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ENVIRONMENTAL RADIOACTIVITY LEVELS
BROWNS FERRY NUCLEAR PLANT

January-June 1975

DECEMBER 1975

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JANUARY-JUNE 1975

Introduction

The Browns Ferry Nuclear Plant (BFNP), operated by the Tennessee Valley Authority, is located on a site owned by TVA containing 840 acres of land in Limestone County, Alabama, bounded on the west and south by Wheeler Reservoir (see figure 1). The site is 10 miles southwest of Athens, Alabama, and 10 miles northwest of Decatur, Alabama. The plant, when completed, will consist of three boiling water reactors; each unit is rated at 3,293 MWt and 1,098 MWe. Unit 1 achieved criticality on August 17, 1973, and began commercial operation on August 1, 1974. Unit 2 began commercial operation on March 1, 1975. However, neither unit has operated since March 22, 1975, when a fire in the cable trays necessitated the shutdown of both reactors.

The preoperational environmental monitoring program established a baseline of data on the distribution of natural and manmade radioactivity in the environment near the plant site. However, seasonal, yearly, and random variations in the data were observed. In order to determine the potential increases in environmental radioactivity levels caused by the plant, comparisons were made between data for indicator stations (those near the plant) and control stations (those remote from the plant).

Field staffs in the Division of Environmental Planning and the Division of Forestry, Fisheries, and Wildlife Development carried out the sampling program outlined in tables 1 and 14. Sampling locations are shown in figures 2 and 4. All the radiochemical and instrumental analyses were conducted in a central laboratory at Muscle Shoals, Alabama. Alpha and beta analyses were performed on Beckman Low Beta II and Beckman Wide Beta II low background proportional counters. Two Nuclear Data Model 2200 multichannel analyzer systems were used to analyze the samples for specific gamma-emitting radionuclides. Data were coded and punched on IBM cards or automatically printed on paper tape for computer processing specific to the analysis conducted. An IBM 370 Model 165 computer, employing an Alpha-M least squares code, was used to solve multimatrix problems associated with estimating the activities of the gamma-emitting nuclides.

A primary difficulty in sample analysis was the detection of very low radionuclide concentrations. The minimum sensitivities are those concentrations where the percent counting error is 100%, calculated assuming a 3-sigma counting error, when standard sample sizes and counting time are employed. The minimum sensitivities are therefore those concentration values below which it is impossible to state, at the 99 percent confidence level, that any amount of radioactivity above background exists in the sample. The sensitivities, based wholly on counting statistics, are listed for gross alpha, gross beta, and tritium analyses.

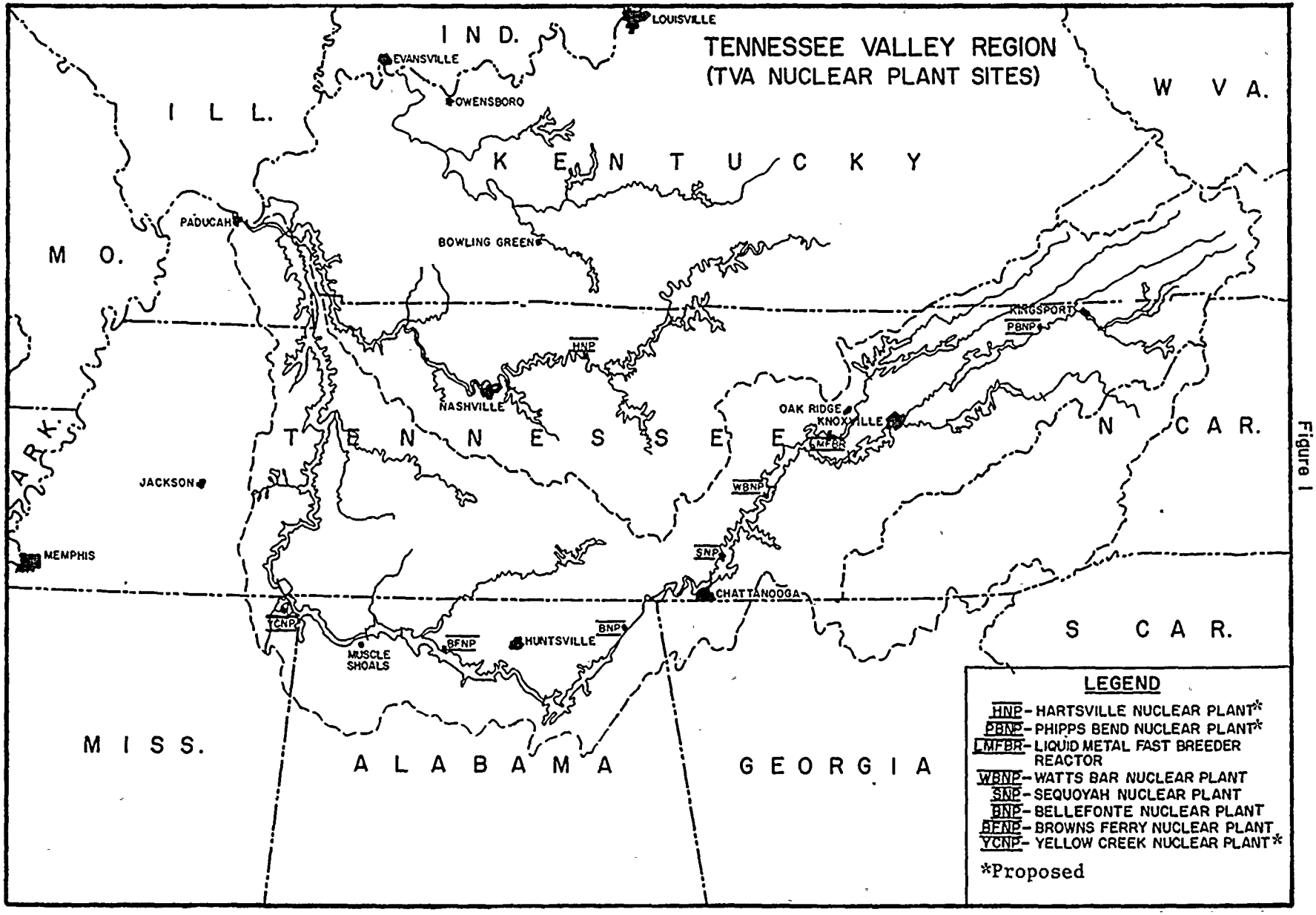

TENNESSEE VALLEY REGION
(TVA NUCLEAR PLANT SITES)
LOUISVILLE
IND.
EVANSVILLE
OWENSBORO
ILL.
W VA.
KENTUCKY
PADUCAH
BOWLING GREEN
MO.
KINGSPORT
PBNP
HNP
NASHVILLE
OAK RIDGE
KNOXVILLE
LMFBR
TENNESSEE
N CAR.
ARK.
JACKSON
WBNP
SNP
MEMPHIS
CHATTANOOGA
YCNP
BFNP
HUNTSVILLE
BNP
S CAR.
MUSCLE SHOALS
MISS.
ALABAMA
GEORGIA
LEGEND
HNP- HARTSVILLE NUCLEAR PLANT*
PBNP- PHIPPS BEND NUCLEAR PLANT*
LMFBR- LIQUID METAL FAST BREEDER REACTOR
WBNP- WATTS BAR NUCLEAR PLANT
SNP- SEQUOYAH NUCLEAR PLANT
BNP- BELLEFONTE NUCLEAR PLANT
BFNP- BROWNS FERRY NUCLEAR PLANT
YCNP- YELLOW CREEK NUCLEAR PLANT*
*Proposed

Figure 1

Standard sensitivities are not listed for specific gamma-emitting radionuclides determined by the Alpha-M program because they are not available. Since the minimum sensitivities are not defined, some concentrations reported may not represent actual concentrations. They may be mathematical artifacts of the Alpha-M program. Concentrations with errors (estimated by the Alpha-M program) larger than the reported concentrations are listed as "not detectable" (ND). The errors reported define the statistical distributions of the errors estimated by the Alpha-M least squares program.

Table 1

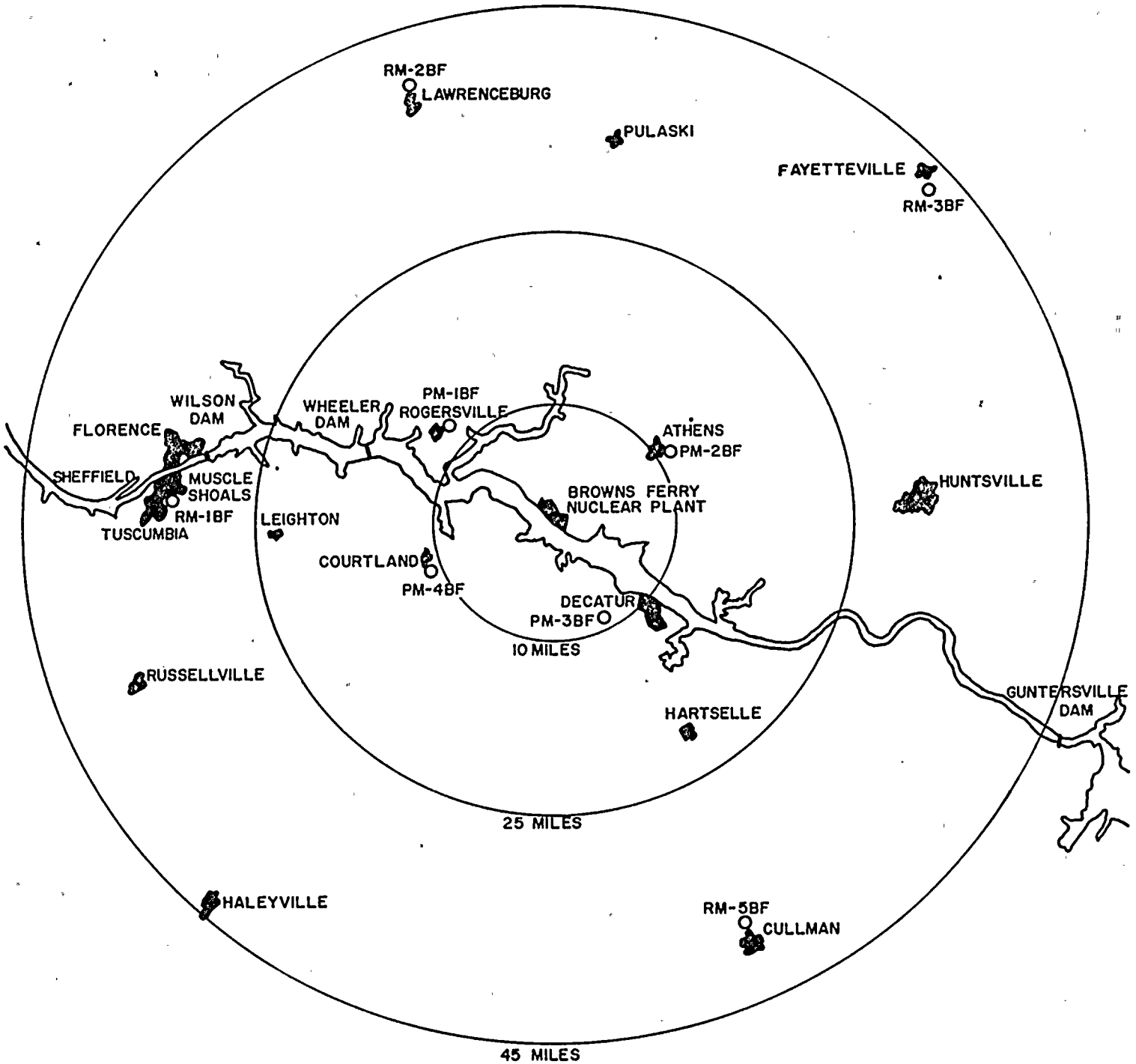
ENVIRONMENTAL RADIOACTIVITY SAMPLING SCHEDULE

Station Location	Air Filter	Charcoal Filter	Rain-water	Heavy Particle Fallout	Soil	Vegetation	Milk	River Water	Well Water	Public Water	Aquatic Life and Sediment
Muscle Shoals	W	W	M	M	Q	Q				M	
Lawrenceburg	W	W	M	M	Q	Q					
Fayetteville	W	W	M	M	Q	Q					
Cullman	W	W	M	M	Q	Q					
Rogersville	W	W	M	M	Q	Q					
Athens	W	W	M	M	Q	Q				Q	
Decatur	W	W	M	M	Q	Q				M	
Courtland	W	W	M	M	Q	Q				Q	
Site NW-1	W	W	M	M	Q	Q					
Site N-2	W	W	M	M	Q	Q					
Site NE-3	W	W	M	M	Q	Q					
Site NW-4	W	W	M	M	Q	Q					
Farm B						M	W		M		
Farm Bi						M	W		M		
Farm H						M	W		M		
Farm T						M	W		M		
Farm L						M	W		M		
Farm G (Control)						M	W		M		
Wheeler Dam										M	
Elk River								M			
Wheeler Reservoir								M			Q
Champion Paper Co.										M	
Wilson Dam										Q	
Colbert Steam Plant										Q	
Clements School										Q	
Town Creek										Q	
Trinity										Q	

W - Weekly M - Monthly Q - Quarterly

Figure 2

ATMOSPHERIC AND TERRESTRIAL MONITORING NETWORK



O – ENVIRONMENTAL MONITORING STATION

NOTE: THE FOLLOWING SAMPLES ARE COLLECTED FROM EACH STATION:

AIR PARTICULATES	RAINWATER
RADIOIODINE	SOIL
HEAVY PARTICLE FALLOUT	VEGETATION

ATMOSPHERIC MONITORING

The atmospheric monitoring network is divided into three groups. Three local air monitors are located on the plant site in the quadrants of greatest wind frequency. One additional station is located at the point of maximum predicted offsite concentration of radionuclides. Four perimeter air monitors are located at distances out to 10 miles from the plant, and four remote air monitors are located at distances out to 45 miles. These monitoring stations are shown in figure 2. The remote monitors are used as control or baseline stations. At each monitor, air is continuously pulled through a Hollingsworth and Voss HV-70 particulate filter at a regulated flow of 3 ft^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 obtain rainwater on a continuous basis and a horizontal platform that is covered with gummed acetate to catch and hold heavy particle fallout. Thermoluminescent dosimeters are used to record gamma radiation levels at each remote and perimeter station.

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 and radiotelemetered into the plant. These stations will detect any significant airborne release from BFNP.

Air filters are collected weekly and analyzed for gross beta activity. No analyses are performed until 3 days after sample collection. The monthly results are combined for each station to obtain a semiannual average. The average semiannual concentrations for the stations in each group of monitors (local, perimeter, and remote) are combined to yield a semiannual average for each group. These data are presented in table 2.

With reference to table 3, which contains the maximum permissible concentrations (MPC) recommended by 10 CFR 20 for nonoccupational exposure, it is seen that the maximum beta concentration is 0.20 percent MPC.

Rainwater is collected and analyzed for gross beta activity, specific gamma-emitting isotopes, and radiostrontium. 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 and the results averaged by group location as was done with the air filter data. The strontium isotopes are separated chemically and counted in a low background system. The results are shown in table 4. The highest value reported for beta activity is 0.53 percent MPC for drinking water.

The gummed acetate that is used to collect heavy particle fallout is changed monthly. The sample is ashed and counted for gross beta activity. The results are given in table 5.

Charcoal filters are collected and analyzed for radioiodine. The filter is counted in a single channel analyzer system. The data are shown in table 6, where the highest value reported is 0.06 percent MPC for ^{131}I.

Table 2

RADIOACTIVITY IN AIR

pCi/meter^3

Location	No. of Samples	Nonvolatile Beta* Max.	Min.	Avg.	Specific Radionuclides in Composite Samples (Average)	
Local						
Northwest	26	0.186	0.047	0.086	^{141,144}Ce	.021 ± .004
					^{51}Cr	ND
LM-4BF	26	0.173	0.054	0.092	^{131}I	ND
					^{103,106}Ru	.013 ± .006
North	26	0.197	0.049	0.086	^{134}Cs	ND
					^{137}Cs	.003 ± .001
Northwest	26	0.172	0.045	0.082	^{95}Zr-^{95}Nb	.017 ± .002
					^{58}Co	ND
		Average:		0.086	^{54}Mn	ND
					^{65}Zn	ND
					^{60}Co	ND
					^{140}Ba-^{140}La	.015 ± .003
					^{90}Sr	.002 ± .0001
					^{89}Sr	.003 ± .0001
Perimeter						
Rogersville, AL	26	0.171	0.037	0.080	^{141,144}Ce	.024 ± .004
					^{51}Cr	ND
Athens, AL	26	0.199	0.046	0.087	^{131}I	.001 ± .0005
					^{103,106}Ru	.008 ± .005
Decatur, AL	26	0.170	0.042	0.085	^{134}Cs	ND
					^{137}Cs	.003 ± .002
Courtland, AL	26	0.184	0.042	0.085	^{95}Zr-^{95}Nb	.017 ± .002
					^{58}Co	ND
		Average:		0.084	^{54}Mn	ND
					^{65}Zn	ND
					^{60}Co	ND
					^{140}Ba-^{140}La	.016 ± .003
					^{90}Sr	.001 ± .0001
					^{89}Sr	ND

*Sensitivity 0.004
ND - Not detectable

Table 2 (Continued)

Location	No. of Samples	Nonvolatile Beta* Max.	Min.	Avg.	Specific Radionuclides in Composite Samples (Average)	
Remote						
Muscle Shoals, AL	26	0.132	0.040	0.076	^{141,144}Ce	.016 ± .005
					^{51}Cr	ND
Lawrenceburg, TN	26	0.175	0.052	0.091	^{131}I	ND
					^{103,106}Ru	.012 ± .005
Fayetteville, TN	26	0.161	0.054	0.093	^{134}Cs	ND
					^{137}Cs	.003 ± .002
Cullman, AL	26	0.156	0.049	0.088	^{95}Zr-^{95}Nb	.017 ± .002
					^{58}Co	ND
		Average:		0.087	^{54}Mn	ND
					^{65}Zn	.002 ± .0003
					^{60}Co	ND
					^{140}Ba-^{140}La	.015 ± .003
					^{90}Sr	.001 ± .0001
					^{89}Sr	.003 ± .0001

*Sensitivity 0.004
ND - Not detectable

Table 3

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

Table 4

RAIN

pCi/liter

Location	No. of Samples	Nonvolatile Beta* Max.	Min.	Avg.	Specific Radionuclides (Average)	
Local						
Northwest	6	7.33	3.69	5.41	^{141,144}Ce	1.6 ± 0.6
					^{51}Cr	ND
LM-4BF	6	14.10	2.20	6.04	^{131}I	ND
					^{103,106}Ru	0.9 ± 0.4
North	6	16.04	2.92	7.11	^{134}Cs	0.4 ± 0.2
					^{137}Cs	0.7 ± 0.2
Northeast	6	8.84	2.68	5.20	^{95}Zr-^{95}Nb	0.6 ± 0.3
					^{58}Co	0.2 ± 0.1
		Average:		5.94	^{54}Mn	0.6 ± 0.3
					^{65}Zn	0.9 ± 0.6
					^{60}Co	3.5 ± 0.3
					^{140}Ba-^{140}La	3.3 ± 0.3
					^{90}Sr	0.6 ± 0.1
					^{89}Sr	1.3 ± 0.1
					^{3}H**	ND
Perimeter						
Rogersville, AL	6	7.33	2.92	4.54	^{141,144}Ce	0.6 ± 0.4
					^{51}Cr	ND
Athens, AL	6	6.42	2.48	4.63	^{131}I	ND
					^{103,106}Ru	ND
Decatur, AL	6	6.18	ND	3.57	^{134}Cs	0.5 ± 0.2
					^{137}Cs	0.5 ± 0.2
Courtland, AL	6	11.19	2.14	5.72	^{95}Zr-^{95}Nb	1.2 ± 0.3
					^{58}Co	0.1 ± 0.1
		Average:		4.62	^{54}Mn	0.5 ± 0.3
					^{65}Zn	0.9 ± 0.4
					^{60}Co	4.0 ± 0.4
					^{140}Ba-^{140}La	3.6 ± 0.5
					^{90}Sr	0.6 ± 0.1
					^{89}Sr	1.2 ± 0.1
					^{3}H	ND

*Sensitivity 1.6
**Sensitivity 400
ND - Not detectable

Table 4 (Continued)

Location	No. of Samples	Nonvolatile Beta* Max.	Min.	Avg.	Specific Radionuclides (Average)	
Remote						
Muscle Shoals, AL	6	7.69	3.93	6.11	^{141,144}Ce	1.7 ± 0.8
					^{51}Cr	ND
Lawrenceburg, TN	6	12.23	4.55	6.84	^{131}I	ND
					^{103,106}Ru	ND
Fayetteville, TN	6	8.01	3.00	4.95	^{134}Cs	0.4 ± 0.2
					^{137}Cs	0.9 ± 0.4
Cullman, AL	6	8.90	3.77	5.94	^{95}Zr-^{95} Nb	1.4 ± 0.4
					^{58}Co	ND
		Average:		5.96	^{54}Mn	0.8 ± 0.5
					^{65}Zn	2.5 ± 0.7
					^{60}Co	4.1 ± 0.4
					^{140}Ba-^{140}La	4.1 ± 0.3
					^{90}Sr	0.6 ± 0.1
					^{89}Sr	1.2 ± 0.1
					^{3}H**	ND

*Sensitivity 1.6
**Sensitivity 400
ND - Not detectable

Table 5

TOTAL FALLOUT DEPOSITED

mCi/kilometer^2

Location	No. of Samples	Nonvolatile Beta* Max.	Min.	Avg.
Local				
Northwest	6	0.86	0.30	0.58
LM-4BF	6	1.00	0.32	0.59
North	6	0.74	0.26	0.47
Northeast	6	0.83	0.28	0.57
		Average:		0.55
Perimeter				
Rogersville, AL	6	1.09	0.23	0.58
Athens, AL	6	1.08	0.33	0.65
Decatur, AL	6	0.91	0.30	0.54
Courtland, AL	6	1.01	0.26	0.64
		Average:		0.60
Remote				
Muscle Shoals, AL	6	1.17	0.35	0.63
Lawrenceburg, TN	6	0.89	0.22	0.54
Feyetteville, TN	6	0.60	0.20	0.38
Cullman, AL	6	0.86	0.28	0.54
		Average:		0.52

*Sensitivity 0.01

Table 6

CHARCOAL FILTERS

pCi/meter^3

Location	No. of Samples	Radioiodine* Max.	Min.	Avg.
Local				
Northwest	26	0.025	ND	ND
LM-4BF	26	ND	ND	ND
North	26	0.034	ND	ND
Northeast	26	0.035	ND	ND
		Average:		ND
Permieter				
Rogersville, AL	26	0.055	ND	ND
Athens; AL	26	0.030	ND	ND
Decatur, AL	26	ND	ND	ND
Courtland, AL	26	0.048	ND	ND
		Average:		ND
Remote				
Muscle Shoals, AL	26	ND	ND	ND
Lawrenceburg, TN	26	0.022	ND	ND
Fayetteville, TN	26	0.022	ND	ND
Cullman, AL	26	0.042	ND	ND
		Average:		ND

*Sensitivity 0.022
ND - Not detectable

Terrestrial Monitoring

Milk

Milk is collected from five farms within a 10-mile radius of the plant, and from one farm approximately 20 miles from the plant (see figure 3). Raw milk is analyzed weekly for ^{131}I, and monthly for gamma-emitting isotopes and for radiostrontium. The average results for each farm are shown in table 7. So that any relationship between fallout on pastureland and the presence of radionuclides in milk might be seen, pasturage is also sampled at the six farms.

A cow census was completed in June 1975. It was determined that there are no dairy farms nearer the plant than the nearest farm being sampled.

Vegetation

In addition to the pasturage samples mentioned previously, vegetation samples are collected near each monitoring station in the network to determine possible plant uptake of radioactive materials from the soil or from foliar deposition. Table 8 gives the results obtained from the laboratory analyses. The data for the specific radionuclide analysis of vegetation are averaged for the four principal locations--local, perimeter, remote-control, and farm.

Soil

Soil samples are collected near each monitoring station in order that any relationship between the amount of radioactive material found in vegetation and that in soil might be established. The averages for specific analyses are obtained in the same fashion as those for vegetation. The results are given in table 9.

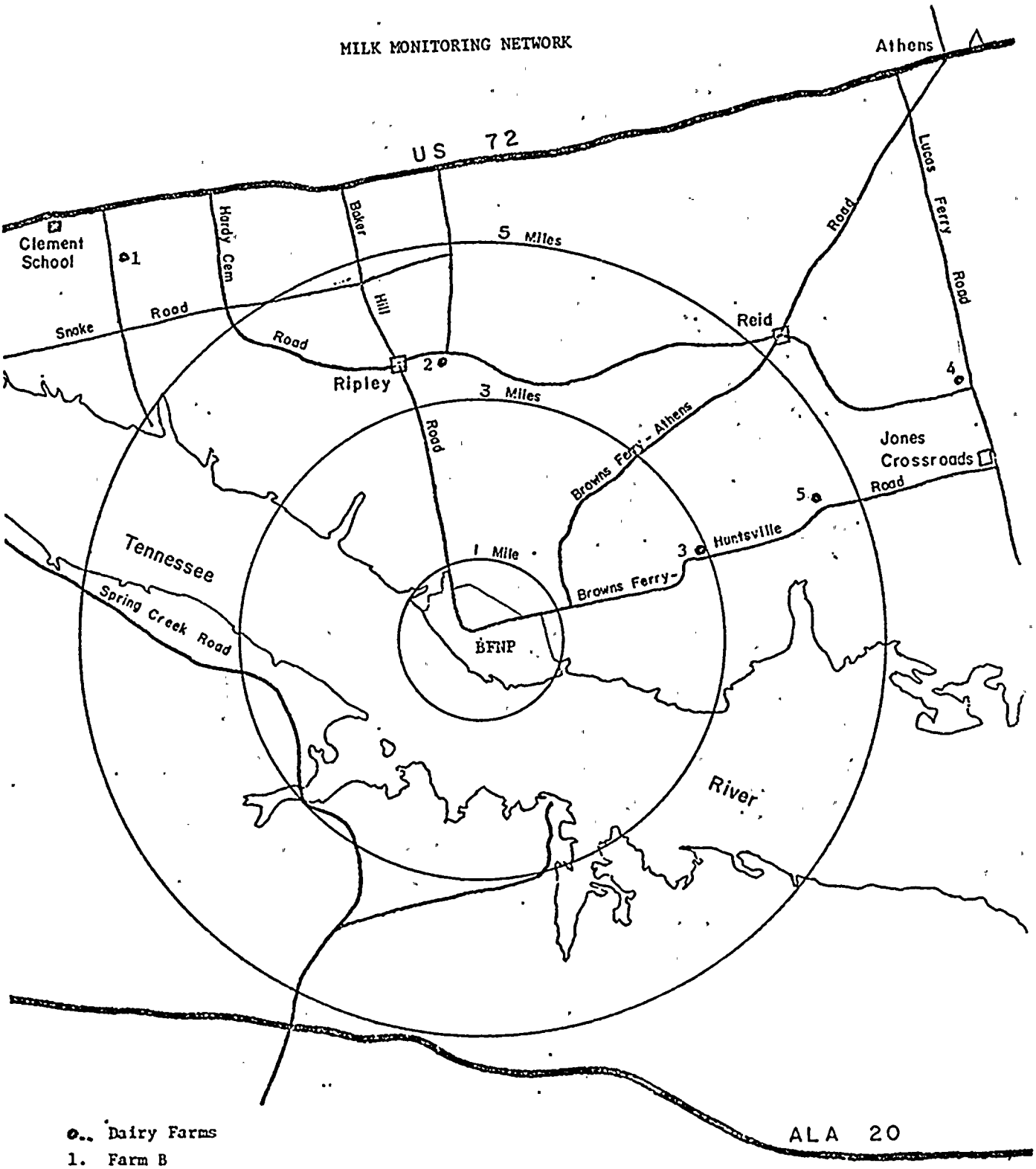
Water

Domestic water supplies, obtained from surface streams and wells, are sampled and analyzed. Well water is obtained from seven private supplies within a 10-mile radius of the plant and from a number of wells on the plant site. The results of analyses of well water are shown in table 10 and indicate that the maximum beta concentration is 0.36 percent MPC. Table 11 indicates the results of samples taken from public water supplies. The maximum beta concentration is 0.14 percent MPC. The specific isotopic concentrations reported are averages for each station for the semiannual period.

Environmental Gamma Radiation Levels

Thermoluminescent dosimeters (TLD's) are placed at nine stations around the plant near the plant boundary and at the perimeter and remote air monitors to determine the gamma exposure rates at these locations. The TLD's are changed every 3 months. The quarterly gamma radiation levels determined from these TLD's are given in table 12.

Figure 3



- Dairy Farms
1. Farm B
2. Farm H
3. Farm L
4. Farm T
5. Farm Bi
6. Farm G (approximately 20 miles west of the plant)

Scale: 1" = 1.5 miles

Poultry and Food Crops

Poultry and food crops raised in the vicinity of Browns Ferry Nuclear Plant are sampled as they become available during the growing season. During this sampling period samples of corn, peaches, green beans, tomatoes, potatoes, and chicken were collected and analyzed for gross beta, specific gamma-emitting radionuclides, ^{89}Sr, and ^{90}Sr. The results are given in table 13.

Table 7

MILK

pCi/liter

Location	No. of Samples	^{131}I* Max.	^{131}I* Min.	^{131}I* Avg.	^{137}Cs	^{40}K	^{140}Ba-^{140}La	^{90}Sr	^{89}Sr
Raw Milk									
Farm G (Control)	9 (3)**	ND	ND	ND	3.4	1100.3	2.0	5.3	1.8
Farm B	25 (6)	ND	ND	ND	6.6	1349.7	0.1	9.2	0.4
Farm Bi	25 (6)	ND	ND	ND	2.5	1243.5	ND	5.5	1.3
Farm H	25 (6)	ND	ND	ND	2.5	1275.3	0.2	4.4	1.2
Farm L	25 (6)	ND	ND	ND	1.9	1263.8	ND	6.3	0.6
Farm T	25 (6)	ND	ND	ND	5.2	1299.3	ND	5.2	0.8
Average: (Farms B, Bi, H, L, T)				ND	3.7	1286.3	0.1	6.1	0.9

*Chemical separation of iodine: Sensitivity for ^{131}I--0.5 pCi/l at time of sample collection.
**^{131}I analysis weekly: (gamma scan and ^{89}Sr, ^{90}Sr analyses monthly.)
ND - Not detectable

Table 8

VEGETATION

pCi/gm (Dry Weight)

Location	No. of Samples	Alpha*	Nonvolatile Beta**	Specific Radionuclides (Average)	
Local					
Northwest	2	ND	12.7	^{141,144}Ce	0.9 ± 0.1
				^{51}Cr	0.1 ± 0.1
LM-4BF	2	ND	11.0	^{131}I	0.1 ± 0.01
				^{103,106}Ru	1.2 ± 0.1
North	2	ND	11.8	^{134}Cs	ND
				^{137}Cs	0.2 ± 0.04
Northeast	2	ND	17.0	^{95}Zr-^{95}Nb	0.7 ± 0.04
				^{58}Co	0.1 ± 0.03
	Average:	ND	13.1	^{54}Mn	ND
				^{65}Zn	ND
				^{60}Co	ND
				^{140}Ba-^{140}La	0.4 ± 0.03
				^{90}Sr	0.4 ± 0.01
				^{89}Sr	ND
Perimeter					
Rogersville, AL	2	ND	11.7	^{141,144}Ce	0.7 ± 0.1
				^{51}Cr	ND
Athens, AL	2	ND	13.8	^{131}I	ND
				^{103,106}Ru	1.0 ± 0.1
Decatur, AL	2	ND	11.7	^{134}Cs	ND
				^{137}Cs	0.2 ± 0.03
Courtland, AL	2	ND	13.6	^{95}Zr-^{95}Nb	0.5 ± 0.03
				^{58}Co	ND
	Average:	ND	12.7	^{54}Mn	ND
				^{65}Zn	ND
				^{60}Co	ND
				^{140}Ba-^{140}La	0.4 ± 0.02
				^{90}Sr	0.5 ± 0.01
				^{89}Sr	ND

*Sensitivity 0.1
**Sensitivity 0.1
ND - Not detectable

Table 8 (Continued)

Location	No. of Samples	Alpha*	Nonvolatile Beta**	Specific Radionuclides (Average)	
Remote and Control					
Muscle Shoals, AL	2	ND	15.9	^{141,144}Ce	1.3 ± 0.1
				^{51}Cr	0.2 ± 0.1
Lawrenceburg, TN	2	ND	8.6	^{131}I	ND
				^{103,106}Ru	1.0 ± 0.1
Fayetteville, TN	2	ND	16.3	^{134}Cs	ND
				^{137}Cs	0.3 ± 0.04
Cullman, AL	2	ND	20.3	^{95}Zr-^{95}Nb	1.0 ± 0.04
				^{58}Co	ND
Farm G	2	NA	22.1	^{54}Mn	ND
				^{65}Zn	ND
	Average:	ND	16.6	^{60}Co	ND
				^{140}Ba-^{140}La	0.4 ± 0.02
				^{90}Sr	0.9 ± 0.01
				^{89}Sr	0.2 ± 0.01

Farms		Nonvolatile Beta Max.	Min.	Avg.		
Farm Bi	6	26.9	12.3	20.2	^{141,144}Ce	0.9 ± 0.1
					^{51}Cr	0.3 ± 0.1
Farm B	6	19.2	12.2	15.4	^{131}I	ND
					^{103,106}Ru	1.0 ± 0.1
Farm H	6	30.8	13.0	19.9	^{134}Cs	ND
					^{137}Cs	0.2 ± 0.02
Farm L	6	25.8	9.9	17.7	^{95}Zr-^{95}Nb	0.8 ± 0.02
					^{58}Co	ND
Farm T	6	28.1	12.7	18.0	^{54}Mn	ND
					^{65}Zn	ND
		Average:		18.2	^{60}Co	ND
					^{140}Ba-^{140}La	0.4 ± 0.03
					^{90}Sr	0.5 ± 0.01
					^{89}Sr	0.1 ± 0.01

*Sensitivity 0.1
**Sensitivity 0.1
ND - Not detectable
NA - Not analyzed

Table 9

SOIL

pCi/gm (Dry Weight)

Location	No. of Samples	Nonvolatile Beta*	Specific Radionuclides (Average)	
Local				
Northwest	2	5.18	^{141,144}Ce	0.6 ± 0.1
			^{51}Cr	ND
LM-4BF	2	5.36	^{131}I	ND
			^{103,106}Ru	0.4 ± 0.1
North	2	4.58	^{134}Cs	ND
			^{137}Cs	0.8 ± 0.1
Northeast	2	4.48	^{95}Zr-^{95}Nb	0.2 ± 0.03
			^{58}Co	ND
		Average: 4.90	^{54}Mn	0.1 ± 0.05
			^{65}Zn	ND
			^{60}Co	ND
			^{140}Ba-^{140}La	0.2 ± 0.03
Perimeter				
Rogersville, AL	2	5.04	^{141,144}Ce	0.5 ± 0.1
			^{51}Cr	ND
Athens, AL	2	4.52	^{131}I	ND
			^{103,106}Ru	0.4 ± 0.1
Decatur, AL	2	4.37	^{134}Cs	ND
			^{137}Cs	1.3 ± 0.1
Courtland, AL	2	2.46	^{95}Zr-^{95}Nb	0.2 ± 0.03
			^{58}Co	ND
		Average: 4.10	^{54}Mn	ND
			^{65}Zn	ND
			^{60}Co	ND
			^{140}Ba-^{140}La	0.1 ± 0.02
Remote				
Muscle Shoals, AL	2	4.60	^{141,144}Ce	0.6 ± 0.1
			^{51}Cr	ND
Lawrenceburg, TN	2	4.66	^{131}I	ND
			^{103,106}Ru	0.6 ± 0.1
Fayetteville, TN	2	3.56	^{134}Cs	ND
			^{137}Cs	2.7 ± 0.1
Cullman, AL	2	3.39	^{95}Zr-^{95}Nb	0.2 ± 0.03
			^{58}Co	ND
		Average: 4.05	^{54}Mn	ND
			^{65}Zn	ND
			^{60}Co	ND
			^{140}Ba-^{140}La	0.1 ± 0.02

*Sensitivity 0.15
ND - Not detectable

Table 10

PRIVATE WELL WATER

pCi/liter

Location	No. of Samples	Nonvolatile Beta*			Specific Radionuclides											
		Max.	Min.	Avg.	^{141}Ce-^{144}Ce	^{51}Cr	^{131}I	^{103}Ru,^{106}Ru	^{134}Cs	^{137}Cs	^{95}Zr-^{95}Nb	^{58}Co	^{54}Mn	^{65}Zn	^{60}Co	^{140}Ba-^{140}La
Farm G Control	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.5±2.2	7.1±1.2
Farm B	6	2.5	ND	ND	ND	ND	0.4±0.3	ND	ND	ND	0.7±0.6	ND	0.3±0.2	1.4±1.2	8.0±1.1	4.2±0.7
Barn 3[illegible]	6	10.7	4.2	5.9	ND	ND	ND	ND	ND	0.9±0.5	0.6±0.6	ND	1.2±0.3	ND	6.3±0.7	4.2±0.5
Farm H	6	3.1	1.7	2.3	2.2±1.9	ND	1.0±0.4	ND	ND	1.2±0.6	1.3±0.8	ND	ND	2.2±1.4	5.5±0.7	4.0±0.8
Farm L	6	ND	ND	ND	ND	ND	0.6±0.4	ND	1.4±0.4	0.6±0.3	0.4±0.4	ND	ND	2.3±1.2	6.3±0.7	2.0±0.6
Farm T	6	2.7	ND	ND	ND	ND	ND	ND	ND	0.5±0.4	1.8±0.5	ND	1.2±0.9	1.2±1.1	3.7±0.6	3.4±0.5
Residence BT	6	4.6	ND	ND	ND	ND	ND	ND	ND	1.3±0.4	ND	ND	ND	ND	4.0±0.7	4.0±0.5
Residence BK	6	1.7	ND	ND	1.7±1.4	ND	ND	ND	ND	0.8±0.5	1.1±0.7	ND	ND	1.5±0.9	5.6±0.7	2.7±0.6
BFNP - 1	6	ND	ND	ND	ND	ND	ND	ND	0.6±0.4	ND	0.8±0.6	ND	ND	ND	5.7±0.8	4.1±0.7
BFNP - 2	6	2.9	ND	ND	ND	ND	ND	ND	1.6±0.6	ND	ND	ND	ND	1.9±1.3	6.5±0.8	5.1±0.7
BFNP - 3	6	2.7	ND	ND	ND	ND	ND	2.0±1.9	0.8±0.2	ND	1.2±0.6	ND	ND	1.9±1.0	4.3±0.8	4.0±0.6
BFNP - 4	6	3.8	ND	2.1	1.8±1.2	ND	ND	ND	0.8±0.5	1.2±0.6	0.9±0.4	ND	1.1±0.9	1.3±0.3	5.9±0.8	4.9±0.6
BFNP - 5	6	ND	ND	ND	ND	ND	1.6±0.6	ND	2.1±0.5	ND	ND	ND	ND	ND	7.5±0.8	3.0±0.8
BFNP - 6	4	5.9	ND	2.9	ND	ND	ND	ND	ND	0.7±0.4	ND	ND	1.9±0.6	ND	2.8±0.6	1.7±0.5
BFNP - 7	6	ND	ND	ND	ND	ND	ND	ND	0.7 0.4	ND	1.4±0.7	ND	1.2±0.9	0.9±0.6	6.3±0.7	3.2±0.5
		Average:		ND	0.4±0.2	ND	0.2±0.1	0.1±0.1	0.5±0.1	0.5±0.1	0.7±0.1	ND	0.5±0.1	1.0±0.2	5.6±0.2	3.8±0.2

*Sensitivity 1.6
ND - Not detectable

Table 11

PUBLIC WATER

pCi/liter

Location	No. of Samples	Nonvolatile beta*			Specific Radionuclides													
		Max.	Min.	Avg.	$^{141,144}Ce$	^{51}Cr	^{131}I	$^{103,106}Ru$	^{134}Cs	^{137}Cs	^{95}Zr-^{95}Nb	^{58}Co	^{54}Mn	^{65}Zn	^{60}Co	^{140}Ba-^{140}La	^{3}H**
Wilson Dam	2	1.9	ND	ND	ND	ND	ND	ND	ND	ND	2.1±0.6	ND	ND	ND	3.9±1.1	4.3±0.9	ND
Colbert SP	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.7±0.4	ND	4.0±1.1	3.0±0.7	0.8±0.4	ND
Clements School	2	ND	ND	ND	ND	3.1±0.9	ND	ND	ND	ND	ND	ND	ND	ND	3.0±0.9	0.9±0.6	ND
Athens	2	3.4	1.9	2.6	ND	ND	ND	ND	ND	1.5±0.7	ND	0.3±0.1	ND	ND	2.5±0.3	ND	ND
Courtland	2	1.9	1.6	1.8	ND	ND	1.6±0.9	ND	2.5±0.9	2.5±1.2	ND	ND	ND	ND	3.9±1.2	2.0±0.9	ND
Town Creek	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.6±1.0	3.5±0.9	ND
Trinity	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.1±1.0	1.7±0.6	ND
Decatur	6	4.1	ND	2.2	2.6±1.7	ND	0.8±0.3	ND	0.5±0.4	ND	ND	1.0±0.9	ND	3.0±1.6	5.0±1.2	3.4±0.6	ND
Sheffield (Muscle Shoals)	6	2.3	ND	1.8	2.3±1.3	ND	ND	ND	0.5±0.4	0.8±0.6	ND	ND	0.7±0.5	ND	4.3±0.9	5.6±0.8	ND
Wheeler Dam	6	2.2	ND	1.7	ND	ND	ND	ND	0.6±0.2	1.3±0.5	ND	ND	ND	1.4±1.2	4.5±0.7	2.9±0.5	408±55
Champion Paper Co.	6	2.6	ND	2.0	ND	ND	ND	ND	1.0±0.5	1.3±0.5	ND	ND	ND	1.7±1.2	3.4±0.8	5.4±0.7	416±55
	Weighted Average:			ND	0.8±0.2	0.1±0.1	0.2±0.1	ND	0.5±0.1	0.7±0.2	0.1±0.1	0.2±0.1	ND	1.2±0.2	4.2±0.3	3.4±0.2	ND

*Sensitivity 1.6
**Sensitivity 400
ND - Not detectable

Table 12

ENVIRONMENTAL GAMMA RADIATION LEVELS

Quarter	Location	Environmental Gamma Radiation Levels mR/Hour	mR/Quarter
January-March, 1975	On-Site (9)*		
	Maximum	0.018	39.9
	Minimum	0.012	26.3
	Average**	0.015±0.005	31.8±10.0
	Off-Site (8)		
	Maximum	0.015	31.8
	Minimum	0.010	21.6
	Average	0.012±0.003	26.4±7.4
April-June, 1975	On-Site (9)		
	Maximum	0.016	34.0
	Minimum	0.011	23.7
	Average	0.013±0.003	28.4±7.0
	Off-Site (8)		
	Maximum	0.015	33.1
	Minimum	0.009	20.0
	Average	0.012±0.004	26.2±8.4

*Number of stations (three TLD's at each station)
**All averages reported ±2σ

Table 13

POULTRY AND FOOD CROPS

pCi/Kg (wet weight)

	Corn		Green beans	
	Plant Area	Muscle Shoals	Plant Area	Muscle Shoals
Gross beta*	876.4	1735.7	1481.8	700.5
Specific Radionuclides				
$^{141,144}Ce$	ND	ND	ND	ND
^{51}Cr	ND	ND	ND	ND
^{131}I	ND	ND	ND	ND
$^{103,106}Ru$	ND	ND	ND	ND
^{134}Cs	ND	ND	ND	ND
^{137}Cs	ND	5.5±3.3	ND	ND
^{95}Zr-^{95}Nb	ND	ND	ND	ND
^{58}Co	ND	ND	ND	ND
^{54}Mn	ND	ND	ND	ND
^{65}Zn	ND	ND	ND	ND
^{60}Co	ND	11.5±3.8	9.9±3.6	ND
^{40}K	1622.0±69.0	1986.6±87.5	2211.1±91.1	1344.6±89.1
^{140}Ba-^{140}La	7.3±1.2	5.2±2.5	ND	6.9±1.9
^{90}Sr	ND	ND	46.8±4.8	54.8±3.0
^{89}Sr	ND	4.6±2.3	8.4±6.0	ND

*Sensitivity 0.1 (pCi/g, dry weight)
ND - Not detectable

Table 13 (Continued)

POULTRY AND FOOD CROPS

	pCi/Kg (wet weight)			
	Peaches		Potatoes	
	Plant Area	Muscle Shoals	Plant Area	Muscle Shoals
Gross beta*	532.0	923.3	1525.4	516.8
Specific Radionuclides				
$^{141,144}Ce$	ND	ND	ND	ND
^{51}Cr	ND	ND	ND	ND
^{131}I	ND	ND	ND	ND
$^{103,106}Ru$	ND	ND	ND	ND
^{134}Cs	5.3±1.9	ND	ND	ND
^{137}Cs	ND	ND	ND	ND
$^{95}Zr-^{95}Nb$	ND	ND	ND	ND
^{58}Co	ND	ND	ND	ND
^{54}Mn	ND	ND	ND	ND
^{65}Zn	ND	ND	ND	ND
^{60}Co	ND	4.5±3.8	7.9±5.0	ND
^{40}K	1511.7±63.3	1106.1±90.8	2406.6±112.8	2493.3±111.1
$^{140}Ba-^{140}La$	4.0±2.1	1.8±1.3	1.5±1.4	ND
^{90}Sr	15.1±1.6	12.3±3.1	5.6±1.9	3.9±1.3
^{89}Sr	ND	ND	ND	5.2±2.6

*Sensitivity 0.1 (pCi/g, dry weight)
ND - Not detectable

Table 13 (Continued)

POULTRY AND FOOD CROPS

	pCi/Kg (wet weight)	pCi/g (dry weight)	
	Tomatoes	Chicken	
	Muscle Shoals	Plant Area	Muscle Shoals
Gross beta*	769.9	3.35	3.33
Specific Radionuclides			
$^{141,144}Ce$	ND	ND	ND
^{51}Cr	ND	ND	0.2±0.1
^{131}I	ND	ND	ND
$^{103,106}Ru$	ND	ND	0.2±0.1
^{134}Cs	ND	ND	ND
^{137}Cs	ND	ND	ND
^{95}Zr-^{95}Nb	ND	ND	ND
^{58}Co	ND	ND	ND
^{54}Mn	ND	ND	ND
^{65}Zn	ND	ND	ND
^{60}Co	ND	ND	ND
^{40}K	1380.9±104.5	5.50±0.70	6.4±0.4
^{140}Ba-^{140}La	ND	ND	ND
^{90}Sr	9.9±1.4	ND	ND
^{89}Sr	ND	ND	ND

*Sensitivity 0.1 (pCi/g, dry weight)
ND - Not detectable

Reservoir Monitoring

Samples are collected quarterly along seven cross sections in Wheeler Reservoir--at Tennessee River miles 277.98, 283.94, 288.78, 291.76, 293.70, 295.87, and 307.52 as detailed in table 14. Samples collected for radiological analysis include plankton from three of these cross sections and bottom fauna and sediment from four cross sections. The locations of these cross sections are shown on the accompanying map (figure 4) and conform to sediment ranges established and surveyed by the Hydraulic Data Services Branch, TVA. Station 307.52 is located 13.5 miles upstream from the plant diffuser outfall and was selected as a control station.

Samples of water, net plankton, sediment, Asiatic clams, and two species of fish collected quarterly (plankton in only two quarters) are analyzed for radioactivity. Gamma and gross beta activity are determined in water (dissolved and total activity), net plankton, sediment, shells and flesh of clams, flesh of a commercial and a game fish species, and also in the whole body of the commercial species. The ^{89}Sr and ^{90}Sr contents are determined in all samples where sufficient quantities are available. The activity of 12 gamma-emitting radionuclides is determined with a multichannel gamma spectrometer. The ^{89}Sr and ^{90}Sr contents are determined by appropriate radiochemical techniques.

Water

From five of the seven cross sections a total of 15 water samples is collected quarterly for determination of total and dissolved radioactivity. The locations and depths for sampling are shown in table 14. Results are displayed in tables 15 and 16. Samples from all horizontal locations and depths at each river mile cross section are composited quarterly for tritium analysis. Water samples are also collected monthly at the point of plant discharge to the Tennessee River and at a point on the Elk River. These samples are a part of the quality control program. From the data in table 17, the maximum average beta concentration is 0.20 percent of MPC for samples collected at these two locations.

Fish

Radiological monitoring for fish is accomplished by analysis of composite samples of adult fish taken from each of three contiguous reservoirs--Wilson, Wheeler, and Guntersville. 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. Two species, white crappie and smallmouth buffalo, are collected representing both commercial and game species. Sufficient fish are collected in each reservoir to yield 250 to 300 grams oven-dry weight for analytical purposes. All samples are collected quarterly and analyzed for gamma,

gross alpha, gross beta activity, ^{89}Sr, and ^{90}Sr. The composite samples contain approximately the same quantity of flesh from each fish. For each composite a subsample of material is drawn for counting. Results are given in table 18.

Plankton

As indicated in table 14, net plankton (all phytoplankton and zooplankton caught with a 100 μ mesh net) is collected for radiological analyses at each of three stations by vertical tows with a ½-meter net. At least 50 grams (wet weight) of material is necessary for analytical accuracy. Collection of this amount will probably be practical only during the period April to September (spring and summer quarters) because of seasonal variability in plankton abundance. Samples are analyzed for gross beta activity and, when quantities are sufficient, for gamma activity and ^{89}Sr and ^{90}Sr content. Results are shown in table 19.

Sediment

Sediment samples are collected from Ponar dredge hauls made for bottom fauna. Gamma and gross beta radioactivity and ^{89}Sr and ^{90}Sr content are determined quarterly in composite samples collected from each of four stations. Locations of these stations are shown in table 14. Results are shown in table 20.

Bottom Fauna

The flesh and shells of Asiatic clams collected from the cross sections at four stations (table 14) are analyzed for gamma and gross beta activity at quarterly intervals. The ^{89}Sr and ^{90}Sr contents are determined on the shells, and on the flesh when sufficient amounts were available. A 50-gram (wet weight) sample provides sufficient activity for counting. Results are given in table 21.

Table 14

SAMPLING SCHEDULE - RESERVOIR MONITORING

Tennessee River (Mile)	Biological Samples: Zooplankton, Chlorophyll, Phytoplankton*	Benthic Fauna*	Sediment*	Fish**	Water Samples: Distance From Left Bank Feet	Percent	Depths (Meters)
277.98	2	2	2				
283.94					3600	40	1
					7100	78	1, 10
288.78		2	2				
291.76	2				5000	60	1
					7000	84	1, 5
293.70		2	2		6800	65	1
					9200	88	1, 5
295.87					4000	44	1, 5
					7500	82	1
307.52	2	2	2		1800	24	1, 5
					2800	37	1

*Replicate samples
**Gill net and/or electroshocker will be used for collection. Samples of fish are collected from Guntersville, Wheeler, and Wilson Reservoirs.

Figure 4

RESERVOIR MONITORING NETWORK

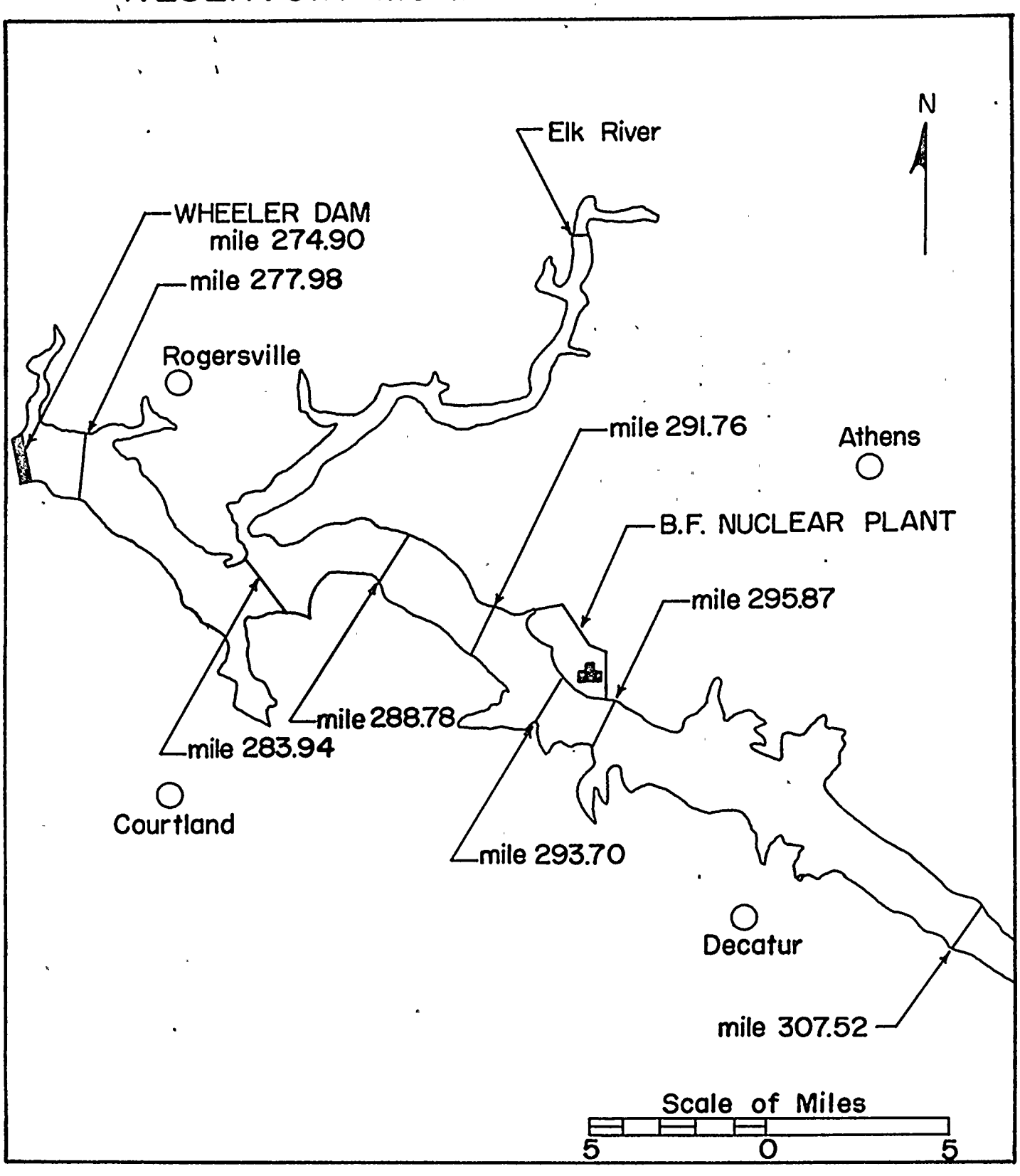


Table 15

RIVER WATER

Dissolved Activity, pCi/liter

TN River Mile	No. of Samples	Horiz. Location*	Depth in Meters	Gross Alpha**	Nonvolatile Beta***	Specific Radionuclides													
						$^{141,144}Ce$	^{51}Cr	^{131}I	$^{103,106}Ru$	^{134}Cs	^{137}Cs	$^{95}Zr-^{95}Nb$	^{58}Co	^{54}Mn	^{65}Zn	^{60}Co	$^{140}Ba-^{140}La$	^{89}Sr	^{90}Sr
283.94	2	40	1	ND	2.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.6±1.1	4.6±0.9	ND	0.9±0.4
283.94	2	78	1	ND	2.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.4±0.4	1.5±0.6	0.6±0.4	ND
283.94	2	78	10	ND	3.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.5±1.2	2.1±0.7	ND	0.8±0.5
291.76	2	60	1	ND	2.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.7±1.1	3.8±0.8	ND	0.4±0.3
291.76	2	84	1	ND	2.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.5±0.6	2.1±0.6	0.5±0.4	ND
291.76	2	84	5	ND	2.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.5±0.7	1.7±0.6	0.8±0.3	ND
293.70	2	65	1	ND	1.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.1±1.0	1.3±0.7	0.7±0.4	ND
293.70	2	88	1	ND	ND	3.9±2.0	ND	ND	ND	ND	0.7±0.4	1.5±0.8	ND	ND	ND	3.1±0.8	1.4±0.6	0.8±0.4	0.6±0.3
293.70	2	88	5	ND	2.3	ND	ND	ND	ND	ND	ND	1.7±0.6	ND	ND	ND	5.0±1.2	3.2±0.9	0.4±0.3	ND
295.87	2	44	1	ND	2.8	ND	ND	ND	ND	1.4±0.4	ND	ND	ND	ND	ND	1.7±0.5	2.4±0.7	0.4±0.3	0.8±0.4
295.87	2	44	5	ND	2.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.0±1.2	3.5±0.9	1.1±0.4	ND
295.87	2	82	1	ND	1.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.9±0.8	1.1±0.7	ND	0.5±0.4
307.52	2	24	1	ND	2.4	3.9±1.4	ND	ND	ND	ND	ND	1.1±0.9	ND	ND	ND	4.7±1.1	2.7±0.8	ND	0.7±0.5
307.52	2	24	5	ND	4.1	ND	ND	ND	ND	ND	ND	ND	1.4±0.6	ND	ND	3.1±0.6	2.1±0.5	ND	0.9±0.6
307.52	2	37	1	ND	2.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.0±0.9	2.1±0.6	0.5±0.3	0.7±0.5
		Average:		ND	2.3	0.5±0.2	ND	ND	ND	ND	ND	0.3±0.1	ND	ND	ND	3.5±0.2	2.4±0.2	0.4±0.1	0.4±0.1

*Percent of distance across river from left bank looking downstream
**Sensitivity 1.2
***Sensitivity 1.6
ND - Not detectable

Table 16

RIVER WATER

Total Activity, pCi/liter

In River Mile	No. of Samples	Horiz. Location*	Depth in Meters	Gross Alpha**	Nonvolatile Beta***	Specific Radionuclides														
						$^{141,144}Ce$	^{51}Cr	^{131}I	$^{103,106}Ru$	^{134}Cs	^{137}Cs	^{95}Zr-^{95}Nb	^{58}Co	^{54}Mn	^{65}Zn	^{60}Co	^{140}Ba-^{140}La	^{90}Sr	^{89}Sr	^{3}H****
283.94	2	40	1	ND	2.8	ND	ND	ND	ND	ND	ND	2.0±0.9	ND	ND	ND	5.3±1.4	3.8±0.9	1.4±0.4	0.7±0.4	ND
283.94	2	78	1	ND	2.6	ND	ND	ND	ND	ND	2.0±0.8	ND	ND	ND	ND	4.0±1.0	4.5±1.0	1.0±0.5	1.6±0.7	
283.94	2	78	10	ND	3.1	ND	ND	ND	ND	1.3±0.9	ND	1.8±1.4	ND	ND	ND	4.1±1.2	4.0±1.1	0.6±0.4	0.8±0.3	
291.76	2	60	1	ND	4.0	ND	ND	ND	ND	ND	2.6±0.3	ND	ND	ND	ND	4.6±1.5	3.1±1.0	0.8±0.3	0.5±0.2	ND
291.76	2	84	1	ND	3.4	3.2±2.0	ND	ND	ND	ND	1.6±0.9	0.8±0.6	ND	ND	ND	6.5±1.4	4.6±1.2	0.6±0.4	0.5±0.3	
291.76	2	84	5	ND	1.7	3.4±3.1	ND	ND	ND	ND	ND	1.6±1.1	ND	ND	ND	2.3±1.1	5.3±1.0	0.7±0.5	0.6±0.5	
293.70	2	65	1	ND	2.2	ND	ND	ND	3.6±3.0	ND	ND	ND	ND	ND	ND	5.9±1.3	2.5±1.2	0.8±0.3	ND	ND
293.70	2	88	1	ND	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.0±1.0	4.8±0.9	ND	0.7±0.4	
293.70	2	88	5	ND	2.2	5.2±3.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.1±1.6	3.8±1.1	0.9±0.4	ND	
295.87	2	44	1	ND	3.5	ND	ND	ND	ND	0.9±0.8	ND	0.9±0.5	ND	ND	ND	6.1±1.6	4.0±1.3	0.8±0.4	0.5±0.4	ND
295.87	2	44	5	ND	3.5	4.1±3.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.1±1.1	2.6±0.8	ND	0.7±0.4	
295.87	2	82	1	ND	2.9	ND	ND	ND	ND	1.3±0.4	ND	ND	ND	1.8±1.1	2.9±2.4	5.6±1.2	2.7±1.1	0.6±0.4	0.9±0.5	
307.52	2	24	1	ND	2.6	ND	ND	ND	ND	ND	1.1±0.9	0.7±0.5	ND	ND	ND	6.1±1.1	3.4±0.9	1.3±0.4	ND	ND
307.52	2	24	5	ND	2.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.2±1.1	2.2±0.8	0.5±0.3	0.6±0.4	
307.52	2	37	1	ND	2.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.4±1.3	3.3±0.9	ND	0.8±0.5	
		Average:		ND	2.7	1.1±0.4	ND	ND	0.2±0.2	0.2±0.1	0.5±0.1	0.5±0.1	ND	0.1±0.1	0.2±0.2	4.8±0.3	3.6±0.3	0.7±0.1	0.6±0.1	ND

*Percent of distance across river from left bank looking downstream
**Sensitivity 1.2
***Sensitivity 1.6
****Sensitivity 400
ND - Not detectable

Table 17

RIVER WATER

pCi/liter

Location	No. of Samples	Alpha* (Avg.)	Nonvolatile Beta** Max.	Min.	Avg.	Specific Radionuclides (Average)	
Browns Ferry at discharge location	6	ND	6.1	2.1	3.3	$^{141,144}Ce$	ND
						^{51}Cr	ND
						^{131}I	0.7±0.6
						$^{103,106}Ru$	ND
						^{134}Cs	1.1±0.7
						^{137}Cs	1.0±0.6
						^{95}Zr-^{95}Nb	ND
						^{58}Co	ND
						^{54}Mn	ND
						^{65}Zn	2.8±1.4
						^{60}Co	4.4±0.9
						^{140}Ba-^{140}La	5.4±1.2
						^{90}Sr	0.4±0.2
						^{89}Sr	0.8±0.2
						^{3}H***	ND
Elk River	6	ND	5.3	2.2	2.9	$^{141,144}Ce$	ND
						^{51}Cr	ND
						^{131}I	ND
						$^{103,106}Ru$	ND
						^{134}Cs	1.2±0.4
						^{137}Cs	0.9±0.4
						^{95}Zr-^{95}Nb	ND
						^{58}Co	0.6±0.5
						^{54}Mn	ND
						^{65}Zn	3.4±1.2
						^{60}Co	3.8±0.6
						^{140}Ba-^{140}La	5.3±0.6
						^{90}Sr	0.4±0.2
						^{89}Sr	0.6±0.3
						^{3}H***	ND
	Average:	ND	Average:		3.1		

*Sensitivity 1.2
**Sensitivity 1.6
***Sensitivity 400
ND - Not detectable

Table 18

FISH

pCi/gm, Dry Weight

Location (Reservoir)	Type of Fish	No. of Samples	Gross Alpha*	Gross Beta**	Specific Radionuclide													
					$^{141,144}Ce$	^{51}Cr	^{131}I	$^{103,106}Ru$	^{134}Cs	^{137}Cs	^{95}Zr-^{95}Nb	^{58}Co	^{54}Mn	^{65}Zn	^{60}Co	^{140}Ba-^{140}La	^{90}Sr	^{89}Sr
Guntersville	Smallmouth Buffalo (Whole)	2	ND	5.30	ND	ND	ND	ND	ND	0.1±0.02	ND	ND	ND	ND	ND	ND	0.2±0.03	ND
	Smallmouth Buffalo (Flesh)	2	ND	4.52	ND	0.3±0.1	ND	ND	ND	0.2±0.04	ND	ND	ND	ND	ND	ND	ND	ND
	White Crappie (Flesh)	2	ND	5.50	ND	0.1±0.06	ND	ND	ND	0.4±0.04	ND	ND	ND	ND	ND	ND	ND	ND
Wheeler	Smallmouth Buffalo (Whole)	2	ND	5.14	ND	0.4±0.07	ND	ND	ND	0.1±0.02	ND	ND	ND	ND	ND	ND	ND	ND
	Smallmouth Buffalo (Flesh)	2	ND	4.47	ND	0.1±0.06	ND	ND	ND	0.1±0.03	ND	ND	ND	ND	ND	ND	ND	ND
	White Crappie (Flesh)	2	ND	5.88	ND	0.3±0.1	ND	ND	ND	0.3±0.05	ND	ND	ND	ND	ND	ND	ND	ND
Wilson	Smallmouth Buffalo (Whole)	2	ND	3.78	ND	0.1±0.06	ND	ND	ND	0.2±0.02	ND	ND	ND	ND	ND	ND	0.2±0.02	ND
	Smallmouth Buffalo (Flesh)	1	ND	3.79	ND	ND	ND	ND	ND	0.1±0.02	ND	ND	ND	ND	ND	ND	ND	0.2±0.05
	White Crappie (Flesh)	2	ND	5.97	ND	0.2±0.09	ND	ND	ND	0.4±0.03	ND	ND	ND	ND	ND	ND	ND	ND

*Sensitivity 0.02
**Sensitivity 0.03
ND - Not detectable

Table 19

PLANKTON

pCi/gm, Dry Weight

Tennessee River Mile	No. of Samples	Gross Alpha*	Gross Beta**	Specific Radionuclides***
277.98	4	1.08	19.43	
291.76	4	1.30	13.36	
307.52	4	2.14	18.34	
	Average:	1.51	17.04	

*Sensitivity 0.03
**Sensitivity 0.04
***Sample size not sufficient to perform specific isotopic analysis

Table 20

SEDIMENT

pCi/gm, Dry Weight

	TN River Mile				
	277.98	288.78	293.70	307.52	Average
No. of Samples	4	4	4	4	
Gross Alpha*	0.94	0.81	0.54	0.92	0.80
Nonvolatile Beta**	8.07	8.48	5.47	7.47	7.37
Specific Radionuclides					
^{141,144}Ce	ND	1.0±0.3	0.4±0.2	ND	0.4±0.1
^{51}Cr	ND	ND	ND	ND	ND
^{131}I	ND	ND	ND	ND	ND
^{103,106}Ru	0.4±0.2	1.1±0.2	0.3±0.1	0.5±0.2	0.6±0.1
^{134}Cs	ND	ND	ND	ND	ND
^{137}Cs	6.4±0.2	3.6±0.2	2.1±0.1	0.6±0.1	3.2±0.1
^{95}Zr-^{95}Nb	0.2±0.1	0.8±0.1	0.2±0.04	0.2±0.06	0.4±0.04
^{58}Co	ND	ND	ND	ND	ND
^{54}Mn	0.1±0.1	0.2±0.1	0.2±0.05	0.2±0.1	0.2±0.05
^{65}Zn	ND	ND	ND	ND	ND
^{60}Co	ND	ND	ND	ND	ND
^{140}Ba-^{140}La	0.2±0.1	0.3±0.06	0.2±0.03	0.3±0.05	0.2±0.03
^{90}Sr	0.2±0.05	0.2±0.05	0.2±0.06	0.2±0.05	0.2±0.03
^{89}Sr	ND	0.2±0.1	0.1±0.06	0.1±0.07	0.1±0.03

*Sensitivity 0.11
**Sensitivity 0.15
ND - Not detectable

Table 21

CLAM

pCi/gm, Dry Weight

Clam Shell

	TN River Mile				
	277.98	288.78	293.70	307.52	Average
No. of Samples	4	4	4	4	
Gross Alpha*	ND	ND	0.11	0.24	0.09
Nonvolatile Beta**	2.30	2.36	2.69	3.01	2.59
Specific Radionuclides					
$^{141,144}Ce$	0.5±0.07	0.5±0.05	0.5±0.08	0.5±0.1	0.5±0.04
^{51}Cr	ND	ND	ND	ND	ND
^{131}I	ND	ND	ND	ND	ND
$^{103,106}Ru$	ND	0.1±0.02	ND	0.1±0.07	ND
^{134}Cs	ND	ND	ND	ND	ND
^{137}Cs	ND	ND	ND	ND	ND
^{95}Zr-^{95}Nb	ND	ND	ND	ND	ND
^{58}Co	ND	ND	ND	ND	ND
^{54}Mn	ND	ND	ND	ND	ND
^{65}Zn	ND	ND	ND	ND	ND
^{60}Co	ND	ND	ND	ND	ND
^{140}Ba-^{140}La	ND	ND	ND	0.1±0.02	ND
^{90}Sr	3.3±0.2	4.2±0.3	5.6±0.2	4.9±0.3	4.5±0.1
^{89}Sr	0.3±0.3	0.6±0.2	ND	0.3±0.2	0.3±0.1

*Sensitivity - 0.11
**Sensitivity - 0.14
ND - Not detectable

Table 21 (Continued)

CLAM

pCi/gm, Dry Weight

Clam Flesh

	TN River Mile 277.98	288.78	293.70	307.52	Average
No. of Samples	4	4	4	4	
Gross Alpha*	ND	ND	ND	ND	ND
Nonvolatile Beta**	1.73	1.19	1.28	0.87	1.27
Specific Radionuclides					
$^{141,144}Ce$	2.4±0.4	1.3±0.6	2.0±0.5	2.2±0.5	2.0±0.3
^{51}Cr	1.8±1.0	3.2±0.9	2.9±0.9	0.5±0.4	2.1±0.4
^{131}I	0.2±0.05	0.3±0.1	0.6±0.1	0.5±0.1	0.4±0.05
$^{103,106}Ru$	0.4±0.3	0.4±0.2	0.7±0.4	ND	0.4±0.1
^{134}Cs	ND	ND	0.2±0.1	0.1±0.05	0.1±0.03
^{137}Cs	0.7±0.2	0.3±0.1	0.7±0.2	0.6±0.3	0.6±0.1
^{95}Zr-^{95}Nb	ND	ND	0.2±0.1	ND	ND
^{58}Co	ND	ND	ND	ND	ND
^{54}Mn	ND	ND	ND	ND	ND
^{65}Zn	0.4±0.2	ND	ND	ND	0.1±0.05
^{60}Co	0.5±0.1	0.3±0.1	0.3±0.1	0.2±0.05	0.3±0.05
^{140}Ba-^{140}La	0.6±0.1	0.5±0.1	0.6±0.1	0.5±0.1	0.6±0.05
^{90}Sr	0.2±0.03	NA	0.1±0.02	NA	0.2±0.02
^{89}Sr	ND	NA	ND	NA	ND

*Sensitivity 0.03
**Sensitivity 0.04
NA - Not analyzed
ND - Not detectable

Quality Control

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

Data Analysis

Data measured at each indicator and control station were averaged for the 6-month reporting period. In order to describe the distribution of control station data, a mean, standard deviation, and 3-sigma value were calculated. We can expect, with 99 percent confidence, that background concentrations would be distributed within these limits. This provides us the basis for comparing control and indicator data. If the indicator data fall within the limits defined for control data, we can say, with 99 percent confidence, that the indicator data were not significantly affected by the nuclear plant. If the data do not fall within the limits, we will perform further analyses to determine if the difference is attributable to the nuclear plant.

Conclusions

A vast majority of the indicator station data were found to be within the distribution defined by the control station data. The Alpha-M least squares computer program identified concentrations slightly exceeding the limits of the control station data for a small number of radionuclides in samples from indicator stations. Many of these values may be discounted because the error reported by the Alpha-M program was greater than the calculated concentration. The remaining isolated elevated concentrations may be the result of fallout, computer program artifacts, or analytical errors. The same type of isolated high values occurred in the control station data and may be attributed to the same sources.

Exposures were measured with thermoluminescent dosimeters (TLD) at nine indicator stations near the site boundary and at eight control stations remote from the plant. Some anomalies were observed in the TLD exposure measurements at both indicator and control stations. A student's "t" test performed on the data indicated that, at the 99% confidence level, the radiation levels found at the onsite stations are not statistically different from the levels found at the offsite stations.