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UCC-ND-244

# ENVIRONMENTAL MONITORING REPORT

# UNITED STATES ATOMIC ENERGY COMMISSION

# OAK RIDGE FACILITIES

## Calendar Year 1972

UNION CARBIDE

NUCLEAR DIVISION - GENERAL STAFF

OAK RIDGE, TENNESSEE

*prepared for the* U.S. ATOMIC ENERGY COMMISSION

*under* U.S. GOVERNMENT *Contract W-7405 eng 26*

UCC-ND-244

Addendum

Date of Issue: July 23, 1973

# ENVIRONMENTAL MONITORING REPORT

# UNITED STATES ATOMIC ENERGY COMMISSION

# OAK RIDGE FACILITIES

## CALENDAR YEAR 1972

Dose to the Population

The Oak Ridge population received the largest average individual whole body dose as a population group. The maximum potential exposure to an Oak Ridge resident was calculated to be 0.14 mrem/year to the whole body and 4 mrem to the lung. These calculated exposures are 0.02% and 0.3%, respectively, of the allowable standard (AEC Manual, Appendix 0524). The average dose to an Oak Ridge resident was estimated to be 0.09 mrem/year.

The cumulative whole body dose to the population within a 50-mile radius of the Oak Ridge facilities resulting from plant effluents was calculated to be 12 man-rem. This dose may be compared to an estimated 72,000 man-rem to the same population resulting from natural background radiation.

## CALCULATION OF POTENTIAL RADIATION DOSE TO THE PUBLIC

Potential radiation doses resulting from plant effluents were calculated for a number of dose reference points within the Oak Ridge environs. All significant sources and modes of exposure were examined and a number of general assumptions were used in making the calculations.

The site boundary for the Oak Ridge complex was defined as the perimeter of the AEC-controlled area.

For dispersion calculations of airborne material, it was assumed that the Gaussian Plume model was everywhere valid, that the meteorological data collected at the ORNL Tower Shielding Facility hold for all facilities, and that the monitored emission rates are representative of the actual situation. The calculations were made using a computer program developed for use in the Environmental Impact Project by Reeves, Fowler, and Cowser (ORNL-TM-3613).

Dose factors used in the calculations were taken from EXREM II and INREM computer codes developed by Turner, Kaye, and Rohwer, K-1752 (1968) and Turner, CTC-8 (1969).

### Maximum Potential Exposure at the Site Boundary

The point of maximum potential exposure to an individual on the site boundary is located at the mouth of White Oak Creek where it enters the Clinch River. The source of the exposure is primarily the radioactive material deposited in the bottom sediments and on the bank of the creek as a result of liquid effluent releases. A maximum potential whole body exposure of 300 mrem/year was calculated for this location assuming that an individual remained in a position two feet above the bank of the creek for 24 hrs/day for the entire year. The calculated maximum potential exposure is 60% of the allowable standard (AEC Manual, Appendix 0524). This is an atypical exposure location and the probability of an exposure of the magnitude calculated is considered remote since access to the creek is only by boat via the Clinch River and the mouth of the creek is blocked by a barrier chain.

The whole body dose to a "hypothetical maximum exposed individual" at the same location was calculated using a more realistic residence time of 500 hrs/year. The calculated dose under these conditions was 18 mrem/year which is 3.6% of the allowable standard (AEC Manual, Appendix 0524) and represents what is considered a probable upper limit of exposure. The probable dose to a fisherman in a fishing boat with the bow on the bank would be much less.

A more probable exposure potential might be considered to occur at other locations on the site boundary as a result of airborne effluent releases. The calculated maximum potential exposure to an individual from this pathway was 0.4 mrem/year to the whole body and 15 mrem to the lung assuming the individual was in constant residence at the maximum exposure location. These levels are equal to or less than 1% of the allowable standard (AEC Manual, Appendix 0524).

UCC-ND-244

Date of Issue: March 26, 1973

# ENVIRONMENTAL MONITORING REPORT
# UNITED STATES ATOMIC ENERGY COMMISSION
# OAK RIDGE FACILITIES

## Calendar Year 1972

**UNION CARBIDE CORPORATION** • NUCLEAR DIVISION

Oak Ridge Gaseous Diffusion Plant
Oak Ridge National Laboratory
Oak Ridge Y-12 Plant

Office of Safety and Environmental Protection
Post Office Box Y
Oak Ridge, Tennessee 37830

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# INTRODUCTION

Oak Ridge is located in East Tennessee in a broad valley which lies between the Cumberland Mountains on the northwest and the Great Smoky Mountains on the southeast. The AEC Reservation is located in the Ridge and Valley physiographic province which is characterized by parallel ridges of sandstone, shale, and cherty dolomite, separated by valleys of less weather-resistant limestone and shale. The ridges are oriented southwest-northeast. Topography of the area is due to differential erosion of severely folded and faulted rocks ranging in age from Early Cambrian to Early Mississippian. Elevations range from 740 feet to 1360 feet above mean sea level with a maximum relief of 620 feet. The area includes gently sloping valleys and rolling to steep slopes and ridges. The Tennessee Valley Authority's (TVA) Melton Hill and Watts Bar Reservoirs on the Clinch River form the southern, western, and eastern boundaries of the Reservation while the City of Oak Ridge (approximately 28,000 population) is the northern boundary.

The local climate is noticeably influenced by topography. Prevailing winds are usually either up-valley, from west to southwest, or down-valley, from east to northeast. During periods of light winds, daytime winds are usually southwesterly and nighttime winds usually northeasterly. Wind velocities are somewhat decreased by the mountains and ridges, and tornadoes rarely occur. In winter, the Cumberland Mountains have a moderating influence on the local climate by retarding the flow of cold air from the north and west. Temperatures of 100° or higher and zero or below are unusual. Low-level temperature inversions occur during approximately 56 percent of the hourly observations. Winter and early spring are the seasons of heaviest precipitation with the monthly maximum normally occurring during January to March. The mean annual precipitation is approximately 54 inches.

The topography of the Oak Ridge Area is such that all drainage from the AEC Reservation flows into the Clinch River which has its headwaters in southwestern Virginia and flows southwest to its mouth near Kingston, Tennessee. The Clinch River flow is regulated by several dams which provide reservoirs for flood control, electric power generation, and recreation. The principal tributaries through which liquid waste effluents from the plant areas reach the Clinch River are White Oak Creek and Poplar Creek.

With the exception of the City of Oak Ridge, the land within 5 miles of the AEC Reservation is predominately rural being utilized largely for residences, small farms, and pasturage for cattle. The approximate location and population of the towns nearest the AEC Reservation are: Oliver Springs (pop. 3400) 7 miles to the northwest; Clinton (pop. 4800) 10 miles to the northeast; Lenoir City (pop. 5300) 7 miles to the southeast; Kingston (pop. 4100) 7 miles to the southwest and Harriman (pop. 8700) 8 miles to the west. Knoxville, the major

metropolitan area nearest Oak Ridge, is located about 25 miles to the east and has a population of approximately 175,000.

The AEC Reservation contains three major operating facilities: the Oak Ridge National Laboratory (ORNL), the Oak Ridge Gaseous Diffusion Plant (ORGDP), and the Y-12 Plant, all of which are operated by Union Carbide Corporation, Nuclear Division. In addition, two smaller AEC facilities are in the area: the UT-AEC Agricultural Research Station, and Oak Ridge Associated Universities.

The Oak Ridge National Laboratory is a large multipurpose research laboratory whose basic mission is the discovery of new knowledge, both basic and applied, in all areas related to nuclear energy. To accomplish this mission, the Laboratory conducts research in all fields of modern science and technology. Oak Ridge National Laboratory employs a multidisciplinary staff of approximately 4500 employees composed largely of engineers and scientists in the traditional science fields, supplemented by social scientists and support personnel. The Laboratory's facilities consist of nuclear reactors, chemical pilot plants, research laboratories, radioisotope production laboratories, and support facilities.

The Oak Ridge Gaseous Diffusion Plant occupies an area of approximately 640 acres and is a complex of production, research, development, and supporting facilities, employing approximately 2800 personnel. The primary mission of the plant is the enrichment of uranium hexafluoride in the uranium-235 isotope, with the performance of other atomic energy related activities as required by the Atomic Energy Commission. To accomplish these assignments, a physical plant has been constructed at an initial capital cost of about $815,000,000. The principal process facilities are the five gaseous diffusion cascade buildings, portions of which are now in standby. These are supplemented by about 70 support buildings and facilities (maintenance, supply stores, administration, cafeteria, data processing, etc.).

The Oak Ridge Y-12 Plant occupies approximately 500 acres and is located immediately adjacent to the City of Oak Ridge. It is about 2-1/2 miles long and 1/4 mile wide. Today, Y-12 employs about 6500 people, including some 700 scientists and engineers and over 2000 craftsmen. The Y-12 Plant has four major responsibilities: (1) production of nuclear weapon components, (2) fabrication support for weapon design agencies, (3) support for the Oak Ridge National Laboratory, and (4) support and assistance to other government agencies. Activities associated with these functions include the production of lithium compounds, the recovery of enriched uranium from unirradiated scrap material, and the fabrication of uranium and other materials into finished parts and assemblies. Fabrication operations include vacuum casting, arc melting, powder compaction, rolling, forming, heat treating, machining, inspection, and testing. As an indication of the scope of Y-12's work, the plant has over 1500 machine tools located in over 50 environmentally controlled shops.

Operations associated with the AEC research and production facilities in Oak Ridge give rise to several types of waste materials.

Radioactive wastes are generated from reactor operations, pilot plant operations involving radioactive materials, isotope separation processes, uranium enrichment, and uranium processing operations. Nonradioactive wastes are generated by normal industrial-type support operations that include water demineralizers, air conditioning, cooling towers, acid disposal, sewage plant operations, and steam plant operations.

Nonradioactive solid wastes are buried in a centralized sanitary landfill or designated burial areas. Radioactive solid wastes are buried in designated burial areas or placed in retrievable storage either above or below ground depending upon the type and quantity of radioactive material present and the economic value involved.

Gaseous wastes generally are treated by filtration, electrostatic precipitation, and/or chemical scrubbing techniques prior to release to the atmosphere. The major gaseous waste streams are released through stacks to provide atmospheric dilution for the small amount of waste materials which may remain in the stream following treatment.

Liquid radioactive wastes are not released but are concentrated and contained in tanks for ultimate disposal. Process water which may contain small quantities of radioactive or chemical pollutants is discharged, after treatment, to White Oak Creek, Poplar Creek, East Fork Poplar Creek, and Bear Creek, which are small tributaries to the Clinch River.

## SUMMARY

The Environmental Monitoring Program for the Oak Ridge area includes sampling and analysis of air, water from surface streams, several food products, flora, and soil for both radioactive and nonradioactive materials. This report presents a summary of the results of the program for calendar year 1972.

Surveillance of radioactivity in the Oak Ridge environs indicates the atmospheric concentrations of radioactivity were not significantly different from other areas in East Tennessee. Concentrations of radioactivity in the Clinch River and in fish collected from the river were less than one percent of the permissible concentration and intake guides for individuals in the neighboring environment. Only very low-level radioactivity is being released to the environment from plant operations and the resulting concentrations in all of the media sampled were well below permissible standards.

Surveillance of nonradioactive materials in the Oak Ridge environs shows that established limits were not exceeded for those materials possibly present in the air as a result of plant operations. While the sulfonation rate for reactive sulfur compounds was equal to the established standard at some locations on the Reservation, sources other than AEC facilities contributed significantly to the levels measured. The data obtained from the water sampling program indicate compliance with "standards" with the exception of chromium in the discharge of White Oak Dam and chromium, pH, and dissolved oxygen at the outlet of New Hope Pond on East Fork Poplar Creek. These problems are being investigated. Although cyanide and cadmium data from the outlet of New Hope Pond and Bear Creek show concentrations approximately equal to the U. S. Public Health Service Drinking Water Standard, the sensitivity of the analytical method used was inadequate for the required detection limit. Furthermore, these streams are not direct sources of public drinking water. Concentrations of fluorides measured in pine needles and grass are below levels expected to produce adverse effects in the most sensitive species.

## MONITORING DATA
## COLLECTION, ANALYSIS, AND EVALUATION

Environmental monitoring data for calendar year 1972 are summarized in Tables 1 through 21. In general, the data tables show the number of samples collected at each location, the maximum concentration, the minimum concentration, the average concentration, the relevant standard, and percent of standard for the average of each parameter. Averages are usually accompanied by plus-or-minus (±) values which represent the 95% confidence limits. The 95% confidence limit is calculated from the standard deviation of the average, assuming a normal frequency distribution, and is a measure of the variability in the range of concentrations measured. It does not represent the conventional error in the average of repeated measurements on identical samples. Data which are below the minimum detectable limit are expressed as less than (<) the minimum detectable value. In computing average values, sample results below the detection limit are assigned the detection limit value with the resulting average value being expressed as less than (<) the computed average value.

Average concentrations are compared with environmental quality standards, where such standards have been established, as a means of evaluating the impact of waste releases. In some cases, for lack of an official standard, stream concentrations have been compared with U. S. Public Health Service Drinking Water Standards even though the streams are not a source of drinking water.

### Air Monitoring

Radioactive - Atmospheric concentrations of radioactive materials occurring

in the general environment of East Tennessee are monitored by two systems of monitoring stations. One system consists of nine stations (HP-31 through HP-39) which encircle the perimeter of the Oak Ridge area and provides data for evaluating releases from Oak Ridge facilities to the immediate environment, Figure 1. A second system consists of eight stations (HP-51 through HP-58) encircling the Oak Ridge area at distances of from 12 to 75 miles, Figure 2. This system provides background data to aid in evaluating local conditions. Sampling for radioactive particulates is carried out by passing air continuously through filter papers. Filter papers are evaluated by gross beta and gross alpha counting techniques for normal operations. More detailed analyses are performed when concentrations in the environment are significantly above normal. Airborne radioactive iodine is monitored by passing air continuously through cartridges containing activated charcoal. Charcoal cartridges are evaluated for radioactive iodine by gamma spectrometry.

Data on the concentrations of radioactive materials in air in the Oak Ridge and surrounding areas are given in Tables 1 through 3. The average gross beta concentrations of radioactivity from particulates in air measured by both the perimeter and remote monitoring systems were 0.08% of the applicable concentration guide (CG) specified in the AEC Manual, Appendix 0524,[1] for individuals in uncontrolled areas (Table 1). The average gross alpha concentrations were 0.13% or less of the concentration guide for natural uranium in both systems (Table 2). The average concentration of $^{131}$I measured by the perimeter air monitoring system was less than 0.01% of the inhalation concentration guide for individuals in uncontrolled areas (Table 3).

The uniform level of filterable activity measured by the perimeter and remote stations indicates that the activity was of nonplant origin. While some $^{131}$I was released to the atmosphere during the year, measurements in the Oak Ridge area show that environmental concentrations were well below established standards.

Non-Radioactive - Environmental air samples are taken for the determination of fluorides, reactive sulfur, dustfall, and suspended particulates.

Sampling locations for fluorides are indicated by F-1 through F-6, Figure 1. Concentrations in the ppb range are determined by collecting 24 hour samples in caustic solution in a Boyce-Thompson type sampler and analyzing the resulting solution colorimetrically, utilizing eriochrome cyanine R as a color reagent.

Air sampling locations for the determination of reactive sulfur are indicated by S-1 through S-11, Figure 1. The lead peroxide candle technique is used for the collection of reactive sulfur (oxides). Each sampling station consists of a stand, a louvered shelter, and a prepared lead peroxide candle. Candles are exposed to the atmosphere for a period of one month. Sulfur oxides react with the lead peroxide to form lead sulfate. The analytical procedure is a gravimetric method and results are calculated as mg $SO_3$/100 $cm^2$/day.

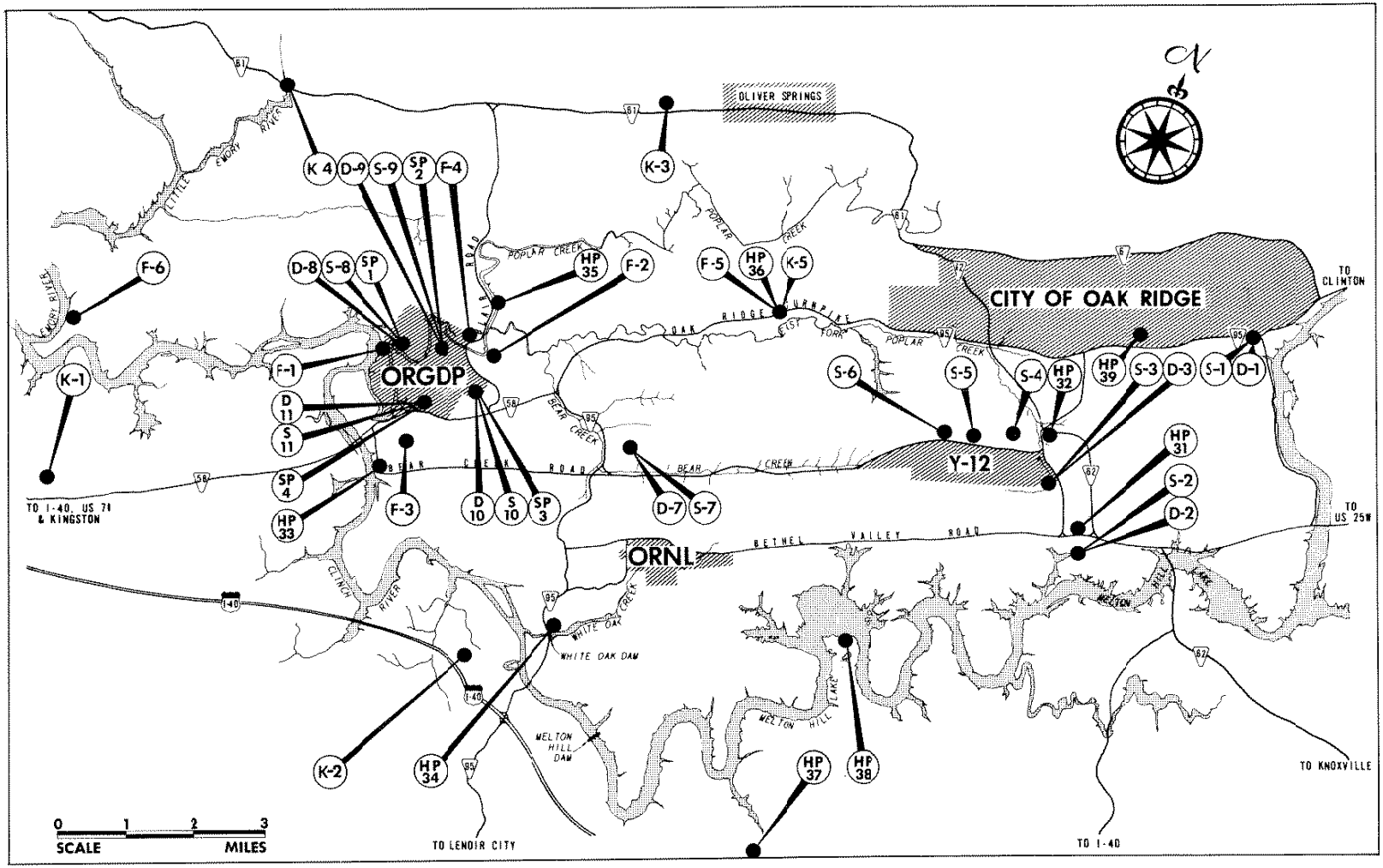


Figure 1

**LOCATIONS OF AIR MONITORING STATIONS**

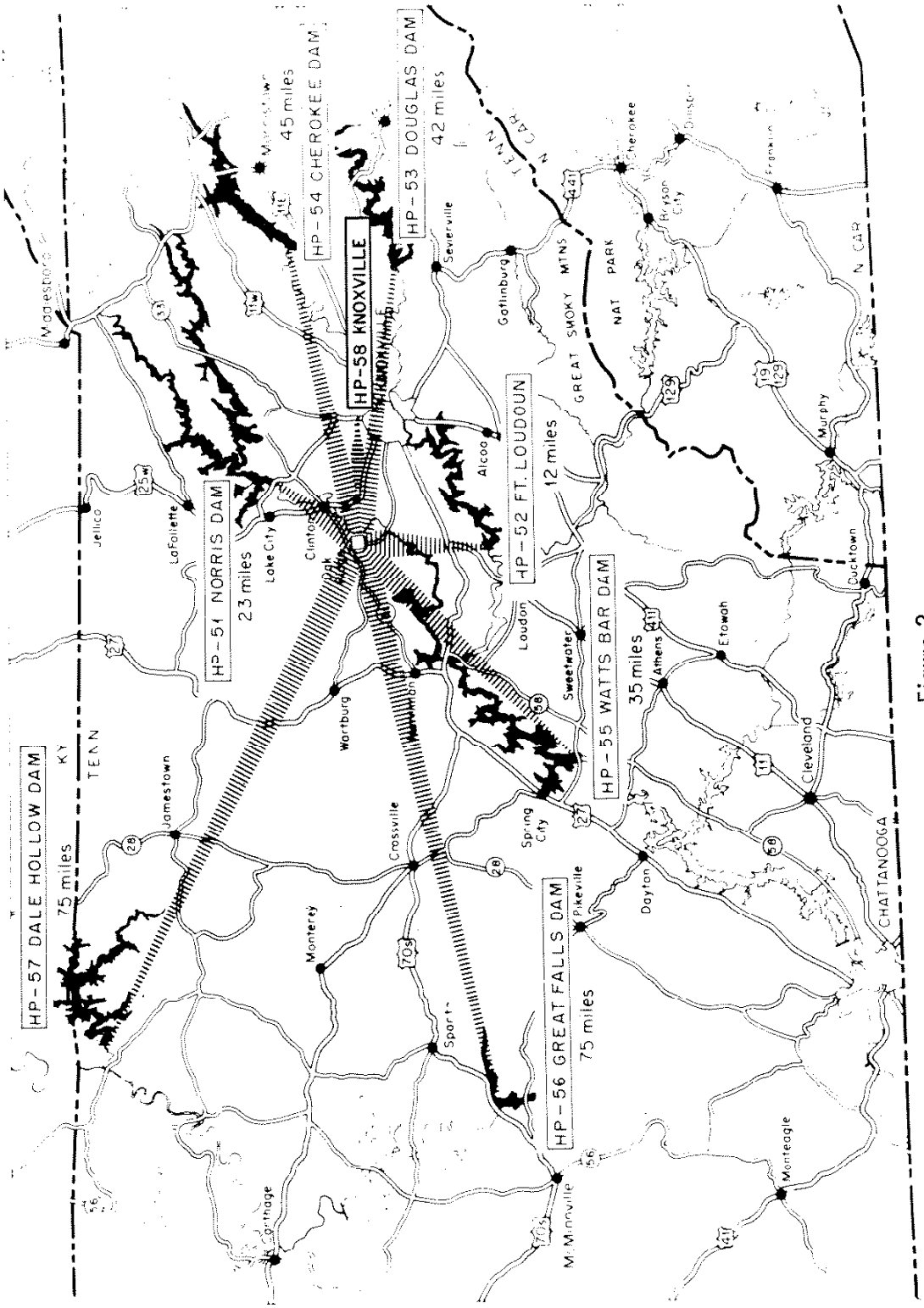


Figure 2

**STATION SITES FOR REMOTE AIR MONITORING SYSTEM**

Dustfall concentrations are determined at points D-1, D-2, D-3, and D-7 through D-11, Figure 1. The sampling stations consist of a stand and a collection container. Samples are collected for a period of one month and analyzed by the standard gravimetric method of analysis for dustfall. Results are calculated as $gm/m^2$/30-day period.

Suspended particulates are measured at locations SP-1 through SP-4, Figure 1. The method for the determination of suspended particulates is the high volume method. Particles are collected by drawing air through weighed filter paper. The filter paper is allowed to equilibrate in a humidity controlled atmosphere and the filter is reweighed. From the weight of particulates, the sampling time, and the air flow rate, the particulate concentration in micrograms per cubic meter is calculated. The sampling period is 24 hours.

Air monitoring data for fluorides, reactive sulfur, dustfall, and suspended particulates are presented in Tables 4 through 7, respectively. These data indicate that the average concentrations in each case did not exceed the applicable standard for calendar year 1972. While the sulfonation rate was equal to the established standard at some locations on the Reservation, sources other than AEC facilities contributed significantly to the levels measured.

Water Monitoring

Radioactive - A continuous proportional sample is collected at White Oak Dam (Station W-1), which is the last on-site control point prior to the entry of White Oak Creek into the Clinch River, and composited for monthly analysis. Continuous proportional samples are collected in the Clinch River at Melton Hill Dam (Station C-2) 2.3 miles above White Oak Creek outfall and at the ORGDP water intake (Station C-3) 6.3 miles downstream of the entry of White Oak Creek. A sample is collected daily from the Clinch River at Center's Ferry near Kingston, Tennessee (Station C-5), Figure 3. Clinch River samples are composited for quarterly analysis.

The concentrations of radionuclides present in detectably significant amounts are determined by specific radionuclide analysis and gamma spectrometry. The concentration of each radionuclide is compared with its respective concentration guide (CG) value as specified in the AEC Manual, Appendix 0524, and the resulting fractions are summed to obtain the percent CG in the Clinch River.

Water samples are collected in Poplar Creek upstream of the ORGDP (Station P-1), in Poplar Creek downstream from the ORGDP waste discharges (Station P-2), and in the Clinch River downstream from the Poplar Creek outfall (Station C-4), Figure 3. Weekly samples are collected in Poplar Creek and composited for monthly analysis. A continuous sample is collected in the Clinch River and composited for monthly analysis. Samples are analyzed for uranium by the fluorometric method.

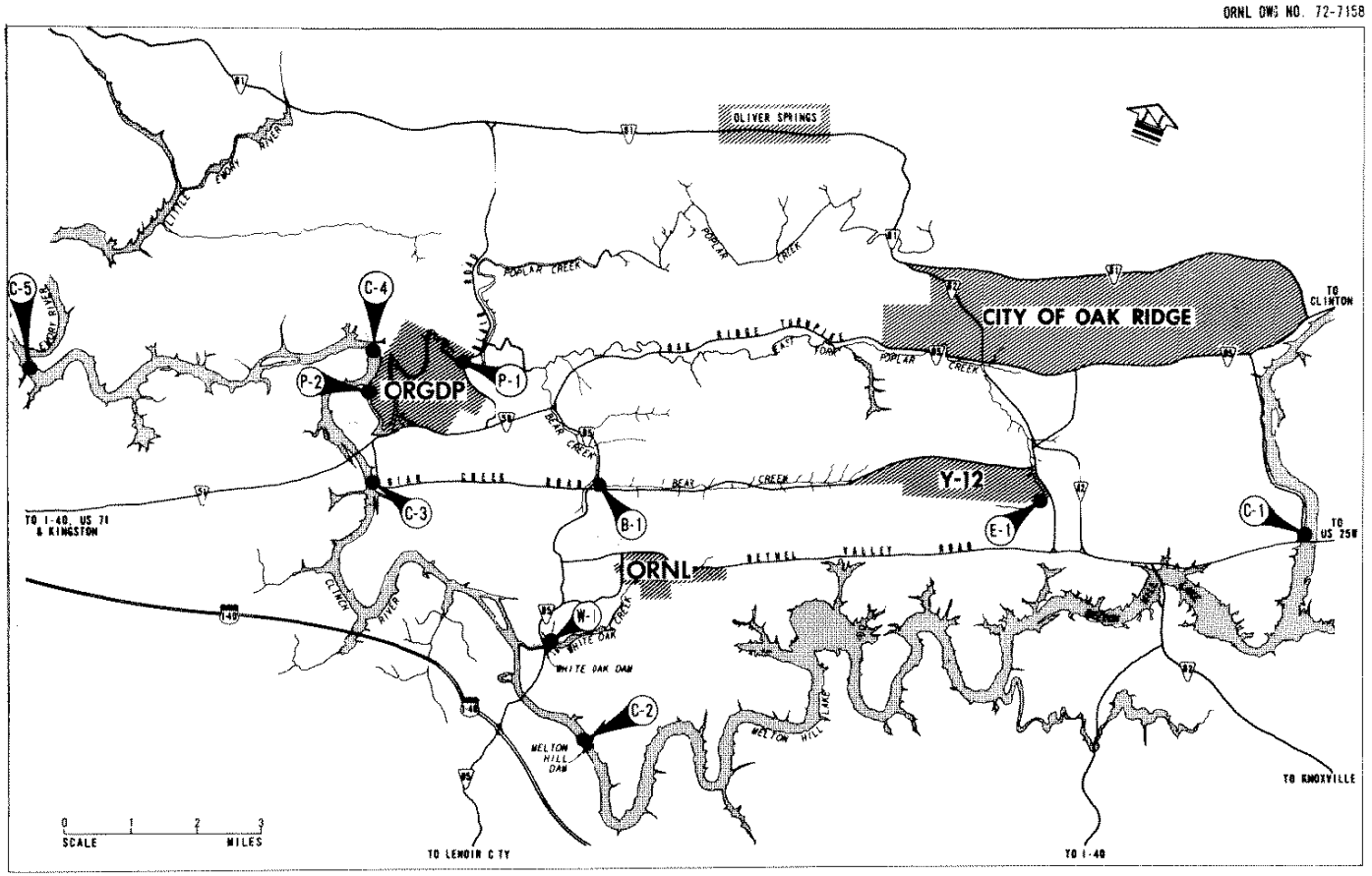


Figure 3

**LOCATIONS OF STREAM MONITORING STATIONS**

Continuous proportional water samples are collected at the outlet of New Hope Pond on East Fork Poplar Creek (Station E-1) and Bear Creek (Station B-1), Figure 3. Samples are analyzed on a monthly basis by gross alpha counting techniques.

The average concentrations of specific radionuclides in the Clinch River at all points of measurement were less than 1% of the applicable concentration guides for uncontrolled areas (Table 8). The average concentration of transuranic alpha emitters in the Clinch River at CRM 20.8 was $8.0 \times 10^{-12}$ μCi/ml, which is less than 0.01% of the concentration guide for water in uncontrolled areas containing an unknown mixture of radionuclides.* Average concentrations of uranium in the surface streams on the Oak Ridge area were no greater than 1.4% of the applicable concentration guide for uncontrolled area (Table 9).

Non-Radioactive - Water samples are collected on a weekly basis at locations W-1, C-1, and C-3 (Figure 3). After a portion of each weekly sample has been analyzed, the remainder of the sample is composited with a preservative into a monthly and/or quarterly composite. Samples are analyzed for chromium, phenols, sulfates, nitrates, and chlorides. The analytical procedures used are: chromium by atomic absorption, phenols by chromatographic technique, sulfates by turbidimetric method, chlorides by specific ion electrodes, and nitrates by spectrophotometric technique.

Samples are also collected at locations P-1, P-2, and C-4 (Figure 3) for the determination of nitrates, fluorides, and chromium. Nitrates and fluorides are analyzed from monthly samples taken at each location. Chromium is analyzed from monthly composites of weekly samples taken at locations P-1 and P-2 and from continuous samples collected at location C-4. Samples are composited for monthly analysis. Samples are analyzed for nitrates by wet chemistry, for fluorides by specific ion electrodes, and for chromium by atomic absorption.

Sampling for a variety of cations and anions is also performed at locations E-1 and B-1 (Figure 3). The pH and flow of East Fork Poplar Creek (E-1) are recorded continuously and the pH value is telemetered to a central point where any abnormal changes may be noted. The analytical procedures used for the cations and anions are those recommended by the Environmental Protection Agency.

Instrumentation for measuring pH, temperature, DO, and flow and telemetering of data to a central location was installed at White Oak Dam (W-1) during the summer of 1972. Operational difficulties with the telemetering equipment were encountered and no data are available. These difficulties were corrected by the

* CG is $1 \times 10^{-7}$ μCi/ml - AEC Manual, Appendix 0524. (1)

end of the year and future reports will include data from this continuous monitor. Sufficient data were obtained late in the year, however, to indicate that temperature fluctuation is a direct result of the environmental conditions, dissolved oxygen values are within the specified limit of > 5 ppm, and pH values are in the range of 6.5-8.5.

Water monitoring data for sample locations W-1, C-1, and C-3 are shown in Tables 10, 11, and 12. With the exception of chromium at location W-1, the concentrations of all substances analyzed are below the "standards".[3] Investigations are under way to reduce the chromium levels at location W-1.

Water monitoring data for locations P-1, P-2, and C-4 (Figure 3) are shown in Table 13. Concentrations determined on all three parameters are less than the "standard".

Water monitoring data for location E-1 are shown in Table 14. Average chromium concentrations at this point (E-1) are 3.2 times the U. S. Public Health Service Drinking Water Standard. This is a direct result of the corrosion inhibitor used in cooling tower water. The month-to-month fluctuations in chromium discharges are unexplainably high and are being investigated. As a means of coping with the chromium problem, several cooling towers have been placed on a phosphate inhibitor test program. Automatic control equipment will be installed on all cooling towers in CY 1973 which should decrease total blowdown and reduce the chromium concentration in the creek. The stream is not a direct source of public drinking water, however.

The cyanide and cadmium concentrations for location E-1 (Table 14) are indicated as equal to the U. S. Public Health Service Drinking Water Standard. The analytical techniques available for cyanides and cadmium are not adequate to provide reliable data at the level of the drinking water standard. Whether the limits are actually equal to the standard cannot be determined until samples are analyzed by a new technique with a lower limit of detection. It should also be pointed out that all values reported as less than the minimum detection limits were in fact assigned that value for the purpose of determining an average concentration and percent of standard. This results in an average higher than the absolute average. Consequently, these values for percent standard are indicated as less than (<) values.

The pH in the effluent from New Hope Pond on East Fork Poplar Creek (E-1) slightly exceeded the State limits for fish and aquatic life streams. The lower limit of 6.5 was exceeded on six days during 1972. The maximum change in pH in 24 hours exceeded the State limit of 1 pH unit on only one day. The pH variations described above would not be expected to produce any significant impact on the receiving stream.

Measurements of the dissolved oxygen content in the effluent from the New Hope Pond into East Fork Poplar Creek (E-1) were 8.4 mg/l mximum, 3.0 mg/l minimum, and 4.3 mg/l average for CY 1972. All measurements were obtained with a direct reading meter. The average was out of compliance with the State limit of 5.0 mg/l minimum for fish and aquatic life streams. The decomposition of algae in the pond may be imposing an abnormal BOD loading. The decaying algae and sediment will be dredged from the pond in 1973. The project will be completed by April and is expected to improve the level of dissolved oxygen in the stream. The holdup time will also be increased from about 8 hours to 24 hours and the larger storage volume created by the dredging should greatly improve the pH problem.

The water monitoring data for location B-1 are shown in Table 15. These data indicate that with the exception of cyanides and cadmium, all concentrations are less than drinking water standards. As previously indicated, the method of averaging and calculating percent standard tends to bias the results high. The comments above on the reliability of the analytical technique for East Fork Poplar Creek (E-1) also apply to Bear Creek (B-1).

## Food Sources

Milk Monitoring - Raw milk is monitored for $^{131}I$ and $^{90}Sr$ by the collection and analysis of samples from 12 sampling stations located within a radius of 50 miles of Oak Ridge. Samples are collected weekly at each of eight stations located near the Oak Ridge area. Four stations, located more remotely with respect to Oak Ridge Operations, are sampled at a rate of one station each week. Milk sampling locations for the eight stations near the Oak Ridge area are shown in Figure 4. Samples are analyzed by ion exchange techniques and results are compared to intake guides specified by the Federal Radiation Council (FRC). [5]

The average concentrations of $^{131}I$ and $^{90}Sr$ in raw milk are given in Tables 16 and 17. If one assumes the average intake of milk per individual to be one liter per day, the average concentration of $^{131}I$ in the milk in the immediate environs of the Oak Ridge area was just above the lower limit of FRC Range II. The average concentration in the environs remote from Oak Ridge was within FRC Range I. The maximum levels are related to world-wide fallout. The average concentrations of $^{90}Sr$ in milk from both the immediate and remote environs were within the FRC Range I. The average concentrations measured in the Oak Ridge area do not differ significantly from the values in the southeastern United States reported by the Environmental Protection Agency's Pasteurized Milk Sampling Network.

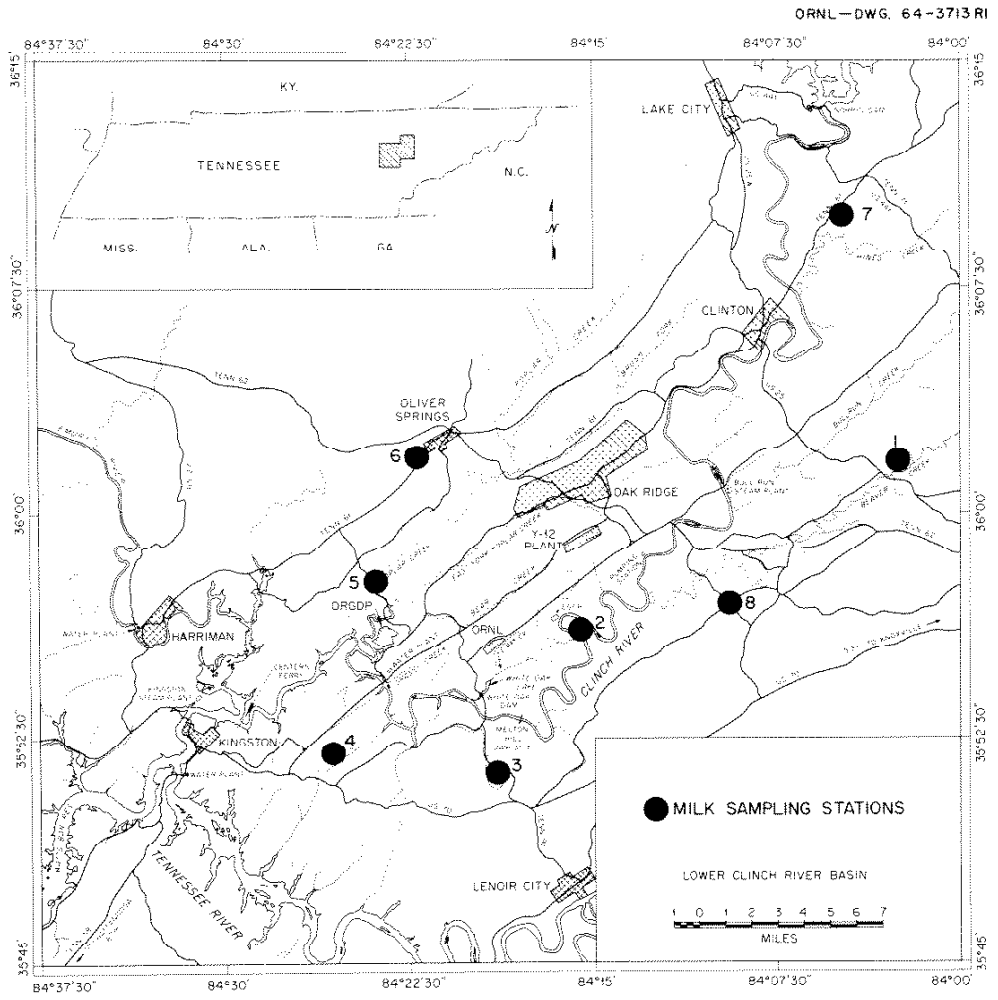


Figure 4

**LOCATIONS OF MILK SAMPLING STATIONS**

Fish Sampling - Two species of fish from the Clinch River are sampled during the spring and summer of each year. The fish are prepared for radiochemical analysis in a manner analogous to human utilization. Ten fish of each species are composited for each sample and the samples are analyzed by gamma spectrometry and radiochemical techniques for the critical radionuclides contributing significantly to the potential radiation dose to man. An estimate of man's intake of radionuclides from eating Clinch River fish is made by assuming an annual rate of fish consumption of 14 lbs.,[6] and the estimated percentage of maximum permissible intake is calculated by assuming a maximum permissible intake of radionuclides from eating fish to be comparable to a daily intake of 2.2 liters[7] of water containing the concentration guide of the radionuclides in question for a period of one year.

Data on the concentrations of radionuclides in Clinch River fish are given in Table 18. The levels measured were less than 1% of that required to obtain an estimated maximum permissible intake.

## Flora and Soil

Radioactive - Soil samples are collected annually from near the Perimeter Air Monitoring Stations, Figure 1. Nine samples, approximately three inches in diameter and one centimeter thick, are collected in a one-square-meter area at each location, composited, and analyzed radiochemically for uranium and plutonium content to determine background information for future comparison in event of an accidental release.

Soil, pine needle, and grass samples are collected quarterly from five sampling locations (K-1 through K-5) located on a five-mile radius from the ORGDP, Figure 1. Samples are analyzed for uranium by the fluorometric method.

Data on uranium concentrations in soil and flora are given in Tables 19 and 20.

Non-Radioactive - Samples of pine needles and grasses are collected at locations K-1 through K-5 (Figure 1) and analyzed for fluorides. The data are shown in Table 21. Since the average concentrations detected in both pine needles and grass are less than 30 ppm at all locations, no adverse effects would be anticipated. This is substantiated by an article appearing in open literature[8] which states that dairy cattle, the species of livestock most sensitive to fluorides in grasses, would suffer no adverse effects.

Table 1

CONTINUOUS AIR MONITORING DATA

Long-Lived Gross Beta Activity of
Particulates in Air

1972

| Station Number | Location | Number of Samples Taken | Units of $10^{-13}$ µCi/ml | | | % CG[c] |
|---|---|---|---|---|---|---|
| | | | Maximum[a] | Minimum[b] | Average | |
| | | Perimeter Stations[d] | | | | |
| HP-31 | Kerr Hollow Gate | 53 | 5.4 | 0.1 | 0.71 ± 0.12 | 0.07 |
| HP-32 | Midway Gate | 53 | 6.3 | 0.1 | 0.80 ± 0.13 | 0.08 |
| HP-33 | Gallaher Gate | 53 | 6.3 | 0.1 | 0.74 ± 0.13 | 0.07 |
| HP-34 | White Oak Dam | 53 | 4.6 | 0.1 | 0.71 ± 0.10 | 0.07 |
| HP-35 | Blair Gate | 53 | 6.2 | 0.2 | 0.87 ± 0.13 | 0.09 |
| HP-36 | Turnpike Gate | 53 | 8.8 | 0.1 | 1.1 ± 0.18 | 0.11 |
| HP-37 | Hickory Creek Bend | 53 | 6.6 | 0.1 | 0.62 ± 0.13 | 0.06 |
| HP-38 | East of EGCR | 53 | 3.9 | 0.1 | 0.69 ± 0.09 | 0.07 |
| HP-39 | Townsite | 53 | 8.4 | 0.1 | 0.89 ± 0.17 | 0.09 |
| Average | | | 6.3 | 0.1 | 0.79 ± 0.05 | 0.08 |
| | | Remote Stations[e] | | | | |
| HP-51 | Norris Dam | 52 | 8.0 | 0.06 | 0.76 ± 0.16 | 0.08 |
| HP-52 | Loudoun Dam | 52 | 7.9 | 0.04 | 0.87 ± 0.16 | 0.09 |
| HP-53 | Douglas Dam | 52 | 5.8 | 0.03 | 0.81 ± 0.14 | 0.08 |
| HP-54 | Cherokee Dam | 52 | 7.9 | 0.04 | 0.84 ± 0.16 | 0.08 |
| HP-55 | Watts Bar Dam | 52 | 10.6 | 0.05 | 0.95 ± 0.20 | 0.10 |
| HP-56 | Great Falls Dam | 53 | 9.3 | 0.05 | 0.98 ± 0.19 | 0.10 |
| HP-57 | Dale Hollow Dam | 52 | 5.5 | 0.07 | 0.73 ± 0.12 | 0.07 |
| HP-58 | Knoxville | 48 | 8.2 | 0.03 | 0.78 ± 0.17 | 0.08 |
| Average | | | 7.9 | 0.05 | 0.84 ± 0.03 | 0.08 |

[a] Maximum weekly average concentration.

[b] Minimum weekly average concentration - minimum detectable level is $5 \times 10^{-6}$ µCi per sample.

[c] CG is $10^{-10}$ µCi/ml for unidentified radionuclides (AEC Manual, Appendix 0524, Annex A, Table II).

[d] See Figure 1.

[e] See Figure 2.

Table 2

CONTINUOUS AIR MONITORING DATA

Long-Lived Gross Alpha Activity
of Particulates in Air

1972

| Station Number | Location | Number of Samples Taken | Units of $10^{-15}$ µCi/ml | | | % CG[c] |
|---|---|---|---|---|---|---|
| | | | Maximum[a] | Minimum[b] | Average | |
| | | Perimeter Stations[d] | | | | |
| HP-31 | Kerr Hollow Gate | 53 | 8 | 1 | 2 ± 0.15 | 0.10 |
| HP-32 | Midway Gate | 53 | 6 | 1 | 3 ± 0.23 | 0.15 |
| HP-33 | Gallaher Gate | 53 | 8 | 1 | 2 ± 0.23 | 0.10 |
| HP-34 | White Oak Dam | 53 | 7 | 1 | 2 ± 0.20 | 0.10 |
| HP-35 | Blair Gate | 53 | 9 | 1 | 3 ± 0.31 | 0.15 |
| HP-36 | Turnpike Gate | 53 | 10 | 1 | 5 ± 0.47 | 0.25 |
| HP-37 | Hickory Creek Bend | 53 | 6 | 1 | 2 ± 0.16 | 0.10 |
| HP-38 | East of EGCR | 52 | 6 | 1 | 2 ± 0.16 | 0.10 |
| HP-39 | Townsite | 53 | 7 | 1 | 2 ± 0.17 | 0.10 |
| Average | | | 7 | 1 | 3 ± 0.34 | 0.13 |
| | | Remote Stations[e] | | | | |
| HP-51 | Norris Dam | 52 | 4 | 1 | 2 ±0.14 | 0.10 |
| HP-52 | Loudoun Dam | 52 | 4 | 1 | 2 ±0.18 | 0.10 |
| HP-53 | Douglas Dam | 52 | 6 | 1 | 2 ±0.18 | 0.10 |
| HP-54 | Cherokee Dam | 52 | 4 | 1 | 2 ±0.14 | 0.10 |
| HP-55 | Watts Bar Dam | 52 | 4 | 1 | 2 ±0.18 | 0.10 |
| HP-56 | Great Falls Dam | 53 | 5 | 1 | 2 ±0.16 | 0.10 |
| HP-57 | Dale Hollow Dam | 52 | 4 | 1 | 2 ±0.12 | 0.10 |
| HP-58 | Knoxville | 48 | 4 | 1 | 2 ±0.12 | 0.10 |
| Average | | | 4 | 1 | 2 ±0.0 | 0.10 |

[a] Maximum weekly average concentration.

[b] Minimum weekly average concentration - minimum detectable level is $2 \times 10^{-6}$ µCi per sample.

[c] CG is $20 \times 10^{-13}$ µCi/ml for natural uranium (AEC Manual, Appendix 0524, Annex A, Table II).

[d] See Figure 1.

[e] See Figure 2.

Table 3

CONCENTRATION OF $^{131}I$ IN AIR
AS MEASURED BY THE PERIMETER AIR MONITORING STATIONS[a]

1972

| Number of Samples | Units of $10^{-14}$ µCi/ml | | | % CG[c] |
|---|---|---|---|---|
| | Maximum | Minimum[b] | Average | |
| 477 | 6.6 | < 0.5 | < 1.1 ± 0.1 | < 0.01 |

[a] See Figure 1.

[b] Minimum detectable amount of $^{131}I$ is $10 \times 10^{-6}$ µCi per sample.

[c] CG is $1 \times 10^{-10}$ µCi/ml (AEC Manual, Appendix 0524, Annex A, Table II).

Table 4

AIR MONITORING DATA - FLUORIDES

1972

| Location[a] | Number of Samples[b] | Concentration, ppb | | | % STD.[c] |
|---|---|---|---|---|---|
| | | Maximum | Minimum | Average | |
| F-1 | 51 | 3.3 | 0.2 | 1.2 ± 0.2 | 80 |
| F-2 | 51 | 4.0 | 0.2 | 1.1 ± 0.2 | 73 |
| F-3 | 45 | 4.0 | 0.2 | 1.3 ± 0.3 | 87 |
| F-4 | 52 | 3.6 | 0.2 | 1.2 ± 0.2 | 80 |
| F-5 | 53 | 3.3 | 0.2 | 1.0 ± 0.2 | 67 |
| F-6 | 51 | 2.5 | 0.2 | 0.9 ± 0.2 | 60 |

[a]See Figure 1.

[b]Sample duration - 24 hours.

[c]Tennessee Air Pollution Control Regulations -
4.5 ppb for 12 hr. averaging interval
3.5 ppb for 24 hr. averaging interval
2.0 ppb for 7 day averaging interval
1.5 ppb for 30 day averaging interval
All values are maximum - not to be exceeded more than once per year.
Percent standard calculated using the average value and the 30 day standard.

Table 5

AIR MONITORING DATA - REACTIVE SULFUR

1972

| Location[a] | Number of Samples | Concentration mg $SO_3$/100 $cm^2$/day | | | % STD.[b] |
|---|---|---|---|---|---|
| | | Maximum | Minimum | Average | |
| S-1 | 12 | 0.2 | 0.00 | 0.07 ± 0.05 | 9 |
| S-2 | 12 | 0.2 | 0.00 | 0.09 ± 0.05 | 11 |
| S-3 | 12 | 0.6 | 0.02 | 0.2 ± 0.1 | 25 |
| S-4 | 12 | 0.7 | 0.09 | 0.3 ± 0.1 | 38 |
| S-5 | 12 | 0.5 | 0.1 | 0.3 ± 0.06 | 38 |
| S-6 | 12 | 0.4 | 0.02 | 0.20 ± 0.06 | 25 |
| S-7 | 12 | 0.3 | 0.00 | 0.09 ± 0.05 | 11 |
| S-8 | 11 | 1.3 | 0.3 | 0.8 ± 0.2 | 100 |
| S-9 | 11 | 1.2 | 0.3 | 0.8 ± 0.2 | 100 |
| S-10 | 11 | 1.4 | 0.2 | 0.7 ± 0.2 | 87 |
| S-11 | 9 | 1.0 | 0.2 | 0.8 ± 0.2 | 100 |

[a] See Figure 1.

[b] Tennessee Air Pollution Control Regulations for Land Area Classification "A": 0.8 mg $SO_3$/100 $cm^2$/day.

Table 6

AIR MONITORING DATA - DUSTFALL

1972

| Location[a] | Number of Samples | Concentration gm /$m^2$/30-day period | | | % STD.[b] |
|---|---|---|---|---|---|
| | | Maximum | Minimum | Average | |
| D-1 | 12 | 0.6 | 0.03 | 0.2 ± 0.1 | 2[c] |
| D-2 | 12 | 3.8 | 0.2 | 1.0 ± 0.6 | 11[c] |
| D-3 | 12 | 0.6 | 0.2 | 0.3 ± 0.08 | 3[c] |
| D-7 | 12 | 4.0 | 0.2 | 0.8 ± 0.08 | 9[c] |
| D-8 | 11 | 1.0 | 0.2 | 0.4 ± 0.2 | 4[c] |
| D-9 | 11 | 2.0 | 0.1 | 0.4 ± 0.4 | 4[c] |
| D-10 | 11 | 3.3 | 0.1 | 0.7 ± 0.6 | 8[c] |
| D-11 | 11 | 2.0 | 0.1 | 0.6 ± 0.4 | 7[c] |

[a] See Figure 1.

[b] Tennessee Air Pollution Control Regulations for Land Area Classification "A": 9 - 18 gm/$m^2$/30-day period. The lower limit of nine should not be exceeded more than 50% of the time during any 12-month period. The upper limit of 18 is not to be exceeded during any 30-day period.

[c] Calculated by using the average value and lower limit of nine.

Table 7

AIR MONITORING DATA - SUSPENDED PARTICULATES

1972

| Location[a] | Number of Samples | Concentration, $\mu g/m^3$ | | | % STD.[b] |
|---|---|---|---|---|---|
| | | Maximum | Minimum | Average | |
| SP-1 | 28 | 126.0 | 15.0 | 43.4 ± 9.0 | 58 |
| SP-2 | 28 | 117.7 | 7.0 | 46.6 ± 10.7 | 62 |
| SP-3 | 29 | 119.5 | 10.2 | 42.5 ± 8.1 | 57 |
| SP-4 | 28 | 103.3 | 12.3 | 46.2 ± 9.2 | 62 |

[a] See Figure 1.

[b] Tennessee Air Pollution Control Regulations - Primary standard based on annual geometric mean is 75.0 $\mu g/m^3$.

Table 8

RADIONUCLIDES IN THE CLINCH RIVER

1972

| Sampling Location | No. Samples | Range | Concentration of Radionuclides of Primary Concern Units of $10^{-9}$ µCi/ml | | | | % CG[c] |
|---|---|---|---|---|---|---|---|
| | | | $^{90}Sr$ | $^{137}Cs$ | $^{106}Ru$ | $^{3}H$ | |
| C-2 CRM 23.1[a] | 4 | Max. | 0.5 | 0.2 | 0.9 | < 1000 | |
| | | Min. | 0.5 | < 0.1 | 0.2 | < 1000 | |
| | | Avg. | 0.5 ± 0.00 | < 0.1 ± 0.02 | 0.6 ± 0.15 | < 1000 | < 0.18 |
| W-1 CRM 20.8[b] | 12 | Max. | 1.6 | 0.4 | 0.3 | 2720 | |
| | | Min. | 0.3 | < 0.1 | < 0.1 | 440 | |
| | | Avg. | 0.6 ± 0.1 | < 0.1 ± 0.02 | < 0.1 ± 0.02 | 1160 ± 200 | < 0.26 |
| C-3 CRM 14.5[a] | 4 | Max. | 2.1 | 1.1 | 1.2 | 3290 | |
| | | Min. | 1.1 | 0.5 | 0.5 | < 1000 | |
| | | Avg. | 1.5 ± 0.2 | 0.7 ± 0.1 | 0.8 ± 0.2 | < 1880 ± 500 | < 0.58 |
| C-5 CRM 4.5[a] | 4 | Max. | 1.4 | 0.9 | 1.1 | 2070 | |
| | | Min. | 1.0 | 0.3 | 0.2 | < 1000 | |
| | | Avg. | 1.1 ± 0.08 | 0.5 ± 0.1 | 0.6 ± 0.2 | < 1620 ± 400 | < 0.48 |

[a] Measured values.

[b] Values given for this location are calculated values based on the concentrations measured at White Oak Dam and the dilution afforded by the Clinch River. They do not include radioactive materials (e.g., fallout) that may enter the river upstream of White Oak Creek outfall (CRM 20.8).

[c] Applicable concentration guides and the method for calculating percent of concentration guide for a known mixture of radionuclides are given in AEC Manual, Appendix 0524, Annex A.(1)

Table 9

URANIUM CONCENTRATION IN SURFACE STREAMS

1972

| Station Number[a] | Location | Number of Samples | Units of $10^{-8}$ µCi/ml | | | % CG[b] |
|---|---|---|---|---|---|---|
| | | | Maximum | Minimum | Average | |
| P-1 | Poplar Creek | 12 | 2.9 | 0.1 | 1.0 ± 0.6 | < 0.1 |
| P-2 | Poplar Creek | 11 | 0.7 | 0.2 | 0.4 ± 0.1 | < 0.1 |
| C-4 | Clinch River | 12 | 0.5 | 0.0 | 0.2 ± 0.1 | < 0.1 |
| E-1 | East Fork Poplar Creek | 12 | 100 | 10 | 27 ± 15 | 1.4 |
| B-1 | Bear Creek | 12 | 60 | 6 | 21 ± 8 | 1.1 |

[a]See Figure 3.

[b]CG is $2 \times 10^{-5}$ µCi/ml (AEC Manual, Appendix 0524, Annex A, Table II).

Table 10

NON-RADIOACTIVE WATER MONITORING DATA—WHITE OAK DAM
(Location W-1, Figure 3)

1972

| Substance | Number of Samples | Concentration, mg/l | | | | % STD. |
|---|---|---|---|---|---|---|
| | | Maximum | Minimum | Average | STD. | |
| Cr | 4 | 0.20 | 0.05 | 0.1 ± 0.01 | 0.05[a] | 228 |
| Phenols | 4 | 0.006 | < 0.0001 | < 0.0002 ± 0.00002 | 0.001[a] | < 20 |
| $SO_4^{=}$ | 19 | 72.5 | 13.5 | 51.5 ± 9.4 | 250[a] | 21 |
| $NO_3^{-}$ | 10 | 6.5 | 3.1 | 5.1 ± 0.3 | 45[a] | 11 |
| $Cl^{-}$ | 3 | 3.4 | 1.7 | 2.2 ± 0.1 | 250[a] | 1 |

[a]U. S. Public Health Service Drinking Water Standards.

[b]Proposed EPA Standards.[9]

NOTE: Stream not a source of drinking water. Drinking water standards used for water quality comparison only.

Table 11

NON-RADIOACTIVE WATER MONITORING DATA - MELTON HILL LAKE
(Location C-1, Figure 3)

1972

| Substance | Number of Samples | Concentration, mg/l | | | | % STD. |
|---|---|---|---|---|---|---|
| | | Maximum | Minimum | Average | STD. | |
| Cr | 4 | 0.01 | < 0.005 | < 0.0057 ± 0.0006 | 0.05[a] | < 11 |
| Phenols | 3 | < 0.0001 | < 0.0001 | < 0.0001* | 0.001[a] | < 10 |
| $SO_4^{=}$ | 18 | 19.2 | 8.3 | 15.5 ± 2.8 | 250[a] | 6.2 |
| $NO_3^-$ | 10 | 5.5 | 0.5 | 3.1 ± 0.2 | 45[a] | 6.8 |
| $Cl^-$ | 3 | 2.1 | 1.5 | 1.8 ± 0.1 | 250[a] | 1 |

[a]U. S. Public Health Service Drinking Water Standards.

[b]Proposed EPA Standard.[9]

*All values below limit of detection.

Table 12

NON-RADIOACTIVE WATER MONITORING DATA—ORGDP PUMPING STATION
(Location C-3, Figure 3)

1972

| Substance | Number of Samples | Concentration, mg/l | | | | % STD. |
|---|---|---|---|---|---|---|
| | | Maximum | Minimum | Average | STD. | |
| Cr | 4 | 0.01 | < 0.005 | < 0.005 ± 0.0005 | 0.05[a] | < 10 |
| Phenols | 3 | < 0.0001 | < 0.0001 | < 0.0001* | 0.001[a] | < 10 |
| $SO_4^{=}$ | 19 | 17.0 | 8.5 | 13.0 ± 2.4 | 250[a] | 5.2 |
| $NO_3^-$ | 10 | 4.4 | 1.9 | 2.9 ± 0.2 | 45[a] | 6.4 |
| $Cl^-$ | 3 | 2.4 | < 1.0 | < 1.2 ± 0.07 | 250[a] | < 0.5 |

[a]U. S. Public Health Service Drinking Water Standards.

[b]Proposed EPA Standard. (9)

*All values below limit of detection.

Table 13

NON-RADIOACTIVE WATER MONITORING DATA - POPLAR CREEK AND CLINCH RIVER

1972

| Substance | Location[a] | Number of Samples | Concentration, mg/l | | | | % STD. |
|---|---|---|---|---|---|---|---|
| | | | Maximum | Minimum | Average | STD.[b] | |
| $NO_3^-$ | P-1 | 12 | 3.4 | 0.18 | 1.6 ± 0.7 | 45 | 3 |
| | P-2 | 11 | 24.3 | 0.71 | 4.8 ± 4.5 | 45 | 11 |
| | C-4 | 12 | 20.9 | 0.98 | 4.5 ± 3.6 | 45 | 10 |
| $F^-$ | P-1 | 12 | 2.3 | 0.06 | 0.68 ± 0.4 | 1.2 | 57 |
| | P-2 | 11 | 1.2 | 0.05 | 0.51 ± 0.2 | 1.2 | 43 |
| | C-4 | 12 | 1.7 | 0.10 | 0.49 ± 0.3 | 1.2 | 41 |
| Cr | P-1 | 12 | 0.09 | 0.005 | 0.022 ± 0.017 | 0.05 | 44 |
| | P-2 | 11 | 0.02 | 0.005 | 0.012 ± 0.003 | 0.05 | 24 |
| | C-4 | 12 | 0.06 | < 0.005 | < 0.02 ± 0.016 | 0.05 | < 40 |

[a] See Figure 3.

[b] U. S. Public Health Service Drinking Water Standards.

NOTE: Poplar Creek not a source of drinking water. Drinking Water Standard used for comparison of water quality only.

Table 14

NON-RADIOACTIVE WATER MONITORING DATA—EAST FORK POPLAR CREEK
(Location E-1, Figure 3)

1972

| Substance | Number of Samples | Concentration, mg/l | | | | | % STD. |
|---|---|---|---|---|---|---|---|
| | | Maximum | Minimum | Average | | STD. | |
| Cd | 12 | < 0.01 | < 0.01 | < 0.01* | | 0.01[a] | < 100 |
| $Cl^-$ | 12 | 18.5 | 8.7 | 11.7 | ± 1.6 | 250[a] | 5 |
| Cr | 12 | 0.34 | 0.012 | 0.16 | ± 0.08 | 0.05[a] | 320 |
| CN | 12 | < 0.01 | < 0.01 | < 0.01* | | 0.01[a] | < 100 |
| DO | 19 | 8.4 | 3.0 | 4.3 | ± 0.8 | 5.0[c] | 116 |
| $F^-$ | 12 | 1.3 | 0.4 | 1.0 | ± 0.2 | 1.2[a] | 83 |
| Hg | 12 | 0.0009 | < 0.0005 | < 0.0006 | ± 0.00006 | 0.005[b] | < 12 |
| $NO_3^-$ | 12 | 12.4 | 0.4 | 2.8 | ± 2.1 | 450[a] | 6 |
| Pb | 12 | 0.025 | < 0.002 | < 0.02 | ± 0.004 | 0.05[a] | < 40 |
| $SO_4^=$ | 12 | 72 | 40 | 56 | ± 5 | 250[a] | 22 |
| T.D.S. | 12 | 275 | 35 | 196 | ± 40 | 500[a] | 39 |
| Zn | 12 | 0.6 | 0.03 | 0.10 | ± 0.1 | 5.0[a] | 2 |

[a]U.S. Public Health Service Drinking Water Standards.

[b]Proposed EPA Standards.[e]

[c]Tennessee Water Quality Standard.

*All values below limit of detection.

NOTE: Stream not a source of drinking water. Drinking water standards used for water quality comparison only.

Table 15

NON-RADIOACTIVE WATER MONITORING DATA—BEAR CREEK
(Location B-1, Figure 3)

1972

| Substance | Number of Samples | Concentration, mg/l | | | | % STD. |
|---|---|---|---|---|---|---|
| | | Maximum | Minimum | Average | STD.[a] | |
| Cd | 12 | < 0.01 | < 0.01 | < 0.01* | 0.01 | < 100 |
| $Cl^-$ | 12 | 8 | < 1 | < 4.9 ± 1.2 | 250 | < 2 |
| Cr | 12 | 0.02 | < 0.001 | < 0.01 ± 0.003 | 0.05 | < 20 |
| CN | 12 | < 0.01 | < 0.01 | < 0.01* | 0.01 | < 100 |
| $F^-$ | 12 | 0.48 | < 0.2 | < 0.26 ± 0.05 | 1.2 | < 22 |
| $NO_3^-$ | 12 | 28.3 | 2.1 | 11 ± 5 | 45 | 24 |
| $SO_4^=$ | 12 | 49 | 17 | 22.5 ± 6 | 250 | 9 |
| Zn | 12 | 0.04 | 0.007 | 0.02 ± 0.007 | 5 | < 1 |

[a]U. S. Public Health Drinking Water Standards.

*All values below limit of detection.

NOTE: Stream not a source of drinking water. Drinking Water Standard used for comparison of water quality only.

Table 16

CONCENTRATION OF $^{131}I$ IN RAW MILK

1972

| Location | No. Samples | Units of $10^{-9}$ μCi/ml | | | Comparison with Standard[b] |
|---|---|---|---|---|---|
| | | Maximum | Minimum[a] | Average | |
| Immediate Environs[c] | 396 | 130[d] | < 10 | < 11.4 ± 0.84 | FRC Range II |
| Remote Environs | 39 | 104[d] | < 10 | < 10 ± 2.5 | FRC Range I |

[a]Minimum detectable concentration of $^{131}I$ is $10 \times 10^{-9}$ μCi/ml.

[b]Applicable FRC standard, assuming 1 liter per day intake:

| | | |
|---|---|---|
| Range I | 0 to $1 \times 10^{-8}$ μCi/ml | - Adequate surveillance required to confirm calculated intakes. |
| Range II | $1 \times 10^{-8}$ μCi/ml to $1 \times 10^{-7}$ μCi/ml | - Active surveillance required. |
| Range III | $1 \times 10^{-7}$ μCi/ml to $1 \times 10^{-6}$ μCi/ml | - Positive control action required. |

Note: Upper limit of Range II can be considered the concentration guide.

[c]See Figure 4.

[d]See text.

Table 17

CONCENTRATION OF $^{90}Sr$ IN RAW MILK

1972

| Location | No. Samples | Units of $10^{-9}$ μCi/ml | | | Comparison with Standard[b] |
|---|---|---|---|---|---|
| | | Maximum | Minimum[a] | Average | |
| Immediate Environs[c] | 396 | 29 | 2.0 | 10.9 ±0.30 | FRC Range I |
| Remote Environs | 38 | 23 | 2.0 | 8.6 ±0.65 | FRC Range I |

[a]Minimum detectable concentration of $^{90}Sr$ in milk is $2 \times 10^{-9}$ μCi/ml.

[b]Applicable FRC Standard, assuming 1 liter per day intake:

| | | |
|---|---|---|
| Range I | 0 to $2 \times 10^{-8}$ μCi/ml | - Adequate surveillance required to confirm calculated intakes. |
| Range II | $2 \times 10^{-8}$ μCi/ml to $2 \times 10^{-7}$ μCi/ml | - Active surveillance required. |
| Range III | $2 \times 10^{-7}$ μCi/ml to $2 \times 10^{-6}$ μCi/ml | - Positive control action required. |

Note: Upper limit of Range II can be considered the concentration guide.

[c]See Figure 4.

Table 18

RADIONUCLIDE CONTENT OF CLINCH RIVER FISH

1972

| Species | No. Samples[a] | pCi/kg Wet Weight | | Estimated % MPI[b] |
|---|---|---|---|---|
| | | $^{90}Sr$ | $^{137}Cs$ | |
| White Crappie | 1 | 62 | 185 | 0.18 |
| Carp | 1 | 35 | 43 | 0.10 |

[a]Composite of ten fish in each species.

[b]Maximum Permissible Intake - Assumes intake of radionuclides from eating fish to be comparable to a daily intake of 2.2 liters of water for the year containing the concentration guide level of the radionuclides in question.

Table 19

SOIL SAMPLES FROM NEAR
PERIMETER AIR MONITORING STATIONS

1972

| Sampling[a] Location | Number Samples[b] | Dry Soil[c] Units of $10^{-8}$ µCi/g | |
|---|---|---|---|
| | | Plutonium ($\alpha$) | Uranium ($\alpha$) |
| HP-31 | 1 | 2.5 | 25 |
| HP-32 | 1 | 7.2 | 47 |
| HP-33 | 1 | 2.8 | 14 |
| HP-34 | 1 | 5.4 | 11 |
| HP-35 | 1 | 3.4 | 31 |
| HP-36 | 1 | 1.4 | 31 |
| HP-37 | 1 | 2.0 | 11 |
| HP-38 | 1 | 2.0 | 16 |
| HP-39 | 1 | 4.6 | 48 |

[a]See Figure 1.

[b]Nine samples, approximately three inches in diameter and one centimeter thick, collected in a one-square-meter area at each location and composited for analysis.

[c]Applicable guides for soil contamination have not been established.

Table 20

URANIUM IN SOIL, PINE NEEDLES, AND GRASSES
AT FIVE-MILE RADIUS FROM ORGDP

1972

| Substance | Location[a] | Number of Samples | Units of $10^{-8}$ µCi/gram | | |
|---|---|---|---|---|---|
| | | | Maximum | Minimum | Average |
| Soil[b] | K-1 | 4 | 100 | 15 | 55 ± 39 |
| | K-2 | 4 | 95 | 20 | 52 ± 52 |
| | K-3 | 4 | 45 | 15 | 33 ± 20 |
| | K-4 | 4 | 70 | 15 | 40 ± 37 |
| | K-5 | 4 | 75 | 10 | 48 ± 46 |
| Pine Needles[c] | K-1 | 4 | 10 | < 3.5 | < 7.2 ± 5.3 |
| | K-2 | 4 | 5 | < 3.5 | < 4.7 ± 1.2 |
| | K-3 | 4 | 15 | 5 | 11.3 ± 7.6 |
| | K-4 | 4 | 10 | < 3.5 | < 8.4 ± 5.2 |
| | K-5 | 4 | 20 | 10 | 12.5 ± 8 |
| Grass[c] | K-1 | 4 | 45 | 15 | 25 ± 21.5 |
| | K-2 | 4 | 10 | < 3.5 | < 7.2 ± 5.4 |
| | K-3 | 4 | 15 | < 3.5 | < 8.4 ± 8.3 |
| | K-4 | 4 | 15 | 5 | 10 ± 6.5 |
| | K-5 | 4 | 20 | < 3.5 | < 9.7 ± 11.9 |

[a]See Figure 1.

[b]Top two inches of soil on a dry basis.

[c]Dry basis.

NOTE: Applicable guides for flora and soil have not been established.

Table 21

FLORA MONITORING DATA - FLUORIDES

1972

| Substance | Location[a] | Number of Samples | Units of ppm[b] | | |
|---|---|---|---|---|---|
| | | | Maximum | Minimum | Average |
| Pine Needles | K-1 | 4 | 20 | 0.9 | 10.0 ± 9.5 |
| | K-2 | 4 | 14 | 1.0 | 8.0 ± 6.0 |
| | K-3 | 4 | 12 | 0.6 | 8.4 ± 5.8 |
| | K-4 | 4 | 14 | 0.3 | 8.6 ± 6.4 |
| | K-5 | 4 | 24 | 0.3 | 11.1 ± 10.7 |
| Grasses | K-1 | 4 | 52 | 1.1 | 17.0 ± 26.0 |
| | K-2 | 4 | 19 | 3.3 | 9.1 ± 7.7 |
| | K-3 | 4 | 50 | 0.9 | 18.2 ± 24.0 |
| | K-4 | 4 | 26 | 0.7 | 13.2 ± 11.4 |
| | K-5 | 4 | 26 | 1.0 | 11.5 ± 11.9 |

[a] See Figure 1.

[b] Analytical results are on a dry weight basis.

NOTE: Applicable guides for flora have not been established. However, for comparison, the American Industrial Hygiene Association Journal for January-February 1969 (pp. 98-101) states that dairy cattle is the species of livestock most sensitive to fluorides in grasses. For comparative purposes the following fluoride concentrations and their effect on dairy cattle are given:

| | |
|---|---|
| 30 ppm | - no adverse effects |
| 30 to 40 ppm | - borderline chronic |
| 40 to 60 ppm | - moderate chronic |
| 60 to 110 ppm | - severe chronic |
| above 250 ppm | - acute |

## REFERENCES

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