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Dear Dr. Parzyck:

The enclosed reports, "Environmental Radioactivity Levels - Browns Ferry Nuclear Plant - Annual Report - 1986" and "Environmental Radioactivity Levels - Bellefonte Nuclear Plant - Annual Report - 1986," are furnished for your information and use.

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Sincerely yours,

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ENVIRONMENTAL RADIOACTIVITY LEVELS
BELLEFONTE NUCLEAR PLANT
ANNUAL REPORT - 1986

RADIOLOGICAL CONTROL

ENVIRONMENTAL RADIOACTIVITY LEVELS
BELLEFONTE NUCLEAR PLANT
ANNUAL REPORT - 1986
TVA/NUC SVCS/RC

April 1986

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ANNUAL REPORT

1986

Introduction

The Bellefonte Nuclear Plant (BLN), being constructed by the Tennessee Valley Authority, is located in Jackson County, Alabama, on a peninsula bounded on the west by Town Creek embayment and on the east by Guntersville Reservoir at Tennessee River Mile (TRM) 391.5 (see figure 1). The site is approximately 6 miles (10 kilometers) northeast of Scottsboro, Alabama. The plant will consist of two pressurized water reactors; each unit is rated at 3,620 MWt and 1,271 MWe. Fuel load in unit 1 is scheduled for no earlier than 1993.

A preoperational environmental radiological monitoring program was implemented in August 1978 and continued through 1983. This program had the objective of establishing a baseline of data on the distribution of natural and manmade radioactivity in the environment near the plant site. Because of the extended delay in fuel loading, the sampling program was substantially reduced for 1984 and 1985 with further reductions for 1986. This reduced program (see table 1) will continue until 1 year prior to fuel loading. At that time, the full preoperational sampling program will be restarted. This report presents the results obtained from the program conducted during 1986.

Radiological Control (Office of Nuclear Power) and the Office of Natural Resources and Economic Development carried out the sampling program outlined in table 1. Sampling locations are shown in figures 2, 3, and 4, and table 2 describes the locations of the environmental monitoring stations. All the radiochemical and instrumental analyses were conducted in TVA's Western Area Radiological Laboratory (WARL) located at Muscle Shoals, Alabama. Beta analyses were performed on Beckman Low Beta II or Tennelec LB5100 low background proportional counters. Gamma spectral analyses were performed with a Nuclear Data (ND) Model 6700 multichannel analyzer system utilizing germanium detectors.

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

The detection capabilities for the environmental sample analysis given as the nominal lower limits of detection (LLD) are listed in table 3. All photopeaks found in germanium spectra were identified and quantified. Many of the isotopes identified by germanium spectral analysis are naturally occurring or naturally produced radioisotopes, such as Be-7, K-40, Bi-212, Bi-214, Pb-212, Pb-214, Ra-226, etc. LLDs for additional radionuclides identified by germanium analysis were calculated for each analysis, and nominal values are listed in table 3. In the instance where an LLD has not been established, an LLD value of zero was 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 EPA-Las Vegas. This program provides periodic cross-checks on 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 1986 are shown in table 4. The $\pm 3\sigma$ limits based on one measurement were divided by the square root of 3 to correct for triplicate determinations.

Table 5 contains a list of maximum permissible concentrations (10 CFR 20) for nonoccupational exposure for air and water for selected isotopes.

Table 1

ENVIRONMENTAL RADIOACTIVITY SAMPLING SCHEDULE

BELLEFONTE NUCLEAR PLANT

Station Location	Soil	Fish
Site SW	A	
Site NE	A	
Lim Rock (Control)	A	
Rainsville (Control)	A	
Wheeler Reservoir		S[a]
Guntersville Reservoir		S[a]
Nickajack Reservoir (Control)		S[b]

S = Semiannually

A = Annually

[a]Samples collected as a part of the Browns Ferry Nuclear Plant Monitoring program.

[b]Samples collected as a part of the Sequoyah Nuclear Plant Monitoring program.

Table 2

ENVIRONMENTAL MONITORING STATION LOCATIONS
BELLEFONTE NUCLEAR PLANT

Sample Station	Approximate Distance from Plant	Approximate Direction from Plant
LM - 1 BL, Southwest	0.75 miles (1.2 kilometers)	SW
LM - 2 BL, Northeast	1 mile (1.6 kilometers)	NE
RM - 1 BL, Lim Rock, AL	18 miles (29 kilometers)	W
RM - 2 BL, Rainsville, AL	14.5 miles (23.4 kilometers)	SSE
Nickajack Reservoir	26 miles (41.6 kilometers)	upstream
Guntersville Reservoir	Adjacent to plant	
Wheeler Reservoir	30 miles (48 kilometers)	downstream

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						0.5
I-131		0.01							40	10
Sr-89	0.005			10	0.25	1.5	0.5	5.0	8	2
Sr-90	0.001			2	0.05	0.15	0.1	1.0		

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

B. Radiochemical Analysis of Water (pCi/L)

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

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

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

TABLE 4 (continued)

D. Food (pCi/Kg, Wet Weight)

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

E. Milk (pCi/L)

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

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

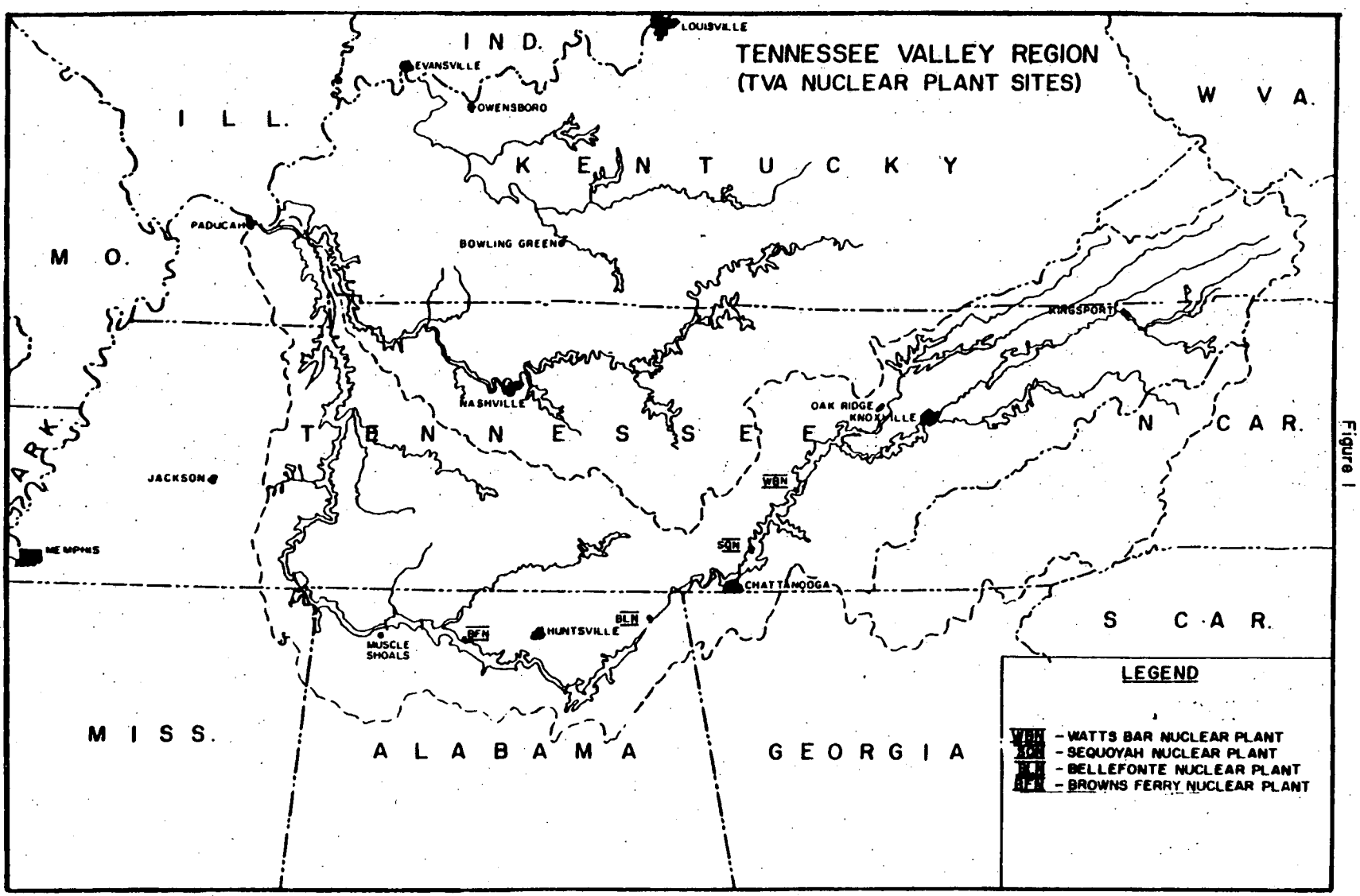
Table 5

MAXIMUM PERMISSIBLE CONCENTRATIONS FOR

NONOCCUPATIONAL EXPOSURE

	MPC	
	In Water pCi/l*	In Water pCi/m3
Alpha	30	
Gross beta	3,000	100
Tritium	3,000,000	200,000
Cs-137	20,000	500
Ru-103,-106	10,000	200
Ce-144	10,000	200
Zr-95 - Nb-95	60,000	1,000
Ba-140 - La-140	20,000	1,000
I-131	300	100
Zn-65	100,000	2,000
Mn-54	100,000	1,000
Co-60	30,000	300
Sr-89	3,000	300
Sr-90	300	30
Cr-51	2,000,000	80,000
Cs-134	9,000	400
Co-58	90,000	2,000
Fe-59	50,000	2,000

*1 pCi = 3.7×10^{-2} Bq.
Source: 10 CFR, Part 20, Appendix B, Table II.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WBN
SQN
MEMPHIS
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S CAR.
BLN
HUNTSVILLE
BFN
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

Environmental Monitoring

The preoperational environmental radiological monitoring program for 1985 was further reduced for 1986. This modified program reflects decisions to slow construction at BLN and thereby extending the projected fuel loading until 1993 or beyond. Approximately 1 year prior to fuel loading, the full environmental sampling program will be restarted.

The interim reduced sampling program included the collection of soil, environmental gamma radiation levels, and fish. The soil samples were collected at two onsite and two offsite locations. Environmental gamma radiation levels were determined by the use of thermoluminescent dosimeters (TLDs) placed at strategic locations in the environs. Fish samples collected as part of the Sequoyah Nuclear Plant and Browns Ferry Nuclear Plant environmental radiological monitoring programs provided preoperational data from the Tennessee River in the vicinity of BLN. Figures 2, 3, and 4 show sampling and TLD locations.

Soil

Soil samples were collected annually at four locations to provide an indication of long-term buildup of radioactivity in the environment. An auger or a "cookie cutter" type sampler was used to obtain samples of the top two inches (5 cm) of soil. These samples were analyzed for gamma-emitting radionuclides; Sr-89, and Sr-90. The results are given in table 6.

Environmental Gamma Radiation Levels

Bulb-type Victoreen Managnaese-activated calcium fluoride (CaF_2: Mn) thermoluminescent dosimeters (TLDs) are placed at 18 stations around the plant near the site boundary, at perimeter and remote locations, and at 18 additional stations approximately 5 miles from the site to determine the gamma exposure rates at these locations (see figures 2, 3, and 4). The dosimeters, located inside energy compensating shields, are placed at approximately one meter above the ground, with two to three TLDs at each station. They are annealed and read with a Victoreen Model 2810 TLD reader. The values are corrected for gamma response, self-irradiation, and fading, with individual gamma response calibrations and self-irradiation factors determined for each TLD. The system meets or exceeds the performance specifications outlined in Regulatory Guide 4.13 for environmental applications of TLDs.

The TLDs are exchanged every 3 months. The quarterly gamma radiation levels determined from these TLDs are given in table 7. It should be noted that even during the preoperational phase of the monitoring program, the average radiation levels onsite are generally 2-6 mR/quarter higher than the levels offsite. 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, and other undetermined influences.

Figure 5 compares plots of the data from the onsite or site boundary stations with those from the offsite stations over the period from 1978 through 1986. To reduce the variations present in the data sets, a 4-quarter moving average was constructed for each set. Figure 6 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.

Fish

Radiological monitoring for fish is accomplished by analyses of composite samples of adult fish taken from each of three continguous reservoirs--the reservoir on which the plant is located and the reservoirs immediately upstream and downstream. No permanent sampling stations are 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. Sufficient fish are collected in each reservoir to yield 250-300 grams oven-dry material for analytical purposes. The composite samples contain approximately the same quantity of flesh from each fish. For each composite, a subsample of material is drawn for analysis.

Samples of white crappie and smallmouth buffalo are taken semiannually from Guntersville and Wheeler Reservoirs and analyzed for gross beta and for gamma-emitting radionuclides as a part of the BFN monitoring program. In the SQN monitoring program, samples of white crappie and smallmouth buffalo are taken semiannually from Nickajack Reservoir and were analyzed only for gamma-emitting radionuclides. Analytical data are summarized in tables 8, 9, and 10.

TABLE 6

RADIOACTIVITY IN SOIL

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

NAME OF FACILITY BELLEFONTE — DOCKET NO. 50-438,439
LOCATION OF FACILITY JACKSON ALABAMA — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA (GELI)						
4						
CS-137	2.00E-02	3.60E-01(2/ 2)	LM1 BL SOUTHWEST	5.93E-01(1/ 1)	2.09E-01(2/ 2)	
		1.28E-01 - 5.93E-01	0.8 MILE SW	5.93E-01 - 5.93E-01	1.51E-01 - 2.67E-01	
K-40	2.50E-01	6.14E+00(2/ 2)	LM1 BL SOUTHWEST	6.97E+00(1/ 1)	2.67E+00(2/ 2)	
		5.31E+00 - 6.97E+00	0.8 MILE SW	6.97E+00 - 6.97E+00	2.59E+00 - 2.75E+00	
BI-214	5.00E-02	1.18E+00(2/ 2)	LM2 BL ENV DATA	1.27E+00(1/ 1)	6.57E-01(2/ 2)	
		1.10E+00 - 1.27E+00	1.0 MILE NE	1.27E+00 - 1.27E+00	6.38E-01 - 6.75E-01	
BI-212	1.00E-01	1.49E+00(2/ 2)	LM1 BL SOUTHWEST	1.53E+00(1/ 1)	6.09E-01(2/ 2)	
		1.45E+00 - 1.53E+00	0.8 MILE SW	1.53E+00 - 1.53E+00	5.72E-01 - 6.47E-01	
PB-214	5.00E-02	1.28E+00(2/ 2)	LM2 BL ENV DATA	1.37E+00(1/ 1)	7.27E-01(2/ 2)	
		1.19E+00 - 1.37E+00	1.0 MILE NE	1.37E+00 - 1.37E+00	6.81E-01 - 7.73E-01	
PB-212	NOT ESTAB	1.29E+00(2/ 2)	LM2 BL ENV DATA	1.33E+00(1/ 1)	5.31E-01(2/ 2)	
		1.25E+00 - 1.33E+00	1.0 MILE NE	1.33E+00 - 1.33E+00	5.22E-01 - 5.40E-01	
RA-226	5.00E-02	1.18E+00(2/ 2)	LM2 BL ENV DATA	1.27E+00(1/ 1)	6.57E-01(2/ 2)	
		1.10E+00 - 1.27E+00	1.0 MILE NE	1.27E+00 - 1.27E+00	6.38E-01 - 6.75E-01	
RA-224	NOT ESTAB	1.40E+00(2/ 2)	LM1 BL SOUTHWEST	1.45E+00(1/ 1)	2 VALUES <LLD	
		1.34E+00 - 1.45E+00	0.8 MILE SW	1.45E+00 - 1.45E+00		
TL-208	2.00E-02	4.57E-01(2/ 2)	LM2 BL ENV DATA	4.71E-01(1/ 1)	1.84E-01(2/ 2)	
		4.43E-01 - 4.71E-01	1.0 MILE NE	4.71E-01 - 4.71E-01	1.84E-01 - 1.84E-01	
AC-228	6.00E-02	1.32E+00(2/ 2)	LM2 BL ENV DATA	1.35E+00(1/ 1)	5.29E-01(2/ 2)	
		1.28E+00 - 1.35E+00	1.0 MILE NE	1.35E+00 - 1.35E+00	5.18E-01 - 5.39E-01	
SR 89	1.50E+00	2 VALUES <LLD			2 VALUES <LLD	
4		ANALYSIS PERFORMED				
SR 90	1.50E-01	1.75E-01(1/ 2)	LM1 BL SOUTHWEST	1.75E-01(1/ 1)	2 VALUES <LLD	
4		1.75E-01 - 1.75E-01	0.8 MILE SW	1.75E-01 - 1.75E-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 7

ENVIRONMENTAL GAMMA RADIATION LEVELS

Average External Gamma Radiation Levels at Various Distances from Bellefonte Nuclear Plant for Each Quarter - 1986
mR/Quarter

Distance miles	Average External Gamma Radiation Levels[b]			
	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
0-1	20.1 ± 1.5	17.0 ± 1.5	21.1 ± 2.9	20.3 ± 1.9
1-2	20.6 ± 4.6	22.6 ± 9.0	24.2 ± 8.5	23.8 ± 6.3
2-4	15.2 ± 1.4	13.9 ± 0.9	14.1 ± 2.1	16.1 ± 1.1
4-6	17.6 ± 1.8	15.0 ± 1.3	16.7 ± 2.8	17.8 ± 1.6
>6	16.1 ± 1.3	13.8 ± 1.0	13.9 ± 1.4	21.7 ± 13.6
Average, 0-2 miles (Onsite)	20.2 ± 1.8	18.1 ± 4.2	21.6 ± 4.2	20.9 ± 3.1
Average, >2 miles (Offsite)	16.8 ± 1.9	14.5 ± 1.2	15.6 ± 2.7	18.3 ± 6.5

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

TABLE 8

RADIOACTIVITY IN WHITE CRAPPIE (FLESH)

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

NAME OF FACILITY BELLEFONTE — DOCKET NO. 50-438,439
LOCATION OF FACILITY JACKSON ALABAMA — REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA 4	1.00E-01	3.15E+01(4/ 4) 2.90E+01 - 3.50E+01	GUNTERSVILLE RES TRM 349-425	3.28E+01(2/ 2) 3.06E+01 - 3.50E+01		
GAMMA (GELI) 6						
CS-137	2.00E-02	9.47E-02(4/ 4) 4.86E-02 - 1.47E-01	WHEELER RES TRM 275-349	1.11E-01(2/ 2) 7.48E-02 - 1.47E-01	1.08E-01(2/ 2) 3.29E-02 - 1.34E-01	
K-40	NOT ESTAB	1.59E+01(4/ 4) 1.38E+01 - 1.76E+01	GUNTERSVILLE RES TRM 349-425	1.60E+01(2/ 2) 1.50E+01 - 1.70E+01	1.67E+01(2/ 2) 1.61E+01 - 1.73E+01	
BI-214	2.00E-02	3.64E-02(1/ 4) 3.64E-02 - 3.64E-02	GUNTERSVILLE RES TRM 349-425	3.64E-02(1/ 2) 3.64E-02 - 3.64E-02	2 VALUES <LLD	
PB-214	NOT ESTAB	2.50E-02(1/ 4) 2.50E-02 - 2.50E-02	GUNTERSVILLE RES TRM 349-425	2.50E-02(1/ 2) 2.50E-02 - 2.50E-02	1.50E-02(1/ 2) 1.50E-02 - 1.50E-02	
PB-212	NOT ESTAB	3.00E-04(1/ 4) 3.00E-04 - 3.00E-04	GUNTERSVILLE RES TRM 349-425	3.00E-04(1/ 2) 3.00E-04 - 3.00E-04	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 9

RADIOACTIVITY IN SMALLMOUTH BUFFALO (FLESH)

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

NAME OF FACILITY BELLEFONTE DOCKET NO. 50-438,439
LOCATION OF FACILITY JACKSON ALABAMA REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD)	ALL INDICATOR LOCATIONS MEAN (F) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE	CONTROL LOCATIONS MEAN (F) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
	SEE NOTE 1	SEE NOTE 2		SEE NOTE 2	SEE NOTE 2	
GROSS BETA 4	1.00E-01	2.04E+01(4/ 4) 1.86E+01 - 2.54E+01	WHEELER RES TRM 275-349	2.22E+01(2/ 2) 1.90E+01 - 2.54E+01		
GAMMA (GELI) 6						
CS-137	2.00E-02	3.90E-02(2/ 4) 3.09E-02 - 4.71E-02	GUNTERSVILLE RES TRM 349-425	4.71E-02(1/ 2) 4.71E-02 - 4.71E-02	3.53E-02(2/ 2) 3.32E-02 - 3.74E-02	
K-40	NOT ESTAB	1.10E+01(4/ 4) 8.99E+00 - 1.39E+01	WHEELER RES TRM 275-349	1.15E+01(2/ 2) 8.99E+00 - 1.39E+01	1.20E+01(2/ 2) 9.42E+00 - 1.46E+01	
PB-214	NOT ESTAB	4 VALUES <LLD			3.73E-02(1/ 2) 3.73E-02 - 3.73E-02	
PB-212	NOT ESTAB	5.70E-03(1/ 4) 5.70E-03 - 5.70E-03	GUNTERSVILLE RES TRM 349-425	5.70E-03(1/ 2) 5.70E-03 - 5.70E-03	3.80E-03(1/ 2) 3.80E-03 - 3.80E-03	

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

TABLE 10

RADIOACTIVITY IN SMALLMOUTH BUFFALO (WHOLE)

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

NAME OF FACILITY BELLEFONTE DOCKET NO. 50-438,439

LOCATION OF FACILITY JACKSON ALABAMA REPORTING PERIOD 1986

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA	1.00E-01	1.61E+01(4/ 4)	WHEELER RES	1.67E+01(2/ 2)		
4		1.02E+01 - 2.09E+01	TRM 275-349	1.34E+01 - 2.01E+01		
GAMMA (GELI)						
6						
CS-137	2.00E-02	2.59E-02(2/ 4)	GUNTERSVILLE RES	2.59E-02(2/ 2)	2.32E-02(1/ 2)	
		2.51E-02 - 2.66E-02	TRM 349-425	2.51E-02 - 2.66E-02	2.32E-02 - 2.32E-02	
K-40	NOT ESTAB	7.33E+00(4/ 4)	GUNTERSVILLE RES	7.80E+00(2/ 2)	6.59E+00(2/ 2)	
		5.75E+00 - 9.52E+00	TRM 349-425	6.09E+00 - 9.52E+00	6.36E+00 - 6.82E+00	
BI-214	2.00E-02	4 VALUES <LLD			3.74E-02(2/ 2)	
					2.06E-02 - 5.41E-02	
PB-214	NOT ESTAB	5.30E-03(2/ 4)	GUNTERSVILLE RES	6.70E-03(1/ 2)	2.34E-02(1/ 2)	
		3.90E-03 - 6.70E-03	TRM 349-425	6.70E-03 - 6.70E-03	2.34E-02 - 2.34E-02	
PB-212	NOT ESTAB	1.94E-02(1/ 4)	WHEELER RES	1.94E-02(1/ 2)	6.40E-03(1/ 2)	
		1.94E-02 - 1.94E-02	TRM 275-349	1.94E-02 - 1.94E-02	6.40E-03 - 6.40E-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).

Figure 2

BELLEFONTE NUCLEAR PLANT

MONITORING NETWORK

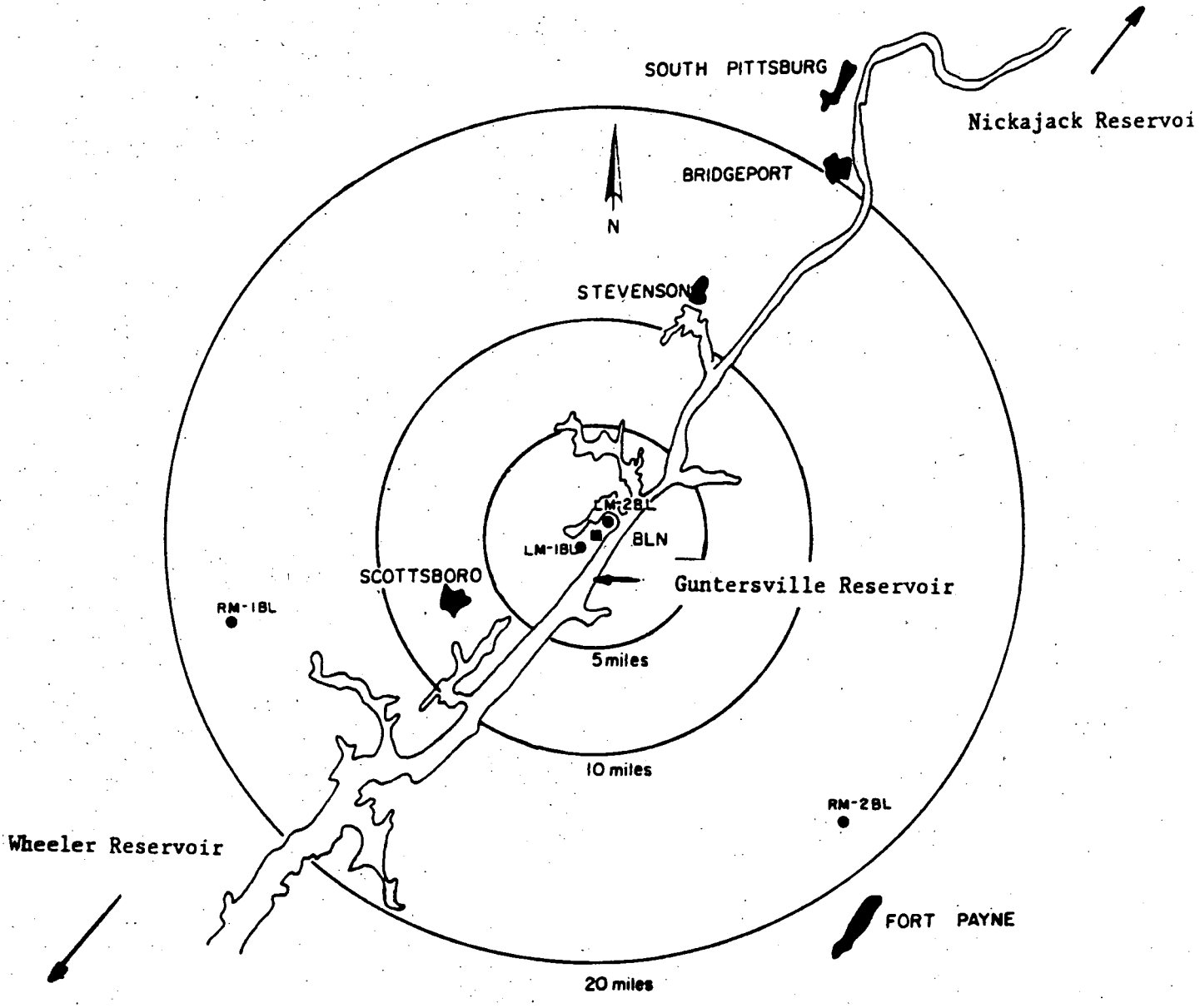


Figure 3

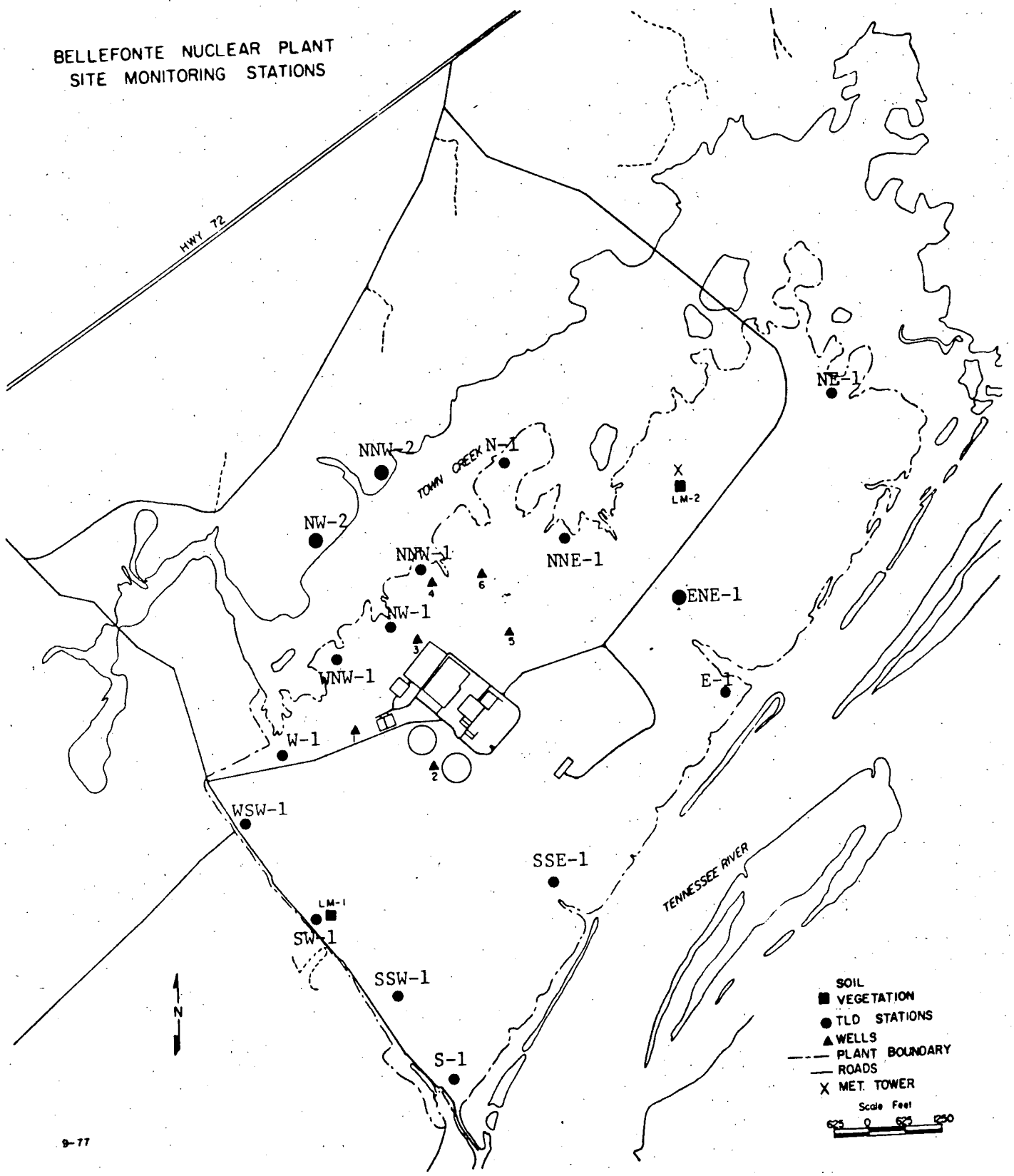

BELLEFONTE NUCLEAR PLANT
SITE MONITORING STATIONS
HWY 72
NNW-2
TOWN CREEK
N-1
NE-1
LM-2
NW-2
NNW-1
NNE-1
ENE-1
NW-1
WNW-1
E-1
W-1
WSW-1
SSE-1
TENNESSEE RIVER
LM-1
SW-1
SSW-1
S-1
N
SOIL
VEGETATION
TLD STATIONS
WELLS
PLANT BOUNDARY
ROADS
MET. TOWER
Scale Feet
9-77

Figure 4

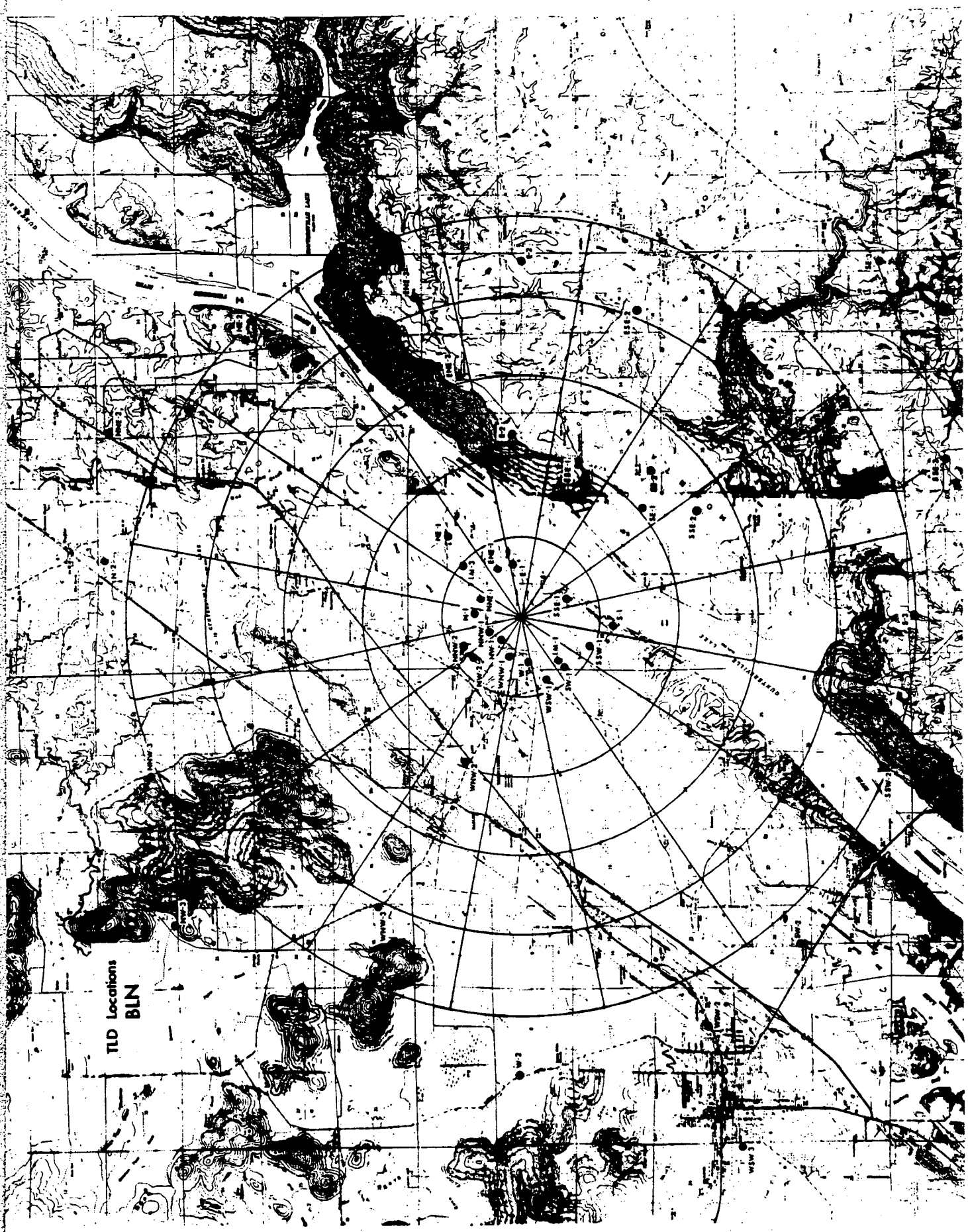


Figure 5

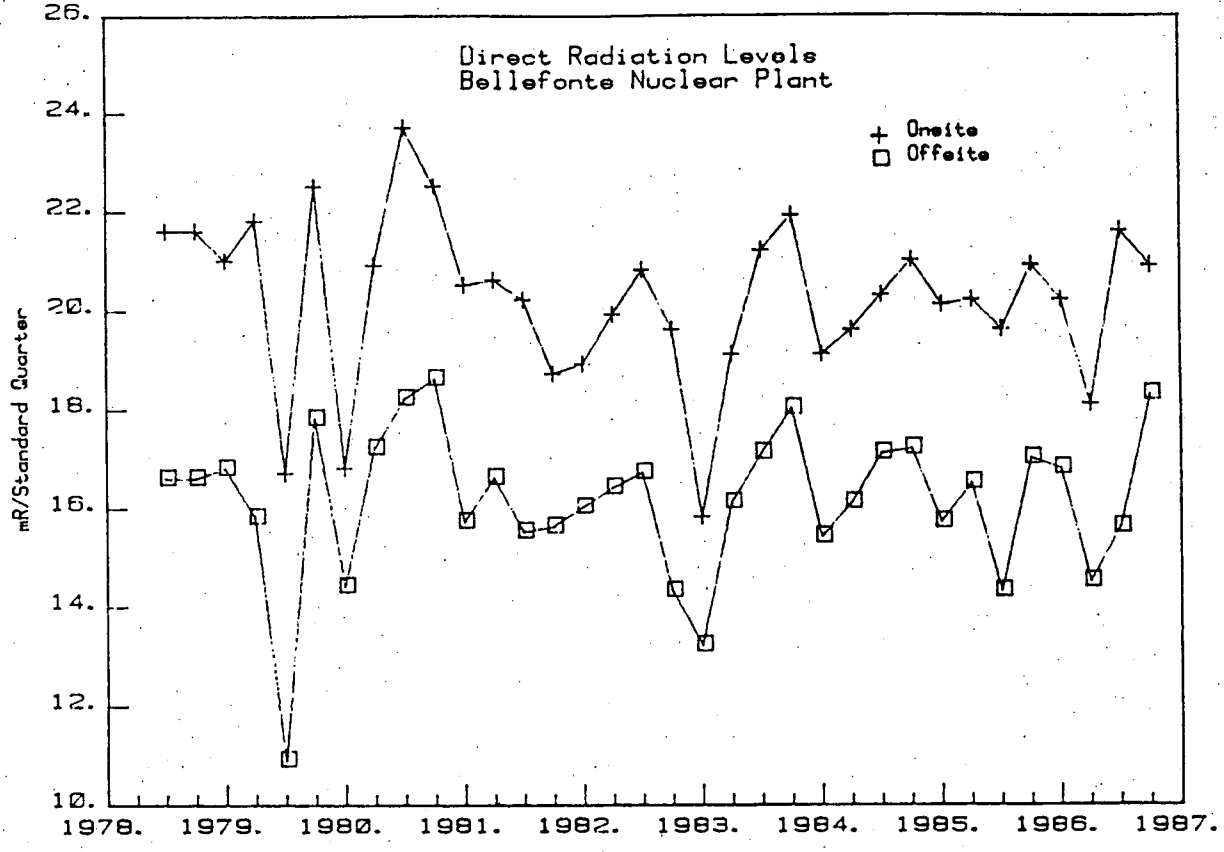
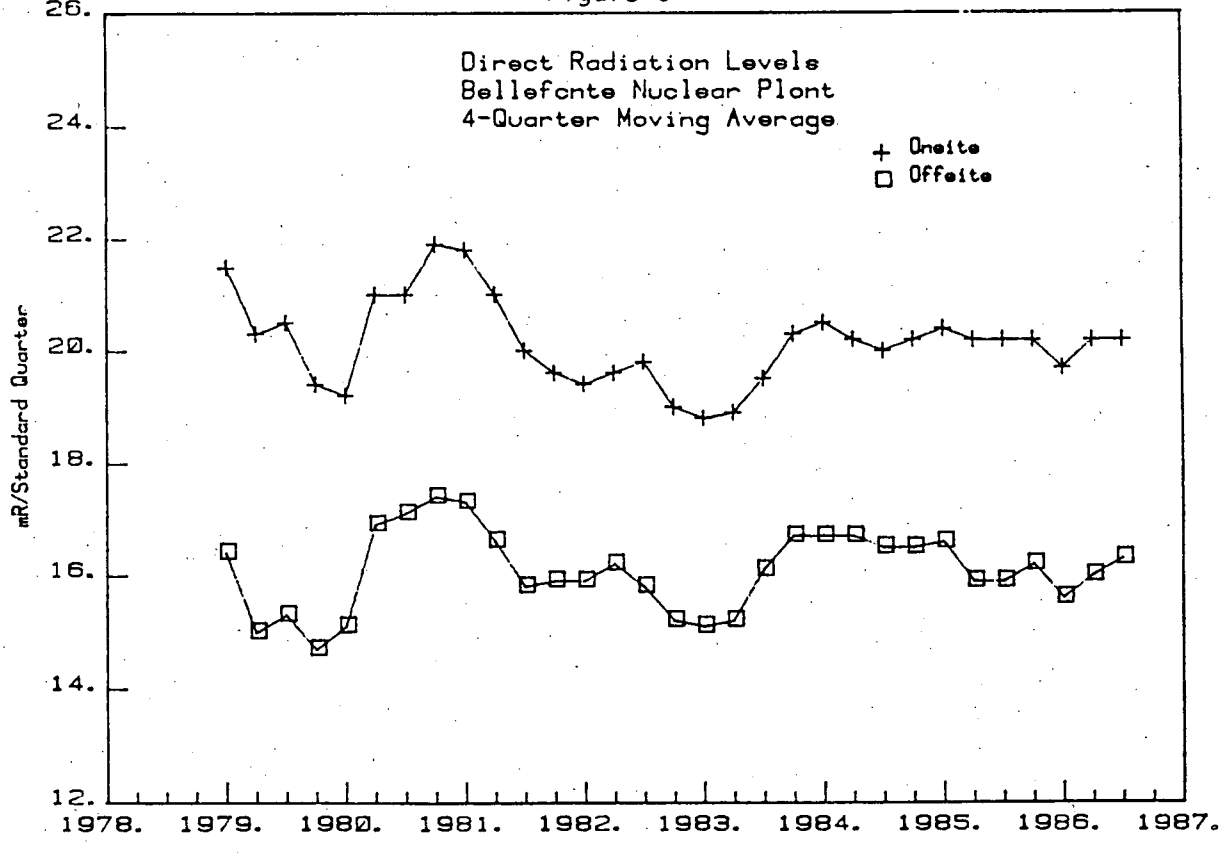


Figure 6



Quality Control

A quality control program has been established with the Alabama 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 BLN has not achieved criticality, there has been no contribution of radioactivity to the environment from the operation of the plant. 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 region.