Tennessee Valley Authority, Post Office Box 2000, Decatur, Alabama 35609-2000

May 15, 2014

10 CFR 50.4

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Browns Ferry Nuclear Plant, Units 1, 2, and 3
Renewed Facility Operating License Nos. DPR-33, DPR-52, and DPR-68
NRC Docket Nos. 50-259, 50-260, and 50-296

Subject: **Annual Radiological Environmental Operating Report - 2013**

In accordance with the Browns Ferry Nuclear Plant Technical Specification 5.6.2 and Offsite Dose Calculation Manual Administrative Control Section 5.1, the Tennessee Valley Authority (TVA) is submitting the Annual Radiological Environmental Operating Report for Browns Ferry Nuclear Plant, Units 1, 2, and 3. Enclosed is the subject report for the period of January 1, 2013, through December 31, 2013.

There are no new regulatory commitments contained within this letter. If you have any questions, please contact J. L. Paul at (256) 729-2636.

Respectfully,

K. J. Polson
Site Vice President

Enclosure: Annual Radiological Environmental Operating Report, Browns Ferry Nuclear Plant, 2013

cc (w/Enclosure):

NRC Regional Administrator – Region II
NRC Senior Resident Inspector – Browns Ferry Nuclear Plant

IE23
NRR

Enclosure

Tennessee Valley Authority

Annual Radiological Environmental Operating Report,
Browns Ferry Nuclear Plant, 2013

(See Attached)

Annual Radiological Environmental Operating Report

Browns Ferry Nuclear Plant 2013

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

BROWNS FERRY NUCLEAR PLANT

2013

TENNESSEE VALLEY AUTHORITY

April 2014

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EXECUTIVE SUMMARY

This report describes the radiological environmental monitoring program conducted by Tennessee Valley Authority (TVA) in the vicinity of the Browns Ferry Nuclear Plant (BFN) in 2013. The program includes the collection of samples from the environment and the determination of the concentrations of radioactive materials in the samples. Samples are taken from stations in the general area of the plant and from areas not influenced by plant operations. Monitoring includes the sampling of air, water, soil, food crops, fish, shoreline sediment, and the measurement of direct radiation levels. Results from stations near the plant are compared with concentrations from control stations and with preoperational measurements to determine potential impacts of plant operations.

The vast majority of the activity detected from environmental samples was the result of naturally occurring radioactive materials. Small amounts of cesium (Cs)-137 were measured in soil and shoreline sediment samples collected during 2013. The concentrations measured for Cs-137 were consistent with levels commonly found in the environment as a result of atmospheric nuclear weapons fallout. The fallout from accidents at the Chernobyl plant in the Ukraine in 1986 and Fukushima plant in Japan in 2011 may have also contributed to the low levels of Cs-137 measured in environmental samples. The level of activity measured in these samples would result in no measurable increase over background dose to the general public.

INTRODUCTION

This report describes and summarizes results of radioactivity measurements made in the vicinity of Browns Ferry Nuclear Plant (BFN) and laboratory analyses of samples collected in the area. The measurements are made to comply with the requirements of 10 CFR 50, Appendix A, Criterion 64 and 10 CFR 50, Appendix I, Sections IV.B.2, IV.B.3 and IV.C, and to determine potential effects on public health and safety. This report satisfies the annual reporting requirements of BFN Technical Specification 5.6.2 and Offsite Dose Calculation Manual (ODCM) Administrative Control 5.1. The data presented in this report include results from the prescribed program and information to help correlate the significance of results measured by this monitoring program to the levels of environmental radiation resulting from naturally occurring radioactive materials.

Naturally Occurring and Background Radioactivity

Most materials in our world today contain trace amounts of naturally occurring radioactivity. Potassium (K)-40, with a half-life of 1.3 billion years, is one of the major types of radioactive materials found naturally in our environment. An individual weighing 150 pounds contains about 140 grams of potassium (Reference 1). Other examples of naturally occurring radioactive materials are beryllium (Be)-7, bismuth (Bi)-212, 214, lead (Pb)-212, 214, thallium (Tl)-208, actinium (Ac)-228, uranium (U)-235, 238, thorium (Th)-234, radium (Ra)-226, radon (Rn)-222 and 220, carbon (C)-14, and hydrogen (H)-3 (generally called tritium). The radiation from these materials makes up a part of the low-level natural background radiation. The remainder of the natural background radiation comes in the form of cosmic ray radiation from outer space.

It is possible to get an idea of the relative hazard of different types of radiation sources by evaluating the amount of radiation the U.S. population receives from each general type of radiation source. The following information is primarily adapted from References 2 and 3.

U.S. GENERAL POPULATION AVERAGE DOSE EQUIVALENT ESTIMATES

Source	millirem (mrem)/Year Per Person
Natural background dose equivalent	
Cosmic	33
Terrestrial	21
In the body	29
Radon	228
Total	311
Medical (effective dose equivalent)	300
Nuclear energy	0.28
Consumer products	13
Total	624 (approximately)

As can be seen from the table, the natural background radiation dose equivalent to the U.S. population normally exceeds that from nuclear plants by several hundred times. This indicates that nuclear plant operations normally result in a population radiation dose equivalent which is insignificant compared to that which results from natural background radiation.

Electric Power Production

Nuclear power plants are similar in many respects to conventional coal burning (or other fossil fuel) electrical generating plants. The basic process behind electrical power production in both types of plants is that fuel is used to heat water to produce steam which provides the force to turn turbines and generators. In a nuclear power plant, the fuel is uranium and heat is produced in the reactor through the fission of the uranium. Nuclear plants include many complex systems to control the nuclear fission process and to safeguard against the possibility of reactor malfunction. The nuclear reactions produce radionuclides commonly referred to as fission and activation products. Very small amounts of these fission and activation products are released into the plant systems. This radioactive material can be transported throughout plant systems and some of it released to the environment.

The pathways through which radioactivity is released are monitored. Liquid and gaseous effluent monitors record the radiation levels for each release. These monitors also provide alarm mechanisms to prompt termination of any release above limits.

Releases are monitored at the onsite points of release and through the environmental monitoring program which measures the environmental radiation in areas around the plant. In this way, not only is the release of radioactive materials from the plant tightly controlled, but measurements are made in surrounding areas to verify that the population is not being exposed to significant levels of radiation or radioactive materials.

The BFN ODCM, which is required by the plant Technical Specifications, prescribes limits for the release of radioactive effluents, as well as limits for doses to the general public from the release of these effluents. The dose to a member of the general public from radioactive materials released to unrestricted areas, as given in Nuclear Regulatory Commission (NRC) guidelines and in the ODCM, is limited as follows:

Liquid Effluents

Total body	≤3 mrem/Year
Any organ	≤10 mrem/Year

Gaseous Effluents

Noble gases:

Gamma radiation	≤10 millirad (mrad)/Year
Beta radiation	≤20 mrad/Year

Particulates:

Any organ	≤15 mrem/Year

The Environmental Protection Agency limits for the total dose to the public in the vicinity of a nuclear power plant, established in the Environmental Dose Standard of 40 CFR 190, are as follows:

Total body	≤25 mrem/Year
Thyroid	≤75 mrem/Year
Any other organ	≤25 mrem/Year

Appendix B to 10 CFR 20 presents the regulatory limits for the annual average concentrations of radioactive materials released in gaseous and liquid effluents at the boundary of the unrestricted area. Table 1 of this report compares the nominal lower limits of detection for the BFN monitoring program with the regulatory limits for maximum annual average effluent concentrations released to unrestricted areas and levels requiring special reports to the NRC. The data presented in this report indicate compliance with the regulations.

SITE/PLANT DESCRIPTION

BFN is located on the north shore of Wheeler Reservoir at Tennessee River Mile 294 in Limestone County in north Alabama (Figure 1). Wheeler Reservoir averages 1 to 1-1/2 miles in width in the vicinity of the plant. The BFN site contains approximately 840 acres. The dominant character of land use is small, scattered villages and homes in an agricultural area. A number of relatively large farming operations occupy much of the land on the north side of the river immediately surrounding the plant. The principal crop grown in the area is cotton.

Approximately 3500 people live within a 5-mile radius of the plant. The town of Athens has a population of about 24,000, and is approximately 10 miles northeast of BFN. Approximately 56,000 people live in the city of Decatur 10 miles southeast. The cities of Madison and Huntsville have a combined population of approximately 220,000 starting 20 miles east of the site.

Area recreation facilities are developed along the Tennessee River. The nearest facilities are public use areas located 2 to 3 miles from the site. The city of Decatur has developed a large municipal recreation area, Point Mallard Park, approximately 15 miles upstream of the site. The Tennessee River is also a popular sport fishing area.

BFN consists of three boiling water reactors. 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, a fire in the cable trays on March 22, 1975, forced the shutdown of both reactors. Units 1 and 2 resumed operation and Unit 3 began testing in August 1976. Unit 3 began commercial operation on March 1, 1977.

All three units were out of service from March 1985 to May 1991. Unit 2 was restarted May 24, 1991 and Unit 3 restarted on November 19, 1995. Recovery work for Unit 1 was completed and the unit was restarted on May 22, 2007.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Most of the radiation and radioactivity generated in a nuclear power reactor is contained within the reactor systems. Plant effluent monitors are designed to detect the small amounts released to the environment. Environmental monitoring is a final verification that the systems are performing as planned. The monitoring program is designed to sample the pathways between the plant and the people in the immediate vicinity of the plant. Sample types are chosen so that the potential for detection of radioactivity in the environment will be maximized. The Radiological Environmental Monitoring Program (REMP) and sampling locations are outlined in Appendix A.

There are two primary pathways by which radioactivity can move through the environment to humans: air and water (see Figure 2). The air pathway can be separated into two components: the direct (airborne) pathway and the indirect (ground or terrestrial) pathway. The direct airborne pathway consists of direct radiation and inhalation by humans. In the terrestrial pathway, radioactive materials may be deposited on the ground or on plants and subsequently be ingested by animals and/or humans. Human exposure through the liquid pathway may result from drinking water, eating fish, or by direct exposure at the shoreline. The types of samples collected in this program are designed to monitor these pathways.

A number of factors were considered in determining the locations for collecting environmental samples. The locations for the atmospheric monitoring stations were determined from a critical pathway analysis based on weather patterns, dose projections, population distribution, and land use. Terrestrial sampling stations were selected after reviewing such things as the locations of dairy animals and gardens in conjunction with the air pathway analysis. Liquid pathway stations were selected based on dose projections, water use information, and availability of media such as fish and sediment. Table A-2 (Appendix A, Table 2: This method of notation is used for all tables and figures given in the appendices.) lists the sampling stations and the types of samples collected from each.

Program modifications made to the REMP are described in Appendix B. There were no program modifications during 2013. Appendix B is included in this report to document a change that occurred in a previous year. Program deviations in the sampling and analysis schedule are discussed in Appendix C.

To determine the amount of radioactivity in the environment prior to the operation of BFN, a preoperational REMP was initiated in 1968 and conducted until the plant began operation in 1973. Sampling and analyses conducted during the preoperational phase has provided data that can be used to establish normal background levels for various radionuclides in the environment.

The preoperational monitoring program is a very important part of the overall program. During the 1950s, 1960s, and 1970s, atmospheric nuclear weapons testing released radioactive material to the environment causing fluctuations in background radiation levels. This radioactive material is the same type as that produced in the BFN reactors. Preoperational knowledge of radionuclide patterns in the environment permits a determination, through comparison and trending analyses, of whether the operation of BFN is impacting the environment and thus the surrounding population.

The evaluation of the impact of plant operations also utilizes data from control stations that have been established in the monitoring program. Results of environmental samples taken at control stations (far from the plant) are compared with those from indicator stations (near the plant) to establish the extent of BFN influence.

Sample analyses are performed by the Tennessee Valley Authority's (TVA's) Environmental Radiological Monitoring and Instrumentation (ERM&I) group located at the Western Area Radiological Laboratory in Muscle Shoals, Alabama, with exception of the strontium (Sr)-89, 90 analyses of soil samples which is performed by a contracted laboratory. The analyses are conducted in accordance with written and approved procedures and are based on accepted methods. A summary of the analysis techniques and methodology is presented in Appendix D. Data tables summarizing the sample analysis results are presented in Appendix H.

The radiation detection devices and analysis methods used to determine the radionuclide content of samples collected in the environment are very sensitive to small amounts of radioactivity. The sensitivity of the measurement process is defined in terms of the lower limit of detection (LLD). A description of the nominal LLDs for the Radioanalytical Laboratory is presented in Appendix E.

The ERM&I Laboratory applies a comprehensive quality assurance/quality control program to monitor laboratory performance throughout the year. The program is intended to detect any problems in the measurement process as soon as possible so they can be corrected. This program includes instrument checks, to ensure that the radiation detection instruments are working properly, and the analysis of quality control samples. To provide for interlaboratory comparison program cross checks, the laboratory participated in a blind sample program administrated by Eckert & Ziegler Analytics. A complete description of the quality control program is presented in Appendix F.

DIRECT RADIATION MONITORING

Direct radiation levels are measured at various monitoring points around the plant site. These measurements include contributions from cosmic radiation, radioactivity in the ground, fallout from atmospheric nuclear weapons tests conducted in the past, and any radioactivity that may be present as a result of plant operations. Because of the relatively large variations in background radiation as compared to the small levels from the plant, contributions from the plant may be difficult to distinguish.

Measurement Techniques

The Landauer InLight environmental dosimeter is used in the REMP for the measurement of direct radiation. This dosimeter contains four elements consisting of aluminum oxide detectors with open windows as well as plastic and copper filters. The dosimeter is processed using optical stimulated luminescence (OSL) technology to determine the amount of radiation exposure.

The dosimeters are placed approximately one meter above the ground, with two at each monitoring location. Sixteen monitoring points are located around the plant near the site boundary, one location in each of the 16 compass sectors. One monitoring point is also located in each of the 16 compass sectors at a distance of approximately four to five miles from the plant.

Dosimeters are also placed at additional monitoring locations out to approximately 32 miles from the site. The dosimeters are exchanged every three months. The dosimeters are sent to Landauer InLight for processing and results reporting. The values are corrected for transit and shielded background exposure. An average of the two dosimeter results is calculated for each monitoring point. The system meets or exceeds the performance specifications outlined in American National Standards Institute (ANSI) N545-1975 and Health Physics Society (HPS) Draft Standard N13.29 for environmental applications of dosimeters.

Results

The results for environmental dosimeter measurements are normalized to a standard quarter (91.25 days or 2190 hours). The monitoring locations are grouped according to the distance from the plant. The first group consists of all monitoring points within 2 miles of the plant. The second group is made up of all locations greater than 2 miles from the plant. Past data have shown that the average results from the locations more than 2 miles from the plant are essentially the same. Therefore, for purposes of this report, monitoring points 2 miles or less from the plant are identified as "onsite" stations and locations greater than 2 miles are considered "offsite."

The quarterly gamma radiation levels determined from the dosimeters deployed around BFN in 2013 are summarized in Table H-1. The exposures are measured in milliroentgens (mR). For purposes of this report, one mR, one mrem, and one mrad are assumed to be numerically equivalent.

The rounded average annual exposures, as measured in 2013, are shown below:

	Annual Average Direct Radiation Levels mR/Year BFN 2013
Onsite Stations	75
Offsite Stations	59

The data in Table H-1 indicates that the average quarterly direct radiation levels at the BFN onsite stations are approximately 4.0 mR/Quarter higher than levels at the offsite stations. This difference is consistent with levels measured for the preoperation and construction phases of TVA nuclear power plant sites where the average levels onsite were slightly higher than levels offsite. Figure H-1 compares plots of the data from the onsite stations with those from the offsite stations over the period from 1977 through 2013.

The new Landauer InLight Optically Stimulated Luminescence (OSL) dosimeters have been deployed since 2007 replacing the Panasonic UD-814 dosimeters used during the previous years.

The data in Table H-2 contains the results of the individual monitoring stations. The results reported in 2013 are consistent with direct radiation levels identified at locations which are not influenced by the operation of BFN. There is no indication that BFN activities increased the background radiation levels normally observed in the areas surrounding the plant.

ATMOSPHERIC MONITORING

The atmospheric monitoring network is divided into three groups identified as local, perimeter, and remote. In the current program, five local air monitoring stations are located on or adjacent to the plant site in the general direction of greatest wind frequency. Three of these stations (LM-1, LM-2, and LM-3) are located on the plant side of the Tennessee River and two stations (LM-6 and LM-7) are located immediately across the river from the plant site. One additional station (station LM-4) is located at the point of maximum predicted offsite concentration of radionuclides based on meteorological data. Three perimeter air monitoring stations are located in communities out to about 13 miles from the plant, and two monitors used as controls are located out to 32 miles. The monitoring program and the locations of monitoring stations are identified in the tables and figures of Appendix A.

Results from the analysis of samples in the atmospheric pathway are presented in Tables H-3 and H-4. Radioactivity levels identified in this reporting period are consistent with background radioactivity levels.

Sample Collection and Analysis

Air particulates are collected by continuously sampling air at a flow rate of approximately 2 cubic feet per minute (cfm) through a 2-inch glass fiber filter. The sampling system consists of a pump, a magnehelic gauge for measuring the drop in pressure across the system, and a dry gas meter. This allows an accurate determination of the volume of air passing through the filter. The sampling system is housed in a metal building. The filter is contained in a sampling head mounted on the outside of the monitoring building. The filter is replaced weekly. Each filter is analyzed for gross beta activity about 3 days after collection to allow time for the radon daughters to decay. Every 4 weeks, composites of the filters from each location are analyzed by gamma spectroscopy.

Gaseous radioiodine is collected using a commercially available cartridge containing Triethylenediamine (TEDA)-impregnated charcoal. This system is designed to collect iodine in both the elemental form and as organic compounds. The cartridge is located in the same sampling head as the air particulate filter and is downstream of the particulate filter. The cartridge is changed at the same time as the particulate filter and samples the same volume of air. Each cartridge is analyzed for iodine (I)-131 by gamma spectroscopy analysis.

Results

The results from the analysis of air particulate samples are summarized in Table H-3. Gross beta activity in 2013 was consistent with levels reported in previous years. The annual average gross beta concentrations was 0.021 pCi/m^3. The annual averages of the gross beta activity in air particulate filters for the years 1968-2013 are presented in Figure H-2. Increased levels due to fallout from atmospheric nuclear weapons testing are evident, especially in 1969, 1970, 1971, 1977, 1978, and 1981. Evidence of a small increase resulting from the Chernobyl accident can also be seen in 1986. These patterns are consistent with data from monitoring programs conducted by TVA at other nuclear power plant sites during construction and preoperational stages.

Only naturally occurring radionuclides were identified by the monthly gamma spectral analysis of the air particulate samples.

There was no I-131 detected in any charcoal cartridge samples collected during 2013. The results for the analysis of charcoal cartridges are reported in Table H-4.

TERRESTRIAL MONITORING

Terrestrial monitoring is accomplished by collecting samples of environmental media that may transport radioactive material from the atmosphere to humans. Samples of soil and food crops are collected and analyzed to determine the potential impacts from exposure to this pathway. The results from the analysis of these samples are shown in Tables H-5 through H-10.

A land use survey is conducted annually to locate milk producing animals and gardens within a 5-mile radius of the plant. No milk-producing animals have been identified within 5 miles of the plant. The results of the 2013 land use survey are presented in Appendix G.

Sample Collection and Analysis

Soil samples are collected annually from the air monitoring locations. The samples are collected with either a "cookie cutter" or an auger type sampler. After drying and grinding, the sample is analyzed by gamma spectroscopy. When the gamma analysis is complete, the sample is analyzed for Sr-89, 90.

Samples representative of food crops raised in the area near the plant are obtained from individual gardens. Types of foods may vary from year to year as a result of changes in the local vegetable gardens. Samples of apples, cabbage, corn, green beans, and tomatoes were collected from local gardens in 2013. Samples of these same food crops were purchased from area produce markets to serve as control samples. The edible portion of each sample is analyzed by gamma spectroscopy.

Results

The only fission or activation product identified in soil samples was Cs-137. The average concentration measured in samples from indicator locations was 0.14 pCi/g. The average concentration for control locations was also 0.07 pCi/g. These concentrations are consistent with levels previously reported from fallout. All other radionuclides reported were naturally

occurring isotopes. The results of the analysis of soil samples are reported in Table H-5. A plot of the annual average Cs-137 concentrations in soil is presented in Figure H-3. The concentration of Cs-137 in soil is steadily decreasing as a result of the cessation of weapons testing in the atmosphere, the 30-year half-life of Cs-137 and transport through the environment.

Only naturally occurring radioactivity was identified in food crops. The predominant natural radionuclide detected in samples of food crops was K-40. Analyses of these samples indicated no contribution from plant activities. The results are reported in Tables H-6 through H-10.

LIQUID PATHWAY MONITORING

Potential exposures from the liquid pathway can occur from drinking water, ingestion of fish, and from direct radiation exposure to radioactive materials deposited in the river shoreline sediment. The liquid pathway monitoring program conducted during 2013 included the collection of samples of surface (river/reservoir) water, groundwater, drinking water supplies, fish, and shoreline sediment. Samples from the reservoir are collected both upstream and downstream from the plant. Results from the analysis of aquatic samples are presented in Tables H-11 through H-16.

Sample Collection and Analysis

Samples of surface water are collected from the Tennessee River using automatic sampling systems from one downstream station and one upstream station. The upstream sample is collected from the raw water intake at the Decatur, Alabama water plant and is utilized as a control sampling location for both surface and drinking water. A timer turns on the system at least once every two hours. The line is flushed and a sample collected into a collection container. A 1-gallon sample is removed from the container every 4 weeks and the remaining water in the jug is discarded. The 4-week composite sample is analyzed for gamma isotopic and gross beta activity. A quarterly composite sample is analyzed for tritium.

Samples are also collected by an automatic sampling system at the first downstream drinking water intake. This sample of raw untreated water is collected at the intake for the water plant. These samples are collected in the same manner as the surface water samples. These monthly samples are analyzed for gamma isotopic and gross beta activity. A quarterly composite is analyzed for tritium.

At other selected locations, grab samples are collected from drinking water systems which use the Tennessee River as their source. These samples are analyzed every 4 weeks for gamma isotopic and gross beta activity. A quarterly composite sample from each station is analyzed for tritium.

A groundwater well onsite is equipped with an automatic water sampler. Water is also collected from a private well in an area unaffected by BFN. Samples from the wells are collected every 4 weeks and analyzed by gamma spectroscopy. A quarterly composite sample is analyzed for tritium.

Samples of commercial and game fish species are collected semiannually from each of the two reservoirs: the reservoir on which the plant is located (Wheeler Reservoir) and the upstream reservoir (Guntersville Reservoir). The samples are collected using a combination of netting techniques and electrofishing. To sample edible portions of the fish, the fish are filleted. After drying and grinding, the samples are analyzed by gamma spectroscopy.

Shoreline sediment was collected from two downstream recreational use areas and one upstream location. The samples were collected at the normal water level shoreline and analyzed by gamma spectroscopy.

Results

Only naturally occurring isotopes were identified by gamma spectral analysis of surface water. No tritium was detected in surface water samples above the LLD of 270 pCi/liter. The gross beta activity for surface water samples was consistent with the results from previous years. The average gross beta concentration measured in samples from the upstream location was 2.5 pCi/liter and the average for samples from the downstream location was 2.6 pCi/liter. A trend plot of the gross beta activity in surface water samples from 1968 through 2013 is presented in Figure H-4. A summary table of the results for this reporting period is shown in Table H-11.

For drinking water (public water), gross beta activity averaged 2.6 pCi/liter at the downstream stations and 2.5 pCi/liter at upstream stations. These results are consistent with previous monitoring results. No fission or activation products were detected by the gamma analysis of drinking water. The tritium analysis results for drinking water were less than the nominal LLD value of 270 pCi/liter. The results are shown in Table H-12 and a trend plot of the gross beta activity from 1968 to 2013 is presented in Figure H-5.

No fission or activation products were detected in groundwater samples from BFN REMP monitoring locations. No tritium was detected above the nominal LLD. Results from the analysis of groundwater samples are presented in Table H-13.

The only isotopes found in fish were naturally occurring radionuclides. The results are summarized in Tables H-14 and H-15. Plots of the annual average Cs-137 concentrations in game fish are presented in Figure H-6.

The gamma spectroscopy analysis of shoreline sediment samples identified trace levels of Cs-137 in samples collected from the upstream sampling location. The maximum concentration was 0.16 pCi/gram. There was no Cs-137 detected in samples from the downstream locations. The Cs-137 levels were consistent with levels present in the environment as the result of past nuclear weapons testing. The results of the analysis of shoreline sediment are provided in Table H-16.

ASSESSMENT AND EVALUATION

Potential doses to the public are estimated from measured effluents using computer models. These models were developed by TVA and are based on methodology provided by the NRC in Regulatory Guide 1.109 for determining the potential dose to individuals and populations living in the vicinity of a nuclear power plant. The results of the effluent dose calculations are reported in the Annual Radioactive Effluent Release Report. The doses calculated are a representation of the dose to a "maximum exposed individual." Some of the factors used in these calculations (such as ingestion rates) are maximum expected values which will tend to overestimate the dose to this "hypothetical" person. The calculated maximum dose due to plant effluents are small fractions of the applicable regulatory limits. In reality, the expected dose to actual individuals is significantly lower.

Based on the very low concentrations of radionuclides actually present in the plant effluents, radioactivity levels measured in the environment, as a result of plant operations, are expected to be negligible. The results for the radiological environmental monitoring conducted for BFN 2013 operations confirm this expectation.

Results

As stated earlier in the report, the estimated increase in radiation dose equivalent to the general public resulting from the operation of BFN is negligible when compared to the dose from natural background radiation. The results from each environmental sample are compared with the concentrations from the corresponding control stations and appropriate preoperational and background data to determine influences from the plant. During this report period, Cs-137 was identified in soil and shoreline sediment samples. The Cs-137 detected in these samples was consistent with levels generally found in the environment as the result of past nuclear weapons testing.

Conclusions

It is concluded from the above analysis of the environmental sampling results and from the trend plots presented in Appendix H that the exposure to members of the general public which may have been attributable to BFN is negligible. The radioactivity reported herein is primarily the results of fallout or natural background radiation. Any activity which may be present as a result of plant operations does not represent a significant contribution to the exposure of members of the public.

REFERENCES

1. Merril Eisenbud, Environmental Radioactivity, Academic Press, Inc., New York, NY, 1987.

2. National Council on Radiation Protection and Measurements, Report No. 160, "Ionizing Radiation Exposure of the Population of the United States," March 2009.

3. United States Nuclear Regulatory Commission, Regulatory Guide 8.29, "Instruction Concerning Risks from Occupational Radiation Exposure," February 1996.

Table 1

COMPARISON OF
PROGRAM LOWER LIMITS OF DETECTION WITH THE REGULATORY LIMITS FOR
MAXIMUM ANNUAL AVERAGE EFFLUENT CONCENTRATIONS
RELEASED TO UNRESTRICTED AREAS
AND REPORTING LEVELS

	Concentrations in Water, pCi/Liter			Concentrations in Air, pCi/Cubic Meter		
Analysis	Effluent Concentration[1]	Reporting Level[2]	Lower limit of Detection[3]	Effluent Concentration[1]	Reporting Level[2]	Lower limit of Detection[3]
H-3	1,000,000	20,000	270	100,000	--	3.0
Cr-51	500,000	--	45	30,000	--	0.02
Mn-54	30,000	1,000	5	1,000	--	0.005
Co-58	20,000	1,000	5	1,000	--	0.005
Co-60	3,000	300	5	50	--	0.005
Zn-65	5,000	300	10	400	--	0.005
Sr-89	8,000	--	5	1,000	--	0.0011
Sr-90	500	--	2	6	--	0.0004
Nb-95	30,000	400	5	2,000	--	0.005
Zr-95	20,000	400	10	400	--	0.005
Ru-103	30,000	--	5	900	--	0.005
Ru-106	3,000	--	40	20	--	0.02
I-131	1,000	2	0.4	200	0.9	0.03
Cs-134	900	30	5	200	10	0.005
Cs-137	1,000	50	5	200	20	0.005
Ce-144	3,000	--	30	40	--	0.01
Ba-140	8,000	200	25	2,000	--	0.015
La-140	9,000	200	10	2,000	--	0.01

Note: 1 pCi = 3.7×10^{-2} Bq.

Note: For those reporting levels that are blank, no value is given in the reference.

1. Table 2 of Appendix B to 10 CFR 20.

2. BFN Offsite Dose Calculation Manual, Table 2.3-3.

3. Table E-1 of this report.

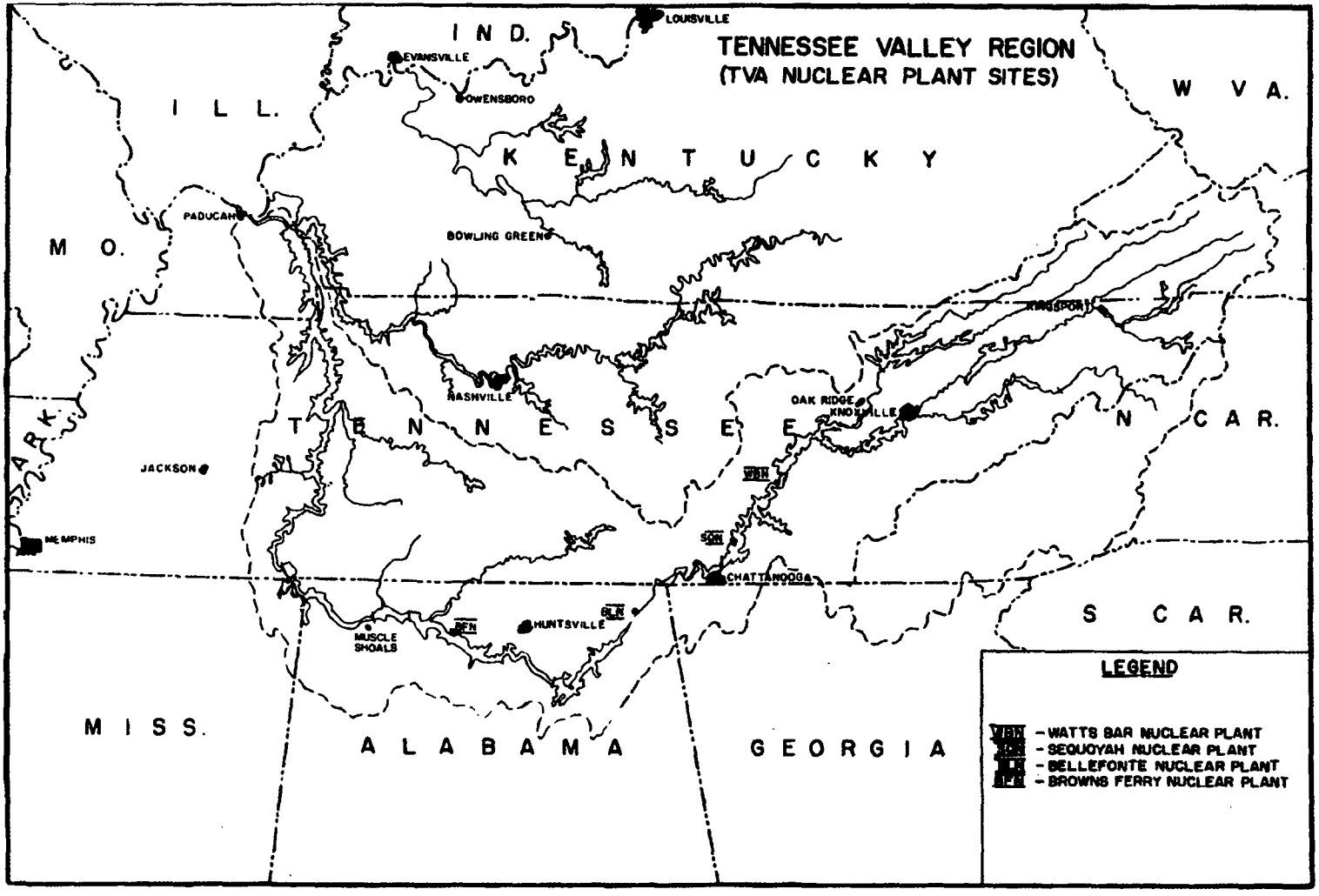
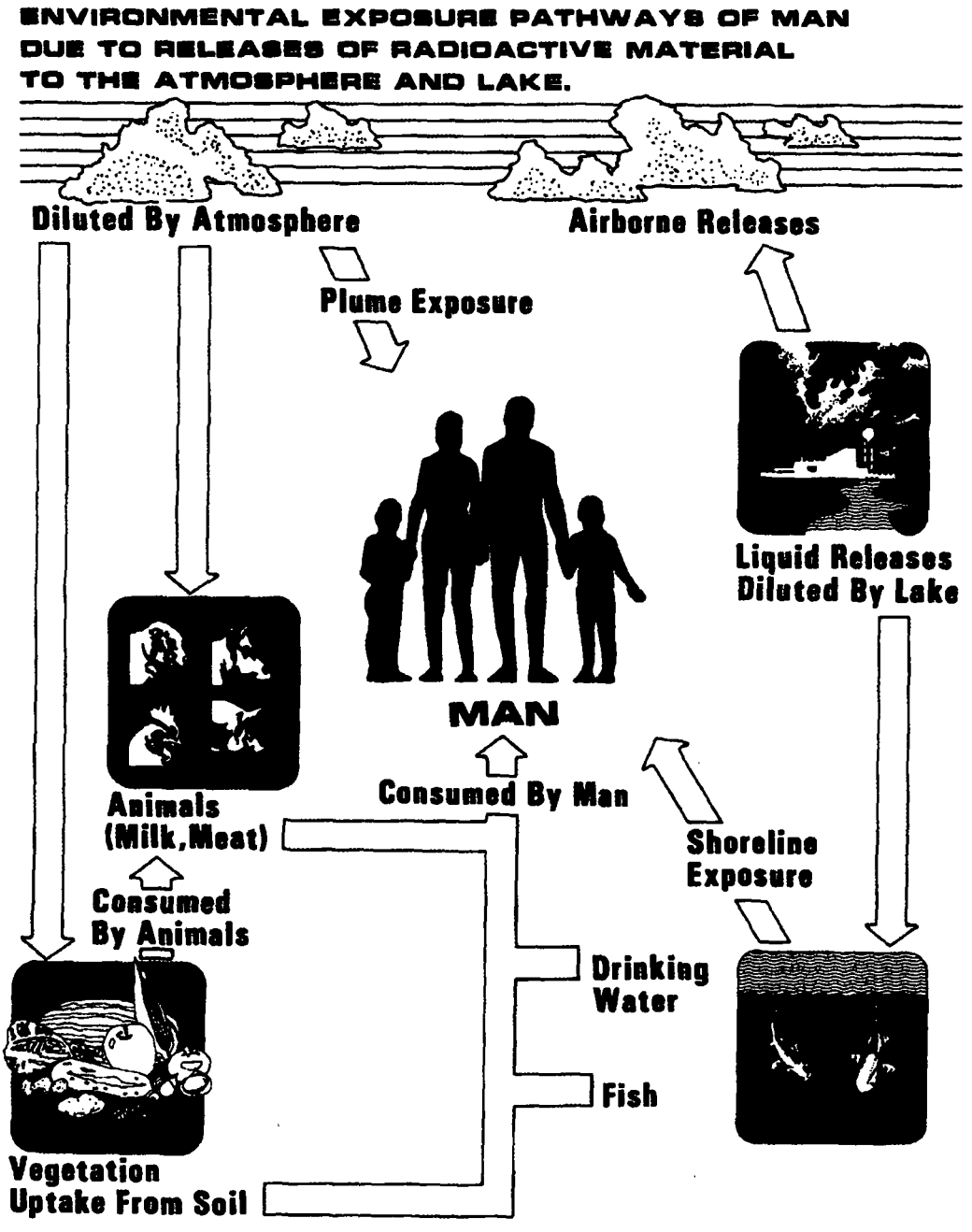

TENNESSEE VALLEY REGION
(TVA NUCLEAR PLANT SITES)
LOUISVILLE
IND.
EVANSVILLE
OWENSBORO
ILL.
W VA.
KENTUCKY
PADUCAH
BOWLING GREEN
MO.
KINGSPORT
NASHVILLE
OAK RIDGE
KNOXVILLE
ARK.
TENNESSEE
N CAR.
JACKSON
WBN
MEMPHIS
SQN
CHATTANOOGA
S CAR.
BLN
BFN
MUSCLE SHOALS
HUNTSVILLE
MISS.
ALABAMA
GEORGIA
LEGEND
WBN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

Figure 1

Figure 2


ENVIRONMENTAL EXPOSURE PATHWAYS OF MAN
DUE TO RELEASES OF RADIOACTIVE MATERIAL
TO THE ATMOSPHERE AND LAKE.
Diluted By Atmosphere
Airborne Releases
Plume Exposure
Liquid Releases
Diluted By Lake
MAN
Animals
(Milk,Meat)
Consumed By Man
Shoreline
Exposure
Consumed
By Animals
Drinking
Water
Fish
Vegetation
Uptake From Soil

APPENDIX A

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM AND SAMPLING LOCATIONS

Table A-1 (1 of 5)
BROWNS FERRY NUCLEAR PLANT
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM[a]

Exposure Pathway and/or Sample	Number of Samples and Locations[b]	Sampling and Collection Frequency	Type and Frequency of Analysis
1. AIRBORNE			
a. Particulates	Six samples from locations (in different sectors) at or near the site boundary (LM-1, LM-2, LM-3, LM-4, LM-6, and LM-7). Two samples from control locations greater than 10 miles from the plant (RM-1 and RM-6). Three samples from locations in communities approximately 10 miles from the plant (PM-1, PM-2, and PM-3).	Continuous sampler operation with sample collection as required by dust loading but at least once per 7 days.	Analyze for gross beta radioactivity following filter change. Perform gamma isotopic analysis on each sample when gross beta activity is greater than 10 times the yearly mean activity for control samples. Perform gamma isotopic analysis on composite (by location) sample at least once per 31 days.
b. Radioiodine	Same locations as air particulates.	Continuous sampler operation with charcoal canister collection at least once per 7 days.	I-131 by gamma scan on each sample.
c. Soil	Samples from same locations as air particulates.	Once every year.	Gamma scan, Sr-89, Sr-90 once per year.

Table A-1 (2 of 5)
BROWNS FERRY NUCLEAR PLANT
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM[a]

Exposure Pathway and/or Sample	Number of Samples and Locations[b]	Sampling and Collection Frequency	Type and Frequency of Analysis
2. DIRECT RADIATION	Two or more dosimeters placed at locations (in different sectors) at or near the site boundary in each of the 16 sectors.	At least once per 92 days.	Gamma dose once per 92 days.
	Two or more dosimeters placed at stations located approximately 5 miles from the plant in each of the 16 sectors.	At least once per 92 days.	Gamma dose once per 92 days.
	Two or more dosimeters in at least 8 additional locations of special interest.		
3. WATERBORNE			
a. Surface Water	One sample upstream (TRM 306.0). One sample immediately downstream of discharge (TRM 293.5).	Collected by automatic sequential-type sampler with composite sample taken at least once per 31 days[c].	Gross beta and gamma isotopic on 4-week composite. Composite for tritium at least once per 92 days.
b. Drinking Water	One sample at the first potable surface water supply downstream from the plant (TRM 286.5).	Collected by automatic sequential-type sampler with composite sample taken at least once per 31 days[c].	Gross beta and gamma isotopic on 4-week composite. Composite for tritium analysis at least once per 92 days.

Table A-1 (3 of 5)
BROWNS FERRY NUCLEAR PLANT
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM[a]

Exposure Pathway and/or Sample	Number of Samples and Locations[b]	Sampling and Collection Frequency	Type and Frequency of Analysis
b. Drinking Water (Continued)	Four additional samples of potable surface water downstream from the plant (TRM 282.6, TRM 274.9, TRM 259.8, and TRM 259.6).	Grab sample taken from water supply at a facility using water from the public supply being monitored. Sample collected at least once per 31 days.	Gross beta and gamma scan on 4-week composite. Composite for tritium analysis at least once per 92 days.
	One sample at a control location[d] (TRM 306).	Collected by automatic sequential-type sampler with composite sample taken at least once per 31 days[c].	Same as downstream location.
c. Ground Water	One sample adjacent to the plant (Well No. 6).	Collected by automatic sequential-type sampler with composite sample taken at least once per 31 days.	Gamma scan on each 4-week composite. Composite for tritium analysis at least once per 92 days.
	One sample at a control location up gradient from the plant. (Farm B)	Grab sample taken at least once per 31 days.	Gamma scan on each sample. Composite for tritium analysis at least once per 92 days.
d. Shoreline Sediment	One sample upstream from a recreational area (TRM 305).	At least once per 184 days.	Gamma scan of each sample.

Table A-1 (4 of 5)
BROWNS FERRY NUCLEAR PLANT
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM[a]

Exposure Pathway and/or Sample	Number of Samples and Locations[b]	Sampling and Collection Frequency	Type and Frequency of Analysis
d. Shoreline Sediment (Continued)	One sample from each of at least two downstream locations with recreational use (TRM 293 and TRM 279.5).	At least once per 184 days.	Gamma scan of each sample.
4. INGESTION			
a. Fish	Two samples representing commercial and game species in Guntersville Reservoir above the plant. Two samples representing commercial and game species in Wheeler Reservoir near the plant.	At least once per 184 days.	Gamma scan at least once per 184 days on edible portions.

Table A-1 (5 of 5)
BROWNS FERRY NUCLEAR PLANT
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM[a]

Exposure Pathway and/or Sample	Number of Samples and Locations[b]	Sampling and Collection Frequency	Type and Frequency of Analysis
b. Fruits and Vegetables	Samples of food crops such as greens, corn, green beans, tomatoes, and potatoes grown at private gardens and/or farms in the immediate vicinity of the plant. One sample of each of the same foods grown at greater than 10 miles distance from the plant.	At least once per year at time of harvest.	Gamma scan on edible portion.

a. The sampling program outlined in this table is the program conducted during 2013.
b. Sample locations, sector and distance from plant, are described in Table A-2 and A-3 and shown in Figures A-1, A-2, and A-3.
c. Composite samples shall be collected by collecting an aliquot at intervals not exceeding 2 hours.
d. The sample location at the Decatur City Water Plant serves as a control sample for both surface water and drinking water.

Table A-2
BROWNS FERRY NUCLEAR PLANT
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
SAMPLING LOCATIONS

Map Location Number[a]	Station	Sector	Approximate Distance (Miles)	Indicator (I) or Control (C)	Samples Collected[b]
1	PM-1	NW	13.8	I	AP,CF,S
2	PM-2	NE	10.9	I	AP,CF,S
3	PM-3	SSE	7.5	I	AP,CF,S
4	LM-7	W	2.1	I	AP,CF,S
5	RM-1	W	31.0	C	AP,CF,S
6	RM-6	E	23.4	C	AP,CF,S
7	LM-1	NNW	1.0	I	AP,CF,S
8	LM-2	NNE	0.9	I	AP,CF,S
9	LM-3	ENE	0.9	I	AP,CF,S
10	LM-4	NNW	1.7	I	AP,CF,S
11	LM-6	SSW	3.0	I	AP,CF,S
12	Farm B	NNW	6.8	C	W
22	Well No.6	NW	0.02	I	W
23	TRM[c] 282.6	-	11.4[d]	I	PW
24	TRM 306.0	-	12.0[d]	C	PW, SW
25	TRM 259.6	-	34.4[d]	I	PW
26	TRM 274.9	-	19.1[d]	I	PW
28	TRM 293.5	-	0.5[d]	I	SW
70	TRM 259.8	-	34.2[d]	I	PW
71	TRM 286.5	-	7.5[d]	I	PW
72	TRM 305	-	11.0[d]	C	SS
73	TRM 293	-	1.0[d]	I	SS
74	TRM 279.5	-	14.5[d]	I	SS
	Wheeler Reservoir (TRM 275-349)		-	I	F
	Guntersville Reservoir (TRM 349-424)		-	C	F

a. See Figures A-1, A-2, and A-3
b. Sample codes:
AP = Air Particulate Filter CF = Charcoal Filter (Iodine) PW = Public Water
Fish = Fish S = Soil SS = Shoreline Sediment
SW = Surface Water W = Well Water
c. TRM = Tennessee River Mile
d. Miles from plant discharge at (TRM 294).

Table A-3
BROWNS FERRY NUCLEAR PLANT
ENVIRONMENTAL DOSIMETER LOCATIONS

Map Location Number[a]	Station	Sector	Approximate Distance (Miles)	Onsite (On)[b] or Offsite (Off)
1	NW-3	NW	13.8	Off
2	NE-3	NE	10.9	Off
3	SSE-2	SSE	7.5	Off
5	W-3	W	31.0	Off
6	E-3	E	23.1	Off
7	N-1	NNW	1.0	On
8	NNE-1	NNE	0.9	On
9	ENE-1	ENE	0.9	On
10	NNW-2	NNW	1.7	On
38	N-2	N	5.0	Off
39	NNE-2	NNE	0.7	On
40	NNE-3	NNE	5.2	Off
41	NE-1	NE	0.8	On
42	NE-2	NE	5.0	Off
43	ENE-2	ENE	6.2	Off
44	E-1	E	0.8	On
45	E-2	E	5.2	Off
46	ESE-1	ESE	0.9	On
47	ESE-2	ESE	3.0	Off
48	SE-1	SE	0.5	On
49	SE-2	SE	5.4	Off
50	SSE-1	SSE	5.1	Off
51	S-1	S	3.1	Off
52	S-2	S	4.8	Off
53	SSW-1	SSW	3.0	Off
54	SSW-2	SSW	4.4	Off
55	SW-1	SW	1.9	On
56	SW-2	SW	4.7	Off
58	WSW-1	WSW	2.7	Off
59	WSW-2	WSW	5.1	Off
60	WSW-3	WSW	10.5	Off
61	W-1	W	1.9	On
62	W-2	W	4.7	Off
64	WNW-1	WNW	3.3	Off
65	WNW-2	WNW	4.4	Off
66	NW-1	NW	2.2	Off
67	NW-2	NW	5.3	Off
68	NNW-1	NNW	1.0	On
69	NNW-3	NNW	5.2	Off
75	N-1A	N	1.0	On

a. See Figures A-1, A-2, and A-3.
b. Dosimeters designated "onsite" are those located 2 miles or less from the plant. Dosimeters designated "offsite" are those located more than 2 miles from the plant.

Figure A-1

Radiological Environmental Sampling Locations

Within 1 mile of the Plant

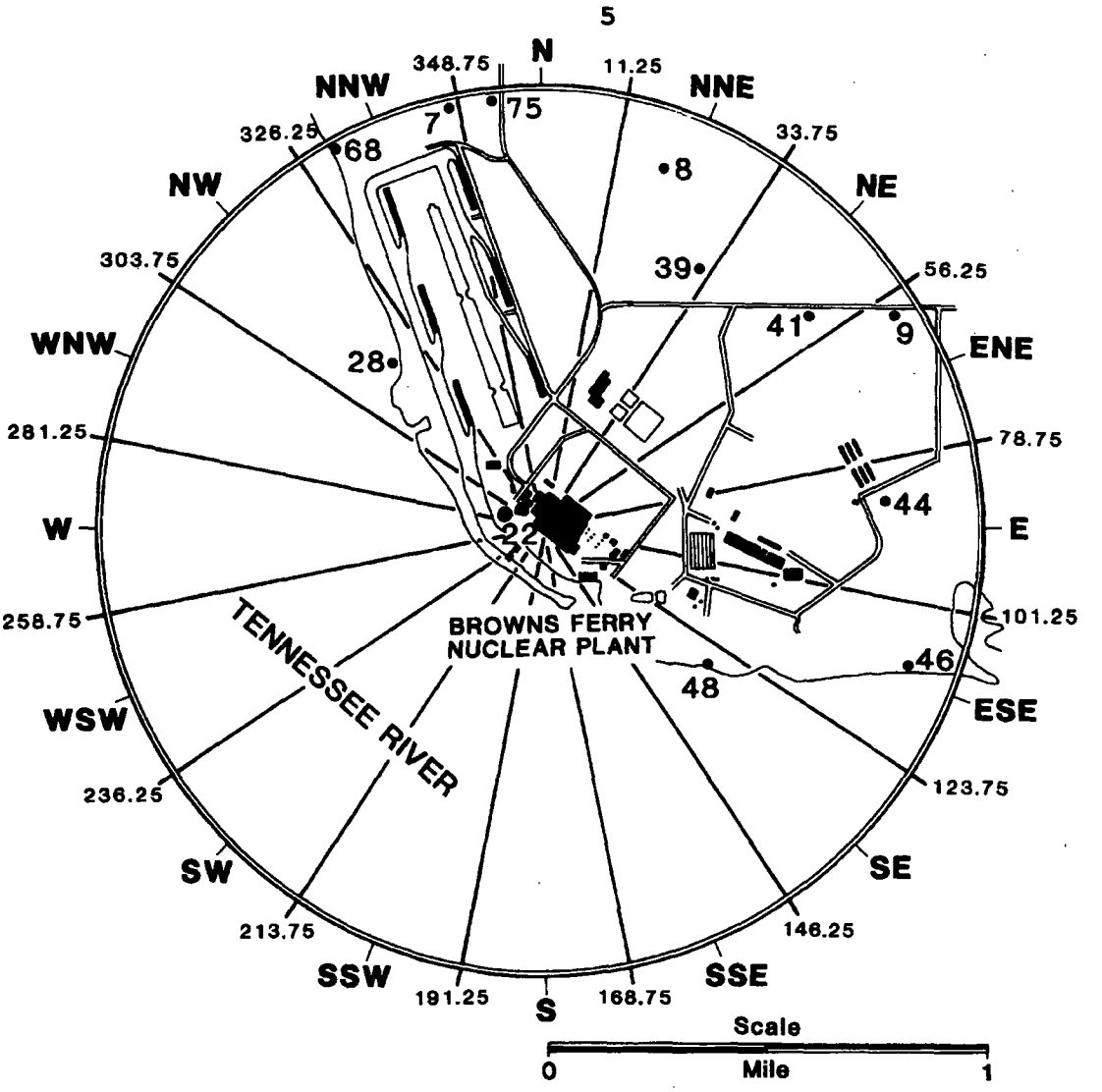


Figure A-2

Radiological Environmental Sampling Locations

1 to 5 miles from the Plant

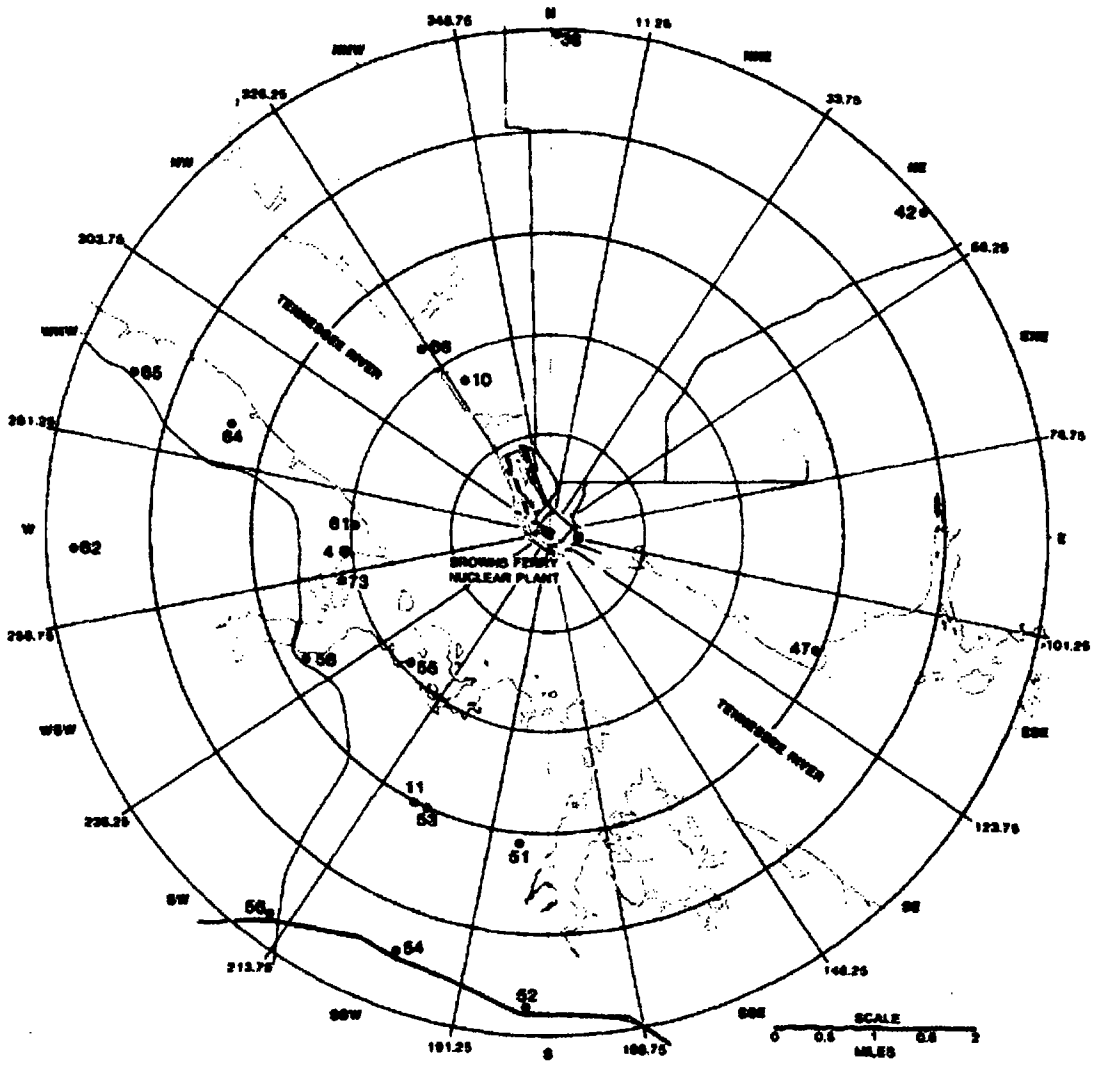
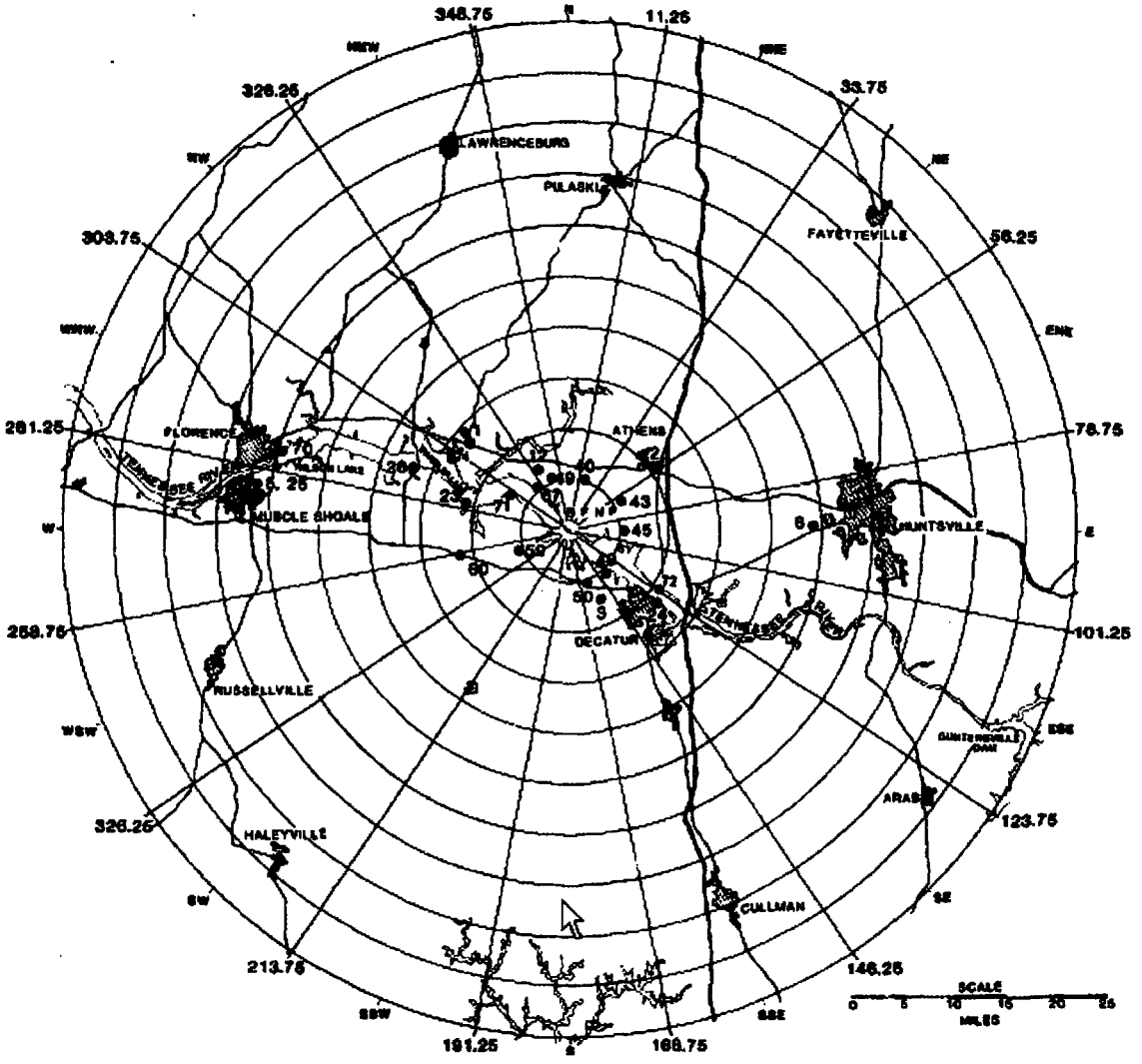


Figure A-3

Radiological Environmental Sampling Locations

Greater than 5 miles from the Plant



APPENDIX B

PROGRAM MODIFICATIONS

APPENDIX B

Radiological Environmental Monitoring Program Modifications

There were no modifications made in the Browns Ferry Nuclear Plant Radiological Environmental Monitoring Program during 2013. A program change that occurred in 2011 was not reflected at the time of the change in the Tables and Figures of Appendix A. The change involved the elimination of one of the extra environmental dosimeter locations that had to be removed due to road construction. The location was identified as station SW-3 and map location 57. Table A-3 and Figure A-3 have been revised in this report to reflect this change. This issue was documented with PER 870426.

APPENDIX C

PROGRAM DEVIATIONS

APPENDIX C

Program Deviations

Issues with sampling equipment resulted in missed air monitoring samples from one of eleven monitoring locations for three different sampling periods during the year. Environmental dosimeters were missing at a total for four locations during the year. Table C-1 provides details of these program deviations. The equipment issues were reviewed and no adverse trends in equipment performance were identified.

Table C-1
Radiological Environmental Monitoring Program Deviations

Date	Station	Location	Sample Type	Description
03/04/2013	RM-1	31.0 miles W	Air Monitor	The sample volume was not adequate for air filter and charcoal cartridge samples. The sampling pump was not running at the time of sample collection. The power cord for the pump was found unplugged. Vibration had most likely caused the cord to pull out of the plug. The cord was adjusted to allow more slack. The pump performed normally during the next sampling cycle. This problem was documented with PER 696773.
05/28/2013	RM-6	23.4 miles E	Air Monitor	The sample volume was not adequate for air filter and charcoal cartridge samples due to low flow on the sampling pump. The flow rate was adjusted and the sampler returned to normal service for the next sampling cycle. The problem was documented with PER 851977
06/17/2013	RM-6	23.4 miles E	Air Monitor	The sample volume was not adequate for air filter and charcoal cartridge samples due to problems with the sampling pump. Repairs were made and the sampler returned to normal service for the next sampling cycle. The problem was documented with PER 851993
1st QTR 2013	WSW-3	10.5 miles WSW	Dosimeter	The environmental dosimeters for the listed location were missing at the quarterly collection. The issue was documented with PER 709772
2nd QTR 2013	SW-1	1.9 miles SW	Dosimeter	The environmental dosimeters for the listed location were missing at the quarterly collection. The issue was documented with PER 753828
3rd QTR 2013	NNE-2 NE-1	0.7 miles NNE 0.8 miles NE	Dosimeter	The environmental dosimeters for the listed locations were missing at the quarterly collection. The issues were documented with PERs 791274 and 791341

APPENDIX D

ANALYTICAL PROCEDURES

Appendix D

Analytical Procedures

Analyses of environmental samples are performed by the radioanalytical laboratory located at the Western Area Radiological Laboratory facility in Muscle Shoals with the exception of the Sr-89, 90 analysis of soil samples which are performed by a commercial lab. All analysis procedures are based on accepted methods. A summary of the analysis techniques and methodology follows.

The gross beta measurements are made with an automatic low background counting system. Normal counting times are 50 minutes. Water samples are prepared by evaporating 500 milliliters of samples to near dryness, transferring to a stainless steel planchet and completing the evaporation process. Air particulate filters are counted directly in a shallow planchet.

Water samples are analyzed for tritium content by first distilling a portion of the sample and then counting by liquid scintillation. A commercially available scintillation cocktail is used.

Gamma analyses are performed in various counting geometries depending on the sample type and volume. Gamma counts are obtained with germanium detectors interfaced with a computer based multichannel analyzer system.

The charcoal cartridges used to sample gaseous radioiodine were analyzed by gamma spectroscopy using a high resolution spectroscopy system with germanium detectors.

The necessary efficiency values, weight-efficiency curves, and geometry tables are established and maintained on each detector and counting system. A series of daily and periodic quality control checks are performed to monitor counting instrumentation. System logbooks and control charts are used to document the results of the quality control checks.

APPENDIX E

NOMINAL LOWER LIMITS OF DETECTION

Appendix E

Nominal Lower Limits of Detection (LLD)

A number of factors influence the LLD for a specific analytical method, including sample size, count time, count efficiency, chemical processes, radioactive decay factors, and interfering isotopes encountered in the sample. The most probable values for these factors have been evaluated for the various analyses performed in the Radiological Environmental Monitoring Program (REMP). The nominal LLD values are calculated using the methodology prescribed in the Offsite Dose Calculation Manual (ODCM). These nominal LLD values are presented in Table E-1. The maximum LLD values specified in the ODCM are shown in Table E-2. Milk samples are not currently collected and analyzed for the Browns Ferry Nuclear Plant (BFN) REMP, but the nominal LLD values for the analysis of milk are included in the tables to maintain the historical record of the laboratory's measurement capabilities.

The nominal LLD values are also presented in the data tables. For analyses for which nominal LLD values have not been established, a LLD of zero is assumed in determining if a measured activity is greater than the nominal LLD.

TABLE E-1

Nominal LLD Values
A. Radiochemical Procedures

Analysis	Air Filters (pCi/m^3)	Water (pCi/L)	Milk (pCi/L)	Sediment and Soil (pCi/g dry)
Gross Beta	0.002	1.9	--	--
Tritium	--	270	--	--
Iodine-131	--	0.4	0.4	--
Strontium-89	--	--	3.5	1.6
Strontium-90	--	--	2.0	0.4

Table E-1
Nominal LLD Values
B. Gamma Analyses

Analysis	Air Particulates pCi/m^3	Charcoal Filter pCi/m^3	Water And Milk pCi/L	Vegetation and Grain pCi/g, dry	Wet Vegetation pCi/kg, wet	Soil and Sediment pCi/g, dry	Fish pCi/g, dry	Foods Tomatoes Potatoes, etc. pCi/kg, wet
Ce-141	0.005	0.02	10	0.07	35	0.10	0.07	20
Ce-144	0.01	0.07	30	0.15	115	0.20	0.15	60
Cr-51	0.02	0.15	45	0.30	200	0.35	0.30	95
I-131	0.005	0.03	10	0.20	60	0.25	0.20	20
Ru-103	0.005	0.02	5	0.03	25	0.03	0.03	25
Ru-106	0.02	0.12	40	0.15	190	0.20	0.15	90
Cs-134	0.005	0.02	5	0.03	30	0.03	0.03	10
Cs-137	0.005	0.02	5	0.03	25	0.03	0.03	10
Zr-95	0.005	0.03	10	0.05	45	0.05	0.05	45
Nb-95	0.005	0.02	5	0.25	30	0.04	0.25	10
Co-58	0.005	0.02	5	0.03	20	0.03	0.03	10
Mn-54	0.005	0.02	5	0.03	20	0.03	0.03	10
Zn-65	0.005	0.03	10	0.05	45	0.05	0.05	45
Co-60	0.005	0.02	5	0.03	20	0.03	0.03	10
K-40	0.04	0.30	100	0.40	400	0.75	0.40	250
Ba-140	0.015	0.07	25	0.30	130	0.30	0.30	50
La-140	0.01	0.04	10	0.20	50	0.20	0.20	25
Fe-59	0.005	0.04	10	0.08	40	0.05	0.08	25
Be-7	0.02	0.15	45	0.25	200	0.25	0.25	90
Pb-212	0.005	0.03	15	0.04	40	0.10	0.04	40
Pb-214	0.005	0.07	20	0.50	80	0.15	0.50	80
Bi-214	0.005	0.05	20	0.10	55	0.15	0.10	40
Bi-212	0.02	0.20	50	0.25	250	0.45	0.25	130
Tl-208	0.002	0.02	10	0.03	30	0.06	0.03	30
Ra-224	--	--	--	--	--	0.75	--	--
Ra-226	--	--	--	--	--	0.15	--	--
Ac-228	0.01	0.07	20	0.10	70	0.25	0.10	50
Pa-234m	--	--	800	--	--	4.0	--	--

Table E-2

Maximum LLD Values
Specified by the BFN ODCM

Analysis	Water pCi/L	Airborne Particulate or Gases pCi/m^3	Fish pCi/kg, wet	Milk pCi/L	Food Products pCi/kg, wet	Sediment pCi/kg, dry
gross beta	4	0.01	N.A.	N.A.	N.A.	N.A.
H-3	2000[a]	N.A.	N.A.	N.A.	N.A.	N.A.
Mn-54	15	N.A.	130	N.A.	N.A.	N.A.
Fe-59	30	N.A.	260	N.A.	N.A.	N.A.
Co-58, 60	15	N.A.	130	N.A.	N.A.	N.A.
Zn-65	30	N.A.	260	N.A.	N.A.	N.A.
Zr-95	30	N.A.	N.A.	N.A.	N.A.	N.A.
Nb-95	15	N.A.	N.A.	N.A.	N.A.	N.A.
I-131	1[b]	0.07	N.A.	1	60	N.A.
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-140	60	N.A.	N.A.	60	N.A.	N.A.
La-140	15	N.A.	N.A.	15	N.A.	N.A.

a. If no drinking water pathway exists, a value of 3000 pCi/L may be used.

b. LLD for analysis of drinking water and surface water samples shall be performed by gamma spectroscopy at approximately 15 pCi/L. If levels greater than 15 pCi/L are identified in surface water samples downstream from the plant, or in the event of an unanticipated release of I-131, drinking water samples will be analyzed at an LLD of 1.0 pCi/L for I-131.

APPENDIX F

QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

Appendix F

Quality Assurance/Quality Control Program

A quality assurance program is employed by the laboratory to ensure that the environmental monitoring data are reliable. This program includes the use of written, approved procedures in performing the work, provisions for staff training and certification, internal self assessments of program performance, audits by various external organizations, and a laboratory quality control program.

The quality control program employed by the radioanalytical laboratory is designed to ensure that the sampling and analysis process is working as intended. The program includes equipment checks and the analysis of quality control samples along with routine samples. Instrument quality control checks include background count rate and counts reproducibility. In addition to these two general checks, other quality control checks are performed on the variety of detectors used in the laboratory. The exact nature of these checks depends on the type of device and the method it uses to detect radiation or store the information obtained.

Quality control samples of a variety of types are used by the laboratory to verify the performance of different portions of the analytical process. These quality control samples include blanks, field and lab duplicates, analytical knowns, blind spikes, and cross-checks.

Blanks are samples which contain no measurable radioactivity or no activity of the type being measured. Such samples are analyzed to determine whether there is any contamination of equipment or commercial laboratory chemicals, cross-contamination in the chemical process, or interference from isotopes other than the one being measured.

Duplicates are samples generated at random by the sample computer program which schedules the collection of the routine samples. For example, if the routine program calls for four milk samples every week, on a random basis each farm might provide an additional sample several

times a year. These duplicate samples are analyzed along with other routine samples. They provide information about the variability of radioactive content in the various sample media.

If enough sample is available for a particular analysis, the laboratory staff can split it into two portions. Such a sample provides information about the variability of the analytical process since two identical portions of material are analyzed side by side.

Analytical knowns are another category of quality control sample. A known amount of radioactivity is added to a sample medium. The lab staff knows the radioactive content of the sample. Whenever possible, the analytical knowns contain the same amount of radioactivity each time they are run. In this way, analytical knowns provide immediate data on the quality of the measurement process.

Blind spikes are samples containing radioactivity which are introduced into the analysis process disguised as ordinary environmental samples. The lab staff does not know the sample contains radioactivity. Since the bulk of the ordinary workload of the environmental laboratory contains no measurable activity or only naturally occurring radioisotopes, blind spikes can be used to test the detection capability of the laboratory or can be used to test the data review process. If an analysis routinely generates numerous zeroes for a particular isotope, the presence of the isotope is brought to the attention of the laboratory supervisor in the daily review process. Blind spikes test this process since the blind spikes contain radioactivity at levels high enough to be detected. Furthermore, the activity can be put into such samples at the extreme limit of detection (near the LLD) to verify that the laboratory can detect very low levels of activity.

Another category of quality control samples is the internal cross-checks. These samples have a known amount of radioactivity added and are presented to the lab staff labeled as cross-check samples. This means that the quality control staff knows the radioactive content or "right answer" but the lab personnel performing the analysis do not. Such samples test the best performance of the laboratory by determining if the lab can find the "right answer". These samples provide information about the accuracy of the measurement process. Further

information is available about the variability of the process if multiple analyses are requested on the same sample. Like blind spikes or analytical knowns, these samples can also be spiked with low levels of activity to test detection limits. The analysis results for internal cross-check samples met the program performance goals for 2013.

To provide for an independent verification of the laboratory's ability to make accurate measurements, the laboratory participated in an environmental level cross-check program available through Eckert and Ziegler Analytics, during 2013 . The results of TVA's participation in this cross-check program are presented in Table F-1. As shown in Table F-1, all results were within program agreement limits.

The quality control data are routinely collected, examined and reported to laboratory supervisory personnel. They are checked for trends, problem areas, or other indications that a portion of the analytical process needs correction or improvement. The end result is a measurement process that provides reliable and verifiable data and is sensitive enough to measure the presence of radioactivity far below the levels which could be harmful to humans.

Table F-1

Results For 2013 External Cross Checks

Test Period	Sample Type / Analysis	Results Known	Results TVA	Agreement
First Quarter	Water (pCi/L)			
	Gross Beta	3.00E+02	2.58E+02	Yes
First Quarter	Water (pCi/L)			
	^{3}H	1.40E+04	1.46E+04	Yes
First Quarter	Water (pCi/L)			
	^{131}I	9.28E+01	9.52E+01	Yes
	^{51}Cr	4.52E+02	4.56E+02	Yes
	^{134}Cs	2.05E+02	2.04E+02	Yes
	^{137}Cs	2.54E+02	2.56E+02	Yes
	^{58}Co	1.99E+02	2.01E+02	Yes
	^{54}Mn	1.99E+02	2.10E+02	Yes
	^{59}Fe	2.41E+02	2.35E+02	Yes
	^{65}Zn	2.88E+02	3.12E+02	Yes
	^{60}Co	3.83E+02	3.88E+02	Yes
	^{141}Ce	1.79E+02	1.84E+02	Yes
First Quarter	Synthetic Urine (pCi/L)			
	^{3}H	1.41E+04	1.32E+04	Yes
First Quarter	Milk (pCi/L)			
	^{131}I	1.00E+02	1.05E+02	Yes
	^{89}Sr	8.90E+01	9.76E+01	Yes
	^{90}Sr	9.82E+00	1.05E+01	Yes
First Quarter	Air Filter (pCi/Filter)			
	Gross Beta	8.46E+01	8.20E+01	Yes
Third Quarter	Water (pCi/L)			
	^{3}H	9.96E+03	1.06E+04	Yes
Third Quarter	Sand (pCi/gram)			
	^{51}Cr	6.01E-01	5.87E-01	Yes
	^{134}Cs	3.73E-01	3.39E-01	Yes
	^{137}Cs	2.83E-01	2.70E-01	Yes
	^{58}Co	2.33E-01	2.43E-01	Yes
	^{54}Mn	3.01E-01	3.23E-01	Yes
	^{59}Fe	2.83E-01	2.88E-01	Yes
	^{65}Zn	5.77E-01	6.31E-01	Yes
	^{60}Co	4.24E-01	4.41E-01	Yes
Third Quarter	Air Filter (pCi/Filter)			
	Gross Beta	9.25E+01	8.63E+01	Yes
Third Quarter	Air Filter (pCi/Filter)			
	^{51}Cr	2.22E+02	2.06E+02	Yes
	^{134}Cs	1.38E+02	1.16E+02	Yes
	^{137}Cs	1.05E+02	1.02E+02	Yes
	^{58}Co	8.63E+01	8.63E+01	Yes
	^{54}Mn	1.11E+02	1.14E+02	Yes
	^{59}Fe	1.05E+02	1.05E+02	Yes
	^{65}Zn	2.13E+02	2.21E+02	Yes
	^{60}Co	1.57E+02	1.59E+02	Yes
Third Quarter	Synthetic Urine (pCi/L)			
	^{3}H	1.01E+04	1.02E+04	Yes
Third Quarter	Milk (pCi/L)			
	^{131}I	9.56E+01	1.04E+02	Yes
	^{89}Sr	8.98E+01	1.00E+02	Yes
	^{90}Sr	1.24E+01	1.02E+01	Yes

APPENDIX G

LAND USE SURVEY

Appendix G

Land Use Survey

A land use survey was conducted to identify the nearest milk animal, the nearest residence, and the nearest garden of greater than 500 square feet producing fresh leafy vegetables in each of 16 meteorological sectors within a distance of 5 miles (8 km) from the plant. The land use survey also identifies all gardens of greater than 500 square feet producing fresh leafy vegetables within a distance of 3 miles (5 km) from the plant.

The land use survey was conducted between April 1, 2013, and October 1, 2013, using appropriate techniques such as door-to-door survey, mail survey, telephone survey, aerial survey, or information from local agricultural authorities or other reliable sources.

In order to identify the locations around Browns Ferry Nuclear Plant (BFN) which have the greatest relative potential for impact by the plant, radiation doses were projected for individuals living near BFN. These projections used the data obtained in the survey and historical meteorological data. The calculations also assumed that releases were equivalent to the design basis source terms. The dose projections are relative in nature and do not reflect actual exposures to individuals living near BFN.

Dose projections from air submersion were calculated for the nearest resident in each sector and dose projections from eating foods produced near the plant were calculated for the areas with gardens.

The location of the nearest resident changed in one sector in 2013. The location of the nearest garden as identified in the 2013 survey changed in six sectors.

There were no locations identified within the five mile radius with milk production for human consumption.

Tables G-1 and G-2 show the comparative calculated doses for 2013 and 2012.

Table G-1
BROWNS FERRY NUCLEAR PLANT

Relative Projected Annual Air Submersion Dose to the Nearest Resident
Within 8 km (5 Miles) of the Plant
(mrem/Year)

	2012 Survey		2013 Survey	
Sector	Approximate Distance Meters	Annual Dose	Approximate Distance Meters	Annual Dose
N	2,440	0.34	2,440	0.34
NNE	2,750	0.14	2,620	0.14
NE	2,020	0.17	2,020	0.17
ENE	2,460	0.17	2,460	0.17
E	1,410	0.40	1,410	0.40
ESE	1,750	0.24	1,750	0.24
SE	a	--	a	--
SSE	a	--	a	--
S	4,540	0.15	4,540	0.15
SSW	4,610	0.16	4,610	0.16
SW	4,650	0.10	4,650	0.10
WSW	4,200	0.07	4,200	0.07
W	2,660	0.17	2,660	0.17
WNW	5,280	0.10	5,280	0.10
NW	3,150	0.33	3,150	0.33
NNW	1,650	0.75	1,650	0.75

a. There is no residence within the 8 km radius for this sector.

Table G-2

BROWNS FERRY NUCLEAR PLANT

Relative Projected Annual Dose to Child's Bone from
Ingestion of Home-Grown Foods
(mrem/Year)

	2012 Survey		2013 Survey		
Sector	Approximate Distance Meters	Annual Dose	Approximate Distance Meters	Annual Dose	Number of Gardens Within 5 km (3 Miles) for 2013
N	2,540	5.99	2,540	5.99	2
NNE	5,910	0.90	2,750	2.62	1
NE	3,790	1.50	3,790	1.50	2
ENE	4,700	1.19	5,070	1.06	1
E	1,410	6.70	1,410	6.70	1
ESE	1,830	6.10	1,830	6.10	5
SE	a	--	a	--	0
SSE	a	--	a	--	0
S	4,540	2.24	4,540	2.24	1
SSW	5,000	2.06	4,880	2.14	1
SW	4,920	1.01	4,940	1.00	1
WSW	4,330	0.60	4,330	0.60	1
W	3,180	1.05	2,860	1.20	2
WNW	a	--	a	--	0
NW	a	--	a	--	0
NNW	1,790	9.95	2,680	6.02	2

a. No garden was found within 8 km radius for this sector.

APPENDIX H

DATA TABLES AND FIGURES

Table H-1

DIRECT RADIATION LEVELS

2013 Average External Gamma Radiation Levels On-site and Off-site for Browns Ferry Nuclear Plant for Each Quarter (mR / Quarter) [a]

Average External Gamma Radiation Levels [b]

	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	mR/Yr
Average, 0 - 2 miles (onsite)	18.1	18.9	19	18.5	75
Average, > 2 miles (offsite)	15.1	14.1	16.1	13.9	59

a. Field periods normalized to one standard quarter (2190 hours).
b. Average of the individual measurements in the set.

Table H-2 (1 of 2)

DIRECT RADIATION LEVELS

Individual Stations at Browns Ferry Nuclear Plant

Map Location Number	Dosimeter Station Number	Direction, Degrees	Approx Distance, Miles	Environmental Radiation Levels mR / Quarter 1st Qtr Jan - Mar 2013	2nd Qtr Apr - Jun 2013	3rd Qtr Jul - Sep 2013	4th Qtr Oct - Dec 2013	Annual[1] Exposure mR/Year
7	N-1	348	1.0	20.8	22.0	17.3	22.8	82.9
75	N-1A	355	1.0	19.7	23.4	21.6	20.0	84.7
38	N-2	1	5.0	14.0	12.6	15.1	13.2	54.9
8	NNE-1	12	0.9	17.4	19.6	19.4	20.0	76.4
39	NNE-2	31	0.7	16.3	16.4	(1)	20.4	70.8
40	NNE-3	19	5.2	13.5	14.5	15.1	12.7	55.8
41	NE-1	51	0.8	19.1	20.1	(1)	19.0	77.6
42	NE-2	49	5.0	17.4	16.4	18.9	15.5	68.2
2	NE-3	56	10.9	16.8	14.9	18.4	15.1	65.2
9	ENE-1	61	0.9	16.8	22.9	21.6	16.7	78.0
43	ENE-2	62	6.2	16.8	16.4	17.8	15.5	66.5
44	E-1	85	0.8	20.8	18.7	23.2	23.7	86.4
45	E-2	91	5.2	13.5	17.3	15.7	14.1	60.6
6	E-3	90	23.1	16.8	15.4	18.4	17.9	68.5
46	ESE-1	110	0.9	16.8	14.5	16.2	16.7	64.2
47	ESE-2	112	3.0	16.8	12.1	17.3	14.6	60.8
48	SE-1	130	0.5	17.4	19.2	19.4	17.6	73.6
49	SE-2	135	5.4	16.3	15.9	17.3	16.0	65.5
50	SSE-1	163	5.1	12.9	15.4	16.2	13.2	57.7
3	SSE-2	165	7.5	15.7	17.8	17.8	14.6	65.9
51	S-1	185	3.1	14.6	17.3	16.8	14.6	63.3

(1) Sum of available quarterly data normalized to 1 year for the annual exposure value.

Table H-2 (2 of 2)

DIRECT RADIATION LEVELS

Individual Stations at Browns Ferry Nuclear Plant

				Environmental Radiation Levels mR / Quarter				
Map Location Number	Dosimeter Station Number	Direction, Degrees	Approx Distance, Miles	1st Qtr Jan - Mar 2013	2nd Qtr Apr - Jun 2013	3rd Qtr Jul - Sep 2013	4th Qtr Oct - Dec 2013	Annual[1] Exposure mR/Year
52	S-2	182	4.8	15.2	10.2	13.0	10.9	49.3
53	SSW-1	203	3.0	15.7	11.2	16.8	11.8	55.5
54	SSW-2	199	4.4	15.7	13.5	14.6	13.2	57.0
55	SW-1	228	1.9	16.8	(1)	15.1	14.4	61.7
56	SW-2	219	4.7	17.4	12.6	15.7	12.7	58.4
58	WSW-1	244	2.7	12.3	11.2	15.7	10.9	50.1
59	WSW-2	251	5.1	15.7	15.4	16.8	15.5	63.4
60	WSW-3	257	10.5	(1)	14.0	14.1	12.7	54.4
61	W-1	275	1.9	15.7	16.8	20.0	13.0	65.5
62	W-2	268	4.7	14.0	14.5	14.6	11.8	54.9
5	W-3	275	31.0	13.5	12.1	14.6	13.7	53.9
64	WNW-1	291	3.3	15.7	12.6	15.1	13.7	57.1
65	WNW-2	293	4.4	14.0	12.1	16.2	15.1	57.4
66	NW-1	326	2.2	11.2	12.1	13.5	13.7	50.5
67	NW-2	321	5.3	14.0	18.7	18.4	16.5	67.6
1	NW-3	310	13.8	14.6	9.8	14.1	12.7	51.2
68	NNW-1	331	1.0	17.4	16.4	16.2	19.5	69.5
10	NNW-2	331	1.7	19.7	16.8	19.4	16.2	72.1
69	NNW-3	339	5.2	17.4	14.9	17.8	14.1	64.2

(1) Sum of available quarterly data normalized to 1 year for the annual exposure value.

Tennessee Valley Authority

RADIOACTIVITY IN AIR FILTER

pCi/m^3 = 0.037 Bq/m^3

Name of Facility: BROWNS FERRY NUCLEAR PLANT
Location of Facility: LIMESTONE, ALABAMA

Docket Number: 50-259,260,296
Reporting Period: 2013

Type and Total Number of Analysis Performed	Lower Limit of Detection (LLD) See Note 1	Indicator Locations Mean (F) Range See Note 2	Location with Highest Annual Mean Location Description with Distance and Direction	Mean (F) Range See Note 2	Control Locations Mean (F) Range See Note 2	Number of Nonroutine Reported Measurements See Note 3
GROSS BETA - 569						
	2.00E-03	2.09E-02 (468 / 468) 8.50E-03 - 4.66E-02	LM-6BF BAKER BOTTOM 3.0 MILES SSW	2.20E-02 (52 / 52) 9.56E-03 - 4.66E-02	2.15E-02 (101 / 101) 7.93E-03 - 4.39E-02	
GAMMA SCAN (GELI) - 143						
AC-228	1.00E-02	1.01E-02 (1 / 117) 1.01E-02 - 1.01E-02	LM2 BF NORTH 0.9 MILE NNE	1.01E-02 (1 / 13) 1.01E-02 - 1.01E-02	26 VALUES < LLD	
BE-7	2.00E-02	1.02E-01 (117 / 117) 5.39E-02 - 1.36E-01	LM-6BF BAKER BOTTOM 3.0 MILES SSW	1.08E-01 (13 / 13) 7.91E-02 - 1.36E-01	1.03E-01 (26 / 26) 7.17E-02 - 1.28E-01	
BI-214	5.00E-03	2.30E-02 (117 / 117) 7.80E-03 - 8.07E-02	LM4 BF TRAILER P 1.7 MILES NNW	3.03E-02 (13 / 13) 1.64E-02 - 6.38E-02	2.44E-02 (26 / 26) 6.60E-03 - 7.35E-02	
K-40	4.00E-02	117 VALUES < LLD	LM2 BF NORTH 0.9 MILE NNE	13 VALUES < LLD	26 VALUES < LLD	
PB-212	5.00E-03	117 VALUES < LLD	LM2 BF NORTH 0.9 MILE NNE	13 VALUES < LLD	5.45E-03 (2 / 26) 5.30E-03 - 5.60E-03	
PB-214	5.00E-03	2.21E-02 (117 / 117) 5.70E-03 - 7.69E-02	LM4 BF TRAILER P 1.7 MILES NNW	3.07E-02 (13 / 13) 1.49E-02 - 7.01E-02	2.34E-02 (26 / 26) 5.00E-03 - 7.42E-02	
TL-208	2.00E-03	2.23E-03 (3 / 117) 2.00E-03 - 2.40E-03	PM-3 BF DECATUR AL 8.2 MILES SSE	2.40E-03 (1 / 13) 2.40E-03 - 2.40E-03	2.25E-03 (2 / 26) 2.20E-03 - 2.30E-03	

Notes: 1. Nominal Lower Level of Detection (LLD) as described in Table E - 1
2. Mean and Range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).
3. Blanks in this column indicate no nonrountine measurements

Tennessee Valley Authority

RADIOACTIVITY IN CHARCOAL FILTER

pCi/m^3 = 0.037 Bq/m^3

Name of Facility: BROWNS FERRY NUCLEAR PLANT
Location of Facility: LIMESTONE, ALABAMA

Docket Number: 50-259,260,296
Reporting Period: 2013

Type and Total Number of Analysis Performed	Lower Limit of Detection (LLD) See Note 1	Indicator Locations Mean (F) Range See Note 2	Location with Highest Annual Mean: Location Description with Distance and Direction	Location with Highest Annual Mean: Mean (F) Range See Note 2	Control Locations Mean (F) Range See Note 2	Number of Nonroutine Reported Measurements See Note 3
GAMMA SCAN (GELI) - 569						
AC-228	7.00E-02	7.40E-02 (1 / 468) 7.40E-02 - 7.40E-02	LM1 BF NORTHWEST 1.0 MILE N	7.40E-02 (1 / 52) 7.40E-02 - 7.40E-02	101 VALUES < LLD	
BI-214	5.00E-02	8.77E-02 (267 / 468) 5.01E-02 - 4.12E-01	LM4 BF TRAILER P 1.7 MILES NNW	1.06E-01 (41 / 52) 5.13E-02 - 2.32E-01	8.50E-02 (52 / 101) 5.08E-02 - 2.43E-01	
I-131	3.00E-02	SEE NOTE 4				
K-40	3.00E-01	3.45E-01 (52 / 468) 3.01E-01 - 5.05E-01	LM1 BF NORTHWEST 1.0 MILE N	3.67E-01 (10 / 52) 3.15E-01 - 4.63E-01	3.70E-01 (9 / 101) 3.10E-01 - 4.97E-01	
PB-212	3.00E-02	468 VALUES < LLD	PM-3 BF DECATUR AL 8.2 MILES SSE	52 VALUES < LLD	101 VALUES < LLD	
PB-214	7.00E-02	1.16E-01 (154 / 468) 7.05E-02 - 3.85E-01	LM2 BF NORTH 0.9 MILE NNE	1.49E-01 (7 / 52) 7.73E-02 - 3.85E-01	1.14E-01 (23 / 101) 7.03E-02 - 2.00E-01	
TL-208	2.00E-02	468 VALUES < LLD	PM-3 BF DECATUR AL 8.2 MILES SSE	52 VALUES < LLD	101 VALUES < LLD	

Notes:
1. Nominal Lower Level of Detection (LLD) as described in Table E - 1
2. *Mean and Range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).*
3. Blanks in this column indicate no nonrountine measurements
4. The analysis of Charcoal Filters was performed by Gamma Spectroscopy. No I-131 was detected. The LLD for I-131 by Gamma Spectroscopy was 0.03 pCi/cubic meter.

Tennessee Valley Authority

RADIOACTIVITY IN SOIL
pCi/g = 0.037 Bq/g (DRY WEIGHT)

Name of Facility: BROWNS FERRY NUCLEAR PLANT
Location of Facility: LIMESTONE, ALABAMA

Docket Number: 50-259,260,296
Reporting Period: 2013

Type and Total Number of Analysis Performed	Lower Limit of Detection (LLD) See Note 1	Indicator Locations Mean (F) Range See Note 2	Location with Highest Annual Mean Location Description with Distance and Direction	Mean (F) Range See Note 2	Control Locations Mean (F) Range See Note 2	Number of Nonroutine Reported Measurements See Note 3
GAMMA SCAN (GELI) - 11						
AC-228	2.50E-01	1.04E+00 (9 / 9) 5.03E-01 - 1.36E+00	PM-3 BF DECATUR AL 8.2 MILES SSE	1.36E+00 (1 / 1) 1.36E+00 - 1.36E+00	7.55E-01 (2 / 2) 6.99E-01 - 8.11E-01	
BE-7	2.50E-01	9 VALUES < LLD	LM3 BF NORTHEAST 1.0 MILE ENE	1 VALUES < LLD	2 VALUES < LLD	
BI-212	4.50E-01	1.10E+00 (9 / 9) 4.74E-01 - 1.35E+00	LM1 BF NORTHWEST 1.0 MILE N	1.35E+00 (1 / 1) 1.35E+00 - 1.35E+00	8.12E-01 (2 / 2) 7.99E-01 - 8.25E-01	
BI-214	1.50E-01	9.12E-01 (9 / 9) 5.55E-01 - 1.08E+00	LM1 BF NORTHWEST 1.0 MILE N	1.08E+00 (1 / 1) 1.08E+00 - 1.08E+00	8.11E-01 (2 / 2) 7.44E-01 - 8.77E-01	
CS-137	3.00E-02	1.43E-01 (8 / 9) 4.06E-02 - 2.41E-01	LM-6BF BAKER BOTTOM 3.0 MILES SSW	2.41E-01 (1 / 1) 2.41E-01 - 2.41E-01	6.89E-02 (2 / 2) 6.77E-02 - 7.00E-02	
K-40	7.50E-01	4.75E+00 (9 / 9) 1.91E+00 - 6.71E+00	LM1 BF NORTHWEST 1.0 MILE N	6.71E+00 (1 / 1) 6.71E+00 - 6.71E+00	3.91E+00 (2 / 2) 3.28E+00 - 4.54E+00	
PA-234M	4.00E+00	9 VALUES < LLD	LM1 BF NORTHWEST 1.0 MILE N	1 VALUES < LLD	2 VALUES < LLD	
PB-212	1.00E-01	1.01E+00 (9 / 9) 4.55E-01 - 1.26E+00	PM-3 BF DECATUR AL 8.2 MILES SSE	1.26E+00 (1 / 1) 1.26E+00 - 1.26E+00	7.24E-01 (2 / 2) 6.84E-01 - 7.63E-01	
PB-214	1.50E-01	9.88E-01 (9 / 9) 5.78E-01 - 1.19E+00	LM1 BF NORTHWEST 1.0 MILE N	1.19E+00 (1 / 1) 1.19E+00 - 1.19E+00	8.92E-01 (2 / 2) 8.07E-01 - 9.77E-01	
RA-224	7.50E-01	1.27E+00 (6 / 9) 7.76E-01 - 1.95E+00	PM-3 BF DECATUR AL 8.2 MILES SSE	1.95E+00 (1 / 1) 1.95E+00 - 1.95E+00	7.62E-01 (1 / 2) 7.62E-01 - 7.62E-01	
RA-226	1.50E-01	9.12E-01 (9 / 9) 5.55E-01 - 1.08E+00	LM1 BF NORTHWEST 1.0 MILE N	1.08E+00 (1 / 1) 1.08E+00 - 1.08E+00	8.11E-01 (2 / 2) 7.44E-01 - 8.77E-01	
TL-208	6.00E-02	3.42E-01 (9 / 9) 1.54E-01 - 4.31E-01	PM-3 BF DECATUR AL 8.2 MILES SSE	4.31E-01 (1 / 1) 4.31E-01 - 4.31E-01	2.45E-01 (2 / 2) 2.31E-01 - 2.58E-01	
SR 89 - 11						
	1.60E+00	9 VALUES < LLD			2 VALUES < LLD	
SR 90 - 11						

Notes: 1. Nominal Lower Level of Detection (LLD) as described in Table E - 1
2. Mean and Range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).
3. Blanks in this column indicate no nonrountine measurements

Tennessee Valley Authority

RADIOACTIVITY IN SOIL
pCi/g = 0.037 Bq/g (DRY WEIGHT)

Name of Facility: BROWNS FERRY NUCLEAR PLANT
Location of Facility: LIMESTONE, ALABAMA

Docket Number: 50-259,260,296
Reporting Period: 2013

Type and Total Number of Analysis Performed	Lower Limit of Detection (LLD) See Note 1	Indicator Locations Mean (F) Range See Note 2	Location with Highest Annual Mean Location Description with Distance and Direction	Mean (F) Range See Note 2	Control Locations Mean (F) Range See Note 2	Number of Nonroutine Reported Measurements See Note 3
SR 90 -						
	4.00E-01	9 VALUES < LLD			2 VALUES < LLD	

Table H-5 continued

Notes: 1. Nominal Lower Level of Detection (LLD) as described in Table E - 1
2. *Mean and Range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).*
3. Blanks in this column indicate no nonroutine measurements

Tennessee Valley Authority

RADIOACTIVITY IN APPLES
pCi/Kg = 0.037 Bq/Kg (WET WEIGHT)

Name of Facility: BROWNS FERRY NUCLEAR PLANT
Location of Facility: LIMESTONE, ALABAMA

Docket Number: 50-259,260,296
Reporting Period: 2013

Type and Total Number of Analysis Performed	Lower Limit of Detection (LLD) See Note 1	Indicator Locations Mean (F) Range See Note 2	Location with Highest Annual Mean Location Description with Distance and Direction	Mean (F) Range See Note 2	Control Locations Mean (F) Range See Note 2	Number of Nonroutine Reported Measurements See Note 3
GAMMA SCAN (GELI) - 2						
BI-214	4.00E+01	6.63E+01 (1 / 1) 6.63E+01 - 6.63E+01	1 MILE NNW	6.63E+01 (1 / 1) 6.63E+01 - 6.63E+01	8.50E+01 (1 / 1) 8.50E+01 - 8.50E+01	
K-40	2.50E+02	8.74E+02 (1 / 1) 8.74E+02 - 8.74E+02	1 MILE NNW	8.74E+02 (1 / 1) 8.74E+02 - 8.74E+02	6.55E+02 (1 / 1) 6.55E+02 - 6.55E+02	
PB-214	8.00E+01	1 VALUES < LLD	1 MILE NNW	1 VALUES < LLD	1 VALUES < LLD	

Table H-6

Notes: 1. Nominal Lower Level of Detection (LLD) as described in Table E - 1
2. Mean and Range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).
3. Blanks in this column indicate no nonrountine measurements

Tennessee Valley Authority

RADIOACTIVITY IN CABBAGE
pCi/Kg = 0.037 Bq/Kg (WET WEIGHT)

Name of Facility: BROWNS FERRY NUCLEAR PLANT
Location of Facility: LIMESTONE, ALABAMA

Docket Number: 50-259,260,296
Reporting Period: 2013

Type and Total Number of Analysis Performed	Lower Limit of Detection (LLD) See Note 1	Indicator Locations Mean (F) Range See Note 2	Location with Highest Annual Mean Location Description with Distance and Direction	Mean (F) Range See Note 2	Control Locations Mean (F) Range See Note 2	Number of Nonroutine Reported Measurements See Note 3
GAMMA SCAN (GELI) - 2						
AC-228	5.00E+01	1 VALUES < LLD	LM-6BF BAKER BOTTOM 3.0 MILES SSW	1 VALUES < LLD	1 VALUES < LLD	
BI-214	4.00E+01	6.11E+01 (1 / 1) 6.11E+01 - 6.11E+01	LM-6BF BAKER BOTTOM 3.0 MILES SSW	6.11E+01 (1 / 1) 6.11E+01 - 6.11E+01	6.52E+01 (1 / 1) 6.52E+01 - 6.52E+01	
K-40	2.50E+02	1.33E+03 (1 / 1) 1.33E+03 - 1.33E+03	LM-6BF BAKER BOTTOM 3.0 MILES SSW	1.33E+03 (1 / 1) 1.33E+03 - 1.33E+03	9.21E+02 (1 / 1) 9.21E+02 - 9.21E+02	
PB-212	4.00E+01	1 VALUES < LLD	LM-6BF BAKER BOTTOM 3.0 MILES SSW	1 VALUES < LLD	1 VALUES < LLD	
PB-214	8.00E+01	1 VALUES < LLD	LM-6BF BAKER BOTTOM 3.0 MILES SSW	1 VALUES < LLD	1 VALUES < LLD	
TL-208	3.00E+01	1 VALUES < LLD	LM-6BF BAKER BOTTOM 3.0 MILES SSW	1 VALUES < LLD	1 VALUES < LLD	

Notes: 1. Nominal Lower Level of Detection (LLD) as described in Table E - 1
2. Mean and Range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).
3. Blanks in this column indicate no nonrountine measurements

Tennessee Valley Authority

RADIOACTIVITY IN CORN
pCi/Kg = 0.037 Bq/Kg (WET WEIGHT)

Name of Facility: BROWNS FERRY NUCLEAR PLANT
Location of Facility: LIMESTONE, ALABAMA

Docket Number: 50-259,260,296
Reporting Period: 2013

Type and Total Number of Analysis Performed	Lower Limit of Detection (LLD) See Note 1	Indicator Locations Mean (F) Range See Note 2	Location with Highest Annual Mean Location Description with Distance and Direction	Mean (F) Range See Note 2	Control Locations Mean (F) Range See Note 2	Number of Nonroutine Reported Measurements See Note 3
GAMMA SCAN (GELI) - 2						
BI-214	4.00E+01	7.47E+01 (1 / 1) 7.47E+01 - 7.47E+01	LM-6BF BAKER BOTTOM 3.0 MILES SSW	7.47E+01 (1 / 1) 7.47E+01 - 7.47E+01	5.62E+01 (1 / 1) 5.62E+01 - 5.62E+01	
K-40	2.50E+02	2.12E+03 (1 / 1) 2.12E+03 - 2.12E+03	LM-6BF BAKER BOTTOM 3.0 MILES SSW	2.12E+03 (1 / 1) 2.12E+03 - 2.12E+03	2.14E+03 (1 / 1) 2.14E+03 - 2.14E+03	
PB-212	4.00E+01	1 VALUES < LLD	LM-6BF BAKER BOTTOM 3.0 MILES SSW	1 VALUES < LLD	1 VALUES < LLD	
PB-214	8.00E+01	1 VALUES < LLD	LM-6BF BAKER BOTTOM 3.0 MILES SSW	1 VALUES < LLD	1 VALUES < LLD	
TL-208	3.00E+01	1 VALUES < LLD	LM-6BF BAKER BOTTOM 3.0 MILES SSW	1 VALUES < LLD	1 VALUES < LLD	

Notes: 1. Nominal Lower Level of Detection (LLD) as described in Table E - 1
2. Mean and Range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).
3. Blanks in this column indicate no nonrountine measurements

Tennessee Valley Authority

RADIOACTIVITY IN GREEN BEANS
pCi/Kg = 0.037 Bq/Kg (WET WEIGHT)

Name of Facility: BROWNS FERRY NUCLEAR PLANT
Location of Facility: LIMESTONE, ALABAMA

Docket Number: 50-259,260,296
Reporting Period: 2013

Type and Total Number of Analysis Performed	Lower Limit of Detection (LLD) See Note 1	Indicator Locations Mean (F) Range See Note 2	Location with Highest Annual Mean Location Description with Distance and Direction	Mean (F) Range See Note 2	Control Locations Mean (F) Range See Note 2	Number of Nonroutine Reported Measurements See Note 3
GAMMA SCAN (GELI) - 2						
AC-228	5.00E+01	1 VALUES < LLD	LM4 BF TRAILER P 1.7 MILES NNW	1 VALUES < LLD	1 VALUES < LLD	
BI-214	4.00E+01	6.92E+01 (1 / 1) 6.92E+01 - 6.92E+01	LM4 BF TRAILER P 1.7 MILES NNW	6.92E+01 (1 / 1) 6.92E+01 - 6.92E+01	1.57E+02 (1 / 1) 1.57E+02 - 1.57E+02	
K-40	2.50E+02	1.78E+03 (1 / 1) 1.78E+03 - 1.78E+03	LM4 BF TRAILER P 1.7 MILES NNW	1.78E+03 (1 / 1) 1.78E+03 - 1.78E+03	1.98E+03 (1 / 1) 1.98E+03 - 1.98E+03	
PB-212	4.00E+01	1 VALUES < LLD	LM4 BF TRAILER P 1.7 MILES NNW	1 VALUES < LLD	1 VALUES < LLD	
PB-214	8.00E+01	1 VALUES < LLD	LM4 BF TRAILER P 1.7 MILES NNW	1 VALUES < LLD	1 VALUES < LLD	

Table H-9

Notes: 1. Nominal Lower Level of Detection (LLD) as described in Table E - 1
2. Mean and Range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).
3. Blanks in this column indicate no nonrountine measurements

Tennessee Valley Authority

RADIOACTIVITY IN TOMATOES
pCi/Kg = 0.037 Bq/Kg (WET WEIGHT)

Name of Facility: BROWNS FERRY NUCLEAR PLANT
Location of Facility: LIMESTONE, ALABAMA

Docket Number: 50-259,260,296
Reporting Period: 2013

Type and Total Number of Analysis Performed	Lower Limit of Detection (LLD) See Note 1	Indicator Locations Mean (F) Range See Note 2	Location with Highest Annual Mean Location Description with Distance and Direction	Mean (F) Range See Note 2	Control Locations Mean (F) Range See Note 2	Number of Nonroutine Reported Measurements See Note 3
GAMMA SCAN (GELI) - 2						
BI-214	4.00E+01	7.72E+01 (1 / 1) 7.72E+01 - 7.72E+01	2 MILES NE	7.72E+01 (1 / 1) 7.72E+01 - 7.72E+01	8.41E+01 (1 / 1) 8.41E+01 - 8.41E+01	
K-40	2.50E+02	1.80E+03 (1 / 1) 1.80E+03 - 1.80E+03	2 MILES NE	1.80E+03 (1 / 1) 1.80E+03 - 1.80E+03	2.23E+03 (1 / 1) 2.23E+03 - 2.23E+03	
PB-214	8.00E+01	8.07E+01 (1 / 1) 8.07E+01 - 8.07E+01	2 MILES NE	8.07E+01 (1 / 1) 8.07E+01 - 8.07E+01	8.07E+01 (1 / 1) 8.07E+01 - 8.07E+01	

Table H-10

Notes: 1. Nominal Lower Level of Detection (LLD) as described in Table E - 1
2. Mean and Range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).
3. Blanks in this column indicate no nonrountine measurements

Tennessee Valley Authority

RADIOACTIVITY IN SURFACE WATER (Total)

pCi/L = 0.037 Bq/L

Name of Facility: BROWNS FERRY NUCLEAR PLANT
Location of Facility: LIMESTONE, ALABAMA

Docket Number: 50-259,260,296
Reporting Period: 2013

Type and Total Number of Analysis Performed	Lower Limit of Detection (LLD) See Note 1	Indicator Locations Mean (F) Range See Note 2	Location with Highest Annual Mean Location Description with Distance and Direction	Mean (F) Range See Note 2	Control Locations Mean (F) Range See Note 2	Number of Nonroutine Reported Measurements See Note 3
GROSS BETA - 26						
	1.90E+00	2.62E+00 (9 / 13) 2.02E+00 - 3.49E+00	TRM 293.5	2.62E+00 (9 / 13) 2.02E+00 - 3.49E+00	2.53E+00 (9 / 13) 2.23E+00 - 3.27E+00	
GAMMA SCAN (GELI) - 26						
AC-228	2.00E+01	13 VALUES < LLD	TRM 293.5	13 VALUES < LLD	13 VALUES < LLD	
BI-214	2.00E+01	2.99E+01 (9 / 13) 2.01E+01 - 4.91E+01	TRM 293.5	2.99E+01 (9 / 13) 2.01E+01 - 4.91E+01	3.88E+01 (6 / 13) 2.81E+01 - 4.86E+01	
K-40	1.00E+02	13 VALUES < LLD	TRM 293.5	13 VALUES < LLD	13 VALUES < LLD	
PB-212	1.50E+01	1.70E+01 (1 / 13) 1.70E+01 - 1.70E+01	TRM 293.5	1.70E+01 (1 / 13) 1.70E+01 - 1.70E+01	1.61E+01 (1 / 13) 1.61E+01 - 1.61E+01	
PB-214	2.00E+01	3.30E+01 (4 / 13) 2.29E+01 - 4.40E+01	TRM 293.5	3.30E+01 (4 / 13) 2.29E+01 - 4.40E+01	3.62E+01 (5 / 13) 2.32E+01 - 4.51E+01	
TL-208	1.00E+01	13 VALUES < LLD	TRM 293.5	13 VALUES < LLD	13 VALUES < LLD	
TRITIUM - 8						
	2.70E+02	4 VALUES < LLD			4 VALUES < LLD	

Notes: 1. Nominal Lower Level of Detection (LLD) as described in Table E - 1
2. Mean and Range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).
3. Blanks in this column indicate no nonrountine measurements

Tennessee Valley Authority

RADIOACTIVITY IN PUBLIC (DRINKING) WATER (Total)

pCi/L = 0.037 Bq/L

Name of Facility: BROWNS FERRY NUCLEAR PLANT
Location of Facility: LIMESTONE, ALABAMA

Docket Number: 50-259,260,296
Reporting Period: 2013

Type and Total Number of Analysis Performed	Lower Limit of Detection (LLD) See Note 1	Indicator Locations Mean (F) Range See Note 2	Location with Highest Annual Mean Location Description with Distance and Direction	Mean (F) Range See Note 2	Control Locations Mean (F) Range See Note 2	Number of Nonroutine Reported Measurements See Note 3
GROSS BETA - 78						
	1.90E+00	2.63E+00 (41 / 65) 1.91E+00 - 4.28E+00	WHEELER DAM, AL TRM 274.9	2.80E+00 (7 / 13) 1.91E+00 - 4.28E+00	2.53E+00 (9 / 13) 2.23E+00 - 3.27E+00	
GAMMA SCAN (GELI) - 78						
AC-228	2.00E+01	2.58E+01 (1 / 65) 2.58E+01 - 2.58E+01	W MOR-E LAWR WAT ATH TRM 286.5	2.58E+01 (1 / 13) 2.58E+01 - 2.58E+01	13 VALUES < LLD	
BI-212	5.00E+01	65 VALUES < LLD	FLORENCE, AL TRM 259.8	13 VALUES < LLD	13 VALUES < LLD	
BI-214	2.00E+01	3.51E+01 (38 / 65) 2.01E+01 - 1.03E+02	WHEELER DAM, AL TRM 274.9	3.85E+01 (9 / 13) 2.07E+01 - 5.55E+01	3.88E+01 (6 / 13) 2.81E+01 - 4.86E+01	
K-40	1.00E+02	65 VALUES < LLD	W MOR-E LAWR WAT ATH TRM 286.5	13 VALUES < LLD	13 VALUES < LLD	
PB-212	1.50E+01	1.70E+01 (1 / 65) 1.70E+01 - 1.70E+01	FLORENCE, AL TRM 259.8	1.70E+01 (1 / 13) 1.70E+01 - 1.70E+01	1.61E+01 (1 / 13) 1.61E+01 - 1.61E+01	
PB-214	2.00E+01	3.31E+01 (26 / 65) 2.02E+01 - 6.73E+01	CHAMPION PAPER TRM 282.6	3.54E+01 (5 / 13) 2.48E+01 - 6.73E+01	3.62E+01 (5 / 13) 2.32E+01 - 4.51E+01	
TL-208	1.00E+01	65 VALUES < LLD	FLORENCE, AL TRM 259.8	13 VALUES < LLD	13 VALUES < LLD	
TRITIUM - 24						
	2.70E+02	20 VALUES < LLD			4 VALUES < LLD	

Notes:
1. Nominal Lower Level of Detection (LLD) as described in Table E - 1
2. Mean and Range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).
3. Blanks in this column indicate no nonrountine measurements

Tennessee Valley Authority

RADIOACTIVITY IN WELL (GROUND) WATER (Total)

pCi/L = 0.037 Bq/L

Name of Facility: BROWNS FERRY NUCLEAR PLANT
Location of Facility: LIMESTONE, ALABAMA

Docket Number: 50-259,260,296
Reporting Period: 2013

Type and Total Number of Analysis Performed	Lower Limit of Detection (LLD) See Note 1	Indicator Locations Mean (F) Range See Note 2	Location with Highest Annual Mean Location Description with Distance and Direction	Mean (F) Range See Note 2	Control Locations Mean (F) Range See Note 2	Number of Nonroutine Reported Measurements See Note 3
GAMMA SCAN (GELI) - 26						
AC-228	2.00E+01	13 VALUES < LLD	BFN WELL #6 0.02 MILES W	13 VALUES < LLD	5.44E+01 (4 / 13) 2.30E+01 - 8.89E+01	
BI-214	2.00E+01	3.09E+01 (11 / 13) 2.18E+01 - 5.06E+01	BFN WELL #6 0.02 MILES W	3.09E+01 (11 / 13) 2.18E+01 - 5.06E+01	4.41E+02 (13 / 13) 2.07E+02 - 7.88E+02	
K-40	1.00E+02	13 VALUES < LLD	BFN WELL #6 0.02 MILES W	13 VALUES < LLD	13 VALUES < LLD	
PB-212	1.50E+01	13 VALUES < LLD	BFN WELL #6 0.02 MILES W	13 VALUES < LLD	1.52E+01 (1 / 13) 1.52E+01 - 1.52E+01	
PB-214	2.00E+01	2.71E+01 (11 / 13) 2.06E+01 - 4.23E+01	BFN WELL #6 0.02 MILES W	2.71E+01 (11 / 13) 2.06E+01 - 4.23E+01	4.36E+02 (13 / 13) 2.17E+02 - 7.85E+02	
TL-208	1.00E+01	13 VALUES < LLD	BFN WELL #6 0.02 MILES W	13 VALUES < LLD	13 VALUES < LLD	
TRITIUM - 8						
	2.70E+02	4 VALUES < LLD			4 VALUES < LLD	

Notes: 1. Nominal Lower Level of Detection (LLD) as described in Table E - 1
2. Mean and Range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).
3. Blanks in this column indicate no nonroutine measurements

Tennessee Valley Authority

RADIOACTIVITY IN COMMERCIAL FISH
pCi/g = 0.037 Bq/g (DRY WEIGHT)

Name of Facility: BROWNS FERRY NUCLEAR PLANT
Location of Facility: LIMESTONE, ALABAMA

Docket Number: 50-259,260,296
Reporting Period: 2013

Type and Total Number of Analysis Performed	Lower Limit of Detection (LLD) See Note 1	Indicator Locations Mean (F) Range See Note 2	Location with Highest Annual Mean Location Description with Distance and Direction	Mean (F) Range See Note 2	Control Locations Mean (F) Range See Note 2	Number of Nonroutine Reported Measurements See Note 3
GAMMA SCAN (GELI) - 4						
AC-228	1.00E-01	2 VALUES < LLD	WHEELER RES TRM 275-349	2 VALUES < LLD	2 VALUES < LLD	
BI-214	1.00E-01	1.30E-01 (2 / 2) 1.10E-01 - 1.50E-01	WHEELER RES TRM 275-349	1.30E-01 (2 / 2) 1.10E-01 - 1.50E-01	2.54E-01 (2 / 2) 2.39E-01 - 2.68E-01	
K-40	4.00E-01	1.41E+01 (2 / 2) 1.38E+01 - 1.43E+01	WHEELER RES TRM 275-349	1.41E+01 (2 / 2) 1.38E+01 - 1.43E+01	1.38E+01 (2 / 2) 1.32E+01 - 1.44E+01	
PB-212	4.00E-02	2 VALUES < LLD	WHEELER RES TRM 275-349	2 VALUES < LLD	2 VALUES < LLD	
PB-214	5.00E-01	2 VALUES < LLD	WHEELER RES TRM 275-349	2 VALUES < LLD	2 VALUES < LLD	
TL-208	3.00E-02	2 VALUES < LLD	WHEELER RES TRM 275-349	2 VALUES < LLD	2 VALUES < LLD	

Table H-14

Notes: 1. Nominal Lower Level of Detection (LLD) as described in Table E - 1
2. Mean and Range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).
3. Blanks in this column indicate no nonrountine measurements

Tennessee Valley Authority

RADIOACTIVITY IN GAME FISH
pCi/g = 0.037 Bq/g (DRY WEIGHT)

Name of Facility: BROWNS FERRY NUCLEAR PLANT
Location of Facility: LIMESTONE, ALABAMA

Docket Number: 50-259,260,296
Reporting Period: 2013

Type and Total Number of Analysis Performed	Lower Limit of Detection (LLD) See Note 1	Indicator Locations Mean (F) Range See Note 2	Location with Highest Annual Mean Location Description with Distance and Direction	Mean (F) Range See Note 2	Control Locations Mean (F) Range See Note 2	Number of Nonroutine Reported Measurements See Note 3
GAMMA SCAN (GELI) - 4						
BI-214	1.00E-01	1.01E-01 (1 / 2) 1.01E-01 - 1.01E-01	WHEELER RES TRM 275-349	1.01E-01 (1 / 2) 1.01E-01 - 1.01E-01	1.43E-01 (2 / 2) 1.00E-01 - 1.86E-01	
CS-137	3.00E-02	2 VALUES < LLD	WHEELER RES TRM 275-349	2 VALUES < LLD	2 VALUES < LLD	
K-40	4.00E-01	1.41E+01 (2 / 2) 1.34E+01 - 1.49E+01	WHEELER RES TRM 275-349	1.41E+01 (2 / 2) 1.34E+01 - 1.49E+01	1.34E+01 (2 / 2) 1.32E+01 - 1.36E+01	
PB-212	4.00E-02	2 VALUES < LLD	WHEELER RES TRM 275-349	2 VALUES < LLD	2 VALUES < LLD	
PB-214	5.00E-01	2 VALUES < LLD	WHEELER RES TRM 275-349	2 VALUES < LLD	2 VALUES < LLD	
TL-208	3.00E-02	2 VALUES < LLD	WHEELER RES TRM 275-349	2 VALUES < LLD	2 VALUES < LLD	

Notes:
1. Nominal Lower Level of Detection (LLD) as described in Table E - 1
2. Mean and Range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).
3. Blanks in this column indicate no nonrountine measurements

Tennessee Valley Authority

RADIOACTIVITY IN SHORELINE SEDIMENT

pCi/g = 0.037 Bq/g (DRY WEIGHT)

Name of Facility: BROWNS FERRY NUCLEAR PLANT
Location of Facility: LIMESTONE, ALABAMA

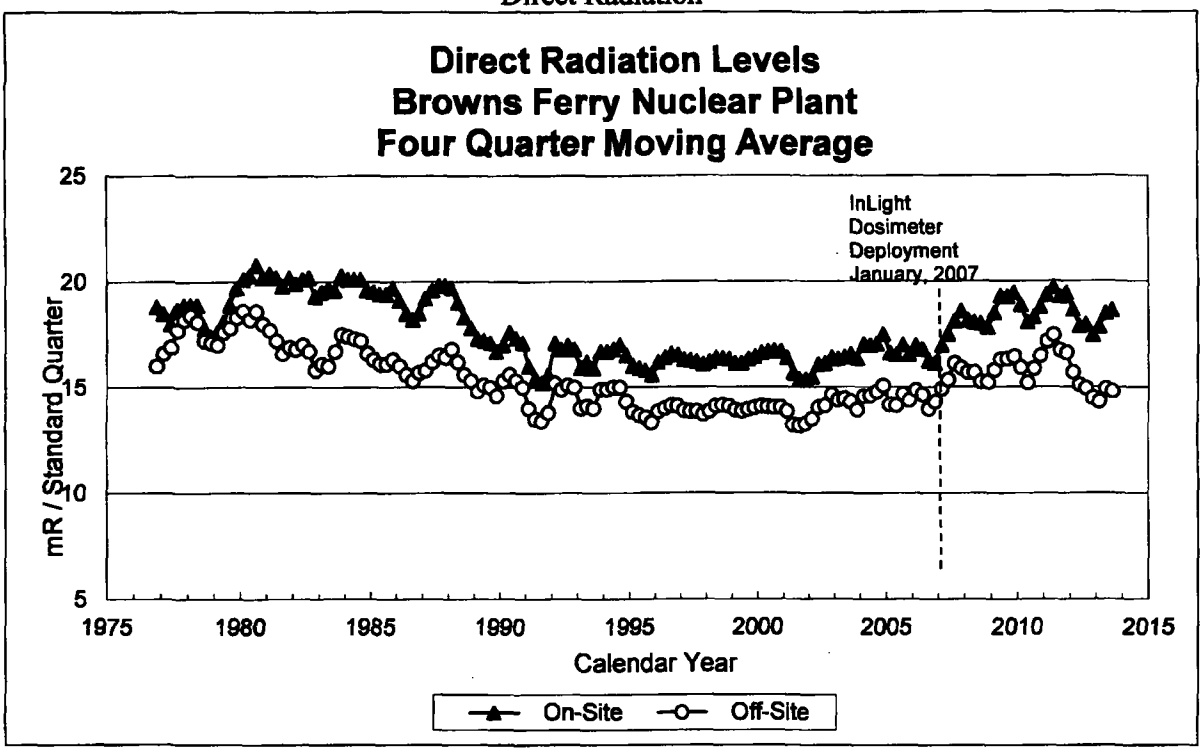
Docket Number: 50-259,260,296
Reporting Period: 2013

Type and Total Number of Analysis Performed	Lower Limit of Detection (LLD) See Note 1	Indicator Locations Mean (F) Range See Note 2	Location with Highest Annual Mean: Location Description with Distance and Direction	Mean (F) Range See Note 2	Control Locations Mean (F) Range See Note 2	Number of Nonroutine Reported Measurements See Note 3
GAMMA SCAN (GELI) - 6						
AC-228	2.50E-01	3.55E-01 (1 / 4) 3.55E-01 - 3.55E-01	JOE WHEELER ST PARK TRM 279.5	3.55E-01 (1 / 2) 3.55E-01 - 3.55E-01	6.23E-01 (2 / 2) 5.10E-01 - 7.36E-01	
BE-7	2.50E-01	4 VALUES < LLD	JOE WHEELER ST PARK TRM 279.5	2 VALUES < LLD	2 VALUES < LLD	
BI-212	4.50E-01	4 VALUES < LLD	MALLARD CREEK REC AR TRM 293.0	2 VALUES < LLD	6.46E-01 (2 / 2) 4.90E-01 - 8.02E-01	
BI-214	1.50E-01	2.40E-01 (4 / 4) 1.85E-01 - 3.49E-01	JOE WHEELER ST PARK TRM 279.5	2.79E-01 (2 / 2) 2.08E-01 - 3.49E-01	5.69E-01 (2 / 2) 5.44E-01 - 5.94E-01	
CS-137	3.00E-02	4 VALUES < LLD	JOE WHEELER ST PARK TRM 279.5	2 VALUES < LLD	9.47E-02 (2 / 2) 3.44E-02 - 1.55E-01	
K-40	7.50E-01	1.68E+00 (1 / 4) 1.68E+00 - 1.68E+00	JOE WHEELER ST PARK TRM 279.5	1.68E+00 (1 / 2) 1.68E+00 - 1.68E+00	5.95E+00 (2 / 2) 4.38E+00 - 7.51E+00	
PB-212	1.00E-01	2.29E-01 (3 / 4) 1.06E-01 - 3.72E-01	JOE WHEELER ST PARK TRM 279.5	3.72E-01 (1 / 2) 3.72E-01 - 3.72E-01	5.84E-01 (2 / 2) 4.97E-01 - 6.70E-01	
PB-214	1.50E-01	2.47E-01 (4 / 4) 1.78E-01 - 3.81E-01	JOE WHEELER ST PARK TRM 279.5	2.90E-01 (2 / 2) 1.98E-01 - 3.81E-01	6.14E-01 (2 / 2) 5.67E-01 - 6.61E-01	
RA-226	1.50E-01	1.97E-01 (2 / 4) 1.85E-01 - 2.08E-01	JOE WHEELER ST PARK TRM 279.5	2.08E-01 (1 / 2) 2.08E-01 - 2.08E-01	5.44E-01 (1 / 2) 5.44E-01 - 5.44E-01	
TL-208	6.00E-02	9.27E-02 (2 / 4) 6.99E-02 - 1.16E-01	JOE WHEELER ST PARK TRM 279.5	1.16E-01 (1 / 2) 1.16E-01 - 1.16E-01	1.99E-01 (2 / 2) 1.71E-01 - 2.28E-01	

Notes: 1. Nominal Lower Level of Detection (LLD) as described in Table E - 1
2. Mean and Range based upon detectable measurements only. Fraction of detectable measurements at specified location is indicated in parentheses (F).
3. Blanks in this column indicate no nonrountine measurements

Figure H-1

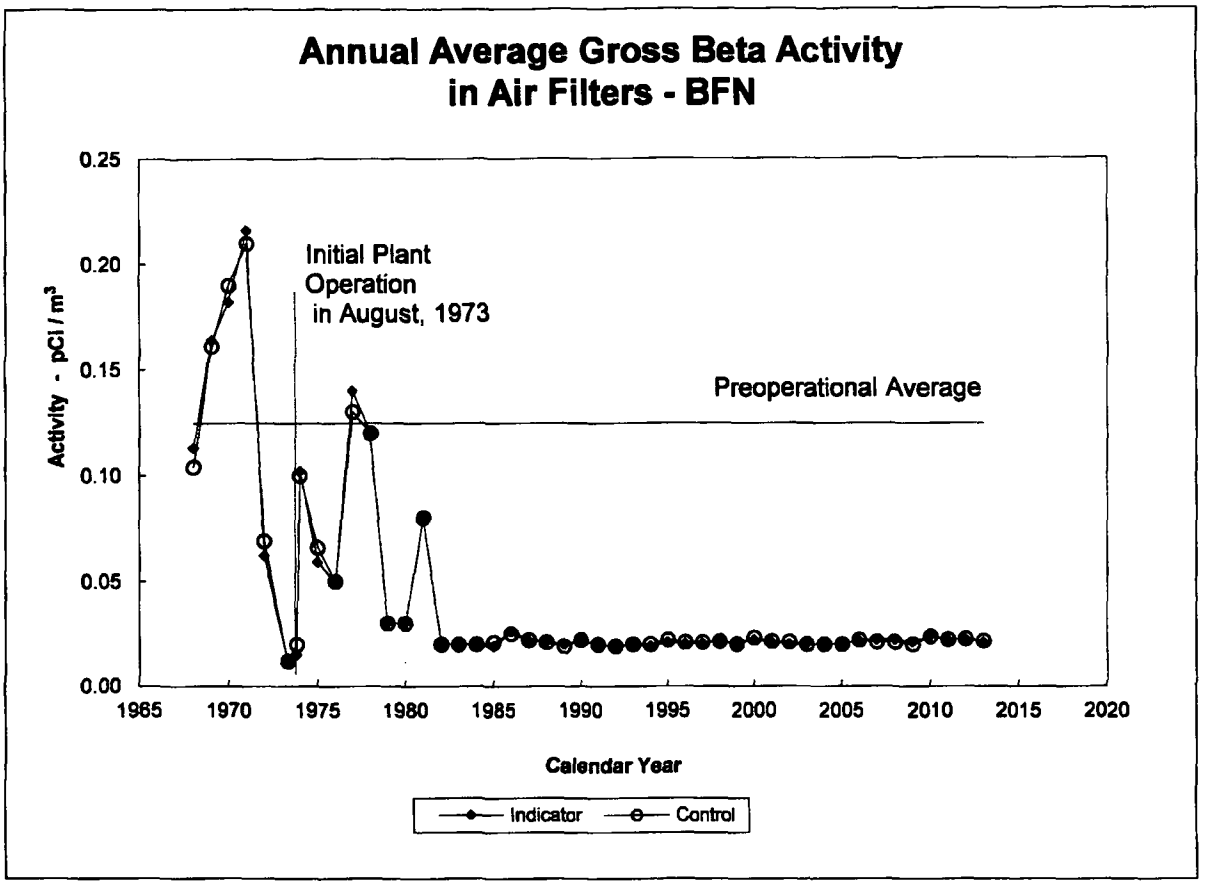
Direct Radiation



Dosimeters are processed quarterly. This chart shows trends in the average measurement for all dosimeters grouped as "on-site" or "off-site". The data from preoperational phase and construction phases of TVA nuclear power plant sites, prior to 1980, show the same trend of "on-site" measurements higher than "off-site" measurements that is observed in current data indicating that the slightly higher "on-site" direct radiation levels are not related to plant operations.

Figure H-2

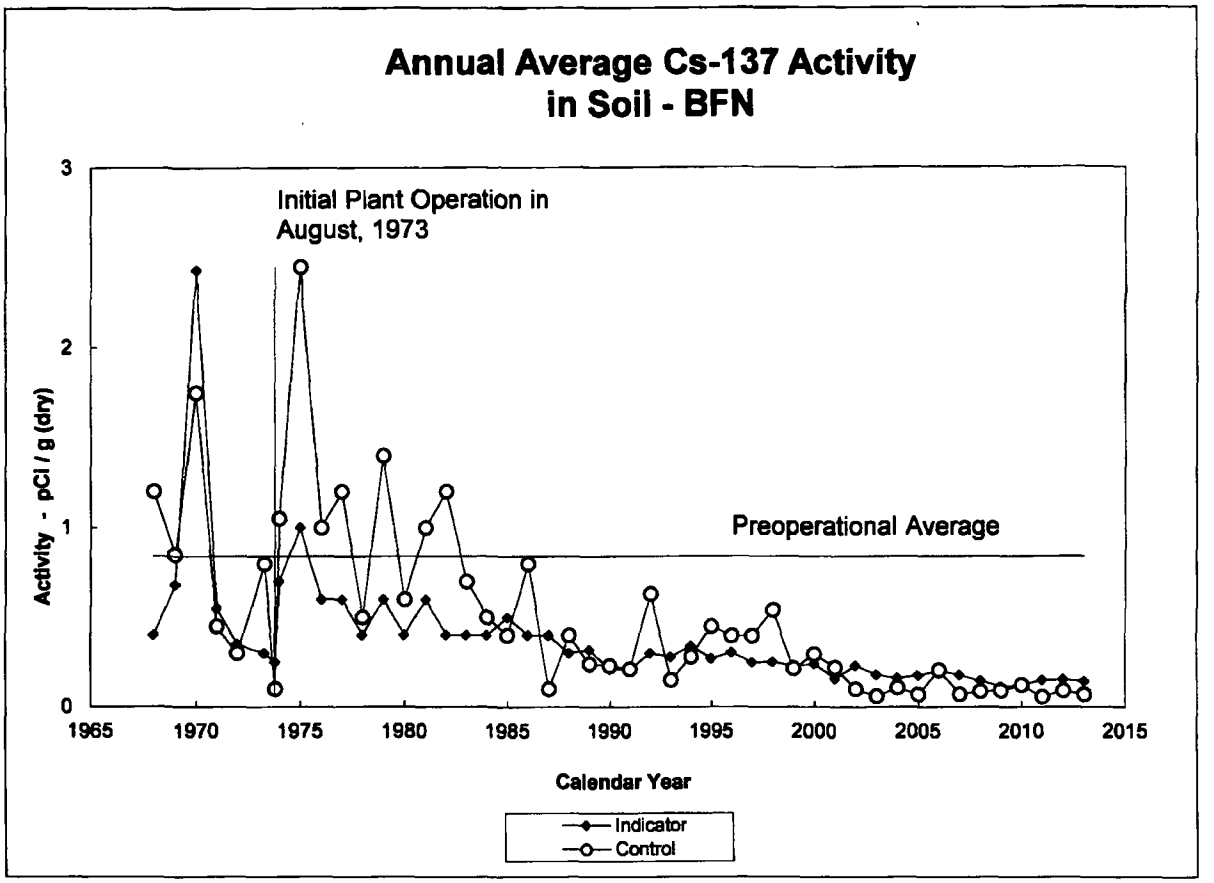
Radioactivity in Air Filters



As can be seen in the trend plot of gross beta activity, the gross beta levels in air particulates have remained relatively constant with the exception of years when the beta activity was elevated due to fallout from nuclear weapons testing. The data also shows that there is no difference in the levels for sampling conducted at the indicator stations as compared to the control stations.

Figure H-3

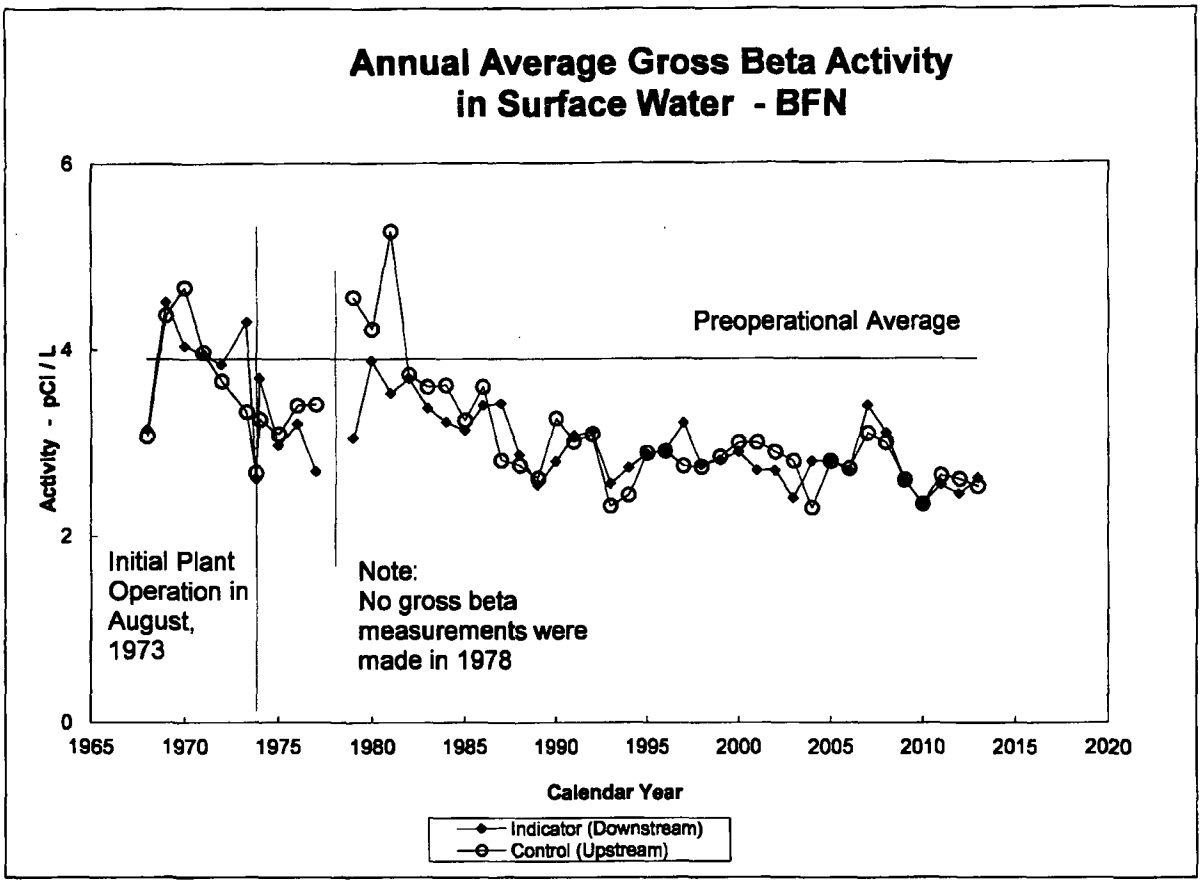
Cs-137 in Soil



Cesium-137 was produced by past nuclear weapons testing and is present in almost every environmental sample exposed to the atmosphere. The "control" and "indicator" locations have generally trended downward with year-to-year variation, since the end of atmospheric nuclear weapons testing in 1980.

Figure H-4

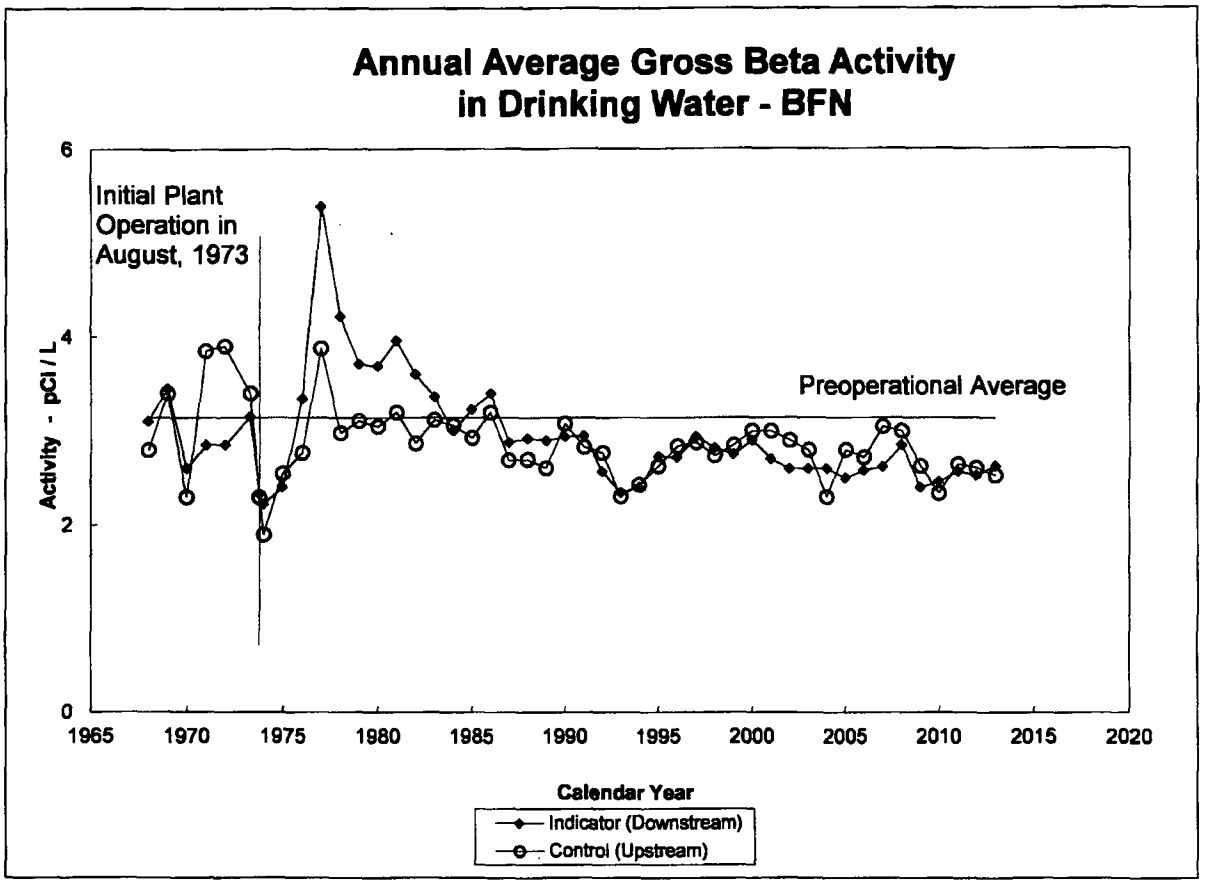
Gross Beta Activity in Surface Water



As shown in the graph, the gross beta activity in samples from the downstream indicator locations has been essentially the same as the activity in samples from the upstream control locations. The average gross beta activity in these samples has been trending down since the early 1980's.

Figure H-5

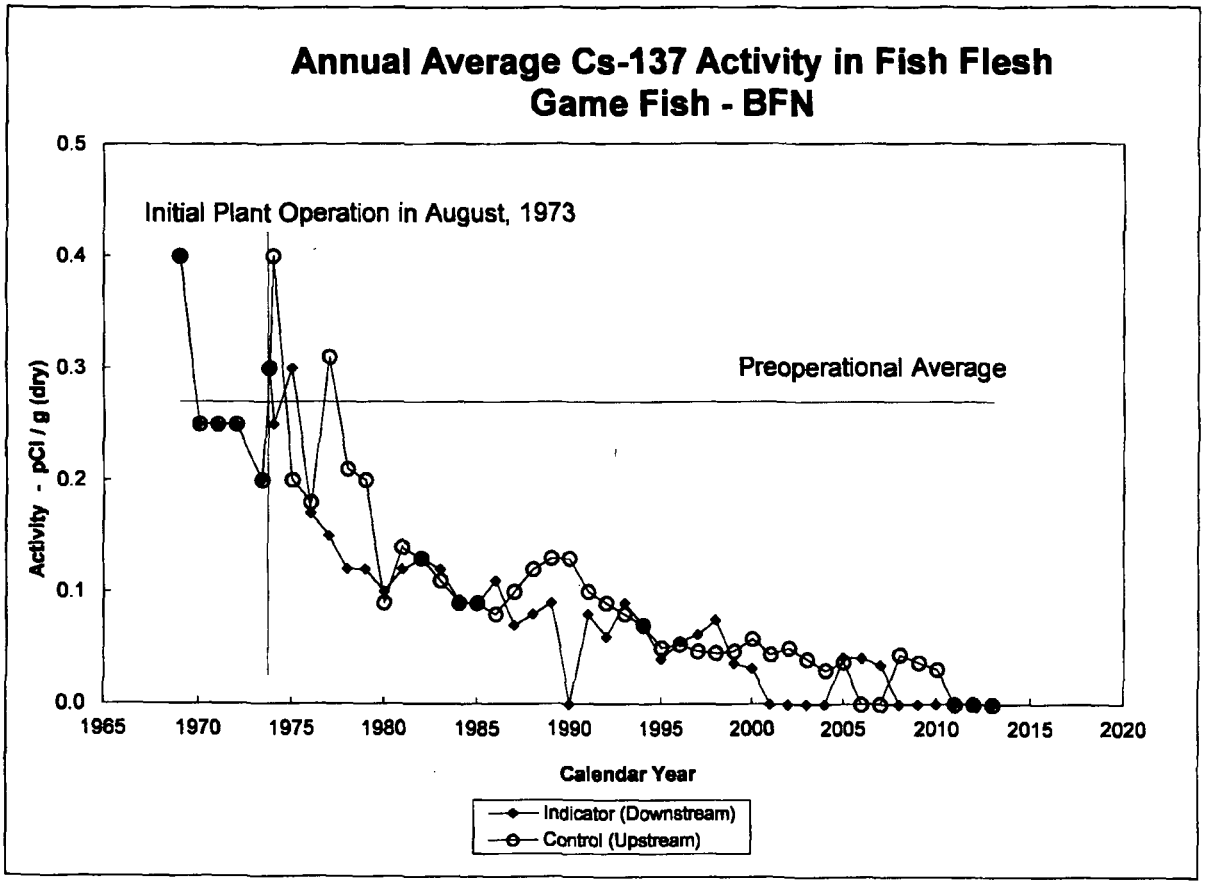
Gross Beta Activity in Drinking Water



The average gross beta activity in drinking water samples from the upstream control locations has typically been slightly higher than activity level measured in samples from the downstream indicator locations. The annual average gross beta activity has been relatively constant since the start of plant operations in 1980 and is slightly lower than preoperational levels.

Figure H-6

Radioactivity in Fish



The concentrations of Cs-137 found in fish are consistent with levels present in the Tennessee River due to past atmospheric nuclear weapons testing. As shown in the graph, the levels of Cs-137 have been decreasing consistent with the overall levels of Cs-137 in the environment.