Annual Radiological Environmental Operating Report

Watts Bar
Nuclear Plant
1997

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT
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1997

TENNESSEE VALLEY AUTHORITY
ENVIRONMENTAL RADIOLOGICAL MONITORING AND INSTRUMENTATION

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

This report describes the radiological environmental monitoring program conducted by TVA in the vicinity of the Watts Bar Nuclear Plant (WBN) in 1997. WBN Unit 1 achieved initial criticality in January 1996 and received a full power operating license on February 7, 1996. Commercial operation began on May 27, 1996. 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 that should not be influenced by plant operations. Station locations are selected after careful consideration of the weather patterns and projected radiation doses to the various areas around the plant. Material sampled includes air, water, milk, foods, vegetation, soil, fish, clams, sediment, and direct radiation levels. Results from stations near the plant are compared with concentrations from control locations and with preoperational measurements to determine potential impacts of plant operations.

The majority of environmental radioactivity measured by the program was due to naturally occurring radioactive materials or radionuclides commonly found in the environment as a result of atmospheric fallout and the operation of other nuclear facilities in the area. Trace levels of a small number of radionuclides of the type that can be produced from the operation of a nuclear power plant were detected in a few of the samples collected and analyzed for the WBN monitoring program. Low levels of Co-58, Cs-137 and Fe-59 were measured in samples of bottom sediment and Co-58 was detected in one sample of clam flesh. In addition, Co-58, Co-60, Cr-51, Fe-59, Nb-95, Zr-95, Sb-124, Cs-134 and Cs-137 were identified in sediment collected from the onsite Yard Holding Pond. The level of activity measured in these samples would result in no measurable increase over background in the dose to the general public.

INTRODUCTION

This report describes and summarizes the results of radioactivity measurements made in the vicinity of WBN 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, Section 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 WBN Technical Specification 5.9.2 and Offsite Dose Calculation Manual (ODCM) Administrative Control 5.1. Estimates of the maximum potential doses to the surrounding population from radioactivity measured both in plant effluents and in environmental samples are summarized in this report. In addition to reporting the data prescribed by specific requirements, other information is included in this report which may be useful or interesting to individuals who do not work with this material routinely.

Naturally Occurring and Background Radioactivity

Most materials in our world today contain trace amounts of naturally occurring radioactivity. Approximately 0.01 percent of all potassium is radioactive potassium-40. Potassium-40 (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). This is equivalent to approximately 100,000 pCi of K-40 which delivers a dose of 15 to 20 mrem per year to the bone and soft tissue of the body. Naturally occurring radioactive materials have always been in the environment. Other examples of naturally occurring radioactive materials are beryllium (Be)-7, bismuth (Bi)-212 and 214, lead (Pb)-212 and 214, thallium (Tl)-208, actinium (Ac)-228, uranium (U)-238, uranium-235, thorium (Th)-234, radium (Ra)-226, radon (Ra)-222, carbon (C) -14, and hydrogen (H)-3 (generally called tritium). These naturally occurring radioactive materials are in the soil, our food, our drinking water, and our bodies. The radiation from these materials makes up a part of the low-level natural background radiation. The remainder of the natural background radiation comes from outer space. We are all exposed to this natural radiation 24 hours per day.

The average dose equivalent at sea level resulting from radiation from outer space (part of natural background radiation) is about 27 mrem/year. This essentially doubles with each 6600-foot increase in altitude in the lower atmosphere. Another part of natural background radiation comes from naturally occurring radioactive materials in the soil and rocks. Because the quantity of naturally occurring radioactive material varies according to geographical location, the part of the natural background radiation coming from this radioactive material also depends upon the geographical location. Most of the remainder of the natural background radiation comes from the radioactive materials within each individual's body. We absorb these materials from the food we eat which contains naturally occurring radioactive materials from the soil. An example of this is K-40 as described above. Even building materials affect the natural background radiation levels in the environment. Living or working in a building which is largely made of earthen material, such as concrete or brick, will generally result in a higher natural background radiation level than would exist if the same structure were made of wood. This is due to the naturally occurring radioisotopes in the concrete or brick, such as trace amounts of uranium, radium, thorium, etc.

Because the city of Denver, Colorado, is over 5000 feet in altitude and the soil and rocks there contain more radioactive material than the U.S. average, the people of Denver receive around 350 mrem/year total natural background radiation dose equivalent compared to about 295 mrem/year for the national average. People in some locations of the world receive over 1000 mrem/year natural background radiation dose equivalent, primarily because of the greater quantity of radioactive materials in the soil and rocks in these locations. Scientists have never been able to show that these levels of radiation have caused harmful effects to anyone.

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 information below is primarily adapted from References 2 and 3.

U.S. GENERAL POPULATION AVERAGE DOSE EQUIVALENT ESTIMATES

Source	Millirem/Year Per Person
Natural background dose equivalent	
Cosmic	27
Cosmogenic	1
Terrestrial	28
In the body	39
Radon	200
Total	295
Release of radioactive material in natural gas, mining, ore processing, etc.	5
Medical (effective dose equivalent)	53
Nuclear weapons fallout	less than 1
Nuclear energy	0.28
Consumer products	0.03
Total	355 (approximately)

As can be seen from the table, 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. It should be noted that the use of radiation and radioactive materials for medical uses has resulted in a similar effective dose equivalent to the U.S. population as that caused by natural background cosmic and terrestrial radiation.

Significant discussion recently has centered around exposures from radon. Radon is an inert gas given off as a result of the decay of naturally occurring Ra-226 in soil. When dispersed in the atmosphere, radon concentrations are relatively low. However, when the gas is trapped in closed spaces, it can build up until concentrations become significant. The National Council of

Radiation Protection and Measurements (Reference 2) has estimated that the average annual effective dose equivalent from radon in the United States is approximately 200 mrem/year. This estimated dose is approximately twice the average dose equivalent from all other natural background sources.

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. However, nuclear plants include many complex systems to control the nuclear fission process and to safeguard against the possibility of reactor malfunction, which could lead to the release of radioactive materials. 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.

Paths through which radioactivity from a nuclear power plant is routinely 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 radiological environmental monitoring program which measures the environmental radiation in outlying areas around the plant. In this way, the release of radioactive materials from the plant is tightly controlled, and verification is provided that the population is not exposed to significant levels of radiation or radioactive materials.

The WBN ODCM, which describes the program 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 NRC guidelines and 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 mrad/year
Beta radiation	≤20 mrad/year

Particulates:

Any organ	≤15 mrem/year

The EPA 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 annual average limits for the concentrations of radioactive materials released in gaseous and liquid effluents at the boundary of the unrestricted areas. Table 1 of this report presents the annual average concentration limits for the principal radionuclides associated with nuclear power plant effluents. The table also presents (1) the concentrations of radioactive materials in the environment which would require a special report to the NRC and (2) the detection limits for measured radionculides. It should be noted that the levels of radioactive materials measured in the environment are typically below or only slightly above the lower limit of detection.

SITE/PLANT DESCRIPTION

The WBN site is located in Rhea county, Tennessee, on the west bank of the Tennessee River at Tennessee River Mile (TRM) 528. Figure 1 shows the site in relation to other TVA projects. The WBN site, containing approximately 1770 acres on Chickamauga Lake, is approximately 2 miles south of the Watts Bar Dam and approximately 31 miles north-northeast of TVA's Sequoyah Nuclear Plant (SQN) site. Also located within the reservation are the Watts Bar Dam and Hydro-Electric Plant, the Watts Bar Steam Plant, the TVA Central Maintenance Facility, and the Watts Bar Resort Area.

Approximately 16,000 people live within 10 miles of the WBN site. More than 80 percent of these live between 5 and 10 miles from the site. Two small towns, Spring City and Decatur, are located in this area. Spring City, with a population of approximately 2,200, is northwest and north-northwest from the site, while Decatur, with about 1,400 people, is south and south-southwest from the plant. The remainder of the area within 10 miles of the site is sparsely populated, consisting primarily of small farms.

The area between 10 and 50 miles from the site includes portions of the cities of Chattanooga and Knoxville. The largest urban concentration in this area is the city of Chattanooga, located to the southwest and south-southwest. The city of Chattanooga has a population of about 160,000, with approximately 80 percent located between 40 and 50 miles from the site and the remainder located beyond 50 miles. The city of Knoxville is located to the east-northeast, with not more than 10 percent of its 165,000 plus people living within 50 miles of the site. Three smaller urban areas of greater than 20,000 people are located between 30 and 40 miles from the site. Oak Ridge is approximately 40 miles to the northeast, the twin cities of Alcoa and Maryville are located 45 to 50 miles to the east-northeast, and Cleveland is located about 30 miles to the south.

Chickamauga Reservoir, on which WBN is located is one of a series of highly controlled multiple-use reservoirs whose primary uses are flood control, navigation, and the generation of

electric power. Secondary uses include industrial and public water supply and waste disposal, commercial fishing, and recreation. Public access areas, boat docks, and residential subdivisions have been developed along the reservoir shoreline.

WBN consists of two pressurized water reactors: each unit is rated at 1160 megawatts (electrical). WBN Unit 1 received a low power operating license (NPF-20) on November 9, 1995, and achieved initial criticality in January 1996. The full operating license (NPF-90) was received on February 7, 1996. WBN Unit 2 remains in a layup and construction condition.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Most of the radiation and radioactivity generated in a nuclear power reactor is contained within the reactor itself or one of the other plant systems. Plant effluent radiation monitors are designed to monitor radionuclides released to the environment. Environmental monitoring is a final verification that the systems are performing as planned. The monitoring program is designed to most efficiently monitor 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) for WBN is 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 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 notation system is used for all tables and figures given in the appendices.) lists the sampling stations and the types of samples

collected from each. Modifications made to the program in 1997 are described in Appendix B and exceptions to the sampling and analysis schedule are presented in Appendix C.

To determine the amount of radioactivity in the environment prior to the operation of WBN, a preoperational radiological environmental monitoring program was initiated in December 1976 and operated through December 31, 1995. Measurements of the same types of radioactive materials that are measured currently were assessed during the preoperational phase 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, 60s, and 70s, 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 which is produced by the operation of the WBN reactor. Preoperational knowledge of preexisting radionuclide patterns in the environment permits a determination, through comparison and trending analyses, of whether the operation of WBN is impacting the environment and thus the surrounding population.

The determination of environmental impact during the operating phase also considers the presence of control stations that have been established in the environment. Results of environmental samples taken at control stations (far from the plant) are compared with those from indicator stations (near the plant) to aid in the determination of the impacts from WBN operation.

All samples are analyzed by the radioanalytical laboratory of TVA's Environmental Radiological Monitoring and Instrumentation group located at the Western Area Radiological Laboratory (WARL) in Muscle Shoals, Alabama. 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 Data Supplement to this report contains the results of all measurements made as a part of this program.

The radiation detection devices used to determine the radionuclide content of samples collected in the environment are generally quite 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 Radioanalytical Laboratory employs 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 equipment checks to ensure that the radiation detection instruments are working properly and the analysis of quality control samples which are included alongside routine environmental samples. The laboratory participates in the Environmental Protection Agency (EPA) Interlaboratory Comparison Program. In addition, samples split with the EPA National Air and Radiation Environmental Laboratory and with the State of Tennessee provide and independent verification of the overall performance of the laboratory. A complete description of the program is presented in Appendix F.

DIRECT RADIATION MONITORING

Direct radiation levels are measured at a number of stations 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.

Direct radiation levels measured in the area around the WBN site in 1997 were consistent with levels from previous years and with levels measured at other locations in the region.

Measurement Techniques

Direct radiation measurements are made with thermoluminescent dosimeters (TLDs). When certain materials are exposed to ionizing radiation, many of the electrons which become displaced are trapped in the crystalline structure of the material. They remain trapped for long periods of time as long as the material is not heated. When heated (thermo-), the electrons are released, producing a pulse of light (-luminescence). The intensity of the light pulse is proportional to the amount of radiation to which the material was exposed. Materials which display these characteristics are used in the manufacture of TLDs.

From 1977 through 1989, TVA used a Victoreen dosimeter consisting of a manganese activated calcium fluoride (Ca_2F:Mn) TLD material encased in a glass bulb. In 1989, TVA began the process of changing from the Victoreen dosimeter to the Panasonic Model UD-814 dosimeter, and completely changed to the Panasonic dosimeter in 1990. This dosimeter contains four elements consisting of one lithium borate and three calcium sulfate phosphors. The calcium sulfate phosphors are shielded by approximately 100 mg/cm^2 plastic and lead to compensate for the over-response of the detector to low energy radiation.

The TLDs are placed approximately one meter above the ground, with two or more TLDs at each station. Sixteen stations are located around the plant near the site boundary; one station in each of the 16 compass sectors. An additional 16 stations are located approximately 5 miles from the plant in each of the 16 sectors. Dosimeters are also placed at the perimeter and remote air monitoring sites and at ten additional stations out to approximately 32 miles from the site. The environmental TLD locations are listed in Table A-3. The TLDs are exchanged every 3 months and the accumulated exposure on the detectors is read with a Panasonic Model UD-710A automatic reader interfaced with a Hewlett Packard Model 9000 computer system. Eight of the locations also have TLD devices which are processed by the NRC. The results from the NRC measurements are reported in NUREG 0837.

Since the calcium sulfate phosphor is much more sensitive than the lithium borate, the measured exposure is taken as the median of the results obtained from the nine calcium sulfate phosphors in three detectors. The values are corrected for gamma response, system variations, and transit exposure, with individual gamma response calibrations for each element. The system meets or exceeds the performance specifications outlined in Regulatory Guide 4.13 for environmental applications of TLDs.

Since 1974, TVA has participated in nine of the eleven intercomparisons of environmental dosimeters conducted by the U. S. Department of Energy and other interested parties. The results, shown in Table 2, demonstrate that direct radiation levels determined by TVA are generally within ten percent of the calculated or known values.

Results

Results are normalized to a standard quarter (91.25 days or 2190 hours). The stations are grouped according to the distance from the plant. The first group consists of stations within 1 mile of the plant. The second group lies between 1 and 2 miles, the third group between 2 and 4 miles, the fourth group between 4 and 6 miles, and the fifth group is made up of stations more than 6 miles from the plant. Past data have shown that the average results from groups greater

than 2 miles from the plant are essentially the same. Therefore, for purposes of this report, stations 2 miles or less from the plant are identified as "onsite" and all others are considered "offsite."

The quarterly gamma radiation levels determined from the TLDs deployed around WBN in 1997 are summarized in Table H-1. The results from all measurements at individual stations are presented in Table H-2. The exposures are measured in milliroentgens (mR). For purposes of this report, one milliroentgen, one millirem (mrem) and one millirad (mrad) are assumed to be numerically equivalent. The rounded average annual exposures are shown below. For comparison purposes, the average direct radiation measurements made in the preoperational montioring program for the period of 1990 to 1995 are also shown.

Annual Average
Direct Radiation Levels
WBN
mR/Year

	1997	Preoperational Average
Onsite Stations	64	65
Offsite Stations	57	57

The data in Table H-1 indicate that the average quarterly radiation levels at the WBN onsite stations are approximately 1.8 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 generally 2-6 mR/quarter higher than levels offsite. The causes of these differences have not been isolated; however, it is postulated that the differences are probably attributable to combinations of influences such as natural variations in environmental radiation levels, earth-moving activities onsite, and the mass of concrete employed in the construction of the plant. Other undetermined influences may also play a part.

Figure H-1 compares plots of the data from the onsite or site boundary stations with those from the offsite stations over the period from 1990 through 1997. The results reported in 1997 are consistent with direct radiation levels reported in previous years. There is no indication that WBN 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. Four local air monitoring stations are located on or adjacent to the plant site in the general directions of greatest wind frequency. Four perimeter air monitoring stations are located between 6 to 11 miles from the plant, and two remote air monitors are located out to 15 miles. The monitoring program and the locations of monitoring stations are identified in the tables and figures of Appendix A. The remote stations are used as control or baseline stations.

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 and preoperational program data. There is no indication of an increase in atmospheric radioactivity as a result of WBN.

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. This system is housed in a building approximately 2 feet by 3 feet by 4 feet. The filter is contained in a sampling head mounted on the outside of the monitor building. The filter is replaced every 7 days. 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 for gamma-emitting radionuclides (gamma spectroscopy).

Gaseous radioiodine is collected using a commercially available cartridge containing 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 I-131 by a complete gamma spectroscopy analysis.

Rainwater is collected by use of a collection tray attached to the monitor building. The collection tray is protected from debris by a screen cover. As water drains from the tray, it is collected in one of two 5-gallon containers inside the monitor building. A 1-gallon sample is removed from the container every 4 weeks. Any excess water is discarded. Rainwater samples are held to be analyzed only if air particulate samples indicate the presence of elevated levels or if fallout is expected. For example, rainwater samples were analyzed during the period of fallout following the accident at Chernobyl in 1986. Since no plant-related air activity was detected in 1997, no rainwater samples from WBN were analyzed in this reporting period.

Results

The results from the analysis of air particulate samples are summarized in Table H-3. Gross beta activity in 1997 was consistent with levels reported in previous years. The average gross beta activity measured for air particulate samples was 0.021 pCi/m^3 for both indicator and control locations. The annual averages of the gross beta activity in air particulate filters at these stations for the period 1977-1997 are presented in Figure H-2. Increased levels due to fallout from atmospheric nuclear weapons testing are evident in the years prior to 1981 and a small increase from the Chernobyl accident can be seen in 1986. These patterns are consistent with data from monitoring programs conducted by TVA at other nuclear power plant construction sites. Comparison with the same data for the preoperational period of 1990-1995 indicates that the annual average gross beta activity for air particulates as measured in the 1997 monitoring program was consistent with preoperational data.

Only natural radioactive materials were identified by the monthly gamma spectral analysis of the air particulate samples. As shown in Table H-4, I-131 was not detected in any charcoal cartridge samples collected in 1997.

TERRESTRIAL MONITORING

Terrestrial monitoring is accomplished by collecting samples of environmental media that may transport radioactive material from the atmosphere to humans. For example, radioactive material may be deposited on a vegetable garden and be ingested along with the vegetables or it may be deposited on pasture grass where dairy cattle are grazing. When the cow ingests the radioactive material, some of it may be transferred to the milk and consumed by humans who drink the milk. Therefore, samples of milk, vegetation, soil, and food crops are collected and analyzed to determine potential impacts from exposure through this pathway. The results from the analysis of these samples are shown in Tables H-5 through H-13.

A land use survey is conducted annually between April and October to identify the location of 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 from the plant. This land use survey satisfies the requirements 10 CFR 50, Appendix I, Section IV.B.3. From data produced by the land use survey, radiation doses are projected for individuals living near the plant. Doses from air submersion are calculated for the nearest residence in each sector, while doses from drinking milk or eating foods produced near the plant are calculated for the areas with milk-producing animals and gardens, respectively. The doses projected as a result of the 1997 land use survey are presented in Appendix G.

Sample Collection and Analysis

Milk samples are collected every 2 weeks from three indicator dairies and from at least one of three control dairies. Milk samples are placed on ice for transport to the radioanalytical laboratory. A specific analysis for I-131 and a gamma spectral analysis are performed on each sample and once per quarter samples are analyzed for Sr-89 and Sr-90.

Samples of vegetation are collected every 4 weeks from one farm that had milk producing animals in the past. In addition, samples are also collected every 4 weeks from one dairy farm

and from one control station. The samples are collected by cutting or breaking enough vegetation to provide between 100 and 200 grams of sample. Care is taken not to include any soil with the vegetation. The sample is placed in a container with 1650 ml of 0.5N NaOH for transport back to the Radioanalytical Laboratory for I-131 analysis. A second sample of between 750 and 1000 grams is also collected from each location. After drying and grinding, these samples are analyzed by gamma spectroscopy. Once each quarter, the sample is ashed after the gamma analysis is completed and analyzed for Sr-89 and Sr-90.

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 ashed and analyzed for Sr-89 and Sr-90.

Samples representative of food crops raised in the area near the plant are obtained from individual gardens, corner markets, or cooperatives. Types of foods may vary from year to year as a result of changes in the local vegetable gardens. In 1997 samples of apples, cabbage, corn, green beans, potatoes, and tomatoes were collected from local vegetable gardens. Samples of the same food products grown in areas that would not be effected by the plant were collected as control samples. The edible portion of each sample is analyzed by gamma spectroscopy.

Results

The results from the analysis of milk samples are presented in Table H-5. All I-131 values were below the established nominal LLD of 0.4 pCi/liter. Sr-90 was detected in levels above the nominal LLD of 2.0 pCi/liter in two samples from control dairies. The average concentration was 2.1 pCi/liter. These levels are consistent with concentrations measured in samples collected in the preoperational radiological environmental monitoring program and with concentrations reported in milk as a result of fallout from atmospheric nuclear weapons tests (Reference 1). Figure H-3 displays the average Sr-90 concentrations measured in milk since 1976. The concentrations have steadily decreased as a result of the 28-year half-life of Sr-90 and the

washout and transport of the element through the soil over the period. The only other radionuclides detected in the analysis of milk samples were naturally occurring radionuclides. The predominant isotope reported in milk samples was the naturally occurring K-40. An average of approximately 1350 pCi/liter of K-40 was identified in all milk samples.

Results from the analysis of vegetation samples are presented in Table H-6. Sr-90 was identified in four samples from indicator locations with an average concentration of 33.2 pCi/kg. The average concentration for samples from control locations was 26.6 pCi/Kg. The highest concentrations of radionculides identified in vegetation were for the naturally occurring isotopes K-40 and Be-7. The concentrations of Sr-90 were consistent with preoperational data and represent the levels of Sr-90 in the environment as the result of fallout from past nuclear weapons testing.

The only fission product identified in soil samples was Cs-137. The maximum concentration of Cs-137 was 0.68 pCi/g. This value is consistent with levels previously reported from fallout. All other radionuclides reported were naturally occurring isotopes. The results of the analysis of soil samples are summarized in Table H-7.

A plot of the annual average Cs-137 concentrations in soil is presented in Figure H-4. Like the levels of Sr-90 in milk, concentrations of Cs-137 in soil are 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.

All radionuclides reported in food samples were naturally occurring. The maximum K-40 value was 4110 pCi/kg in potatoes. The results are reported in Tables H-8 through H-13.

AQUATIC MONITORING

Potential exposures from the liquid pathway can occur from drinking water, ingestion of edible fish and invertebrates, or from direct radiation exposure from radioactive materials deposited in the river sediment. The aquatic monitoring program includes the collection of samples of river (reservoir) water, groundwater, drinking water supplies, fish, Asiatic clams (no known human consumption), and bottom 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 Table H-14 through H-24. Radioactivity levels in water, fish, and shoreline sediment were consistent with background and/or fallout levels previously reported. Low levels of Co-58, Fe-59 and Cs-137 were measured in samples of bottom sediment and Co-58 was identified in one sample of clam flesh. There is no direct exposure pathway to the public through radioactivity in either bottom sediment or Asiatic clams. Results for the sediment sampling conducted in the onsite Yard Holding Pond and Low Volume Waste Treatment Pond are discussed later in this section.

Sample Collection and Analysis

Samples of surface water are collected from the Tennessee River using automatic sampling systems from two downstream stations and one upstream station. A timer turns on the system at least once every 2 hours. The line is flushed and a sample collected into a composite container. A 1-gallon sample is removed from the container at 4-week intervals and the remaining water is discarded. Each sample is analyzed for gamma-emitting radionculides and for gross beta activity. The samples are composited quarterly and analyzed for Sr-89, Sr-90, and tritium.

Samples are also collected by an automatic sampling system at the first two downstream drinking water intakes. These samples are collected in the same manner as the surface water samples. These monthly samples are analyzed for gamma-emitting radionuclides and for gross beta activity. Quarterly composites are analyzed for Sr-89, Sr-90, and tritium. The samples collected by the automatic sampling device are taken directly from the river at the intake structure. Since

the sample at this point is raw water, not water processed through the water treatment plant, the control sample should also be unprocessed water. The upstream surface water sample is used as a control sample for drinking water to meet this condition.

Groundwater is sampled from one onsite well down gradient from the plant and one onsite well up gradient from the plant. The onsite wells are sampled with a continuous sampling system. In addition, a grab sample is collected from a private well in an area unaffected by WBN. The samples are composited by location quarterly and analyzed for gross beta activity, for gamma-emitting radionuclides and for Sr-89, Sr-90 and tritium content.

Samples of commercial and game fish species are collected semiannually from each of two reservoirs: the reservoir on which the plant is located (Chickamauga Reservoir) and the upstream reservoir (Watts Bar Reservoir). The samples are collected using a combination of netting techniques and electrofishing. The ODCM specifies analysis of the edible portion of the fish. To comply with this requirement, filleted portions are taken from several fish of each species. Crappie is collected as a game species and channel catfish and smallmouth buffalo are sampled as commercial species. The samples are analyzed by gamma spectroscopy. Since the TVA SQN plant is also located on Chickamauga Reservoir, the results for fish sampling conducted on Chickamauga have been used for both the SQN and WBN monitoring programs. Due to the tendency for channel catfish to gather in large numbers within a two mile region below the SQN plant, the channel catfish sample from Chickamauga has historically been collected in this region. The decision was made in 1997 to add a second sample of channel catfish from the Chickamauga reservoir to be collected from a region within approximately two miles downstream of WBN. The results of both samples are reported in the WBN report.

Bottom sediment is collected semiannually from selected Tennessee River Mile (TRM) locations using a dredging apparatus or divers. Samples of shoreline sediment are also taken from recreation areas in the vicinity of the plant. The samples are dried, ground, and analyzed by gamma spectroscopy.

Samples of sediment are also collected from the onsite Yard Holding Pond and Low Volume Waste Treatment Pond. These samples have been collected for several years to provide baseline data. The reduction in the number of pond sediment samples discussed in the 1996 annual report was implemented in 1997. The total number of samples was reduced to five.

Efforts are made to sample Asiatic clams semiannually from one location downstream from the plant and one location upstream. The clams are usually collected in the sampling process with the sediment. However, the clams are becoming more and more difficult to find. Enough clams are collected to produce approximately 50 grams of wet flesh. The flesh is separated from the shells and the dried flesh samples are analyzed by gamma spectroscopy.

Results

Gross beta activity was present in most of the surface water samples. Concentrations averaged 3.6 pCi/liter in downstream samples and 3.2 pCi/liter in upstream samples. These levels were consistent with results found during the preoperational monitoring program and agreed with previously reported levels from fallout or naturally occurring isotopes. A summary table of the results is shown in Table H-14.

No fission or activation products were identified in drinking water samples. Average gross beta activity at downstream stations was 3.0 pCi/liter while the average for upstream stations was 3.2 pCi/liter. The results are shown in Table H-15. Trend plots of the gross beta activity in surface water and drinking water samples from 1977 through 1997 are presented in Figure H-5.

Only naturally occurring radionuclides were identified in ground water samples. Gross beta concentrations in samples from the onsite indicator location averaged 6.4 pCi/liter, while concentrations from the control locations averaged 2.9 pCi/liter. These results were consistent with the well water results from the preoperational program in that the down gradient well has always produced higher gross beta activity than the samples from the control locations. The results are presented in Table H-16.

Measurable levels of Cs-137 were identified in a total of five fish samples. The maximum concentration measured for indicator (downstream) samples was 0.07 pCi/g, while the maximum for upstream samples was 0.05 pCi/g. Other radioisotopes found in fish were naturally occurring, with the most notable being K-40. The concentrations of K-40 ranged from 8.1 pCi/g to 17.3 pCi/g.

The results are summarized in Tables H-17, H-18, and H-19. Trend plots of the annual average Cs-137 concentrations measured in fish samples are presented in Figure H-6. The Cs-137 activities are consistent with preoperational results produced by fallout or effluents from other nuclear facilities.

Three radionuclides of the type produced in nuclear power plants were identified in bottom sediment samples. These radionuclides were Co-58, Fe-59, and Cs-137. The highest concentration of Co-58 measured in sediment collected downstream was 0.24 pCi/gm. One downstream sediment sample also contained 0.06 pCi/gm of Fe-59. There was no Co-58 or Fe-59 detected in the upstream bottom sediment samples. A total of five downstream and two upstream samples contained measurable concentrations of Cs-137. The average concentration of Cs-137 measured in bottom sediment collected downstream of WBN was 0.36 pCi/gm while the average concentration for the upstream samples was 1.85 pCi/gm. Results from the analysis of bottom sediment samples are shown in Table H-20.

The only manmade radionuclide identified in samples of shoreline sediment was Cs-137. The average concentration measured in samples from the downstream sampling location was 0.06 pCi/gm. One sample collected from the upstream sampling point contained a measurable level of Cs-137 at 0.03 pCi/gm. These concentrations are consistent with previously identified levels of Cs-137 in shoreline sediment from these locations. The results for the analysis of shoreline sediment is presented in Table H-21. Trend plots of the average concentration of Cs-137 in bottom and shoreline sediment are presented in Figure H-7.

Consistent with previous monitoring conducted for the onsite ponds, Cs-137 was detected in all five samples. The average of the Cs-137 levels measured in sediment from the onsite ponds was 0.23 pCi/gm. Several radionuclides not previously detected in sediment samples from the onsite ponds were found in samples collected from the Yard Holding Pond in 1997. In addition to the Cs-137 discussed above, Co-58, Co-60, Fe-59, Cr-51, Nb-95, Zr-95, Cs-134 and Sb-124 were detected in varying concentrations. Three samples from the Yard Holding Pond contained measurable Co-58. The average of the Co-58 levels was 0.92 pCi/gm. Two samples contained measurable levels of Co-60 with highest concentration being 0.19 pCi/gm. Two samples contained Cr-51 at an average concentration of 0.77 pCi/gm and two samples contained Fe-59 with an average concentration of 0.61 pCi/gm. The highest concentration measured for Nb-95 was 0.11 pCi/gm. One sample contained Zr-95 at 0.07 pCi/gm and Cs-134 was measured in two samples with an average concentration of 0.05 pCi/gm. One sample of sediment contained Sb-124 at 0.05 pCi/gm. The results for the analysis of pond sediment samples are provided in Table H-22.

These radionuclides were most likely deposited in the sediment in the Yard Holding Pond as a result of back flow from the plant discharge. The back flow occurs into the Yard Holding Pond if discharge to the river has to be temporarily halted. Since these radionuclides were present in relatively low concentrations and confined to the Yard Holding Pond located in the owner controlled area not open to the general public, the presence of these radionuclides would not represent any increased risk of exposure to the general public.

The presence of Co-58 was detected in one sample of clam flesh collected from the downstream location. The measured concentration was 0.34 pCi/gm. Since there is no human consumption of the Asiatic clams, the presence of Co-58 would present no health risk to the general public. The results from the analysis of clams samples is presented in Table H-23.

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 guidance provided by the NRC in Regulatory Guide 1.109 for determining the potential dose to individuals and populations living in the vicinity of the plant. 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 the "hypothetical" person. In reality, the expected dose to actual individuals is significantly lower.

The area around the plant is analyzed to determine the pathways through which the public may receive an exposure. As indicated in Figure 2, the two major ways by which radioactivity is introduced into the environment are through liquid and gaseous effluents.

For liquid effluents, the public can be exposed to radiation from three sources: drinking water from the Tennessee River, eating fish caught in the Tennessee River, and direct exposure to radioactive material due to activities on the banks of the river (recreational activities). Data used to determine these doses are based on guidance given by the NRC for maximum ingestion rates, exposure times, and distribution of the material in the river. Whenever possible, data used in the dose calculation are based on specific conditions for the WBN area.

For gaseous effluents, the public can be exposed to radiation from several sources: direct radiation from the radioactivity in the air, direct radiation from radioactivity deposited on the ground, inhalation of radioactivity in the air, ingestion of vegetation which contains radioactivity deposited from the atmosphere, and ingestion of milk from animals which consumed vegetation containing deposited radioactivity. The concentrations of radioactivity in the air and the soil are estimated by computer models which use the actual meteorological conditions to determine the

distribution of the effluents in the atmosphere. Again, as many of the parameters as possible are based on actual site specific data.

Results

The estimated doses to the maximum exposed individual due to radioactivity released from WBN in 1997 are presented in Table 3. These estimates were made using the concentrations of the liquids and gases measured at the effluent monitoring points. Also shown are the regulatory limits for these doses and a comparison between the calculated dose and the corresponding limit. The maximum calculated whole body dose equivalent from measured liquid effluents as presented in Table 3 is 2.5E-01 mrem/year, or 8.3 percent of the limit. The maximum organ dose equivalent from gaseous effluents is 3.4E-02 mrem/year. This value is 0.2 percent of the ODCM limit. A more complete description of the effluents released from WBN and the corresponding doses projected from these effluents can be found in the WBN Annual Radioactive Effluent Release Report.

The estimated increase in radiation dose equivalent to the general public resulting from the operation of WBN 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 detected in sediment, soil, and fish collected for the WBN program and Sr-90 was measured in milk and vegetation samples. The concentrations measured were consistent with levels measured through out the preoperational monitoring program. The trace amounts of Co-58 and Fe-59 found in bottom sediment and the Co-58 measured in clam flesh would produce no measurable increase in the dose to the general public.

Dose estimates were made from concentrations of radioactivity found in samples of environmental media. Media evaluated include, but are not limited to, air, milk, food products, drinking water, fish and shoreline sediment. Inhalation, ingestion and direct exposure dose

estimates for persons at the indicator locations were essentially identical to those determined for persons at control stations. More than 99 percent of the doses to the public produced by radionuclides in the environmental media sampled in the WBN program were contributed by the naturally occurring radionuclide K-40 and by Sr-90 and Cs-137. The concentrations of Sr-90 and Cs-137 are consistent with levels measured in TVA's preoperational radiological environmental monitoring programs.

The samples of pond sediment were not included in the assessment of doses from environmental radionuclides. As discussed earlier, these radionuclides were contained in the sediment from the Yard Holding Pond which is in the owner controlled area and would not present an exposure pathway for the general public.

Conclusions

It is concluded from the above analysis of environmental samples and from the trend plots presented in Appendix H, that exposure to members of the general public which may have been attributable to WBN is negligible. The radioactivity reported herein is primarily the result of fallout or natural background. Any activity which may be present in the environment 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. 93, "Ionizing Radiation Exposure of the Population of the United States," September 1987.

3. United States Nuclear Regulatory Commission, Regulatory Guide 8.29, "Instruction Concerning Risks from Occupational Radiation Exposure," July 1981.

4. Hansen, W.G., Campbell, J. E., Fooks, J. H., Mitchell, H.C., and Eller C.H., Farming Practices and Concentrations of Emission Products in Milk, U.S. Department of Health, Education, and Welfare; Public Health Service Publication No. 999-R-6, May 1964.

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		
	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	300	100,000		
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	30,000	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		0.011
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 Source: Table 2 of Appendix B to 10 CFR 20.1001-20.2401

2 Source: WBN Offsite Dose Calculation Manual, Table 2.3-2

3 Source: Table E-1 of this report.

Table 2
Results from the
Intercomparison of Environmental Dosimeters

Year	TVA Results mrem	Average, all Respondents mrem	Calculated Exposure (See Note 1) mrem	% Difference TVA: Calculated	% Difference Respondents: Calculated
Field Dosimeters					
74	15.0	16.3	16.3	-8.0	0.0
77	30.4	31.5	34.9	-12.9	-9.7
79	13.8	16.0	14.1	-2.1	13.5
81	31.8	30.2	30.0	6.0	0.7
82	43.2	45.0	43.5	-0.7	3.4
84	73.0	75.1	75.8	-3.7	-0.9
86a	33.2	28.9	29.7	11.8	-2.7
86b	9.4	10.1	10.4	-9.6	-2.9
93a	24.4	26.4	27.0	-9.6	-2.2
93b	27.6	26.4	27.0	2.2	-2.2
96a	16.9	18.9	19.0	-10.9	-0.5
96b	17.6	18.9	19.0	-7.4	-0.5
Low Irradiated Dosimeters					
74	27.9	28.5	30.0	-7.0	-5.0
79	12.1	12.1	12.2	-0.8	-0.8
86	18.2	16.2	17.2	5.8	-5.8
93a	24.9	25.0	25.9	-3.9	-3.5
93b	27.8	25.0	25.9	7.3	-3.5
High Irradiated Dosimeters					
77	99.4	86.2	91.7	8.4	-6.0
79	46.1	43.9	45.8	0.7	-4.1
81a	84.1	75.8	75.2	11.8	0.8
81b	102.0	90.7	88.4	15.4	2.6
82a	179.0	191.0	202.0	-11.4	-5.4
82b	136.0	149.0	158.0	-13.9	-5.7
84a	85.6	77.9	79.9	7.1	-2.5
84b	76.8	73.0	75.0	2.4	-2.7
93a	67.8	69.8	72.7	-6.7	-4.0
93b	80.2	69.8	72.7	10.3	-4.0
96a	60.7	55.2	58.1	4.5	-5.0
96b	59.4	55.2	58.1	2.2	-5.0

Notes: 1. The calculated exposure is the "known" exposure determined by the testing agency.

Table 3

Maximum Dose Due to Radioactive Effluent Releases

Watts Bar Nuclear Plant
1997
mrem/year

Dose From Liquid Effluents

Type	1997 Dose	NRC Limit	Percent of NRC Limit
Total Body	2.5E-1	3	8.3
Any Organ	3.6E-1	10	3.6

Doses From Gaseous Effluents

Type	1997 Dose	NRC Limit	Percent of NRC Limit
Noble Gas (Gamma)	7.7E-2	10	0.7
Noble Gas (Beta)	2.1E-1	20	1.1
Any Organ	3.4E-2	15	0.2

Total Cumulative Dose

Type	1997 Dose	EPA Limit	Percent of EPA Limit
Total Body or Any Other Organ	6.9E-1	25	2.8
Thyroid	3.6E-1	75	<1

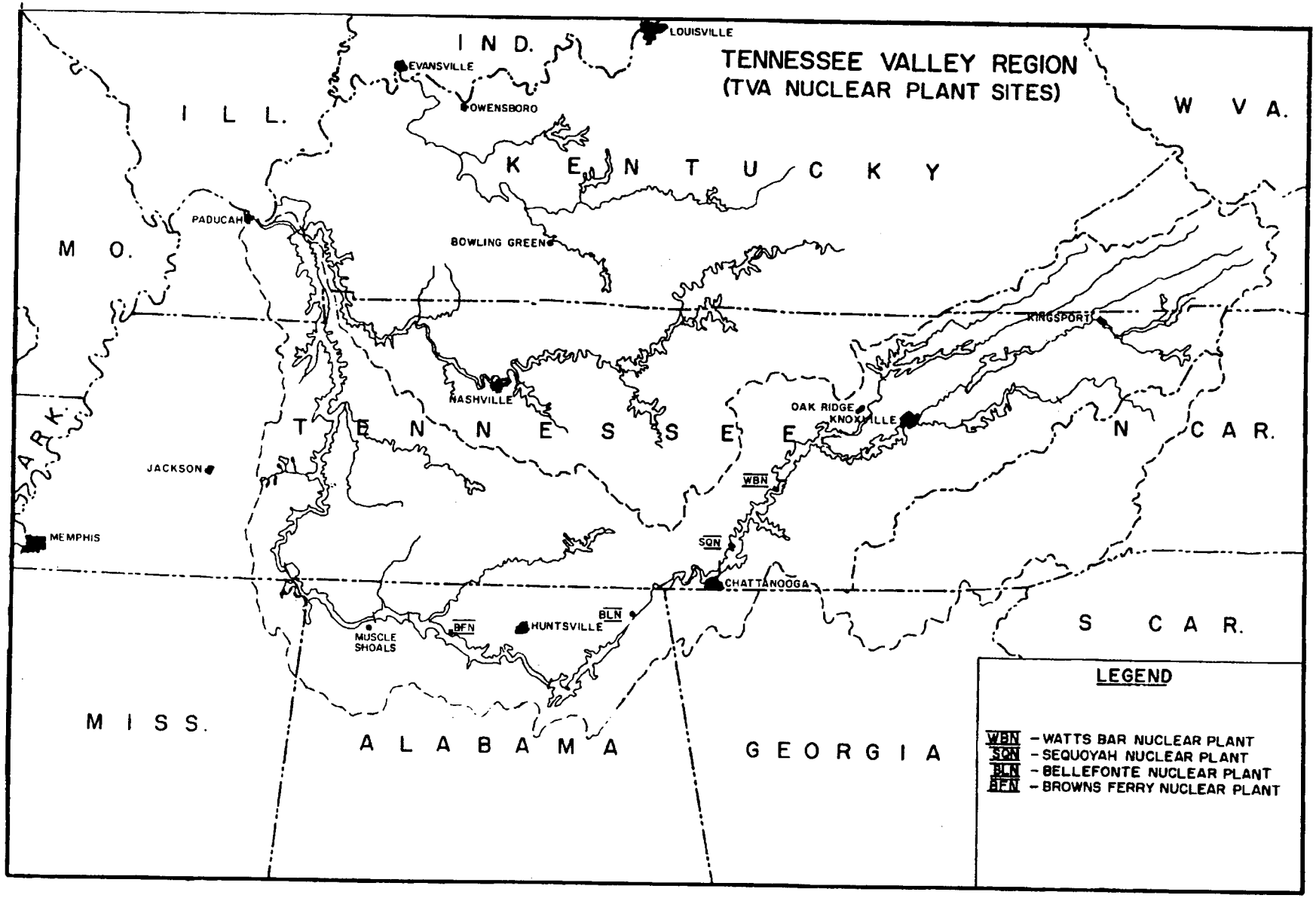
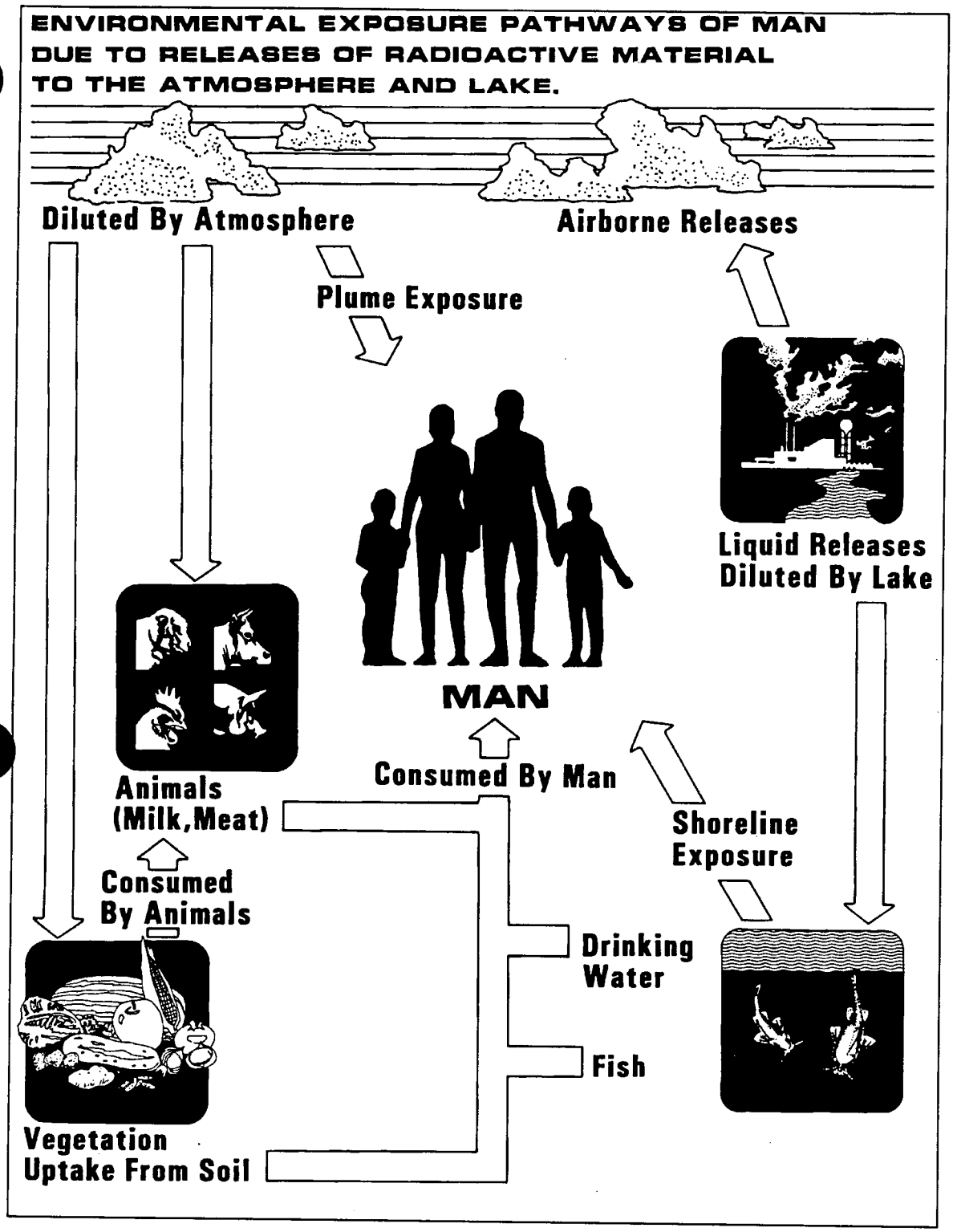

TENNESSEE VALLEY REGION
(TVA NUCLEAR PLANT SITES)
LOUISVILLE
IND.
EVANSVILLE
OWENSBORO
ILL.
W VA.
KENTUCKY
PADUCAH
BOWLING GREEN
MO.
KINGSPORT
NASHVILLE
OAK RIDGE
KNOXVILLE
ARK.
TENNESSEE
N CAR.
JACKSON
WBN
MEMPHIS
SQN
CHATTANOOGA
BLN
BFN
HUNTSVILLE
MUSCLE SHOALS
S CAR.
MISS.
ALABAMA
GEORGIA
LEGEND
WBN - 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
Consumed By Man
Animals
(Milk,Meat)
Shoreline
Exposure
Consumed
By Animals
Drinking
Water
Fish
Vegetation
Uptake From Soil

APPENDIX A

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM AND SAMPLING LOCATIONS

Table A-1

WATTS BAR NUCLEAR PLANT
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Samples and Locations[b]	Sampling and Collection Frequency	Type and Frequency of Analysis
1. AIRBORNE			
a. Particulates	4 samples from locations (in different sectors) at or near the site boundary (LM-1, 2, 3, and 4).	Continuous sampler operation with sample collection once per 7 days (more frequently if required by dust loading).	Analyze for gross beta radioactivity greater than or equal to 24 hours following filter change. Perform gamma isotopic analysis on each sample if gross beta is greater than 10 times yearly mean of control sample. Composite at least once per 31 days (by location) for gamma scan.
	4 samples from communities approximately 6-10 miles from the plant (PM-2, 3, 4, and 5).		
	2 samples from control locations greater than 10 miles from the plant (RM-1 and 3).		
b. Radioiodine	Samples from same locations as air particulates.	Continuous sampler operation with filter collection once per 7 days.	I-131 at least once per 7 days. Analysis is performed by gamma spectroscopy.
c. Rainwater	Samples from same locations as air particulates.	Rainwater collected continuously with composite sample taken monthly.	Analyzed for gamma activity only if radioactivity in other media indicates the presence of increased levels of fallout.
d. Soil	Samples from same locations as air particulates.	Once per year.	Gamma scan, Sr-89, Sr-90 once per year.

Table A-1

WATTS BAR 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	2 or more dosimeters (TLDs) placed at or near the site boundary in each of the 16 sectors.	At least once per 92 days.	Gamma dose at least once per 92 days.
	2 or more dosimeters placed at stations located approximately 5 miles from the plant in each of the 16 sectors.		
	2 or more dosimeters in approximately 16 additional locations of special interest.		
3. WATERBORNE			
a. Surface	2 samples downstream from plant discharge (TRM 517.9 and TRM 523.1).	Collected by automatic sequential-type sampler[c] with composite samples collected over a period of approximately 31 days.	Gross beta and gamma scan of each composite sample. Composite for Sr-89, Sr-90, and tritium analysis at least once per 92 days.
	1 sample at a control location upstream from plant discharge (TRM 529.3).		
b. Ground	One sample adjacent to plant (well No. 1).	Collected by automatic sequential-type sampler[c] with composite samples collected over a period of approximately 31 days.	Composited for gross beta, gamma scan, Sr-89, Sr-90 and tritium at least once per 92 days.

Table A-1

WATTS BAR 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. Ground (Continued)	1 sample from ground water source up gradient (well No. 5).	Same as well No. 1.	Gross beta, gamma scan, Sr-89, Sr-90 and tritium at least once per 92 days.
	1 sample from ground water source up gradient (Farm L).	Grab sample at least once per 92 days.	Same as above.
c. Drinking	1 sample at the first two potable surface water supplies downstream from the plant (TRM 503.8 and TRM 473.0).	Collected by automatic sequential-type sampler[c] with composite sample analyzed monthly[e].	Gross beta and gamma scan on each composite. Quarterly composite also analyzed for tritium, Sr-89, and Sr-90.
	1 sample at a control location TRM529.3[d].		
d. Sediment	1 sample in the area immediately downstream of plant discharge (TRM 527.4).	At least once per 184 days.	Gamma scan of each sample.
	2 additional samples downstream of plant discharge (TRM 518.0 and 496.5).		
	1 sample at a control location upstream from plant discharge (TRM 532.1).		

Table A-1

WATTS BAR 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
e. Sediment from shoreline.	1 sample downstream from plant Discharge (TRM 513.0). 1 sample from a control location upstream from plant discharge (TRM 530.2).	At least once per 184 days.	Gamma scan of each sample.
f. Pond Sediment	1 sample from at least three locations in the Yard Holding Pond.	At least once per year.	Gamma scan of each sample.
5. INGESTION			
a. Milk	3 samples from farms and/or dairies in the immediate vicinity of the plant (Farms L, Mu and N). 1 or more samples from control locations (Farms B, C, and/or S). (Also used at SQN).	Every 2 weeks.	I-131 and gamma analysis on each sample. Sr-89 and Sr-90 once per quarter.
b. Fish	At least one sample of each monitored species from Chickamauga and Watts Bar Reservoirs.	At least once per 184 days. One sample of each of the following species: Channel Catfish Crappie Smallmouth Buffalo	Gamma scan on edible portions.

Table A-1

WATTS BAR NUCLEAR PLANT
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Samples and Locations[b]	Sampling and Collection Frequency	Type and Frequency of Analysis
c. Clams	1 sample downstream of plant discharge. 1 sample at a control location upstream from plant discharge.	At least once per 184 days.	Gamma scan on flesh only.
d. Vegetation (Pasturage and grass)	2 samples from farms from which milk is or has been obtained (Farms L and OH).	Monthly	I-131 analysis and gamma scan of each sample. Sr-89 and Sr-90 Analysis at least once per 92 days.
	1 sample from a control location (Farm S; also used for SQN).	Monthly	
e. Food Products	1 sample each of principal food products grown at private gardens and/or farms in the immediate vicinity of the plant.	Annually at time of harvest. The types of foods available for sampling will vary. Following is a list of typical foods which may be available: Cabbage and/or Lettuce Corn Green Beans Potatoes Tomatoes	Gamma scan on edible portion.

a. The sampling program outlined in this table is that which was in effect at the end of 1997.
b. Sample locations are shown on Figures A-1, A-2, A-3.
c. Samples shall be collected by collecting an aliquot at intervals not exceeding 2 hours.
d. The samples collected at TRMs 503.8 and 473.0 are taken from the raw water supply, therefore, the upstream surface water sample will be considered the control sample for drinking water.

Table A-2
WATTS BAR 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]
2	PM-2	NW	7.0	I	AP,CF,R,S
3	PM-3	NNE	10.4	I	AP,CF,R,S
4	PM-4	NE/ENE[c]	7.6	I	AP,CF,R,S
5	PM-5	S	6.2	I	AP,CF,R,S
6	RM-2	SW	15.0	C	AP,CF,R,S
7	RM-3	NNW	15.0	C	AP,CF,R,S
8	LM-1	SSW	0.5	I	AP,CF,R,S
9	LM-2	N	0.5	I	AP,CF,R,S
10	LM-3	NNE	1.9	I	AP,CF,R,S
11	LM-4	SE	0.9	I	AP,CF,R,S
12	Farm L	SSW	1.3	I[d]	M,V,W
15	Farm B	E	15.0	C	M
16	Farm C	SSW	16.0	C	M
17	Farm S	SW	19.5	C	M,V
18	Well #1	S	0.6	I	W
19	Farm Mu	ESE	3.7	I	M
20	Farm N	ESE	4.1	I	M
21	Farm OH	WSW	4.8	I	V
22	Well #5	N	0.5	C	W
25	TRM 517.9	--	9.9[e]	I	SW
25a	TRM 518.0	--	9.8[e]	I	SD
26	TRM 523.1	--	4.7[e]	I	SW
27	TRM 529.3	--	1.5[e]	C	SW,PW[f]
28	TRM 532.1	--	4.3[e]	C	SD
29	TRM 527.4	--	0.4[e]	I	SD
31	TRM 473.0 (C. F. Industries)		54.8[e]	I	PW
32	TRM 513.0	--	14.8[e]	I	SS
33	TRM 530.2	--	2.4[e]	C	SS
35	TRM 503.8 (Dayton)	--	24.0[e]	I	PW
36	TRM 496.5	--	31.3[e]	I	SD
38	Chickamauga Reservoir			I	F
39	Watts Bar Reservoir			C	F
81	Yard Pond	SSE/S/SSW	Onsite	I	PS

a. See Figures A-1, A-2, and A-3
b. Sample codes:
AP = Air particulate filter
CF = Charcoal filter
CL = Clams
F = Fish
M = Milk
PW = Public Water
PS = Pond Sediment
R = Rainwater
S = Soil
SD = Sediment
SS = Shoreline sediment
SW = Surface water
V = Vegetation
W = Well water
c. Station located on the boundary between these two sectors.
d. A control for well water.
e. Distance from the plant discharge (TRM 527.8)
f. The surface water sample is also used as a control for public water.

Table A-3
WATTS BAR NUCLEAR PLANT
THERMOLUMINESCENT DOSIMETER (TLD) LOCATIONS

Map[a] Location Number	Station	Sector	Approximate Distance (miles)	Onsite (On)[b] or Offsite (Off)
2	NW-3	NW	7.0	Off
3	NNE-3	NNE	10.4	Off
4	ENE-3	ENE	7.6	Off
5	S-3	S	6.2	Off
6	SW-3	SW	15.0	Off
7	NNW-4	NNW	15.0	Off
10	NNE-1A	NNE	1.9	On
11	SE-1A	SE	0.9	On
12	SSW-2	SSW	1.3	On
14	W-2	W	4.8	Off
15	E-3	E	15.0	Off
40	N-1	N	1.2	On
41	N-2	N	4.7	Off
42	NNE-1	NNE	1.2	On
43	NNE-2	NNE	4.1	Off
44	NE-1	NE	0.9	On
45	NE-2	NE	2.9	Off
46	NE-3	NE	6.1	Off
47	ENE-1	ENE	0.7	On
48	ENE-2	ENE	5.8	Off
49	E-1	E	1.3	On
50	E-2	E	5.0	Off
51	ESE-1	ESE	1.2	On
52	ESE-2	ESE	4.4	Off
54	SE-2	SE	5.3	Off
55	SSE-1	SSE	0.6	On
56	SSE-2	SSE	5.8	Off
57	S-1	S	0.7	On
58	S-2	S	4.8	Off
59	SSW-1	SSW	0.8	On
60	SSW-3	SSW	5.0	Off
62	SW-1	SS	0.8	On
63	SW-2	SW	5.3	Off
64	WSW-1	WSW	0.9	On
65	WSW-2	WSW	3.9	Off
66	W-1	W	0.9	On
67	WNW-1	WNW	0.9	On
68	WNW-2	WNW	4.9	Off
69	NW-1	NW	1.1	On
70	NW-2	NW	4.7	Off
71	NNW-1	NNW	1.0	On
72	NNW-2	NNW	4.5	Off
73	NNW-3	NNW	7.0	Off
74	ENE-2A	ENE	3.5	Off
75	SE-2A	SE	3.1	Off
76	S-2A	S	2.0	Off
77	W-2A	W	3.2	Off
78	NW-2A	NW	3.0	Off

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

Figure A-1

Radiological Environmental Sampling Locations

Within 1 Mile of the Plant

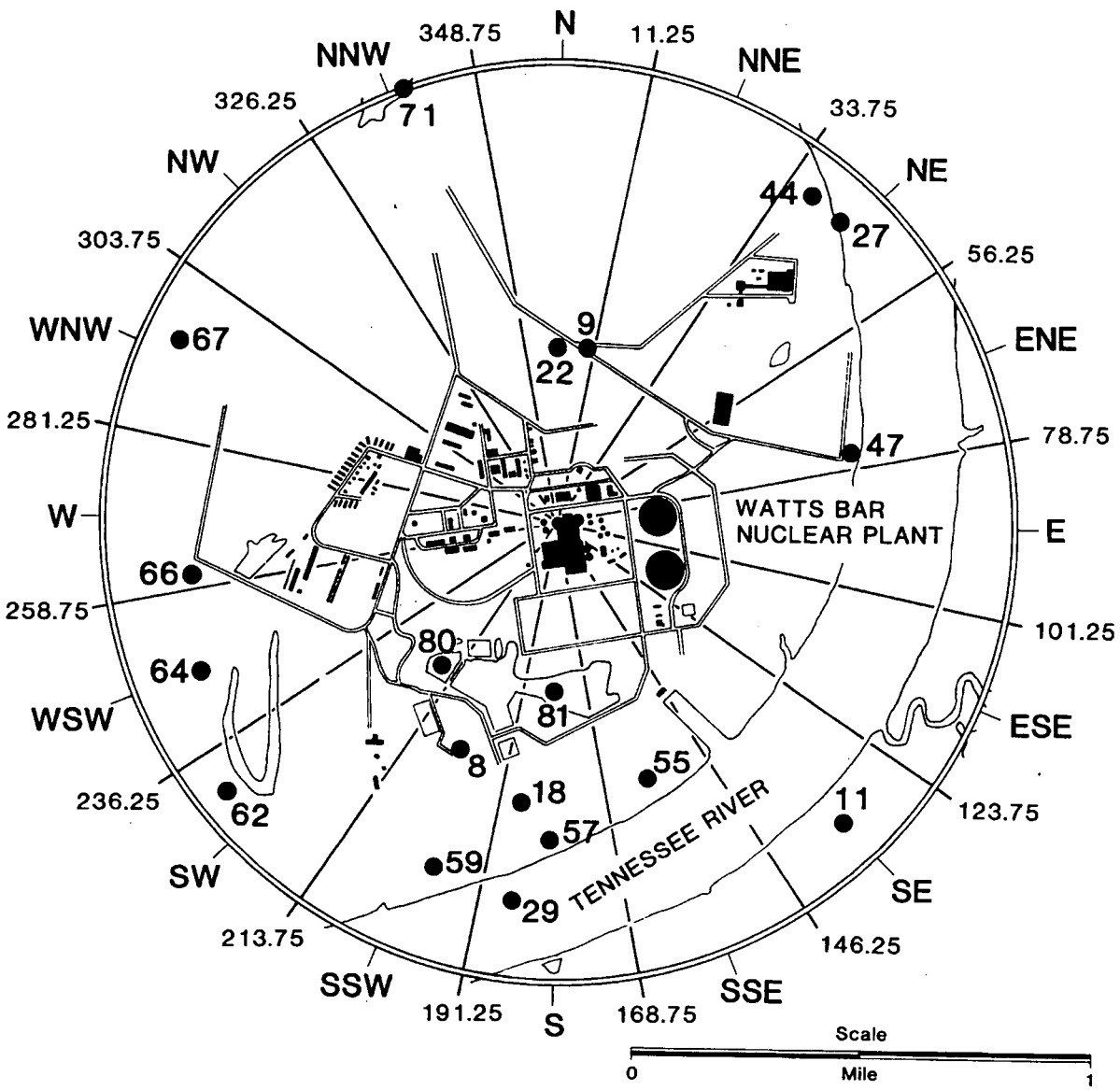


Figure A-2

Radiological Environmental Sampling Locations

From 1 to 5 Miles From The Plant

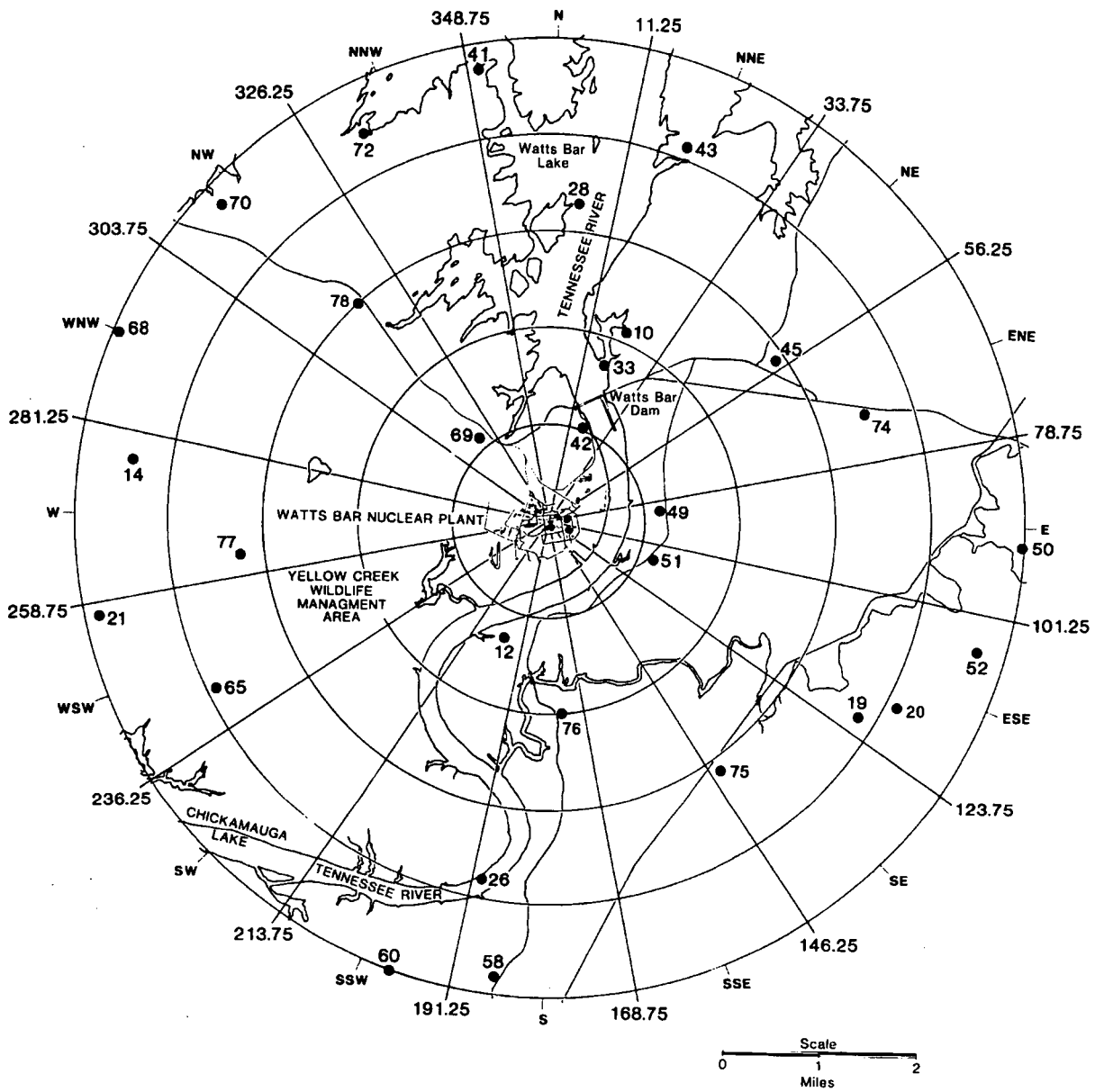
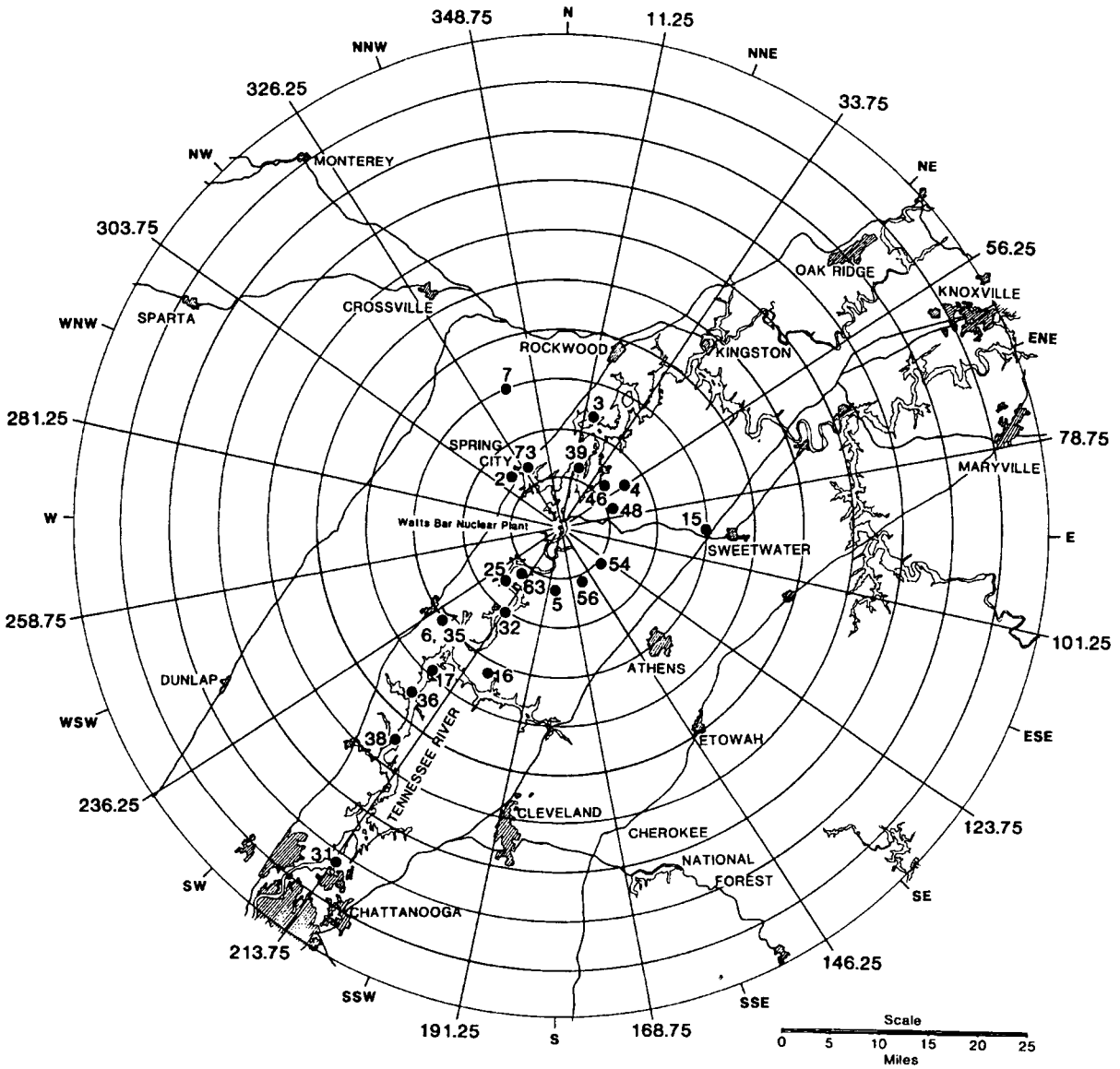


Figure A-3

Radiological Environmental Sampling Locations

Greater Than 5 Miles From the Plant



APPENDIX B

1997 PROGRAM MODIFICATIONS

Appendix B

Radiological Environmental Monitoring Program Modification

During 1997, only two minor modifications were made in the WBN radiological environmental monitoring program. A change was implemented in the sampling location used for the collection of channel catfish. The sampling location for channel catfish collected for the WBN program was redefined to be the region of the reservoir from the WBN discharge to a distance of approximately two miles downstream, assuming adequate fish can be found in this region. Since SQN and WBN plants are both located on the Chickamauga Reservoir, one set of fish samples from Chickamauga has been used for both monitoring programs. This decision was based on evaluations by aquatic biologists that fish within a reservoir migrate throughout the reservoir. However, due to a high concentration of channel catfish within the region two miles downstream of the SQN plant discharge, the sample of channel catfish had been historically collected from that region of the reservoir. The sample of channel catfish from the region downstream of the WBN discharge was added in 1997 to ensure sampling of this species adequately addressed WBN operations. No changes were made in the sampling of crappie or smallmouth buffalo.

The second modification was a reduction in the number of sediment samples collected from the onsite pond. A larger number of samples were collected in previous years to provide adequate background information for this sampling activity. The reduction implemented in 1997 was consistent with the program requirements contained in the WBN ODCM.

APPENDIX C

PROGRAM DEVIATIONS

Appendix C

Program Deviations

During 1997, there were five sampling periods when air particulate filter and charcoal cartridge samples could not be collected from one of the ten sampling locations due to equipment problems. The stations and dates are listed in the Table C-1.

A total of six surface water samples were not available from the sampling locations at either TRM 523.1 or TRM 529.3 at various sampling periods during the year due to problems with the sampling system equipment. TRM 523.1 is the first of two downstream sampling points. The sample from the second downstream location at TRM 517.9 was collected as scheduled each sampling period. The sampling point at TRM 529.3 is the upstream control location for surface water. In each case of equipment problem, repair efforts were concentrated on returning the sampler to service prior to the next scheduled sample collection but in cases where a diver was required to support repairs to the sampling pump and sampling line the sampler could not be returned to service in time to collect an adequate sample volume for the next scheduled sample.

Table C-1 provides a detail summary of these missed samples.

Table C-1

Radiological Environmental Monitoring Program Deviations

Date	Station	Location	Remarks
01/22/97	PM-4	7.6 miles NE	The air particulate filter and charcoal cartridge samples were not available due to equipment problems. The drive belt was broken on the sampling pump. Repairs were made and the sampler was working in time for the next scheduled sample.
05/27/97 06/24/97	TRM 523.1	4.7 miles downstream	Surface water sample could not be collected due to equipment problems. A diver was required for repairs to the sampling pump and sampling line. Availability of a diver delayed completing repairs.
06/17/97	PM-3	10.4 miles NNE	A problem with a loose drive belt on the pump resulted in a low volume of air sampled. The volume of air sampled was not adequate for a suitable air particulate filter and charcoal cartridge sample.
10/14/97	LM-2	0.5 miles N	The air particulate filter and charcoal cartridge samples were not available due to equipment problems. The drive belt was broken on the sampling pump. Repairs were made and the sampler was working in time for the next scheduled sample.
10/21/97 10/28/97	PM-2	7.0 miles NW	The air particulate filter and charcoal cartridge samples were not available due to equipment problems. The drive belt was broken on the sampling pump. Repairs were made prior to the next sampling period but a problem with the electrical power supply for the monitor prevented collection on 10/28/97 also.
10/14/97 11/12/97	TRM 523.1	4.7 miles downstream	Surface water sample was not collected due to problems with the sampling equipment. A diver was required for repairs to the sampling pump and sampling line. Availability of a diver delayed completing repairs.
11/12/97 12/09/97	TRM 529.3	1.5 miles upstream	Surface water sample could not be collected due to equipment problems. A diver was required for repairs to the sampling pump and sampling line. Availability of a diver delayed completing repairs.

(a) Distance from the plant discharge.

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, Alabama. 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 ml 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.

The specific analysis of I-131 in milk, water, or vegetation samples is performed by first isolating and purifying the iodine by radiochemical separation and then counting the final precipitate on a beta-gamma coincidence counting system. The normal count time is 50 minutes. With the beta-gamma coincidence counting system, background counts are virtually eliminated and extremely low levels of activity can be detected.

After a radiochemical separation, samples analyzed for Sr-89,90 are counted on a low background beta counting system. The sample is counted a second time after a 7-day ingrowth period. From the two counts the Sr-89 and Sr-90 concentrations can be determined.

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. All gamma counts are obtained with germanium type detectors interfaced with a computer based multichannel analyzer system. Spectral data reduction is performed by the computer program HYPERMET.

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

All of 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 (LLD)

Appendix E

Nominal Lower Limits of Detection

Sensitive radiation detection devices can produce a signal even when no radioactivity is present in a sample being analyzed. This signal may come from trace amounts of radioactivity in the components of the device, from cosmic rays, from naturally occurring radon gas, or from electronic noise. The signal registered when no activity is present in the sample is called the background.

The point at which the signal is determined to represent radioactivity in the sample is called the critical level. This point is based on statistical analysis of the background readings from any particular device. However, any sample measured over and over in the same device will give different readings, some higher than others. The sample should have a well-defined average reading, but any individual reading will vary from that average. In order to determine the activity present in a sample that will produce a reading above the critical level, additional statistical analysis of the background readings is required. The hypothetical activity calculated from this analysis is called the lower limit of detection (LLD). A listing of typical LLD values that a laboratory publishes is a guide to the sensitivity of the analytical measurements performed by the laboratory.

Every time an activity is calculated from a sample, the background must be subtracted from the sample signal. For the very low levels encountered in environmental monitoring, the sample signals are often very close to the background. The measuring equipment is being used at the limit of its capability. For a sample with no measurable activity, which often happens, about half the time its signal should fall below the average machine background and half the time it should be above the background. If a signal above the background is present, the calculated activity is compared to the calculated LLD to determine if there is really activity present or if the number is an artifact of the way radioactivity is measured.

A number of factors influence the LLD, including sample size, count time, counting efficiency, chemical processes, radioactive decay factors, and interfering isotopes encountered in the sample. The most likely values for these factors have been evaluated for the various analyses performed in the environmental monitoring program. The nominal LLDs calculated from these values, in accordance with the methodology prescribed in the ODCM, are presented in Table E-1. The maximum values for the lower limits of detection specified in the ODCM are shown in Table E-2.

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

TABLE E-1

Nominal LLD Values
A. Radiochemical Procedures

	Air Filters (pCi/m^3)	Water (pCi/L)	Milk (pCi/L)	Fish (pCi/g dry)	Wet Vegetation (pCi/Kg wet)	Sediment and Soil (pCi/g dry)
Gross Beta	0.002	1.9				
Tritium		300				
Iodine-131		0.4	0.4		6.0	
Strontium-89	0.0011	5.0	3.5		31.0	1.6
Strontium-90	0.0004	2.0	2.0		12.0	0.4

Table E-1
Nominal LLD Values
B. Gamma Analyses (GeLi)

	Particulate Filter pCi/m3	Charcoal Filter pCi/m3	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	Clam Flesh pCi/g, dry	Foods Tomatoes Potatoes, etc. pCi/kg, wet
Ce-141	.005	.02	10	.07	35	.10	.07	.35	20
Ce-144	.01	.07	30	.15	115	.20	.15	.85	60
Cr-51	.02	0.15	45	.30	200	.35	.30	2.40	95
I-131	.005	0.03	10	.20	60	.25	.20	1.70	20
Ru-103	.005	0.02	5	.03	25	.03	.03	.25	25
Ru-106	.02	0.12	40	.15	190	.20	.15	1.25	90
Cs-134	.005	0.02	5	.03	30	.03	.03	.14	10
Cs-137	.005	0.02	5	.03	25	.03	.03	.15	10
Zr-95	.005	0.03	10	.05	45	.05	.05	.45	45
Nb-95	.005	0.02	5	.25	30	.04	.25	.25	10
Co-58	.005	0.02	5	.03	20	.03	.03	.25	10
Mn-54	.005	0.02	5	.03	20	.03	.03	.20	10
Zn-65	.005	0.03	10	.05	45	.05	.05	.40	45
Co-60	.005	0.02	5	.03	20	.03	.03	.20	10
K-40	.04	0.30	100	.40	400	.75	.40	3.50	250
Ba-140	.015	0.07	25	.30	130	.30	.30	2.40	50
La-140	.01	0.04	10	.20	50	.20	.20	1.40	25
Fe-59	.005	0.04	10	.08	40	.05	.08	.45	25
Be-7	.02	0.15	45	.25	200	.25	.25	1.90	90
Pb-212	.005	0.03	15	.04	40	.10	.04	.30	40
Pb-214	.005	0.07	20	.50	80	.15	.50	.10	80
Bi-214	.005	0.05	20	.10	55	.15	.10	.50	40
Bi-212	.02	0.20	50	.25	250	.45	.25	2.00	30
Tl-208	.002	0.02	10	.03	30	.06	.03	.25	130
Ra-224	--	--	--	--	--	.75	--	--	--
Ra-226	--	--	--	--	--	.15	--	--	--
Ac-228	.01	0.07	20	.10	70	.25	.10	.75	50

Table E-2

Maximum Values for the Lower Limits of Detection (LLD)
Specified by the WBN Offsite Dose Calculation Manual

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	1×10^{-2}	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]	7×10^{-2}	N.A.	1	60	N.A.
Cs-134	15	5×10^{-2}	130	15	60	150
Cs-137	18	6×10^{-2}	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/liter may be used.

b. If no drinking water pathway exists, a value of 15 pCi/liter may be used.

APPENDIX F

QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

Appendix F

Quality Assurance/Quality Control Program

A thorough 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, a complete training and qualification process, 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.

Radiation detection devices can be tested in a number of ways. There are two primary tests which are performed on all devices. In the first type, the device is operated without a sample on the detector to determine the background count rate. The background counts are usually low values and are due to machine noise, cosmic rays, trace amounts of radioactivity in the materials used to construct the detector, or terrestrial sources. Charts of background counts are kept and monitored to ensure that no unusually high or low values are encountered.

In the second test, the device is operated with a known amount of radioactivity present. The number of counts registered from such a radioactive standard should be very reproducible. These reproducibility checks are also monitored to ensure that they are neither higher nor lower than expected. When counts from either test fall outside the expected range, the device is inspected for malfunction or contamination. It is not placed into service until it is operating properly.

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 may be blanks, replicate samples, blind samples, or 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.

Duplicate samples are 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 personnel can split it into two portions. Such a sample can provide 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. Whenever possible, the analytical knowns contain the same amount of radioactivity each time they are run. In this way, the lab staff has immediate knowledge of the quality of the measurement process. A portion of these samples are also blanks.

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 samples contain 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 they can be used to test the data review process. If an analysis routinely generates numerous zeroes for a particular isotope, the presence of a positive result will be brought to the attention of the laboratory supervisor in the daily review process. Blind spikes test this process since they 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 determine whether or not the laboratory can find any unusual radioactivity whatsoever.

At present, 5 percent of the laboratory workload is in the category of 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 personnel performing the analyses do not. They are aware they are being tested. Such samples test the best performance of the laboratory by determining if the staff 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.

A series of cross-checks is produced by the EPA in Las Vegas. These interlaboratory comparison samples or "EPA cross-checks" are considered to be the primary indicator of laboratory performance. They provide and independent check of the entire measurement process that cannot be easily provided by the laboratory itself. That is, unlike internal cross-checks, EPA cross-checks test the calibration of the laboratory detection devices since different radioactive standards produced by individuals outside TVA are used in the cross-checks. The results of the analysis of these samples are reported back to EPA which then issues a report of all the results of all participants. These reports indicate how well the laboratory is doing compared to others across the nation. Like internal cross-checks, the EPA

cross-checks provide information to the laboratory about the precision and accuracy of the radioanalytical work it does. The results of TVA's participation in the EPA Interlaboratory Comparison Program are presented in Table F-1. For 1997, all EPA cross-check sample concentrations measured by TVA's laboratory were within $\pm$ 3-sigma of the EPA reported values.

TVA splits certain environmental samples with laboratories operated by the States of Alabama and Tennessee and the EPA National Air and Radiation Environmental Laboratory in Montgomery, Alabama. When radioactivity has been present in the environment in measurable quantities, such as following atmospheric nuclear weapons testing, following the Chernobyl incident, or as naturally occurring radionuclides, the split samples have provided TVA with yet another level of information about laboratory performance. These samples demonstrate performance on actual environmental sample matrices rather than on the constructed matrices used in cross-check programs.

All 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 results 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 OBTAINED IN INTERLABORATORY COMPARISON PROGRAM

A. Radiochemical Analysis of Water (pCi/L)

Date	Gross Beta		Strontium-89		Strontium-90		Tritium		Iodine-131	
	EPA Value (±3 sigma)	TVA Avg.	EPA Value (±3 sigma)	TVA Avg.	EPA Value (±3 sigma)	TVA Avg.	EPA Value (±3 sigma)	TVA Avg.	EPA Value (±3 sigma)	TVA Avg.
01/97	15±9	17								
02/97									86±16	75
03/97							7900±1368	7770		
04/97			24±9	25	13±9	12				
07/97	15±9	16	44±9	43	16±9	17				
08/97							11010±1907	11106		
09/97									10±10	10
10/97	49±9	48								
10/97			36±9	33	22±9	24				

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

Date	Barium-133		Cobalt-60		Zinc-65		Cesium-134		Cesium-137	
	EPA Value (±3 sigma)	TVA Avg.	EPA Value (±3 sigma)	TVA Avg.	EPA Value (±3 sigma)	TVA Avg.	EPA Value (±3 sigma)	TVA Avg.	EPA Value (±3 sigma)	TVA Avg.
04/97			21±9	21			31±9	29	22±9	20
06/97	25±9	25	18±9	21	100±17	99	22±9	20	49±9	48
10/97			10±9	10			41±9	39	34±9	33
11/97	99±17	95	27±9	27	75±16	74	10±9	10	74±9	74

APPENDIX G

LAND USE SURVEY

Appendix G

Land Use Survey

A land use survey is conducted annually in accordance with the provisions of ODCM Control 1.3.2 to identify the location of 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 from the plant.

The land use survey is usually conducted between April 1 and October 1 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.

From the data of the surveys, relative radiation doses were projected for individuals near the plant. Doses from air submersion were calculated for the nearest resident in each sector, while doses from drinking milk or eating foods produced near the plant were calculated for the areas with milk producing animals and gardens, respectively. These doses were calculated using design basis source terms and historical meteorological data. They also assume that the effluent releases are equivalent to the design basis source terms. The calculated doses are relative in nature and do not reflect actual exposures received by individuals living near WBN. Calculated doses to individuals based on measured effluents from the plant are well below applicable dose limits (see Assessment and Evaluation Section and Table 3 of this report).

In response to the 1997 WBN land use survey, annual doses were calculated for air submersion, vegetable ingestion, and milk ingestion. The air submersion doses calculated for the nearest residence in each sector were almost identical to those calculated in 1996 with small changes due to differences in rounding. There were no actual changes in the identification of the location of the nearest residence.

For milk ingestion, projected doses were consistent with those calculated for 1996. There were small changes for annual dose results at three locations due to changes in the feeding factor. Except for the farm where the owner does not want to participate in the program (Farm Ho), milk samples are being collected from the three farms where the calculated doses are highest. One of the farms providing a milk sample is between Farm Ho and the plant.

Doses calculated for ingestion of home grown foods were changed slightly in some sectors compared to the results calculated in 1996 due to changes in the location of the nearest garden. Also no gardens were located in three of the sectors during the 1997 survey.

The results of the 1997 land use survey and resulting relative projected annual dose calculations documented that there were no significant changes in land use of unrestricted areas. No required changes in the sampling locations for the radiological environmental monitoring program were identified as result of the land use survey.

Tables G-1, G-2, and G-3 compare results of the relative projected annual dose calculations for 1996 and 1997.

Table G-1

Watts Bar Nuclear Plant
Relative Projected Annual Air Submersion Dose to the Nearest Residence
Within 5 Miles of Plant[a]

mrem/year

	1996		1997	
Sector	Approximate Distance (Miles)	Annual Dose	Approximate Distance (Miles)	Annual Dose
N	1.3	0.24	1.3	0.24
NNE	2.3	0.19	2.3	0.20
NE	2.1	0.19	2.1	0.19
ENE	1.5	0.30	1.5	0.30
E	2.0	0.18	2.0	0.18
ESE	2.9	0.10	2.9	0.10
SE	0.9	0.75	0.9	0.76
SSE	1.0	0.38	1.0	0.38
S	1.0	0.37	1.0	0.37
SSW	1.2	0.29	1.2	0.29
SW	2.7	0.09	2.7	0.09
WSW	1.3	0.38	1.3	0.38
W	1.8	0.07	1.8	0.07
WNS	1.0	0.17	1.0	0.17
NW	1.9	0.04	1.9	0.04
NNW	2.7	0.03	2.7	0.03

a. Assumes the effluent releases are equivalent to design basis source terms.

Table G-2

Watts Bar Nuclear Plant
Relative Projected Annual Ingestion Dose to Child's Critical
Organ from Ingestion of Home-Grown Foods
Nearest Garden Within 5 Miles of Plant[a]

mrem/year

	1996		1997	
Sector	Approximate Distance (Miles)	Annual Dose	Approximate Distance (Miles)	Annual Dose
N	4.8	0.50	4.8	0.50
NNE	4.0	1.47	4.0	1.47
NE	2.8	2.71	3.1	2.13
ENE	1.8	4.96	b	
E	5.0	0.83	5.0	0.83
ESE	2.9	2.34	2.8	2.57
SE	2.9	2.17	2.9	2.17
SSE	1.0	7.46	1.0	7.45
S	1.1	7.07	2.0	3.08
SSW	1.5	5.00	1.2	6.86
SW	b		b	
WSW	1.7	4.30	1.7	4.30
W	2.7	0.78	3.0	0.65
WNW	1.8	1.29	b	
NW	2.0	0.76	2.0	0.76
NNW	2.8	0.69	2.8	0.69

a. Assumes the effluent releases are equivalent to design basis source terms.
b. Garden not identified within 5 miles of the plant in this sector.

Table G-3

Watts Bar Nuclear Plant
Relative Projected Annual Dose to Receptor Thyroid from Ingestion of Milk[a]
(Nearest Milk-Producing Animal Within 5 Miles of Plant)

mrem/year

Location	Sector	Approximate Distance Miles	Annual Dose 1996	Annual Dose 1997	X/Q s/m^3
Cows					
Farm Mu[b]	ESE	3.7	0.07	0.07	1.14 E-6
Farm N[b]	ESE	4.1	0.05	0.04	9.44 E-7
Farm Hu	SE	5.0	0.03	0.02	5.62 E-7
Farm L[b]	SSW	1.3	0.40	0.71	2.36 E-6
Farm Ho[c]	SSW	1.5	2.53	2.53	1.43 E-6
Farm S	NW	4.9	0.01	0.01	1.30 E-7

a. Assumes the plant is operating and effluent releases are equivalent to design basis source terms.
b. Milk being sampled at these locations.
c. Owner unwilling to provide samples or information. The dose calculated assumes consumption of the milk by an adult and a feeding factor equivalent to the higher reported by the other dairies (41%). If milk from this location were to be consumed by teens, children or infants, the estimated doses would be 0.60, 1.23 and 2.92 mrem/year, respectively.

APPENDIX H

DATA TABLES AND FIGURES

Table H - 1

DIRECT RADIATION LEVELS

Average External Gamma Radiation Levels at Various Distances from Watts Bar Nuclear Plant for Each Quarter - 1997
mR / Quarter (a)

Distance miles	Average External Gamma Radiation Levels (b)				per annum mR / yr
	1st qtr	2nd qtr	3rd qtr	4th qtr	
0 - 1	15.8 ± 2.2	16.2 ± 2.6	16.9 ± 2.5	17.2 ± 2.6	66
1 - 2	14.3 ± 0.9	14.6 ± 1.2	15.3 ± 1.7	15.6 ± 1.5	60
2 - 4	13.8 ± 1.1	13.8 ± 1.1	14.2 ± 1.3	14.7 ± 1.1	56
4 - 6	13.9 ± 1.2	14.4 ± 1.6	14.6 ± 1.9	15.3 ± 1.9	58
> 6	13.6 ± 1.6	13.9 ± 2.2	14.0 ± 2.0	14.5 ± 2.3	56
Average 0 - 2 miles (onsite)	15.2 ± 1.9	15.6 ± 2.3	16.3 ± 2.4	16.5 ± 2.4	64
Average > 2 miles (offsite)	13.8 ± 1.3	14.1 ± 1.7	14.3 ± 1.9	14.9 ± 2.0	57

(a) Field periods normalized to one standard quarter (2190 hours)
(b) Average of the individual measurements in the set ± 1 standard deviation of the set

Table H-2

DIRECT RADIATION LEVELS

Individual Stations

Map Location	TVA Location	NRC(note a) Station No.	direction, degrees	approx distance, miles	Environmental Radiation Levels mR / quarter 1st qtr 12/96-2/97	2nd qtr 3/97-5/97	3rd qtr 6/97-8/97	4th qtr 9/97-11/97	Annual Exposure mR/year
40	N-1	16	10	1.2	15.5	16.1	17.7	17.5	66.8
41	N-2	15	350	4.7	14.2	14.4	15.4	16.1	60.1
42	NNE-1		21	1.2	15.1	16.2	17.2	16.6	65.1
10	NNE-1A		22	1.9	13.5	14.1	13.6	14.3	55.5
43	NNE-2		20	4.1	12.7	13.3	13.2	13.6	52.8
3	NNE-3		17	10.4	12.6	13.6	13.7	14.1	54.0
44	NE-1		39	0.9	17.6	18.4	19.2	19.6	74.8
45	NE-2		54	2.9	14.0	14.5	14.4	15.0	57.9
46	NE-3		47	6.1	11.5	11.6	11.9	12.2	47.2
47	ENE-1		74	0.7	15.8	17.1	17.3	17.7	67.9
48	ENE-2		69	5.8	13.6	13.7	13.4	13.9	54.6
74	ENE-2A		69	3.5	12.1	11.9	11.7	12.5	48.2
4	ENE-3		56	7.6	13.3	13.1	13.4	13.6	53.4
49	E-1	20	85	1.3	14.0	14.3	14.6	14.8	57.7
50	E-2		92	5.0	14.3	15.2	15.8	16.5	61.8
15	E-3		90	15.0	16.9	18.0	17.2	18.9	71.0
51	ESE-1	21	109	1.2	13.1	12.6	13.0	13.5	52.2
52	ESE-2		106	4.4	(b)	18.1	18.3	19.1	74.0
11	SE-1A	22	138	0.9	13.6	13.8	14.6	14.8	56.8
54	SE-2		128	5.3	13.1	13.6	12.8	13.7	53.2
75	SE-2A		144	3.1	14.1	14.1	14.1	15.0	57.3
55	SSE-1		156	0.6	15.2	14.7	16.3	15.9	62.1
56	SSE-2		156	5.8	15.4	15.3	15.3	16.2	62.2

note (a) Locations with TVA and NRC stations co-located

note (b) Dosimeter missing or damaged

Table H-2 (continued)

DIRECT RADIATION LEVELS

Individual Stations

Map Location	TVA Location	NRC(note a) Station No.	direction, degrees	approx distance, miles	Environmental Radiation Levels mR / quarter 1st qtr 12/96-2/97	2nd qtr 3/97-5/97	3rd qtr 6/97-8/97	4th qtr 9/97-11/97	Annual Exposure mR/year
57	S-1		182	0.7	14.1	13.5	15.0	14.8	57.4
58	S-2		185	4.8	11.7	12.0	11.9	12.4	48.2
76	S-2A		177	2.0	15.5	15.1	16.3	16.1	63.0
5	S-3		185	6.2	14.3	15.0	14.3	14.8	58.4
59	SSW-1		199	0.8	17.9	18.5	19.3	19.6	75.3
12	SSW-2		200	1.3	13.6	13.7	14.3	14.8	56.4
60	SSW-3		199	5.0	12.8	13.0	12.6	12.7	51.1
62	SW-1		226	0.8	16.4	17.2	18.1	18.2	69.9
63	SW-2		220	5.3	13.0	13.8	13.4	14.3	54.5
6	SW-3		225	15.0	12.8	12.6	12.6	13.2	51.2
64	WSW-1		255	0.9	13.4	14.4	14.5	14.8	57.1
65	WSW-2	9	247	4.0	14.6	15.3	15.7	16.5	62.1
66	W-1		270	0.9	14.9	15.2	16.1	16.1	62.3
14	W-2		277	4.8	12.8	12.2	12.4	13.6	51.0
77	W-2A		268	3.2	14.1	14.2	14.5	15.5	58.3
67	WNW-1		294	0.9	20.8	22.1	22.5	23.1	88.5
68	WNW-2		292	4.9	15.9	16.7	17.6	17.7	67.9
69	NW-1		320	1.1	15.5	15.4	16.3	17.6	64.8
70	NW-2		313	4.7	15.8	15.2	16.0	16.8	63.8
78	NW-2A		321	3.0	12.9	12.7	13.8	14.4	53.8
2	NW-3		317	7.0	15.7	17.1	17.9	18.3	69.0
71	NNW-1	1	340	1.0	13.6	13.6	13.7	14.2	55.1
72	NNW-2		333	4.5	14.9	14.9	15.6	16.4	61.8
73	NNW-3	14	329	7.0	12.6	11.6	12.1	12.1	48.4
7	NNW-4		337	15.0	12.7	12.5	12.8	13.1	51.1

note (a) Locations with TVA and NRC stations co-located

note (b) Dosimeter missing or damaged

TENNESSEE VALLEY AUTHORITY
ENVIRONMENTAL RADIOLOGICAL MONITORING AND INSTRUMENTATION
WESTERN AREA RADIOLOGICAL LABORATORY

RADIOACTIVITY IN AIR FILTER
PCI/M3 - 0.037 BQ/M3

NAME OF FACILITY: WATTS BAR NUCLEAR PLANT
LOCATION OF FACILITY: RHEA TENNESSEE

DOCKET NO.: 50-390,391
REPORTING PERIOD: 1997

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA						
515						
	2.00E-03	2.10E-02(411/ 411)	PM2 SPRING CITY	2.20E-02(50/ 50)	2.09E-02(104/ 104)	
		7.77E-03- 4.53E-02	7.0 MILES NW	8.97E-03- 4.39E-02	8.83E-03- 4.69E-02	
GAMMA SCAN (GELI)						
130						
BE-7	2.00E-02	1.09E-01(104/ 104)	PM3	1.13E-01(13/ 13)	1.12E-01(26/ 26)	
		6.53E-02- 1.60E-01	10.4 MILES NNE	7.53E-02- 1.60E-01	6.94E-02- 1.56E-01	
BI-214	5.00E-03	1.11E-02(70/ 104)	PM3	1.45E-02(8/ 13)	1.11E-02(16/ 26)	
		5.20E-03- 2.89E-02	10.4 MILES NNE	7.30E-03- 2.49E-02	5.00E-03- 1.90E-02	
PB-214	5.00E-03	1.05E-02(66/ 104)	PM3	1.25E-02(8/ 13)	9.51E-03(16/ 26)	
		5.00E-03- 2.98E-02	10.4 MILES NNE	7.20E-03- 1.94E-02	5.20E-03- 1.67E-02	

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

TENNESSEE VALLEY AUTHORITY
ENVIRONMENTAL RADIOLOGICAL MONITORING AND INSTRUMENTATION
WESTERN AREA RADIOLOGICAL LABORATORY

RADIOACTIVITY IN CHARCOAL FILTER
PCI/M3 - 0.037 BQ/M3

NAME OF FACILITY: WATTS BAR NUCLEAR PLANT
LOCATION OF FACILITY: RHEA TENNESSEE

DOCKET NO.: 50-390,391
REPORTING PERIOD: 1997

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA SCAN (GELI) 515						
BI-214	5.00E-02	6.61E-02(47/ 411)	PM2 SPRING CITY	7.05E-02(7/ 50)	6.50E-02(10/ 104)	
		5.01E-02- 9.51E-02	7.0 MILES NW	5.50E-02- 9.39E-02	5.16E-02- 8.85E-02	
K-40	3.00E-01	3.44E-01(25/ 411)	PM2 SPRING CITY	3.65E-01(4/ 50)	3.55E-01(3/ 104)	
		3.01E-01- 4.36E-01	7.0 MILES NW	3.24E-01- 4.16E-01	3.19E-01- 3.76E-01	
PB-214	7.00E-02	9.49E-02(17/ 411)	PM2 SPRING CITY	1.15E-01(2/ 50)	9.45E-02(6/ 104)	
		7.04E-02- 1.55E-01	7.0 MILES NW	7.51E-02- 1.55E-01	7.20E-02- 1.44E-01	
I-131 SEE NOTE 3						

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

TENNESSEE VALLEY AUTHORITY
ENVIRONMENTAL RADIOLOGICAL MONITORING AND INSTRUMENTATION
WESTERN AREA RADIOLOGICAL LABORATORY

RADIOACTIVITY IN MILK
PCI/L - 0.037 BQ/L

NAME OF FACILITY: WATTS BAR NUCLEAR PLANT
LOCATION OF FACILITY: RHEA TENNESSEE

DOCKET NO.: 50-390,391
REPORTING PERIOD: 1997

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
IODINE-131						
155	4.00E-01	78 VALUES < LLD			77 VALUES < LLD	
GAMMA SCAN (GELI)						
155						
BI-214	2.00E+01	1.50E+02(10/ 78)	LAYMAN FARM	1.81E+02(8/ 26)	4.10E+01(10/ 77)	
		2.49E+01- 2.55E+02	1.3 MILES SSW	3.16E+01- 2.55E+02	2.16E+01- 1.05E+02	
K-40	1.00E+02	1.33E+03(78/ 78)	NORTON FARM	1.39E+03(26/ 26)	1.35E+03(77/ 77)	
		6.02E+02- 1.54E+03	4.1 MILES ESE	1.26E+03- 1.54E+03	9.45E+02- 1.54E+03	
PB-214	2.00E+01	1.68E+02(9/ 78)	LAYMAN FARM	1.86E+02(8/ 26)	5.39E+01(5/ 77)	
		2.57E+01- 2.68E+02	1.3 MILES SSW	3.29E+01- 2.68E+02	2.00E+01- 1.03E+02	
SR 89						
24	3.50E+00	12 VALUES < LLD			12 VALUES < LLD	
SR 90						
24						
	2.00E+00	12 VALUES < LLD	LAYMAN FARM	4 VALUES < LLD	2.09E+00(2/ 12)	
			1.3 MILES SSW		2.02E+00- 2.15E+00	

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

TENNESSEE VALLEY AUTHORITY
ENVIRONMENTAL RADIOLOGICAL MONITORING AND INSTRUMENTATION
WESTERN AREA RADIOLOGICAL LABORATORY

RADIOACTIVITY IN VEGETATION
PCI/KG - 0.037 BQ/KG (WET WEIGHT)

NAME OF FACILITY: WATTS BAR NUCLEAR PLANT
LOCATION OF FACILITY: RHEA TENNESSEE

DOCKET NO.: 50-390,391
REPORTING PERIOD: 1997

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
IODINE-131						
39	6.00E+00	26 VALUES < LLD			13 VALUES < LLD	
GAMMA SCAN (GELI)						
39						
BE-7	2.00E+02	1.49E+03(26/ 26)	OWEN HENDERSON FARM	1.94E+03(13/ 13)	1.72E+03(13/ 13)	
		2.46E+02- 6.42E+03	4.8 MILES WSW	3.72E+02- 6.42E+03	4.34E+02- 6.99E+03	
BI-214	5.50E+01	9.04E+01(14/ 26)	OWEN HENDERSON FARM	1.17E+02(6/ 13)	1.06E+02(4/ 13)	
		5.56E+01- 2.86E+02	4.8 MILES WSW	5.58E+01- 2.86E+02	5.53E+01- 1.69E+02	
K-40	4.00E+02	6.26E+03(26/ 26)	LAYMAN FARM	6.55E+03(13/ 13)	5.57E+03(13/ 13)	
		3.44E+03- 1.23E+04	1.3 MILES SSW	3.44E+03- 1.23E+04	3.73E+03- 7.67E+03	
PB-214	8.00E+01	1.56E+02(4/ 26)	OWEN HENDERSON FARM	1.77E+02(3/ 13)	1.34E+02(2/ 13)	
		9.17E+01- 2.99E+02	4.8 MILES WSW	1.04E+02- 2.99E+02	9.28E+01- 1.75E+02	
SR 89						
12	3.10E+01	8 VALUES < LLD			4 VALUES < LLD	
SR 90						
12	1.20E+01	3.32E+01(4/ 8)	OWEN HENDERSON FARM	4.02E+01(3/ 4)	2.66E+01(3/ 4)	
		1.21E+01- 8.03E+01	4.8 MILES WSW	1.49E+01- 8.03E+01	1.57E+01- 3.55E+01	

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

TENNESSEE VALLEY AUTHORITY
ENVIRONMENTAL RADIOLOGICAL MONITORING AND INSTRUMENTATION
WESTERN AREA RADIOLOGICAL LABORATORY

RADIOACTIVITY IN SOIL
PCI/GM - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY: WATTS BAR NUCLEAR PLANT
LOCATION OF FACILITY: RHEA TENNESSEE

DOCKET NO.: 50-390,391
REPORTING PERIOD: 1997

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA SCAN (GELI)						
11						
AC-228	2.50E-01	1.09E+00(8/ 8)	LM2	1.70E+00(1/ 1)	6.67E-01(3/ 3)	
		8.24E-01- 1.70E+00	0.5 MILES N	1.70E+00- 1.70E+00	5.42E-01- 7.46E-01	
BI-212	4.50E-01	1.17E+00(8/ 8)	LM2	1.92E+00(1/ 1)	7.83E-01(3/ 3)	
		7.98E-01- 1.92E+00	0.5 MILES N	1.92E+00- 1.92E+00	6.69E-01- 8.90E-01	
BI-214	1.50E-01	8.81E-01(8/ 8)	LM2	1.59E+00(1/ 1)	6.59E-01(3/ 3)	
		6.79E-01- 1.59E+00	0.5 MILES N	1.59E+00- 1.59E+00	6.01E-01- 6.88E-01	
CS-137	3.00E-02	3.17E-01(8/ 8)	LM3	6.27E-01(1/ 1)	2.60E-01(3/ 3)	
		6.27E-02- 6.27E-01	1.9 MILES NNE	6.27E-01- 6.27E-01	4.92E-02- 6.76E-01	
K-40	7.50E-01	1.16E+01(8/ 8)	LM-4 WB	2.29E+01(1/ 1)	3.26E+00(3/ 3)	
		3.43E+00- 2.29E+01	0.9 MILES SE	2.29E+01- 2.29E+01	2.58E+00- 4.41E+00	
PB-212	1.00E-01	1.13E+00(8/ 8)	LM2	1.62E+00(1/ 1)	6.90E-01(3/ 3)	
		7.78E-01- 1.62E+00	0.5 MILES N	1.62E+00- 1.62E+00	5.67E-01- 7.69E-01	
PB-214	1.50E-01	9.65E-01(8/ 8)	LM2	1.72E+00(1/ 1)	7.16E-01(3/ 3)	
		6.74E-01- 1.72E+00	0.5 MILES N	1.72E+00- 1.72E+00	6.58E-01- 7.47E-01	
RA-224	7.50E-01	1.22E+00(5/ 8)	LM2	1.78E+00(1/ 1)	8.19E-01(1/ 3)	
		9.15E-01- 1.78E+00	0.5 MILES N	1.78E+00- 1.78E+00	8.19E-01- 8.19E-01	
RA-226	1.50E-01	8.81E-01(8/ 8)	LM2	1.59E+00(1/ 1)	6.59E-01(3/ 3)	
		6.79E-01- 1.59E+00	0.5 MILES N	1.59E+00- 1.59E+00	6.01E-01- 6.88E-01	
TL-208	6.00E-02	3.55E-01(8/ 8)	LM2	5.06E-01(1/ 1)	2.18E-01(3/ 3)	
		2.55E-01- 5.06E-01	0.5 MILES N	5.06E-01- 5.06E-01	1.88E-01- 2.39E-01	
SR 89						
11						
	1.60E+00	8 VALUES < LLD			3 VALUES < LLD	
SR 90						
11						
	4.00E-01	8 VALUES < LLD			3 VALUES < LLD	

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

TENNESSEE VALLEY AUTHORITY
ENVIRONMENTAL RADIOLOGICAL MONITORING AND INSTRUMENTATION
WESTERN AREA RADIOLOGICAL LABORATORY

RADIOACTIVITY IN APPLES
PCI/KG - 0.037 BQ/KG (WET WT)

NAME OF FACILITY: WATTS BAR NUCLEAR PLANT
LOCATION OF FACILITY: RHEA TENNESSEE

DOCKET NO.: 50-390,391
REPORTING PERIOD: 1997

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA SCAN (GELI) 2						
BI-214	4.00E+01	7.61E+01(1/ 1) 7.61E+01- 7.61E+01	OWEN HENDERSON FARM 4.8 MILES WSW	7.61E+01(1/ 1) 7.61E+01- 7.61E+01	1 VALUES < LLD	
K-40	2.50E+02	1.00E+03(1/ 1) 1.00E+03- 1.00E+03	OWEN HENDERSON FARM 4.8 MILES WSW	1.00E+03(1/ 1) 1.00E+03- 1.00E+03	7.31E+02(1/ 1) 7.31E+02- 7.31E+02	

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

TENNESSEE VALLEY AUTHORITY
ENVIRONMENTAL RADIOLOGICAL MONITORING AND INSTRUMENTATION
WESTERN AREA RADIOLOGICAL LABORATORY

RADIOACTIVITY IN CABBAGE
PCI/KG - 0.037 BQ/KG (WET WT)

NAME OF FACILITY: WATTS BAR NUCLEAR PLANT
LOCATION OF FACILITY: RHEA TENNESSEE

DOCKET NO.: 50-390,391
REPORTING PERIOD: 1997

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA SCAN (GELI) 2						
K-40	2.50E+02	1.97E+03(1/ 1) 1.97E+03- 1.97E+03	OWEN HENDERSON FARM 4.8 MILES WSW	1.97E+03(1/ 1) 1.97E+03- 1.97E+03	1.22E+03(1/ 1) 1.22E+03- 1.22E+03	

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

TENNESSEE VALLEY AUTHORITY
ENVIRONMENTAL RADIOLOGICAL MONITORING AND INSTRUMENTATION
WESTERN AREA RADIOLOGICAL LABORATORY

RADIOACTIVITY IN CORN
PCI/KG - 0.037 BQ/KG (WET WT)

NAME OF FACILITY: WATTS BAR NUCLEAR PLANT
LOCATION OF FACILITY: RHEA TENNESSEE

DOCKET NO.: 50-390,391
REPORTING PERIOD: 1997

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA SCAN (GELI) 2						
K-40	2.50E+02	1.84E+03(1/ 1) 1.84E+03- 1.84E+03	NORTON FARM 4.1 MILES ESE	1.84E+03(1/ 1) 1.84E+03- 1.84E+03	2.54E+03(1/ 1) 2.54E+03- 2.54E+03	

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

TENNESSEE VALLEY AUTHORITY
ENVIRONMENTAL RADIOLOGICAL MONITORING AND INSTRUMENTATION
WESTERN AREA RADIOLOGICAL LABORATORY

RADIOACTIVITY IN GREEN BEANS
PCI/KG - 0.037 BQ/KG (WET WT)

NAME OF FACILITY: WATTS BAR NUCLEAR PLANT
LOCATION OF FACILITY: RHEA TENNESSEE

DOCKET NO.: 50-390,391
REPORTING PERIOD: 1997

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA SCAN (GELI)						
BI-214	4.00E+01	6.40E+01(1/ 1) 6.40E+01- 6.40E+01	OWEN HENDERSON FARM 4.8 MILES WSW	6.40E+01(1/ 1) 6.40E+01- 6.40E+01	1 VALUES < LLD	
K-40	2.50E+02	2.40E+03(1/ 1) 2.40E+03- 2.40E+03	OWEN HENDERSON FARM 4.8 MILES WSW	2.40E+03(1/ 1) 2.40E+03- 2.40E+03	2.50E+03(1/ 1) 2.50E+03- 2.50E+03	

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

TENNESSEE VALLEY AUTHORITY
ENVIRONMENTAL RADIOLOGICAL MONITORING AND INSTRUMENTATION
WESTERN AREA RADIOLOGICAL LABORATORY

RADIOACTIVITY IN POTATOES
PCI/KG - 0.037 BQ/KG (WET WT)

NAME OF FACILITY: WATTS BAR NUCLEAR PLANT
LOCATION OF FACILITY: RHEA TENNESSEE

DOCKET NO.: 50-390,391
REPORTING PERIOD: 1997

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA SCAN (GELI)						
K-40	2.50E+02	4.11E+03(1/ 1) [2] 4.11E+03- 4.11E+03	OWEN HENDERSON FARM 4.8 MILES WSW	4.11E+03(1/ 1) 4.11E+03- 4.11E+03	3.37E+03(1/ 1) 3.37E+03- 3.37E+03	

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

TENNESSEE VALLEY AUTHORITY
ENVIRONMENTAL RADIOLOGICAL MONITORING AND INSTRUMENTATION
WESTERN AREA RADIOLOGICAL LABORATORY

RADIOACTIVITY IN TOMATOES
PCI/KG - 0.037 BQ/KG (WET WT)

NAME OF FACILITY: WATTS BAR NUCLEAR PLANT
LOCATION OF FACILITY: RHEA TENNESSEE

DOCKET NO.: 50-390,391
REPORTING PERIOD: 1997

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA SCAN (GELI)						
K-40	2.50E+02	2.36E+03(1/ 1) 2.36E+03- 2.36E+03	OWEN HENDERSON FARM 4.8 MILES WSW	2.36E+03(1/ 1) 2.36E+03- 2.36E+03	2.23E+03(1/ 1) 2.23E+03- 2.23E+03	

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

TENNESSEE VALLEY AUTHORITY
ENVIRONMENTAL RADIOLOGICAL MONITORING AND INSTRUMENTATION
WESTERN AREA RADIOLOGICAL LABORATORY

RADIOACTIVITY IN SURFACE WATER(Total)
PCI/L - 0.037 BQ/L

NAME OF FACILITY: WATTS BAR NUCLEAR PLANT
LOCATION OF FACILITY: RHEA TENNESSEE

DOCKET NO.: 50-390,391
REPORTING PERIOD: 1997

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA						
33	1.90E+00	3.55E+00(21/ 22) 2.07E+00- 5.35E+00	TRM 523.1	3.75E+00(9/ 9) 2.21E+00- 5.35E+00	3.21E+00(11/ 11) 1.92E+00- 4.79E+00	
GAMMA SCAN (GELI)						
33						
BI-214	2.00E+01	2.01E+01(1/ 22) 2.01E+01- 2.01E+01	TRM 523.1	2.01E+01(1/ 9) 2.01E+01- 2.01E+01	2.65E+01(3/ 11) 2.16E+01- 3.05E+01	
PB-214	2.00E+01	22 VALUES < LLD	TRM 517.9	13 VALUES < LLD	2.85E+01(1/ 11) 2.85E+01- 2.85E+01	
SR 89						
11	5.00E+00	8 VALUES < LLD			3 VALUES < LLD	
SR 90						
11	2.00E+00	8 VALUES < LLD			3 VALUES < LLD	
TRITIUM						
12	3.00E+02	8 VALUES < LLD			4 VALUES < LLD	

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

TENNESSEE VALLEY AUTHORITY
ENVIRONMENTAL RADIOLOGICAL MONITORING AND INSTRUMENTATION
WESTERN AREA RADIOLOGICAL LABORATORY

RADIOACTIVITY IN PUBLIC WATER(Total)
PCI/L - 0.037 BQ/L

NAME OF FACILITY: WATTS BAR NUCLEAR PLANT
LOCATION OF FACILITY: RHEA TENNESSEE

DOCKET NO.: 50-390,391
REPORTING PERIOD: 1997

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA						
37	1.90E+00	3.03E+00(25/ 26)	RM-2 DAYTON TN	3.33E+00(13/ 13)	3.21E+00(11/ 11)	
		2.00E+00- 4.73E+00	17.8 MILES NNE	2.28E+00- 4.73E+00	1.92E+00- 4.79E+00	
GAMMA SCAN (GELI)						
37						
BI-214	2.00E+01	4.23E+01(5/ 26)	RM-2 DAYTON TN	4.28E+01(4/ 13)	2.65E+01(3/ 11)	
		2.54E+01- 7.29E+01	17.8 MILES NNE	2.54E+01- 7.29E+01	2.16E+01- 3.05E+01	
PB-214	2.00E+01	4.46E+01(3/ 26)	RM-2 DAYTON TN	5.64E+01(2/ 13)	2.85E+01(1/ 11)	
		2.11E+01- 6.63E+01	17.8 MILES NNE	4.65E+01- 6.63E+01	2.85E+01- 2.85E+01	
SR 89						
11	5.00E+00	8 VALUES < LLD			3 VALUES < LLD	
SR 90						
11	2.00E+00	8 VALUES < LLD			3 VALUES < LLD	
TRITIUM						
12	3.00E+02	8 VALUES < LLD			4 VALUES < LLD	

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

TENNESSEE VALLEY AUTHORITY
ENVIRONMENTAL RADIOLOGICAL MONITORING AND INSTRUMENTATION
WESTERN AREA RADIOLOGICAL LABORATORY

RADIOACTIVITY IN WELL WATER(Total)
PCI/L - 0.037 BQ/L

NAME OF FACILITY: WATTS BAR NUCLEAR PLANT
LOCATION OF FACILITY: RHEA TENNESSEE

DOCKET NO.: 50-390,391
REPORTING PERIOD: 1997

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROSS BETA						
12	1.90E+00	6.42E+00(3/ 4) 5.44E+00- 8.25E+00	WBN WELL #1 0.6 MILES S	6.42E+00(3/ 4) 5.44E+00- 8.25E+00	2.92E+00(7/ 8) 2.22E+00- 3.32E+00	
GAMMA SCAN (GELI)						
12						
BI-214	2.00E+01	4 VALUES < LLD	WBN WELL #1 0.6 MILES S	4 VALUES < LLD	3.71E+02(5/ 8) 2.52E+01- 5.63E+02	
PB-214	2.00E+01	4 VALUES < LLD	WBN WELL #1 0.6 MILES S	4 VALUES < LLD	4.61E+02(4/ 8) 3.16E+02- 5.75E+02	
SR 89						
12	5.00E+00	4 VALUES < LLD			8 VALUES < LLD	
SR 90						
12	2.00E+00	4 VALUES < LLD			8 VALUES < LLD	
TRITIUM						
12	3.00E+02	4 VALUES < LLD			8 VALUES < LLD	

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

TENNESSEE VALLEY AUTHORITY
ENVIRONMENTAL RADIOLOGICAL MONITORING AND INSTRUMENTATION
WESTERN AREA RADIOLOGICAL LABORATORY

RADIOACTIVITY IN CHANNEL CATFISH FLESH
PCI/GM - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY: WATTS BAR NUCLEAR PLANT
LOCATION OF FACILITY: RHEA TENNESSEE

DOCKET NO.: 50-390,391
REPORTING PERIOD: 1997

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA SCAN (GELI) 6						
BI-214	1.00E-01	1.21E-01(2/ 4) 1.00E-01- 1.42E-01	DOWNSTREAM STATION 1 DOWNSTREAM	1.21E-01(2/ 2) 1.00E-01- 1.42E-01	2 VALUES < LLD	
CS-137	3.00E-02	4 VALUES < LLD	CHICKAMAUGA RES TRM 471-530	2 VALUES < LLD	3.72E-02(1/ 2) 3.72E-02- 3.72E-02	
K-40	4.00E-01	1.12E+01(4/ 4) 1.05E+01- 1.21E+01	CHICKAMAUGA RES TRM 471-530	1.13E+01(2/ 2) 1.05E+01- 1.21E+01	1.14E+01(2/ 2) 1.11E-01- 1.17E+01	

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

TENNESSEE VALLEY AUTHORITY
ENVIRONMENTAL RADIOLOGICAL MONITORING AND INSTRUMENTATION
WESTERN AREA RADIOLOGICAL LABORATORY

RADIOACTIVITY IN CRAPPIE FLESH
PCI/GM - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY: WATTS BAR NUCLEAR PLANT
LOCATION OF FACILITY: RHEA TENNESSEE

DOCKET NO.: 50-390,391
REPORTING PERIOD: 1997

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA SCAN (GELI) 4						
BI-214	1.00E-01	2 VALUES < LLD	CHICKAMAUGA RES TRM 471-530	2 VALUES < LLD	2.07E-01(1/ 2) 2.07E-01- 2.07E-01	
CS-137	3.00E-02	6.78E-02(2/ 2) 6.47E-02- 7.09E-02	CHICKAMAUGA RES TRM 471-530	6.78E-02(2/ 2) 6.47E-02- 7.09E-02	5.23E-02(2/ 2) 5.11E-02- 5.35E-02	
K-40	4.00E-01	1.61E+01(2/ 2) 1.54E+01- 1.67E+01	CHICKAMAUGA RES TRM 471-530	1.61E+01(2/ 2) 1.54E+01- 1.67E+01	1.53E+01(2/ 2) 1.33E+01- 1.73E+01	

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

TENNESSEE VALLEY AUTHORITY
ENVIRONMENTAL RADIOLOGICAL MONITORING AND INSTRUMENTATION
WESTERN AREA RADIOLOGICAL LABORATORY

RADIOACTIVITY IN SMALLMOUTH BUFFALO FLESH
PCI/GM - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY: WATTS BAR NUCLEAR PLANT
LOCATION OF FACILITY: RHEA TENNESSEE

DOCKET NO.: 50-390,391
REPORTING PERIOD: 1997

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA SCAN (GELI) 4						
K-40	4.00E-01	8.39E+00(2/ 2) 8.12E+00- 8.67E+00	CHICKAMAUGA RES TRM 471-530	8.39E+00(2/ 2) 8.12E+00- 8.67E+00	1.14E+01(2/ 2) 1.12E+01- 1.15E+01	

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

TENNESSEE VALLEY AUTHORITY
ENVIRONMENTAL RADIOLOGICAL MONITORING AND INSTRUMENTATION
WESTERN AREA RADIOLOGICAL LABORATORY

RADIOACTIVITY IN SEDIMENT
PCI/GM - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY: WATTS BAR NUCLEAR PLANT
LOCATION OF FACILITY: RHEA TENNESSEE

DOCKET NO.: 50-390,391
REPORTING PERIOD: 1997

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA SCAN (GELI) 8						
AC-228	2.50E-01	1.58E+00(6/ 6) 1.08E+00- 2.53E+00	TRM 527.4	2.16E+00(2/ 2) 1.80E+00- 2.53E+00	1.61E+00(2/ 2) 1.57E+00- 1.65E+00	
BE-7	2.50E-01	5.50E-01(3/ 6) 3.18E-01- 9.32E-01	TRM 496.5	6.67E-01(2/ 2) 4.01E-01- 9.32E-01	5.46E-01(1/ 2) 5.46E-01- 5.46E-01	
BI-212	4.50E-01	1.60E+00(6/ 6) 1.12E+00- 2.64E+00	TRM 527.4	2.16E+00(2/ 2) 1.67E+00- 2.64E+00	1.67E+00(2/ 2) 1.58E+00- 1.75E+00	
BI-214	1.50E-01	9.92E-01(6/ 6) 7.44E-01- 1.45E+00	TRM 527.4	1.25E+00(2/ 2) 1.05E+00- 1.45E+00	1.07E+00(2/ 2) 9.89E-01- 1.14E+00	
CO-58	3.00E-02	2.20E-01(2/ 6) 2.01E-01- 2.38E-01	TRM 518.0	2.38E-01(1/ 2) 2.38E-01- 2.38E-01	2 VALUES < LLD	
CS-137	3.00E-02	3.55E-01(5/ 6) 3.32E-02- 8.94E-01	TRM 496.5	7.72E-01(2/ 2) 6.49E-01- 8.94E-01	1.85E+00(2/ 2) 1.78E+00- 1.92E+00	
FE-59	5.00E-02	6.01E-02(1/ 6) 6.01E-02- 6.01E-02	TRM 518.0	6.01E-02(1/ 2) 6.01E-02- 6.01E-02	2 VALUES < LLD	
K-40	7.50E-01	1.40E+01(6/ 6) 1.26E+01- 1.56E+01	TRM 496.5	1.45E+01(2/ 2) 1.33E+01- 1.56E+01	1.66E+01(2/ 2) 1.63E+01- 1.68E+01	
PB-212	1.00E-01	1.52E+00(6/ 6) 1.03E+00- 2.51E+00	TRM 527.4	2.11E+00(2/ 2) 1.70E+00- 2.51E+00	1.71E+00(2/ 2) 1.68E+00- 1.75E+00	
PB-214	1.50E-01	1.12E+00(6/ 6) 8.17E-01- 1.68E+00	TRM 527.4	1.44E+00(2/ 2) 1.21E+00- 1.68E+00	1.14E+00(2/ 2) 1.03E+00- 1.25E+00	
RA-224	7.50E-01	1.64E+00(3/ 6) 1.27E+00- 2.18E+00	TRM 527.4	2.18E+00(1/ 2) 2.18E+00- 2.18E+00	1.83E+00(2/ 2) 1.80E+00- 1.87E+00	
RA-226	1.50E-01	9.92E-01(6/ 6) 7.44E-01- 1.45E+00	TRM 527.4	1.25E+00(2/ 2) 1.05E+00- 1.45E+00	1.07E+00(2/ 2) 9.89E-01- 1.14E+00	
TL-208	6.00E-02	4.77E-01(6/ 6) 3.25E-01- 7.89E-01	TRM 527.4	6.71E-01(2/ 2) 5.53E-01- 7.89E-01	5.33E-01(2/ 2) 5.18E-01- 5.49E-01	

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

TENNESSEE VALLEY AUTHORITY
ENVIRONMENTAL RADIOLOGICAL MONITORING AND INSTRUMENTATION
WESTERN AREA RADIOLOGICAL LABORATORY

RADIOACTIVITY IN SHORELINE SEDIMENT
PCI/GM - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY: WATTS BAR NUCLEAR PLANT
LOCATION OF FACILITY: RHEA TENNESSEE

DOCKET NO.: 50-390,391
REPORTING PERIOD: 1997

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA SCAN (GELI) 4						
AC-228	2.50E-01	1.38E+00(2/ 2)	COTTON PORT MARINA	1.38E+00(2/ 2)	8.02E-01(2/ 2)	
		1.31E+00- 1.45E+00	TRM 513	1.31E+00- 1.45E+00	3.03E-01- 1.30E+00	
BE-7	2.50E-01	4.12E-01(2/ 2)	COTTON PORT MARINA	4.12E-01(2/ 2)	2 VALUES < LLD	
		4.07E-01- 4.16E-01	TRM 513	4.07E-01- 4.16E-01		
BI-212	4.50E-01	1.37E+00(2/ 2)	COTTON PORT MARINA	1.37E+00(2/ 2)	1.27E+00(1/ 2)	
		1.34E+00- 1.41E+00	TRM 513	1.34E+00- 1.41E+00	1.27E+00- 1.27E+00	
BI-214	1.50E-01	6.46E-01(2/ 2)	COTTON PORT MARINA	6.46E-01(2/ 2)	5.60E-01(2/ 2)	
		4.72E-01- 8.19E-01	TRM 513	4.72E-01- 8.19E-01	2.59E-01- 8.61E-01	
CS-137	3.00E-02	6.37E-02(2/ 2)	COTTON PORT MARINA	6.37E-02(2/ 2)	3.24E-02(1/ 2)	
		4.39E-02- 8.35E-02	TRM 513	4.39E-02- 8.35E-02	3.24E-02- 3.24E-02	
K-40	7.50E-01	2.37E+01(2/ 2)	COTTON PORT MARINA	2.37E+01(2/ 2)	5.91E+00(2/ 2)	
		1.60E+01- 3.13E+01	TRM 513	1.60E+01- 3.13E+01	1.19E+00- 1.06E+01	
PB-212	1.00E-01	1.31E+00(2/ 2)	COTTON PORT MARINA	1.31E+00(2/ 2)	7.57E-01(2/ 2)	
		1.25E+00- 1.37E+00	TRM 513	1.25E+00- 1.37E+00	2.82E-01- 1.23E+00	
PB-214	1.50E-01	7.28E-01(2/ 2)	COTTON PORT MARINA	7.28E-01(2/ 2)	6.15E-01(2/ 2)	
		5.18E-01- 9.38E-01	TRM 513	5.18E-01- 9.38E-01	2.89E-01- 9.40E-01	
RA-224	7.50E-01	1.38E+00(1/ 2)	COTTON PORT MARINA	1.38E+00(1/ 2)	1.35E+00(1/ 2)	
		1.38E+00- 1.38E+00	TRM 513	1.38E+00- 1.38E+00	1.35E+00- 1.35E+00	
RA-226	1.50E-01	6.46E-01(2/ 2)	COTTON PORT MARINA	6.46E-01(2/ 2)	5.60E-01(2/ 2)	
		4.72E-01- 8.19E-01	TRM 513	4.72E-01- 8.19E-01	2.59E-01- 8.61E-01	
TL-208	6.00E-02	4.11E-01(2/ 2)	COTTON PORT MARINA	4.11E-01(2/ 2)	2.41E-01(2/ 2)	
		4.00E-01- 4.23E-01	TRM 513	4.00E-01- 4.23E-01	8.74E-02- 3.94E-01	

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

TENNESSEE VALLEY AUTHORITY
ENVIRONMENTAL RADIOLOGICAL MONITORING AND INSTRUMENTATION
WESTERN AREA RADIOLOGICAL LABORATORY

RADIOACTIVITY IN POND SEDIMENT
PCI/GM - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY: WATTS BAR NUCLEAR PLANT
LOCATION OF FACILITY: RHEA TENNESSEE

DOCKET NO.: 50-390,391
REPORTING PERIOD: 1997

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA SCAN (GELI) 5						
AC-228	2.50E-01	1.18E+00(5/ 5)	YP-13	1.38E+00(1/ 1)		0 VALUES < LLD
		9.86E-01- 1.38E+00	YARD POND	1.38E+00- 1.38E+00		
BE-7	2.50E-01	5.00E-01(5/ 5)	LV-3	8.96E-01(1/ 1)		0 VALUES < LLD
		3.24E-01- 8.96E-01	LOW VOL WASTE POND	8.96E-01- 8.96E-01		
BI-212	4.50E-01	1.49E+00(5/ 5)	LV-3	1.91E+00(1/ 1)		0 VALUES < LLD
		1.23E+00- 1.91E+00	LOW VOL WASTE POND	1.91E+00- 1.91E+00		
BI-214	1.50E-01	9.61E-01(5/ 5)	LV-3	1.35E+00(1/ 1)		0 VALUES < LLD
		8.13E-01- 1.35E+00	LOW VOL WASTE POND	1.35E+00- 1.35E+00		
CO-58	3.00E-02	9.21E-01(3/ 5)	YP-17	1.81E+00(1/ 1)		0 VALUES < LLD
		3.46E-02- 1.81E+00	YARD POND	1.81E+00- 1.81E+00		
CO-60	3.00E-02	1.75E-01(2/ 5)	YP-17	1.92E-01(1/ 1)		0 VALUES < LLD
		1.58E-01- 1.92E-01	YARD POND	1.92E-01- 1.92E-01		
CR-51	3.50E-01	7.73E-01(2/ 5)	YP-17	1.06E+00(1/ 1)		0 VALUES < LLD
		4.85E-01- 1.06E+00	YARD POND	1.06E+00- 1.06E+00		
CS-134	3.00E-02	5.49E-02(2/ 5)	YP-17	6.83E-02(1/ 1)		0 VALUES < LLD
		4.14E-02- 6.83E-02	YARD POND	6.83E-02- 6.83E-02		
CS-137	3.00E-02	2.31E-01(5/ 5)	YP-16	3.35E-01(1/ 1)		0 VALUES < LLD
		1.37E-01- 3.35E-01	YARD POND	3.35E-01- 3.35E-01		
FE-59	5.00E-02	6.09E-01(2/ 5)	YP-17	8.17E-01(1/ 1)		0 VALUES < LLD
		4.00E-01- 8.17E-01	YARD POND	8.17E-01- 8.17E-01		
K-40	7.50E-01	1.50E+01(5/ 5)	YP-13	1.81E+01(1/ 1)		0 VALUES < LLD
		1.12E+01- 1.81E+01	YARD POND	1.81E+01- 1.81E+01		
NB-95	3.50E-02	8.27E-02(2/ 5)	YP-17	1.06E-01(1/ 1)		0 VALUES < LLD
		5.97E-02- 1.06E-01	YARD POND	1.06E-01- 1.06E-01		
PB-212	1.00E-01	1.24E+00(5/ 5)	LV-3	1.54E+00(1/ 1)		0 VALUES < LLD
		1.03E+00- 1.54E+00	LOW VOL WASTE POND	1.54E+00- 1.54E+00		
PB-214	1.50E-01	1.03E+00(5/ 5)	LV-3	1.36E+00(1/ 1)		0 VALUES < LLD
		8.82E-01- 1.36E+00	LOW VOL WASTE POND	1.36E+00- 1.36E+00		
RA-224	7.50E-01	1.11E+00(3/ 5)	YP-13	1.36E+00(1/ 1)		0 VALUES < LLD
		8.31E-01- 1.36E+00	YARD POND	1.36E+00- 1.36E+00		

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

TENNESSEE VALLEY AUTHORITY
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RADIOACTIVITY IN POND SEDIMENT
PCI/GM - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY: WATTS BAR NUCLEAR PLANT
LOCATION OF FACILITY: RHEA TENNESSEE

DOCKET NO.: 50-390,391
REPORTING PERIOD: 1997

Table H-22
(Continued)

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA SCAN (GELI)						
SB-124	NOT ESTAB	5.38E-02(1/ 1)	YP-17	5.38E-02(1/ 1)	0 VALUES < LLD	
		5.38E-02- 5.38E-02	YARD POND	5.38E-02- 5.38E-02		
TL-208	6.00E-02	3.95E-01(5/ 1)	LV-3	5.32E-01(1/ 1)	0 VALUES < LLD	
		3.31E-01- 5.32E-01	LOW VOL WASTE POND	5.32E-01- 5.32E-01		
ZR-95	5.00E-02	7.39E-02(1/ 1)	YP-17	7.39E-02(1/ 1)	0 VALUES < LLD	
		7.39E-02- 7.39E-02	YARD POND	7.39E-02- 7.39E-02		

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

TENNESSEE VALLEY AUTHORITY
ENVIRONMENTAL RADIOLOGICAL MONITORING AND INSTRUMENTATION
WESTERN AREA RADIOLOGICAL LABORATORY

RADIOACTIVITY IN CLAM FLESH
PCI/GM - 0.037 BQ/G (DRY WEIGHT)

NAME OF FACILITY: WATTS BAR NUCLEAR PLANT
LOCATION OF FACILITY: RHEA TENNESSEE

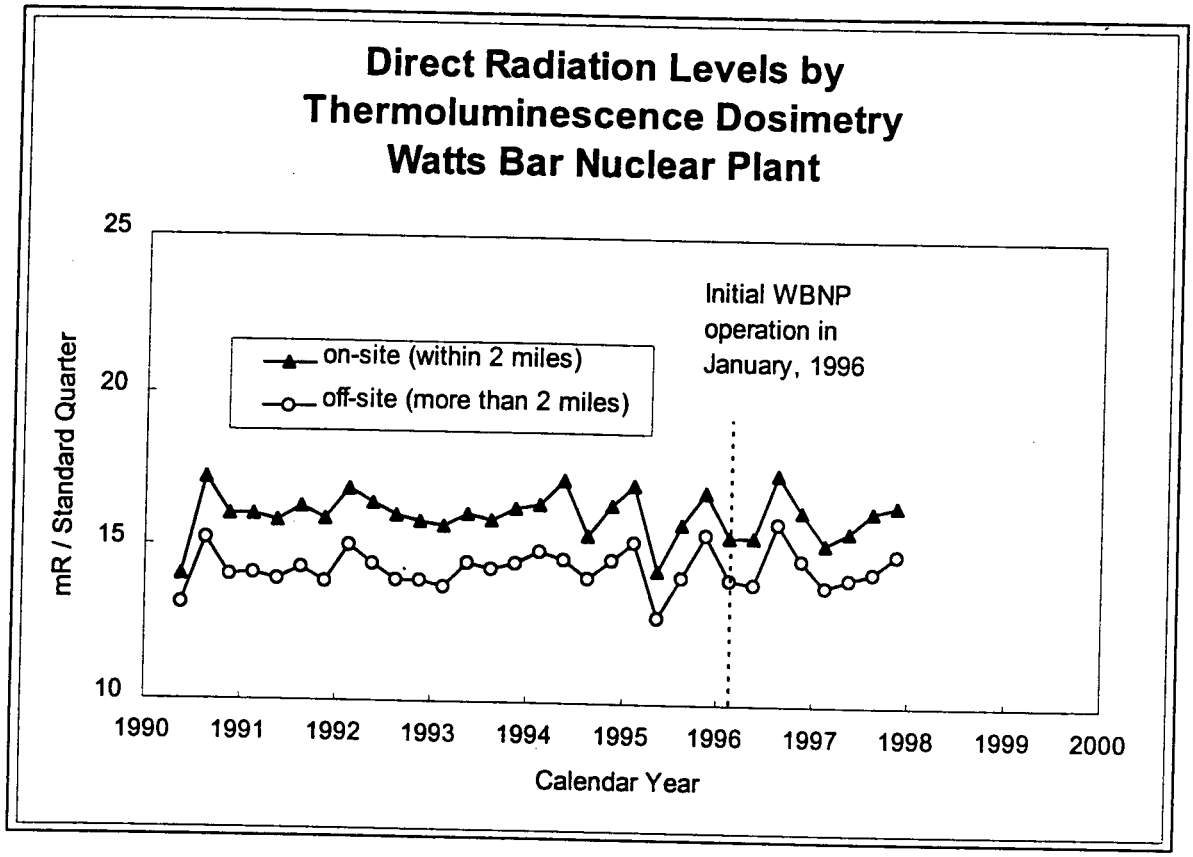
DOCKET NO.: 50-390,391
REPORTING PERIOD: 1997

TYPE AND TOTAL NUMBER OF ANALYSIS PERFORMED	LOWER LIMIT OF DETECTION (LLD) SEE NOTE 1	ALL INDICATOR LOCATIONS MEAN (F) RANGE SEE NOTE 2	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN (F) RANGE SEE NOTE 2	CONTROL LOCATIONS MEAN (F) RANGE SEE NOTE 2	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GAMMA SCAN (GELI) 4						
BI-214	5.00E-01	1.32E+00(1/ 2)	DOWNSTREAM	1.32E+00(1/ 2)	8.38E-01(2/ 2)	
		1.32E+00- 1.32E+00		1.32E+00- 1.32E+00	6.64E-01- 1.01E+00	
CO-58	2.50E-01	3.40E-01(1/ 2)	DOWNSTREAM	3.40E-01(1/ 2)	2 VALUES < LLD	
		3.40E-01- 3.40E-01		3.40E-01- 3.40E-01		
PB-214	1.00E-01	1.26E+00(1/ 2)	DOWNSTREAM	1.26E+00(1/ 2)	8.36E-01(2/ 2)	
		1.26E+00- 1.26E+00		1.26E+00- 1.26E+00	5.56E-01- 1.12E+00	

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

Figure H-1

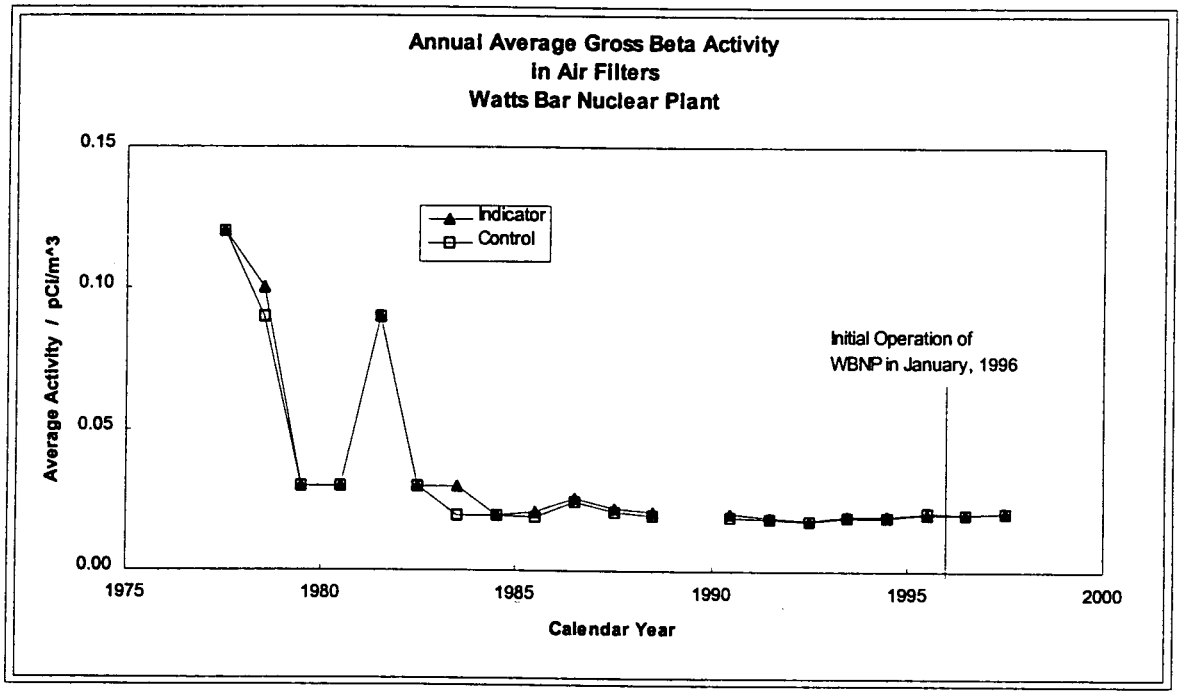
Direct Radiation



Thermoluminescent dosimeters are processed quarterly. This chart shows trends in the average measurement for all dosimeters grouped as "on-site" or "off-site". The persistent difference between "on-site" and "off-site" measurements observed in the preoperational phase indicates that slightly higher on-site levels are not due to plant operations.

Figure H-2

Radioactivity in Air Filters



To more clearly show trends developed since the end of atmospheric weapons testing, the data beginning with the resumption of the monitoring program in 1990 is shown in greater detail.

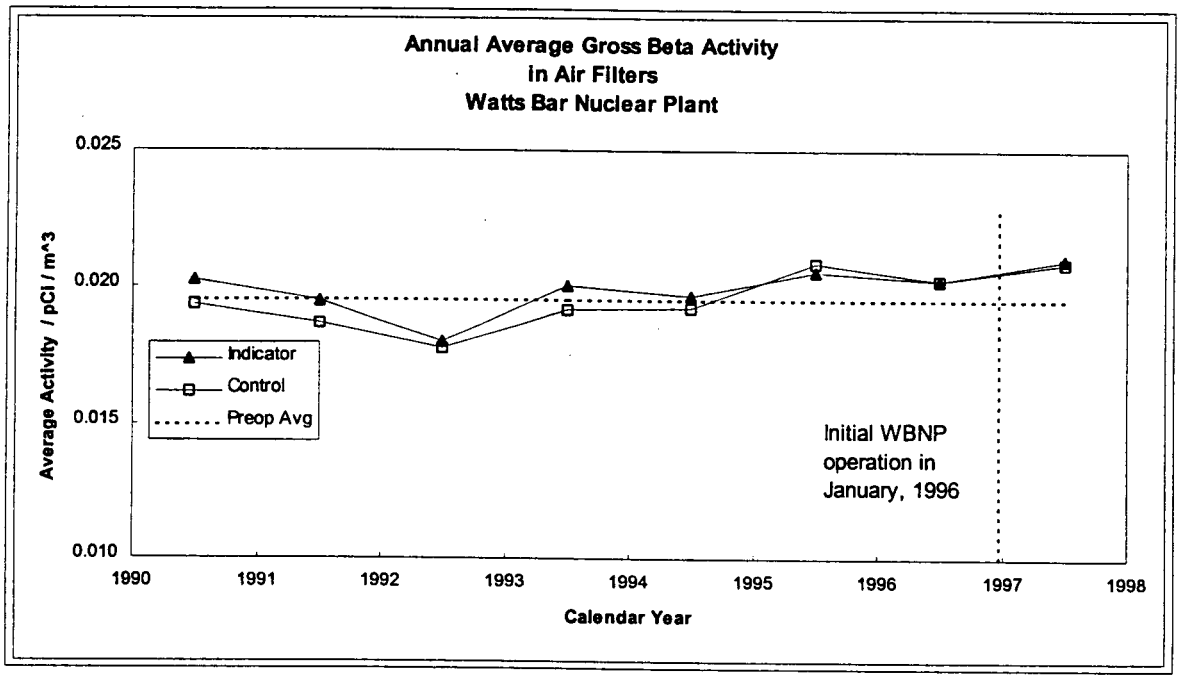
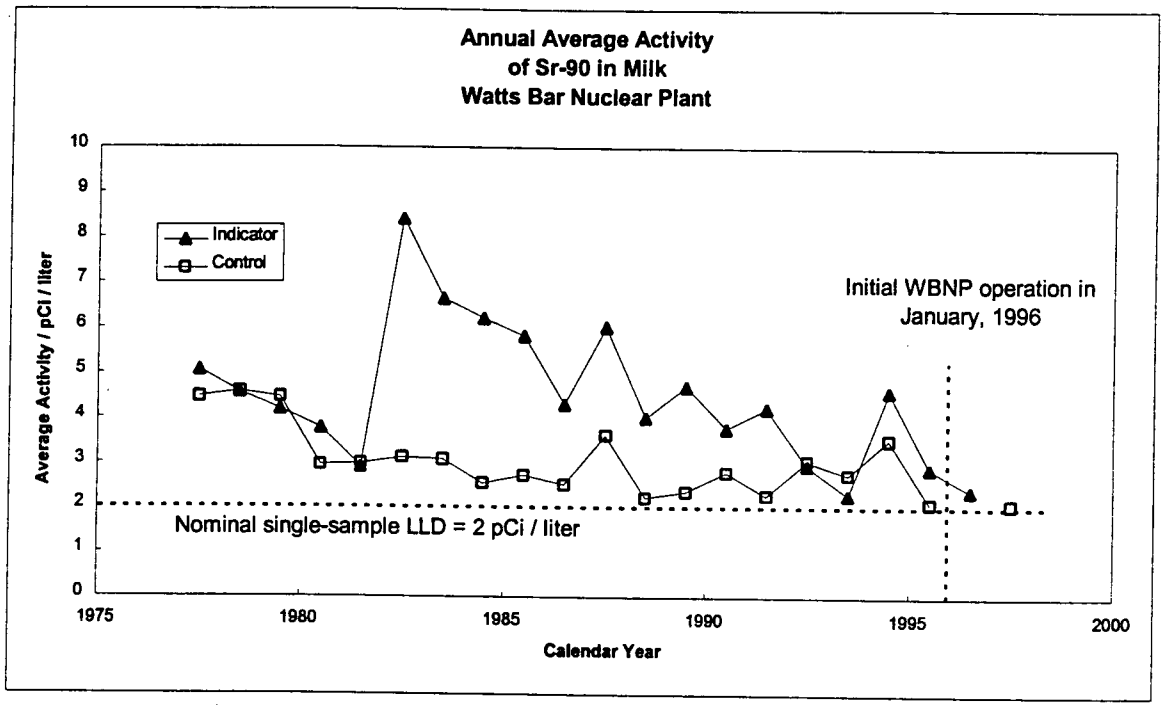


Figure H-3

Strontium-90 in Milk



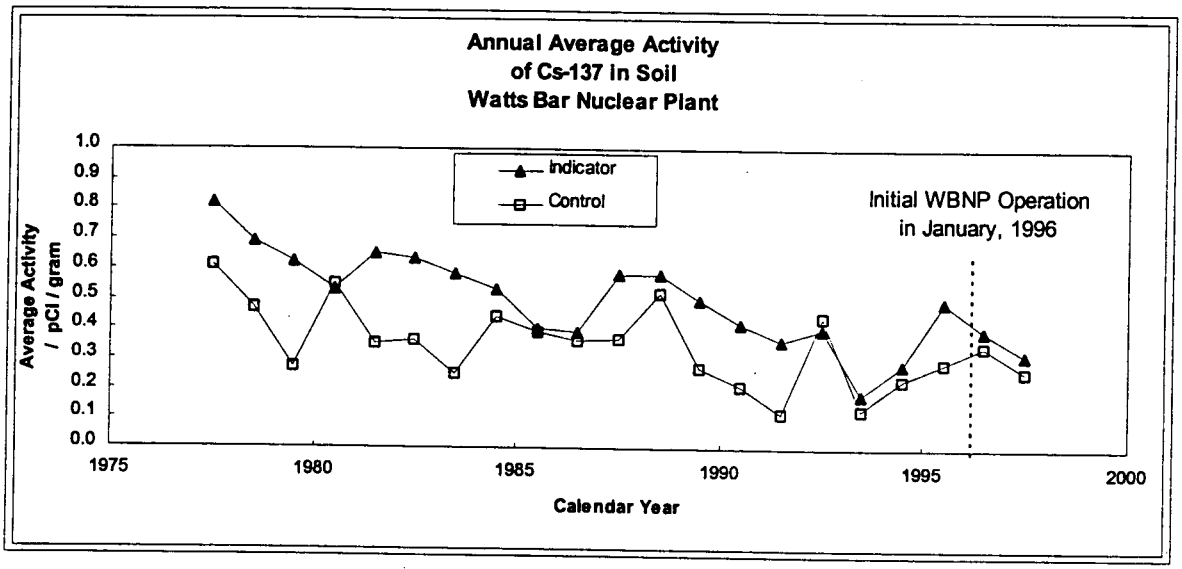
When the environmental radiological monitoring program was initiated for the Watts Bar site in the 1970's, strontium-90 produced by atmospheric detonation of nuclear weapons was present in essentially all milk samples. Since that time, a generally decreasing trend has been observed, due to the 28-year half-life of strontium-90, and due to transport out of the upper layers of soil, and thus out of the vegetation used for feeding cows.

The values plotted above are the average of all samples within the year with a measurement result above the nominal Lower Limit of Detection (LLD) of 2 pCi/liter.

Figure H-4

Cs-137 in Soil

Cesium-137, like strontium-90 , was produced by nuclear weapons detonations 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 beginning of the monitoring program from the Watts Bar site.



In almost every year, the "indicator" locations have shown greater activity of Cs-137 than the "control" locations. This trend, with its preoperational average is shown below.

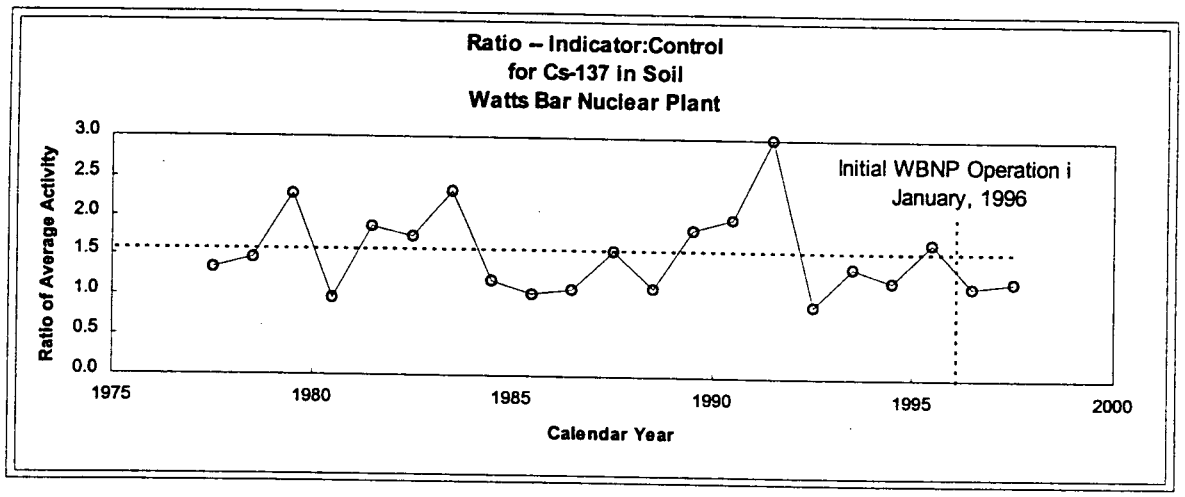
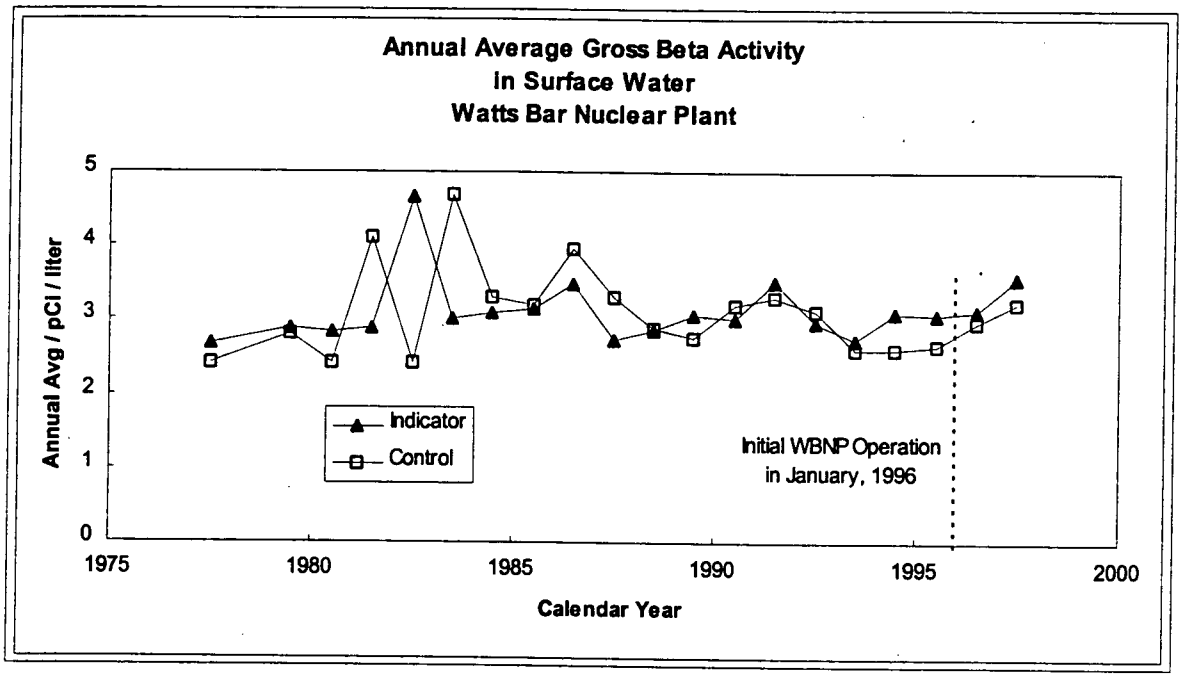


Figure H-5

Gross Beta Activity in Surface and Drinking Water



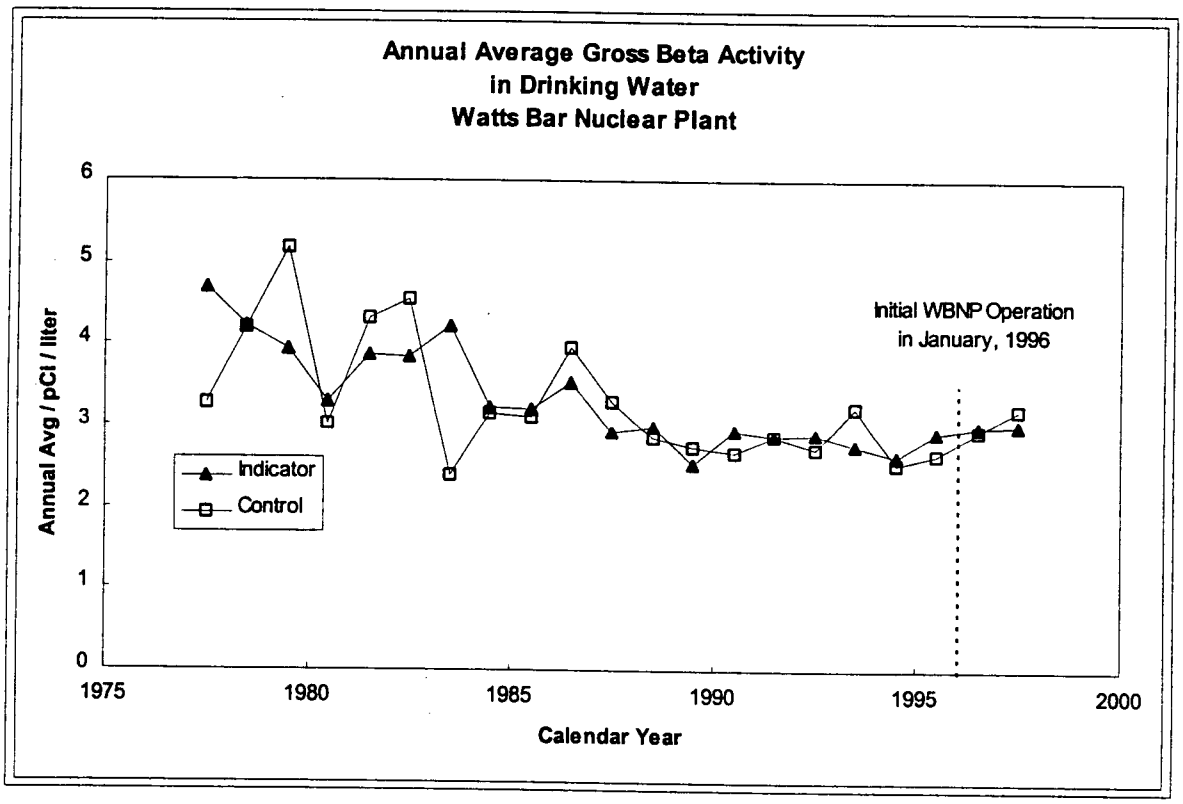
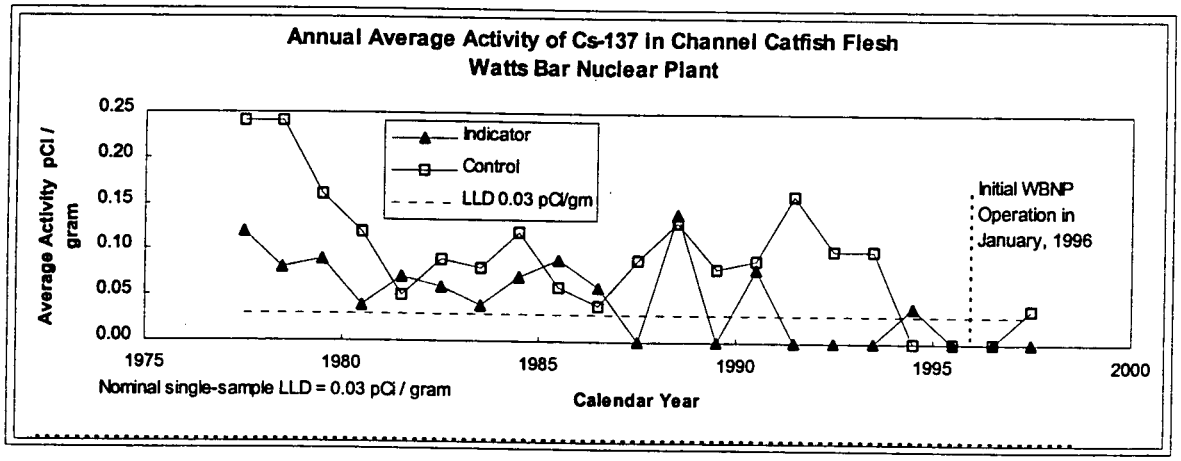
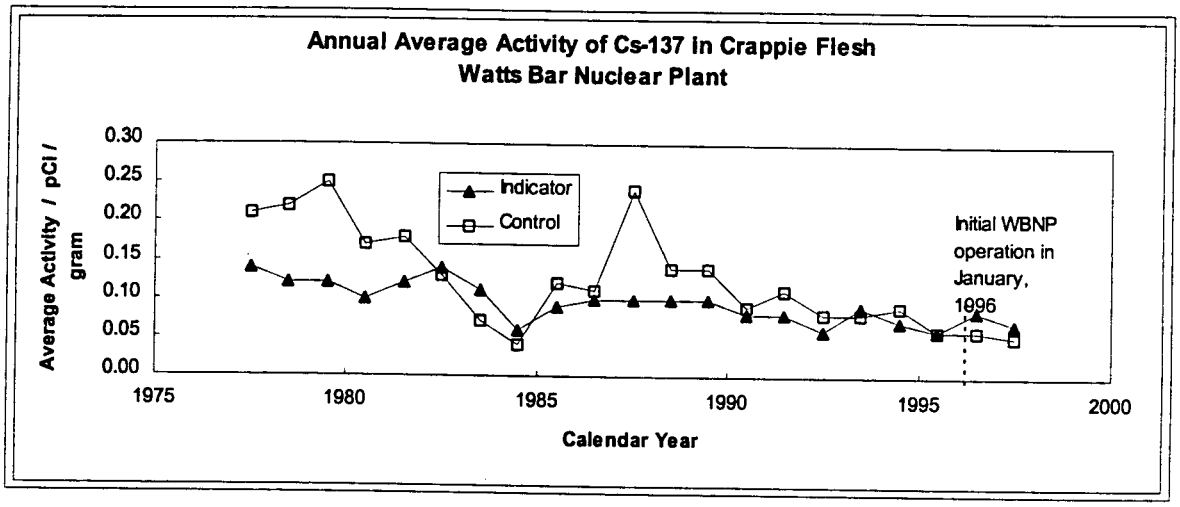


Figure H-6

Radioactivity in Fish





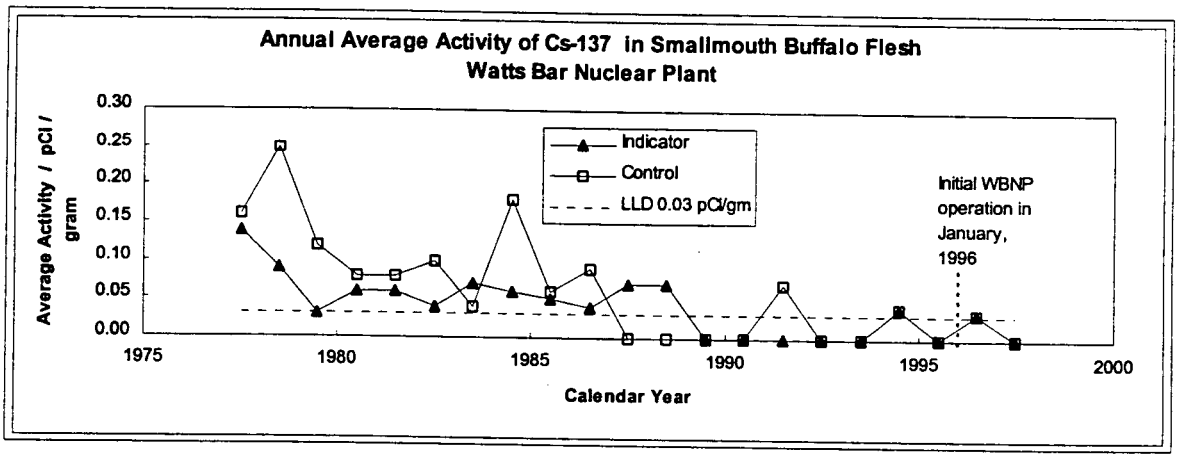


Figure H-7

Radioactivity in Sediment

The Cs-137 present in the shoreline and bottom sediments of the Tennessee River system was produced both by detonation of nuclear weapons and by related nuclear operations in the upper reaches of the Tennessee River watershed. The amounts of Cs-137 have declined significantly during the course of monitoring for the Watts Bar site, so much so that not all samples contain detectable levels.