly at the three control stations in support of the SQN monitoring program. These monthly samples were analyzed for gamma-emitting radionuclides. 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

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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. 999-R-6, May 1964.

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 gross beta, 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 three 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, three 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 operating on a seventh well located downgradient from WBN.

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. The potable water sampling locations downstream from the plant are equipped with automatic samplers with composite samples analyzed monthly. One sample was lost during strontium analysis. Results of laboratory analysis are shown in table 15.

Figure 5 shows the trends in gross beta activity in drinking water from 1977 through 1982. 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 2-3 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 1982. 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 Crops, Poultry, and/or Beef

Food crops, poultry, and/or 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, lettuce, potatoes, tomatoes, and turnip greens were collected and analyzed for gross beta and specific gamma-emitting radionuclides. The results are given in tables 17 through 24. Beef and poultry samples were collected and analyzed for gamma-emitting radionuclides. Analytical results are given in tables 25 and 26. No sample of poultry was taken from a control location.

TABLE 11

RADIOACTIVITY IN MILK

PCI/L - 0.037 BQ/L

NAME OF FACILITY WATTS BAR — DOCKET NO. 50-390,391
LOCATION OF FACILITY RHEA TENNESSEE — REPORTING PERIOD 1982

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)						
32						
K-40	150.000	1256.16(15/ 15)	MOFFETT FARM	1325.82(5/ 5)	1263.55(17/ 17)	
		1021.50- 1459.90	4.5 MILES NW	1205.40- 1459.90	1175.60- 1347.70	
IODINE-131	0.500	34 VALUES <LLD			155 VALUES <LLD	
189		ANALYSIS PERFORMED				
GAMMA (GELI)						
44						
CS-137	5.000	5.94(1/ 22)	HOUSLEY FARM	5.94(1/ 8)	5.36(1/ 22)	
		5.94- 5.94	4.75 MILES W	5.94- 5.94	5.36- 5.36	
K-40	NOT ESTAB	1320.93(22/ 22)	LAYMAN FARM	1407.00(7/ 7)	1313.53(22/ 22)	
		978.03- 1501.55	1.5 MILES SSW	1314.60- 1501.55	844.40- 1476.74	
BI-214	NOT ESTAB	6.96(11/ 22)	LAYMAN FARM	7.51(3/ 7)	9.71(12/ 22)	
		0.60- 14.65	1.5 MILES SSW	0.60- 13.52	2.30- 30.53	
PB-214	NOT ESTAB	4.41(6/ 22)	LAYMAN FARM	6.44(2/ 7)	7.41(8/ 22)	
		0.94- 7.15	1.5 MILES SSW	6.18- 6.71	1.13- 13.93	
PB-212	NOT ESTAB	2.27(11/ 22)	LAYMAN FARM	5.48(2/ 7)	2.39(6/ 22)	
		0.03- 5.57	1.5 MILES SSW	5.40- 5.57	0.98- 5.05	
TL-208	NOT ESTAB	1.61(3/ 22)	LAYMAN FARM	2.91(1/ 7)	2.24(4/ 22)	
		0.78- 2.91	1.5 MILES SSW	2.91- 2.91	0.67- 4.15	
AC-228	NOT ESTAB	0.19(1/ 22)	MOFFETT FARM	0.19(1/ 7)	22 VALUES <LLD	
		0.19- 0.19	4.5 MILES NW	0.19- 0.19		
SR 89	10.000	37 VALUES <LLD			39 VALUES <LLD	
76		ANALYSIS PERFORMED				
SR 90	2.000	8.40(33/ 37)	HOUSLEY FARM	12.19(11/ 12)	3.11(32/ 39)	
76		2.21- 19.55	4.75 MILES W	8.63- 19.55	2.18- 5.79	

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 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 1982

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)						
51						
CE-144	0.220	0.40(3/ 12)	HOUSLEY FARM	0.51(1/ 4)	0.67(6/ 39)	
		0.27- 0.51	4.75 MILES W	0.51- 0.51	0.34- 1.09	
CS-137	0.060	0.07(3/ 12)	MOFFETT FARM	0.09(1/ 4)	0.10(8/ 39)	
		0.06- 0.09	4.5 MILES NW	0.09- 0.09	0.08- 0.14	
NB-95	0.050	12 VALUES <LLD			0.09(6/ 39)	
					0.05- 0.12	
K-40	NOT ESTAB	19.93(12/ 12)	LAYMAN FARM	29.66(4/ 4)	22.29(39/ 39)	
		4.66- 34.57	1.5 MILES SSW	24.08- 34.57	3.67- 69.92	
BI-214	0.100	12 VALUES <LLD			0.24(3/ 39)	
					0.16- 0.37	
PB-214	NOT ESTAB	0.04(6/ 12)	MOFFETT FARM	0.05(2/ 4)	0.07(27/ 39)	
		0.02- 0.08	4.5 MILES NW	0.04- 0.07	0.01- 0.27	
PB-212	NOT ESTAB	0.02(10/ 12)	HOUSLEY FARM	0.03(2/ 4)	0.06(30/ 39)	
		0.00- 0.05	4.75 MILES W	0.00- 0.05	0.00- 0.17	
BE-7	NOT ESTAB	8.62(12/ 12)	MOFFETT FARM	11.00(4/ 4)	6.14(39/ 39)	
		2.01- 20.33	4.5 MILES NW	2.01- 20.33	1.32- 19.03	
TL-208	NOT ESTAB	0.02(6/ 12)	LAYMAN FARM	0.03(3/ 4)	0.02(25/ 39)	
		0.00- 0.04	1.5 MILES SSW	0.02- 0.04	0.00- 0.08	
AC-228	NOT ESTAB	0.10(3/ 12)	LAYMAN FARM	0.13(2/ 4)	0.14(19/ 39)	
		0.05- 0.16	1.5 MILES SSW	0.10- 0.16	0.04- 0.46	
SR 89	0.250	0.49(2/ 12)	HOUSLEY FARM	0.73(1/ 4)	0.38(4/ 12)	
24		0.25- 0.73	4.75 MILES W	0.73- 0.73	0.31- 0.47	
SR 90	0.050	0.22(11/ 12)	HOUSLEY FARM	0.27(4/ 4)	0.14(10/ 12)	
24		0.08- 0.51	4.75 MILES W	0.12- 0.51	0.05- 0.22	

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 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 RHEA TENNESSEE — REPORTING PERIOD 1982

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 21	0.700	20.08(16/ 16) 11.87- 40.11	PM2 SPRING CITY 7.0 MILES NW	30.31(2/ 2) 20.51- 40.11	14.23(5/ 5) 9.19- 21.60	
GAMMA (GELI) 21						
CS-134	0.080	0.16(1/ 16) 0.16- 0.16	LM1 ENV DATA STA 0.5 MILES SSW	0.16(1/ 2) 0.16- 0.16	0.18(1/ 5) 0.18- 0.18	
CS-137	0.020	0.63(16/ 16) 0.15- 2.97	PM2 SPRING CITY 7.0 MILES NW	1.78(2/ 2) 0.59- 2.97	0.36(5/ 5) 0.24- 0.47	
K-40	0.250	8.22(16/ 16) 2.80- 21.28	PM2 SPRING CITY 7.0 MILES NW	14.53(2/ 2) 7.78- 21.28	3.98(5/ 5) 2.53- 6.31	
BI-214	0.050	0.88(16/ 16) 0.68- 1.07	PM1 PETTY FARM 3.75 MILES WSW	1.04(2/ 2) 1.02- 1.07	0.95(5/ 5) 0.58- 1.52	
BI-212	0.100	1.23(16/ 16) 0.71- 1.55	PM1 PETTY FARM 3.75 MILES WSW	1.42(2/ 2) 1.37- 1.46	0.94(5/ 5) 0.49- 1.61	
PB-214	0.050	0.98(16/ 16) 0.71- 1.17	PM1 PETTY FARM 3.75 MILES WSW	1.15(2/ 2) 1.14- 1.16	1.04(5/ 5) 0.63- 1.66	
PB-212	NOT ESTAB	1.17(16/ 16) 0.72- 1.38	LM2 N. WBSP GATE 0.5 MILES N	1.37(2/ 2) 1.35- 1.38	0.89(5/ 5) 0.51- 1.49	
RA-226	0.050	0.88(16/ 16) 0.68- 1.07	PM1 PETTY FARM 3.75 MILES WSW	1.04(2/ 2) 1.02- 1.07	0.95(5/ 5) 0.58- 1.52	
RA-224	NOT ESTAB	1.33(16/ 16) 0.79- 1.69	LM1 ENV DATA STA 0.5 MILES SSW	1.58(2/ 2) 1.47- 1.69	1.01(5/ 5) 0.66- 1.66	
TL-208	0.020	0.36(16/ 16) 0.21- 0.45	LM1 ENV DATA STA 0.5 MILES SSW	0.43(2/ 2) 0.40- 0.45	0.26(5/ 5) 0.16- 0.44	
AC-228	0.060	1.13(16/ 16) 0.64- 1.45	LM1 ENV DATA STA 0.5 MILES SSW	1.30(2/ 2) 1.27- 1.32	0.86(5/ 5) 0.49- 1.45	
PA-234M	NOT ESTAB	2.54(8/ 16) 1.93- 3.19	PM1 PETTY FARM 3.75 MILES WSW	2.97(1/ 2) 2.97- 2.97	3.21(2/ 5) 2.66- 3.75	
SR 89 21	1.500	2.97(3/ 16) 1.68- 3.80	PM4 TEN MILE 7.75 MILES NE	3.80(1/ 2) 3.80- 3.80	1.70(1/ 5) 1.70- 1.70	
SR 90 21	0.300	0.41(5/ 16) 0.30- 0.66	LM1 ENV DATA STA 0.5 MILES SSW	0.48(2/ 2) 0.30- 0.66	5 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 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 1982

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) 127						
K-40	NOT ESTAB	15.55(45/ 91)	WBN WELL #4	27.73(7/ 13)	18.50(22/ 36)	
		0.12- 47.92	ONSITE NNW	6.01- 44.84	2.05- 50.37	
BI-214	NOT ESTAB	6.68(48/ 91)	WBN WELL #5	12.45(7/ 13)	10.90(22/ 36)	
		0.02- 30.34	ONSITE N	0.16- 27.31	0.05- 29.36	
PB-214	NOT ESTAB	7.39(25/ 91)	WBN WELL #2	9.99(4/ 13)	6.52(15/ 36)	
		0.18- 26.15	ONSITE SSE	0.31- 26.15	0.23- 18.90	
PB-212	NOT ESTAB	2.29(35/ 91)	WBN WELL #5	12.41(1/ 13)	1.26(15/ 36)	
		0.24- 12.41	ONSITE N	12.41- 12.41	0.05- 2.65	
TL-208	NOT ESTAB	0.94(15/ 91)	WBN WELL #1	1.18(1/ 13)	1.06(8/ 36)	
		0.21- 2.49	ONSITE S	1.18- 1.18	0.02- 3.39	
AC-228	NOT ESTAB	4.57(1/ 91)	WBN WELL #4	4.57(1/ 13)	1.00(1/ 36)	
		4.57- 4.57	ONSITE NNW	4.57- 4.57	1.00- 1.00	
TRITIUM 39	330.000	27 VALUES <LLD ANALYSIS PERFORMED			12 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 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 RHEA TENNESSEE — REPORTING PERIOD 1982

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 52	2.400	3.84(21/ 26) 2.42- 6.66	CF INDUSTRIES TRM 473.0	4.16(9/ 13) 2.42- 6.66	4.54(1/ 26) 4.54- 4.54	
GAMMA (GELI) 52						
K-40	NOT ESTAB	20.04(10/ 26) 0.34- 39.78	CF INDUSTRIES TRM 473.0	22.70(8/ 13) 0.34- 39.78	17.45(10/ 26) 0.31- 41.93	
BI-214	NOT ESTAB	4.35(12/ 26) 0.04- 21.57	CF INDUSTRIES TRM 473.0	6.98(5/ 13) 0.04- 21.57	7.88(17/ 26) 0.01- 46.10	
PB-214	NOT ESTAB	4.19(7/ 26) 0.12- 9.09	CF INDUSTRIES TRM 473.0	5.69(4/ 13) 0.12- 9.09	8.56(12/ 26) 0.98- 34.35	
PB-212	NOT ESTAB	1.73(8/ 26) 0.06- 3.49	CF INDUSTRIES TRM 473.0	1.74(3/ 13) 1.21- 2.06	0.75(3/ 26) 0.34- 0.99	
TL-208	NOT ESTAB	1.26(6/ 26) 0.12- 3.13	DAYTON, TN 17.75 MILES NNE	1.46(3/ 13) 0.26- 3.13	1.10(7/ 26) 0.08- 2.15	
AC-228	NOT ESTAB	4.05(1/ 26) 4.05- 4.05	CF INDUSTRIES TRM 473.0	4.05(1/ 13) 4.05- 4.05	26 VALUES <LLD	
SR 89 15	10.000	7 VALUES <LLD ANALYSIS PERFORMED			8 VALUES <LLD	
SR 90 15	2.000	7 VALUES <LLD ANALYSIS PERFORMED			8 VALUES <LLD	
TRITIUM 16	330.000	397.43(3/ 8) 378.77- 416.42	CF INDUSTRIES TRM 473.0	397.60(2/ 4) 378.77- 416.42	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 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 - 1982
mR/Quarter[a]

Distance miles	Average External Gamma Radiation Levels[b]			
	1st Quarter (Dec 81-Feb 82)	2nd Quarter (Mar-May 82)	3rd Quarter (Jun-Aug 82)	4th Quarter (Sep-Nov 82)
0-1	19.6 ± 2.1	19.5 ± 1.7	19.4 ± 2.4	19.3 ± 2.0
1-2	20.0 ± 1.1	19.6 ± 1.2	20.2 ± 1.8	19.5 ± 1.1
2-4	16.5 ± 0.2	15.7 ± 0.1	17.2 ± 0.5	16.5 ± 0.9
4-6	17.7 ± 2.3	17.6 ± 2.4	17.7 ± 2.4	17.4 ± 2.6
>6	16.2 ± 2.3	16.2 ± 2.7	15.3 ± 2.1	15.7 ± 2.9
Average, 0-2 miles (Onsite)	19.7 ± 1.8	19.5 ± 1.5	19.7 ± 2.2	19.4 ± 1.7
Average, >2 miles (Offsite)	17.1 ± 2.3	16.9 ± 2.5	16.8 ± 2.4	16.7 ± 2.7

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