MLM-MU-76-70-0001

ANNUAL ENVIRONMENTAL MONITORING SUMMARY

JULY 1975 - JUNE 1976

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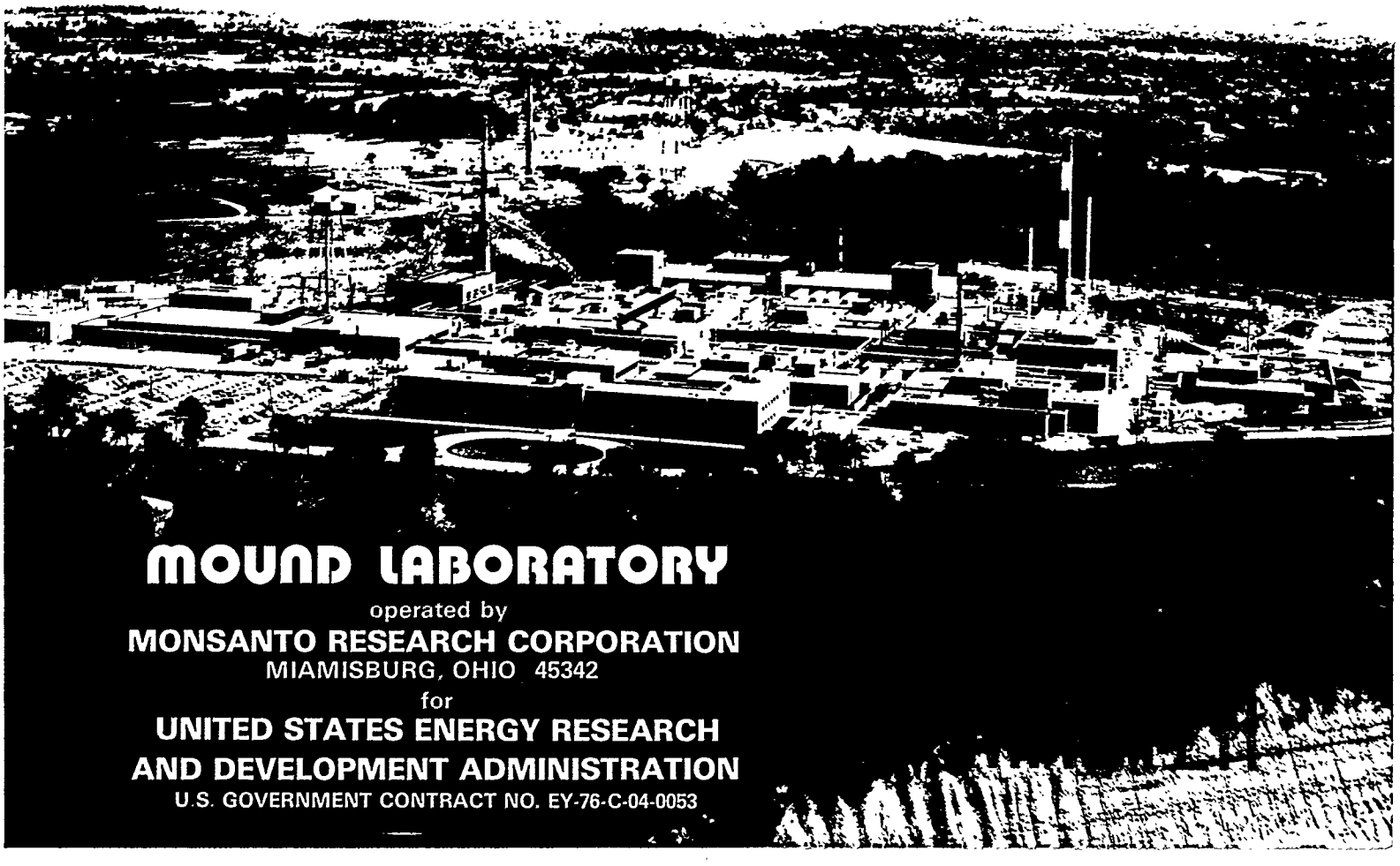

MOUND LABORATORY
operated by
MONSANTO RESEARCH CORPORATION
MIAMISBURG, OHIO 45342
for
UNITED STATES ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
U.S. GOVERNMENT CONTRACT NO. EY-76-C-04-0053

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Annual Environmental Monitoring Summary
July 1975 - June 1976

Issued: October 29, 1976

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MONSANTO RESEARCH CORPORATION

A Subsidiary of Monsanto Company

MOUND LABORATORY

Miamisburg, Ohio 45342

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Highlights

July 1975 - June 1976

- Mound Laboratory has had an effective Effluent Reduction Program since 1969 as demonstrated on the effluent graphs on pp.8-11. Most of this reduction has resulted from self-imposed goals that Mound Laboratory originated and which are now more restrictive than those imposed by ERDA.

- The US EPA has formulated new drinking water standards for radiological, biological and chemical elements in water. The new radiation standards, effective in June 1977, although not based upon new toxicological or epidemiological information, reduce the current federal standard by a factor of approximately 50. Since a few local well water supplies exceed the new highly conservative standard as a result of Mound Laboratory tritium effluents, Mound has undertaken a comprehensive program to bring the affected water supplies into compliance by the time the new standards become applicable. It should be noted that the new standard does not declare the water supply to be unsafe to drink. In fact there is no health problem associated with the water supplies around Mound.

- Mound is performing two studies for the EPA under contracts totalling $115,000. The first is an analysis of radioactive elements in coal of the western United States. The second involves the development of standard methods of analysis for different radioactive elements in air, soil, and water

GLOSSARY

Ambient - surrounding environment.

Background levels - the concentration of both radioactive and nonradioactive elements as they naturally occur in the environment.

Effluent - the route by which pollutants flow into the environment (e.g., via water or stack discharges).

ERDA - the U.S. Energy Research and Development Administration (formerly the Atomic Energy Commission).

Isotope - one of two or more atoms with the same atomic number but with different atomic weights. For example, there are three isotopes of hydrogen (hydrogen, deuterium and tritium). All act chemically like hydrogen, but have somewhat different physical properties.

Monitoring - the observation of the amounts of material in a specific medium (e.g., air, water or soil) involving the use of highly sophisticated instruments to find parts per billion, trillion, or even smaller traces.

Polonium - a radioactive metallic element.

Plutonium - a radioactive man-made metallic element.

Radioactivity - the spontaneous emission of particles or energy from an unstable atom.

Radioactivity Contamination Guide (RCG) - guidelines established by ERDA for the maximum allowable concentration of a material in a given environment. The RCG is an extremely conservative guide to maintain the integrity of the environment.

Radionuclide - a radioactive element.

Radionuclide Concentration - the quantity of a radioactive element in the environment, either naturally existing or man-contributed.

Tritium - a radioactive isotope of hydrogen.

I. INTRODUCTION

Monsanto Research Corporation operates Mound Laboratory, a government-owned facility of the U.S. Energy Research and Development Administration, at Miamisburg, Ohio. Mound Laboratory is an integrated, research, development, and production facility performing work in support of ERDA weapon and nonweapon programs with emphasis on explosive and nuclear technology.

Mound Laboratory originated as a technical organization in 1943 when Monsanto Chemical Company was requested to accept responsibility for determining the chemical and metallurgical properties of polonium as a project of the Manhattan Engineering District. Work was carried on at Monsanto's Central Research Department and several satellite units in the Dayton, Ohio area. Late in 1945, the Manhattan Engineering District determined that the research, development and production organization established by Monsanto at Dayton should become a permanent facility. A search for a suitable location in early 1946 led to the selection of a 180-acre tract adjacent to Miamisburg, about ten miles (16 km) south of Dayton.

Construction of Mound Laboratory, which was named after the Miamisburg Indian Mound adjacent to the site, began in February 1947 and was completed in 1948. The new laboratory was the first permanent facility of the Atomic Energy Commission which had succeeded the Manhattan Engineering District.

All early programs were concerned with polonium-210 and its applications. Additional assignments soon led to a wide variety of technical activities, and during the last 26 years many diversified capabilities for highly specialized research, development, and production operations have been developed. (Polonium-210 has not been handled for the past several years; therefore, due to the short half-life of polonium-210, the report contains no polonium-210 data.)

Separation of the stable isotopes of noble gases began as an expansion of research beginning in 1954 on the thermal diffusion columns. Today, Mound Laboratory is recognized as a world leader in thermal diffusion research and stable isotope separation processes which provide a large number of non-radioactive isotopes for distribution throughout the free world.

In 1954 the thermoelectric generator fueled with polonium-210 was invented at Mound Laboratory. This invention utilized heat from the radioactive decay of polonium-210. The first SNAP generator, SNAP-3, fueled with polonium-210, was demonstrated at the White House in 1959. Since that time a large number of heat sources fueled with plutonium-238 have been developed and fabricated for use in thermoelectric generators and heat sources for lunar experiments, weather satellites, navigational satellites, and spacecraft. Figure 1 shows one of the Pioneer spacecraft powered by Mound heat sources and now en route to an encounter with the planet Saturn. A photograph of the Viking spacecraft which landed on Mars and is currently exploring its surface is shown in Figure 2. Electric power for this Mars mission is provided by thermoelectric generators fueled with plutonium heat sources fabricated at Mound Laboratory. Additional Mound fueled power sources will be used in the Mariner-Jupiter-Saturn mission scheduled for the late 1970's. Other heat sources have been developed for use in life-support systems, swimsuit heaters, artificial hearts and cardiac pacemakers. Figure 3 shows a nuclear powered pacemaker.

Environmental protection has always been a prime concern at the Laboratory. A formal Environmental Control and Monitoring Program was adopted in 1949, the year in which the Laboratory began operations. The scope and effectiveness of this program, which was adopted and implemented long before the concerns of today's environment-sensitive society, demonstrates Mound's concern for the well-being of its employes and the communities surrounding the Laboratory.

In the early 1970's, as national concerns about the environment and the

conservation of resources mounted, Mound expanded its comprehensive programs in environmental control, waste management, and energy conservation. One of the key aspects of Mound's Environmental Control Program deals with the safe handling of radioactive materials. The major elements which comprise that portion of our program are: (a) effective systems for the containment of radioactive material; (b) devices and systems which ensure the quality of air and water effluents; and (c) on-site and off-site monitoring programs of the control systems. This report describes the program for monitoring these materials and provides information concerning the results of our monitoring activities.

Mound has exerted a positive effort in reducing effluents to the environment since 1969. This reduction for the most part resulted from self-imposed goals which are now more restrictive than those imposed by ERDA. The reductions achieved are illustrated by Figures 4 through 7 which show the annual quantities of tritium and plutonium released to water and air.

II. THE MONITORING PROGRAM

Background In its mission assignment for ERDA, Mound Laboratory performs research, development, and production of explosive and nuclear materials. Air, water, foodstuff, and soil samples are collected off-site to

Figure 1 - The Pioneer space probe passed by Jupiter and is now in flight for an encounter with the planet Saturn.

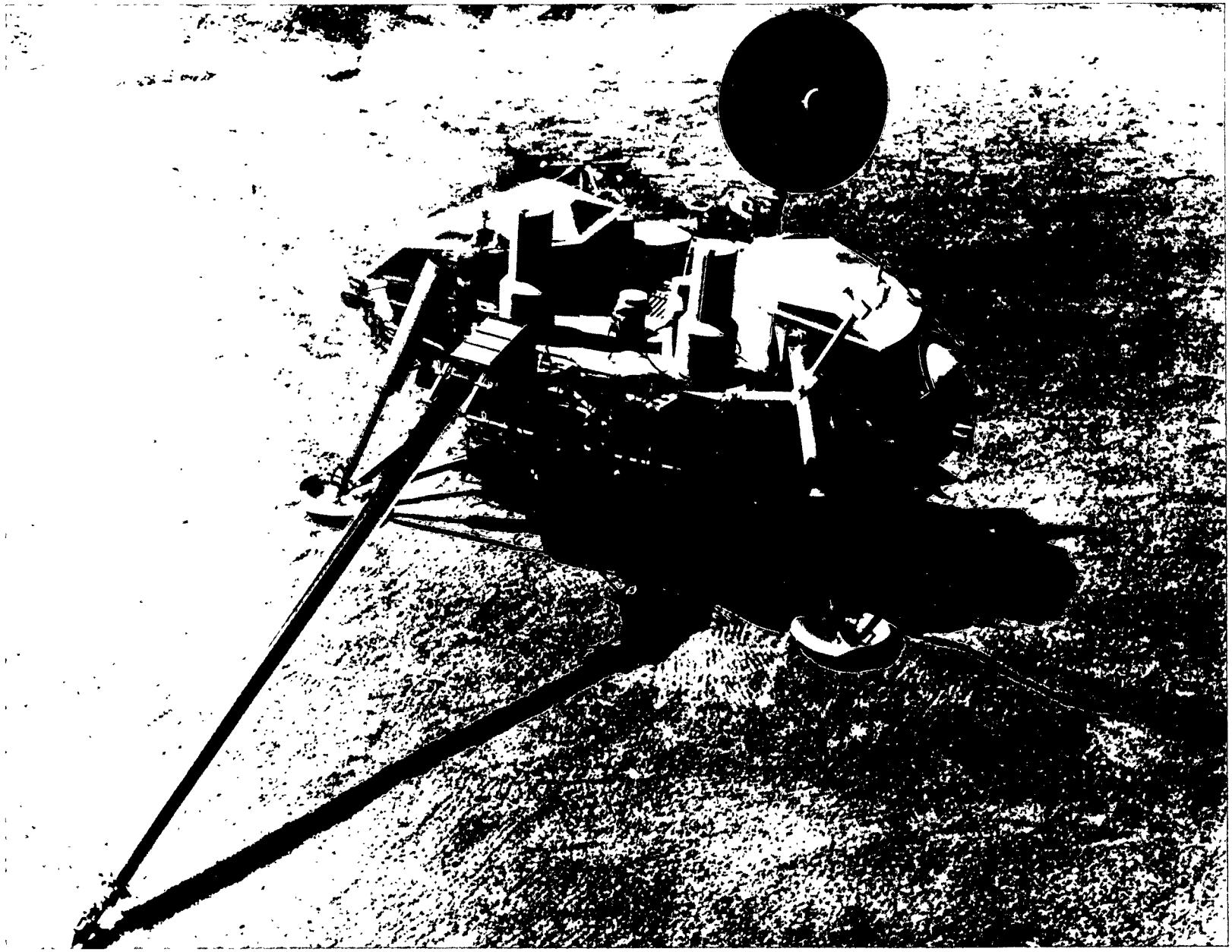

Figure 2 - Viking Mars Lander now is surveying the red planet. The entire unit is powered by Mound heat sources.

Figure 3 - The nuclear powered cardiac pacemaker provides longer service than conventional battery units. The heat source power units were pioneered at Mound.

ensure the integrity of our on-site environmental controls. The monitoring survey is conducted by a staff of professionally trained personnel. A detailed technical report documenting the survey results has been issued on a regular basis since 1959 to the Atomic Energy Commission/ Energy Research & Development Administration, to local, state, and federal agencies, such as the Miami Conservancy District, the Montgomery County Health Department, State of Ohio Department of Health, the Ohio Environmental Protection Agency (established in late 1972), and the Federal Environmental Protection Agency. This report summarizes our environmental monitoring activities for the period July 1975 - June 1976.

Detailed environmental monitoring data are submitted to these agencies in technical report form on an annual basis. A copy of the technical report is available at year-end upon request.

To assist the reader the following is a brief review of some basic radiation facts. The most common types of radiation are alpha and beta particles, gamma rays, x-rays and neutrons. The alpha and beta particles are charged particles, alpha being positively charged and the beta negatively charged. Gamma and x-rays are not particles but are electromagnetic radiations similar to ordinary radiowaves and visible light waves except their frequencies are higher and they

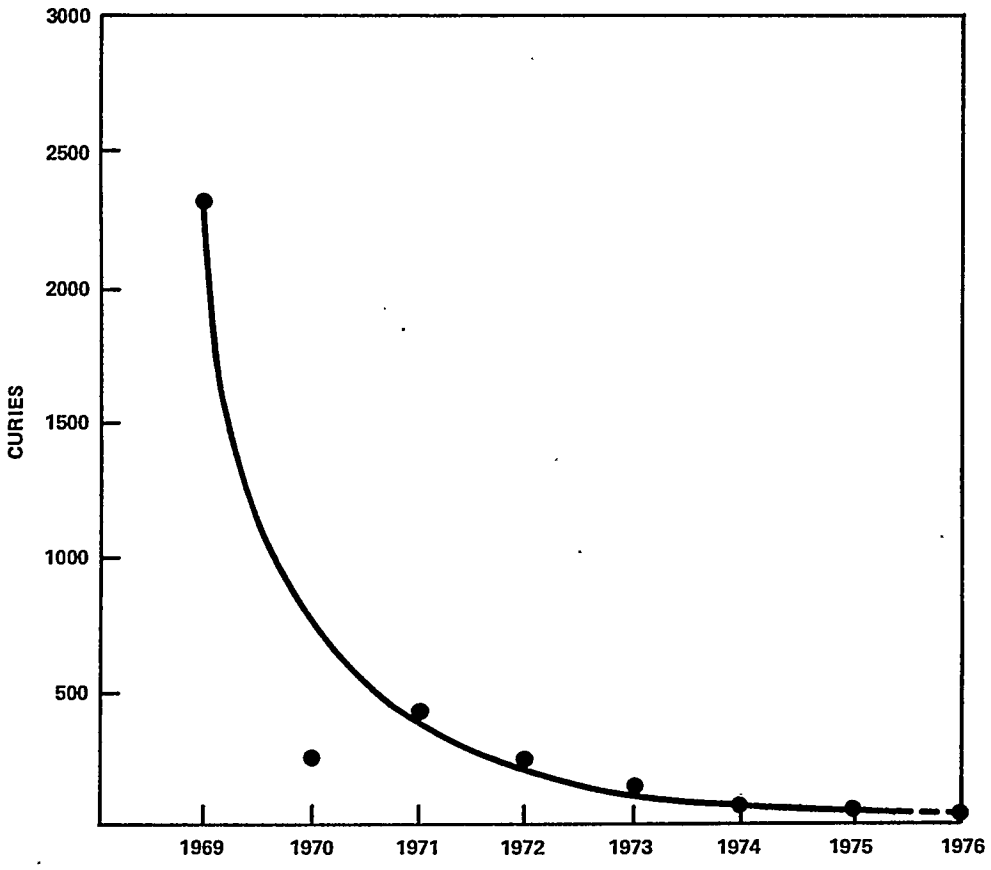

Figure 4 - Annual quantities of tritium released in liquid effluent streams.

are not visible to the human eye. Neutrons are neutral or uncharged particles. Of these types of radiation neutrons and gamma rays have the greatest range and penetration ability, easily penetrating several inches of steel although several inches of lead will stop gamma rays. Beta particles, although less penetrating than gamma, still have enough penetrating ability to penetrate human skin. Alpha particles have the least penetrating power. In fact, alpha particles are unable to penetrate an ordinary sheet of paper or the relatively thick human skin. These relative penetrating powers are illustrated in Figure 8. Plutonium-238 and tritium are the two radionuclides which are monitored in the environment and reported by Mound Laboratory. Plutonium-238 is primarily an alpha emitter and tritium is a beta emitter.

The concentration of liquid and airborne radioactivity in the environment surrounding the Laboratory has consistently been well within the levels established by the U.S. Energy Research and Development Administration. The technical reports which have been made since 1959 bear out this fact.

Water Monitoring All water discharged into the Great Miami River is first carefully treated to ensure that it is well within quality standards. Mound Laboratory collects water samples

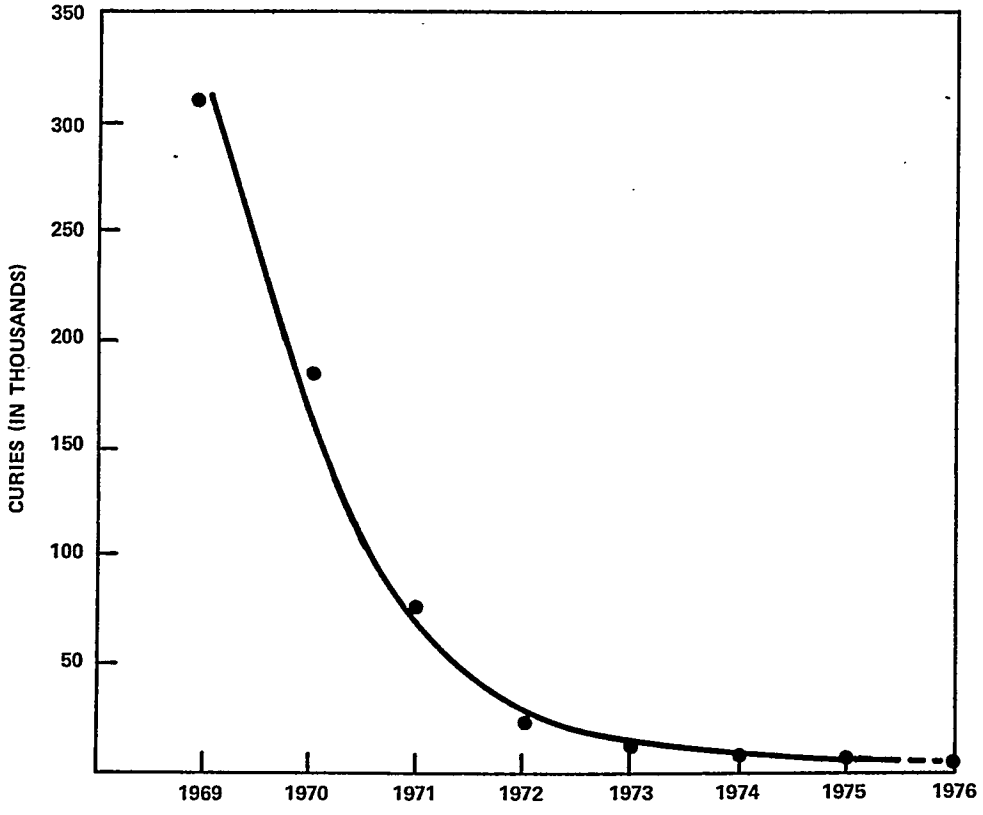

Figure 5 - Annual quantities of tritium in airborne emissions.

along a seven-mile stretch of the Great Miami River, extending from midtown Miamisburg south to Franklin, from nearby ponds and streams, from drinking waters of various communities and a few nearby private wells. The samples are analyzed for radioactive and nonradioactive materials as is detailed in Section IV of this summary. Additionally, two river monitoring stations, one above the Laboratory site and one below, now continuously monitor for six nonradioactive parameters; pH (acidity/alkalinity), temperature, turbidity, chlorides, dissolved oxygen and conductivity.

Air Monitoring Air samples are collected primarily by a system of 21 off-site continuous air sampling stations, and additional samples are obtained from the mobile laboratory. Samples are analyzed for plutonium-238, tritium, and nonradioactive materials.

Soil and Silt Sampling Soil and silt sampling provides Mound and the Energy Research and Development Administration with supplemental data on long-lived radioactive elements that may be deposited on the ground and in silt. Sampling and analytical techniques employed at Mound represent the state-of-the art of this area of environmental monitoring. Samples are

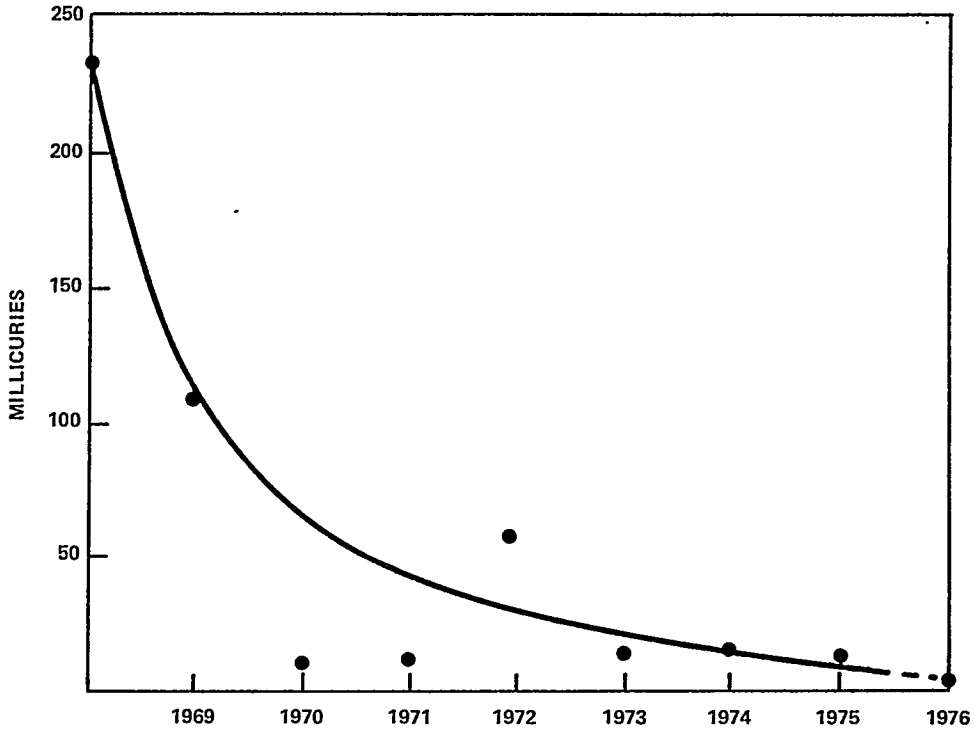

Figure 6 - Annual quantities of plutonium-238 released in liquid effluent streams.

collected and analyzed on a scheduled basis and the results are published in the annual technical report.

Foodstuff-Vegation This section represents an area of environmental monitoring initiated in late 1970. Locally grown foodstuff and vegetation samples are collected and analyzed to determine if there is any absorption and concentration of radioactive elements by plant or animal life. Representative samples are analyzed for concentrations of plutonium-238 and tritium. The results of these analyses are also published in the annual technical report.

III. APPLICABLE STANDARDS

Radioactivity Concentration Guide
ERDA regulations on radiation protection are based principally on the Radioactivity Concentration Guide (RCG) levels recommended by the former Federal Radiation Council and approved by the President for guidance of all federal agencies.

The recommended levels are developed with the assistance of appropriate federal agencies, the National Academy of Sciences, the National Committee on Radiation Protection and Measurements, and the International Commission on Radiological Protection. In

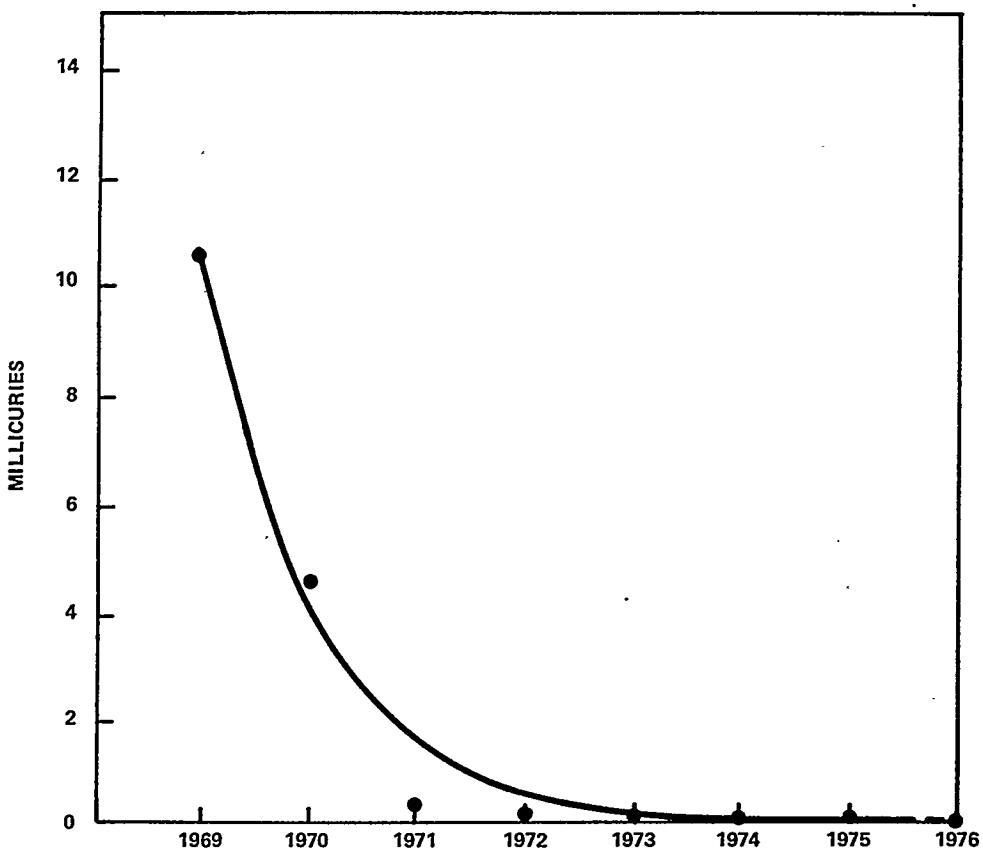

Figure 7 - Annual quantities of plutonium-238 in airborne emissions.

addition to their own expertise, the members of these groups seek the advice of other highly qualified scientists and researchers with specialized knowledge of the many factors that determine the effects of radioactivity on man. The results of the extensive experimental programs on the behavior and effect of radioactive material in the environment and in living tissue are also carefully considered in developing the RCG levels. These levels are reviewed as new research information becomes available or as new problems arise to determine whether changes in these standards are needed.

The RCG which has been established for each specific type of radioactive material is the concentration of radioactivity in the environment which should not be exceeded without careful consideration. The radiation dose received from radioactive materials at the RCG level is less than the radiation dose received routinely by the general population from such sources as cosmic rays, naturally occurring radioactive materials and medical x-rays. These and other examples are illustrated in Figure 9. The levels of radioactive materials documented in this report are small fractions of the RCG.

Nonradioactive Standards The Federal and Ohio Environmental Protection Agencies have established standards for ambient levels of pollutants in the environment. The more restrictive of the standards serve as the criteria for this report. In addition, the Federal EPA has issued a discharge permit for each of Mound's effluent streams effective June 30, 1975. The permit specifies concentration limits for various pollutants.

IV. WATER MONITORING

A. Radioactive Water sampling locations along the Great Miami River were revised during the first half of 1972 to provide more representative samples of river water. The selection of these sampling sites was based on guidelines adopted by the Federal Environmental Protection Agency (see Figure 10).

Water samples are collected each work day from each of these five

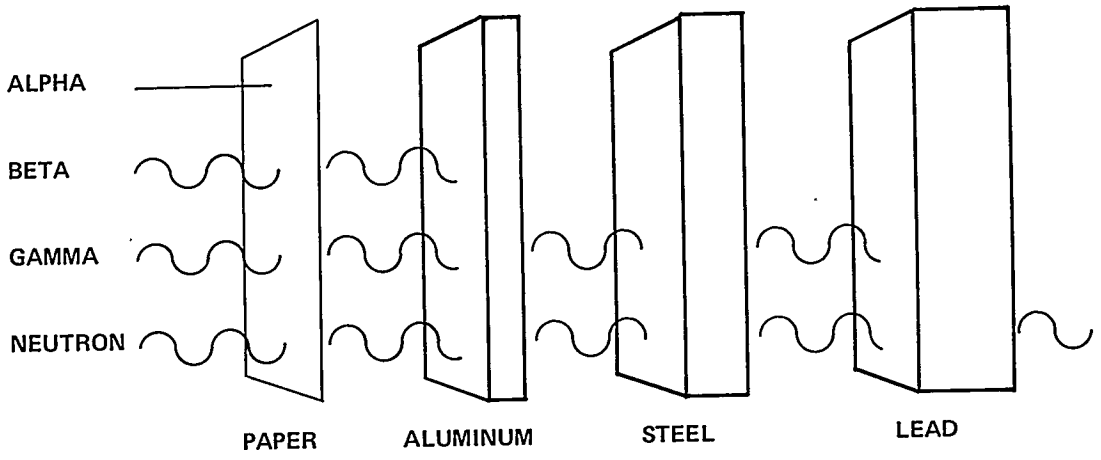

Figure 8 - Relative penetration powers of alpha and beta particles, gamma rays, and neutrons through paper, aluminum, steel and lead.

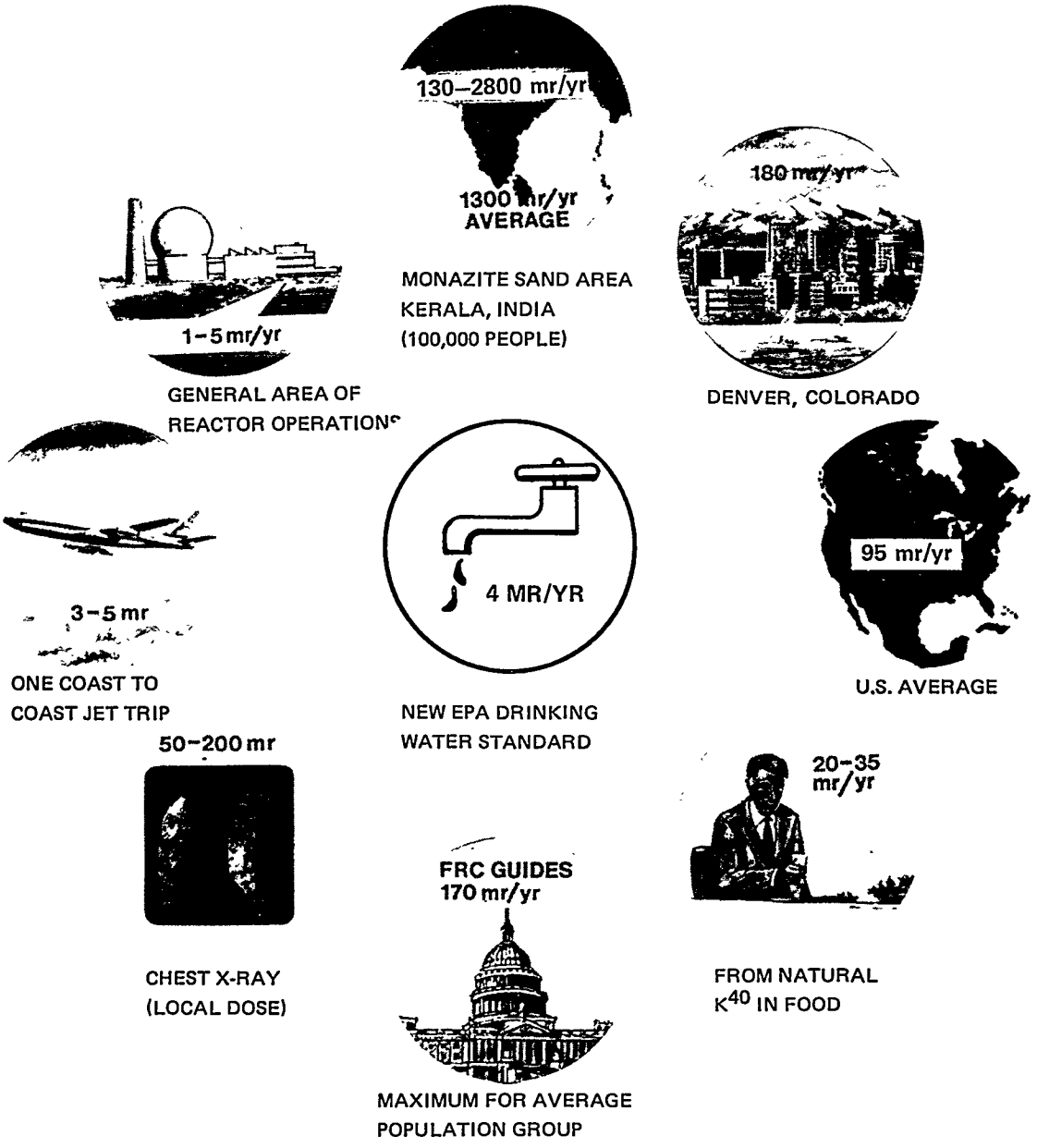

Figure 9 - Typical whole body equivalent doses.

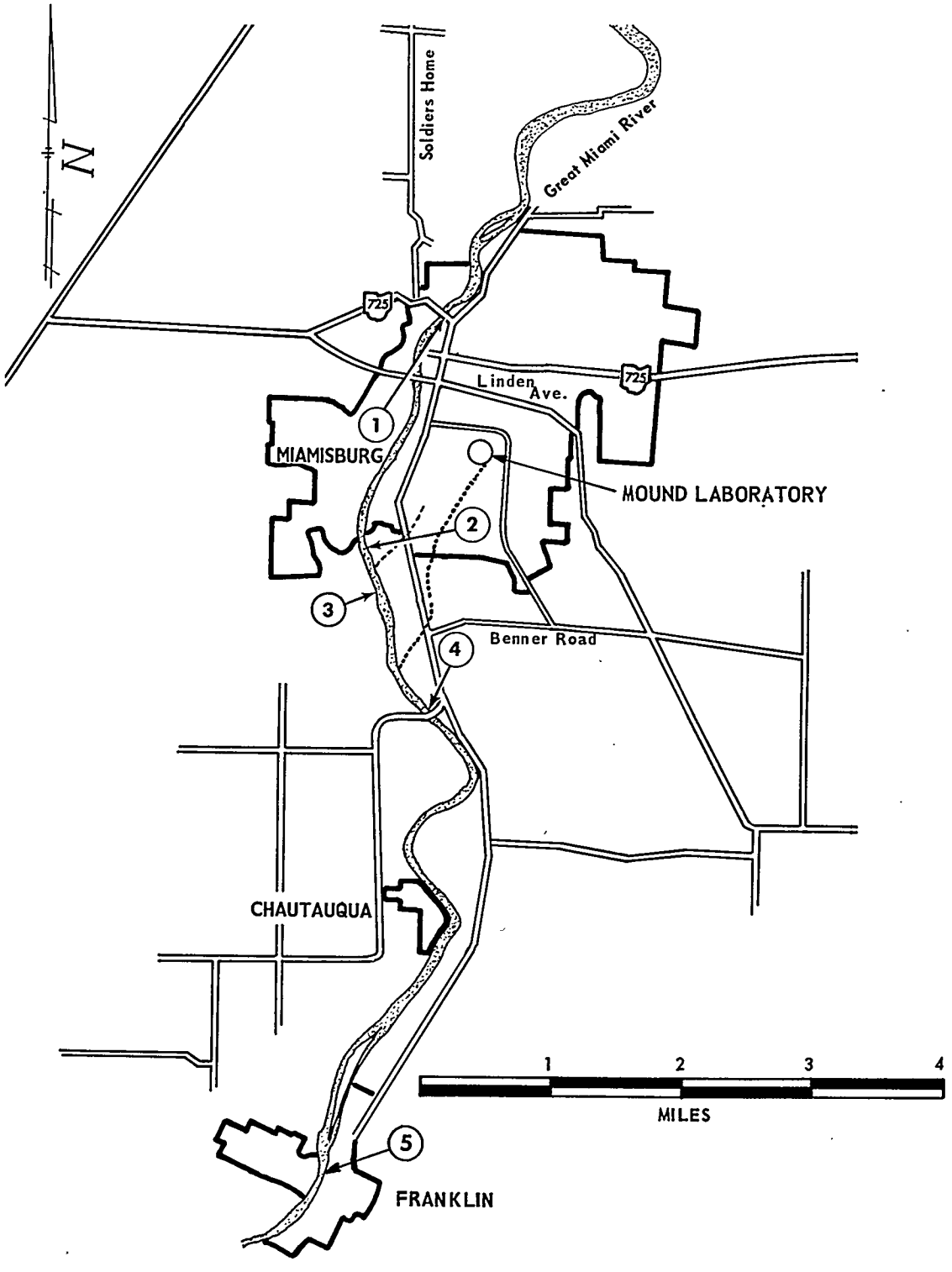

Figure 10 - Water sampling locations.

locations and are analyzed using equipment capable of detecting traces of radioactivity less than 1/10 of 1% of the RCG.

Table 1 shows the percentage of RCG, based on the average concentration detected in the river during the first half of fiscal year 1976 for plutonium-238 and for all of fiscal 1976 for tritium. In this table, a concentration equal to the RCG (maximum recommended concentration) would be shown as 100.0%. The figure 0.5%, therefore, means that the concentration was 1/2 of 1% of the RCG.

Table 1

RADIONUCLIDE CONCENTRATION IN THE GREAT MIAMI RIVER (% RCG)

Location	Plutonium	Tritium
#1	0.001	0.09
#2	0.002	0.11
#3	No data	0.10
#4	0.001	0.09
#5	0.0003	0.08

The results of these figures can be summarized as follows:

Plutonium

Plutonium-238 concentration measured at each location is well within the standard, i.e., significantly less than 1% of the RCG with the maximum being 2/1000 of 1% of the RCG.

Tritium

The average concentration at each sampling location was significantly less than 1% of the RCG with the maximum being 11/100 of 1% of the RCG at Location #2. These data demonstrate that the average concentration in each sampling location was well within the RCG.

In addition to daily samples from the Miami River, drinking water samples have been collected regularly from various communities and a few nearby private wells and analyzed for tritium content. During 1975, the data ranged from less than 1% of the RCG for all community drinking water samples up to 7% of the RCG for water in wells adjacent to the plant site.

The U.S. EPA, however, has formulated a new tritium drinking water standard applicable to large communities. This standard which is 50 times less than the ERDA standard is to be effective in June of 1977 with two years to determine compliance. Municipal drinking water supplies have been sampled around Mound Laboratory and do not exceed the new standard. Some nearby private wells, however, currently exceed the standard. Mound has undertaken a comprehensive program to bring the affected supplies into compliance by the time the new standard becomes applicable.

Since Mound discontinued all intentional liquid tritum releases in 1971, the levels of tritium in the supplies continue to subside (see Figure 4). This reduction is the result of a planned program to minimize tritium discharges.

B. Nonradioactive

Mound's program includes monitoring for nonradioactive materials in water. Samples are collected from Mound's two effluent streams and are analyzed for 32 different water quality parameters listed by the Federal Environmental Protection Agency. Analyses of the data indicate that Mound's water effluents are so minimal that they have no significant effect on the Miami River into which they are discharged. Mound's effluent concentrations are also well within Mound's discharge permit limitations.

V. AIR MONITORING

A. Radioactive

Mound completed the installation

of ten off-site continuous air sampling stations in early 1972 (see Figure 11, Locations 101-110). During the first quarter of 1973, eleven additional sampling stations became operational (see Figure 11, Locations 111-121), completing the air monitoring system. Seven of the samplers are located within a one-mile radius of Mound Laboratory. The others are located up to 20 miles from the Laboratory.

For FY-1976, the number of air sampling stations were reduced due to funding reductions. Mound's monitoring capabilities, however, have not been sacrificed, due to the optimized locations of the remaining air samplers. There are currently 12 air samplers for tritium and 13 samplers for plutonium.

Air samples are collected continuously at each sampling station. Analysis of these samples is made on a regular basis with equipment capable of detecting traces of radioactivity less than 1/10 of 1% of the RCG. The RCG is the maximum allowable concentration of a material in a given environment. Table 2 shows the percentage of RCG, based upon average concentration, for each of the radioactive materials handled at Mound Laboratory during fiscal year 1976. The table lists the data compiled at each of the off-site sampling stations in the completed air monitoring network. As in Table 1, a concentration equal to the RCG would be shown as 100.0%. The figure 0.10%, therefore, means that the concentration was 1/10 of 1% of the RCG.

Table 2

OFF-SITE RADIONUCLIDE CONCENTRATION IN AIR (% RCG)

Location	Plutonium	Tritium
#101	0.06	0.02
#102	0.06	0.02
#103	0.07	0.01
#104	0.03	0.01
#105	0.01	0.01
#108	0.02	0.01
#110	0.01	0.01
#111	0.01	0.01
#112	0.01	0.01
#115	0.01	0.01
#118	0.06	0.01
#119	0.004	0.01
#122	0.06	-

The results of the above figures can be summarized as follows:

Plutonium

The average concentration measured at each location was no more than 7/100 of 1% of the RCG, which is well within the recommended RCG for plutonium-238.

Tritium

The highest average concentration at each location was no more than 2/100 of 1% of the RCG, which is well within the recommended RCG for tritium.

B. Nonradioactive

Since Mound normally uses natural gas rather than oil for its power supply system, sulfur dioxide emissions have been eliminated. Mound's contract with the supplier of natural gas, however, provides for the interruption

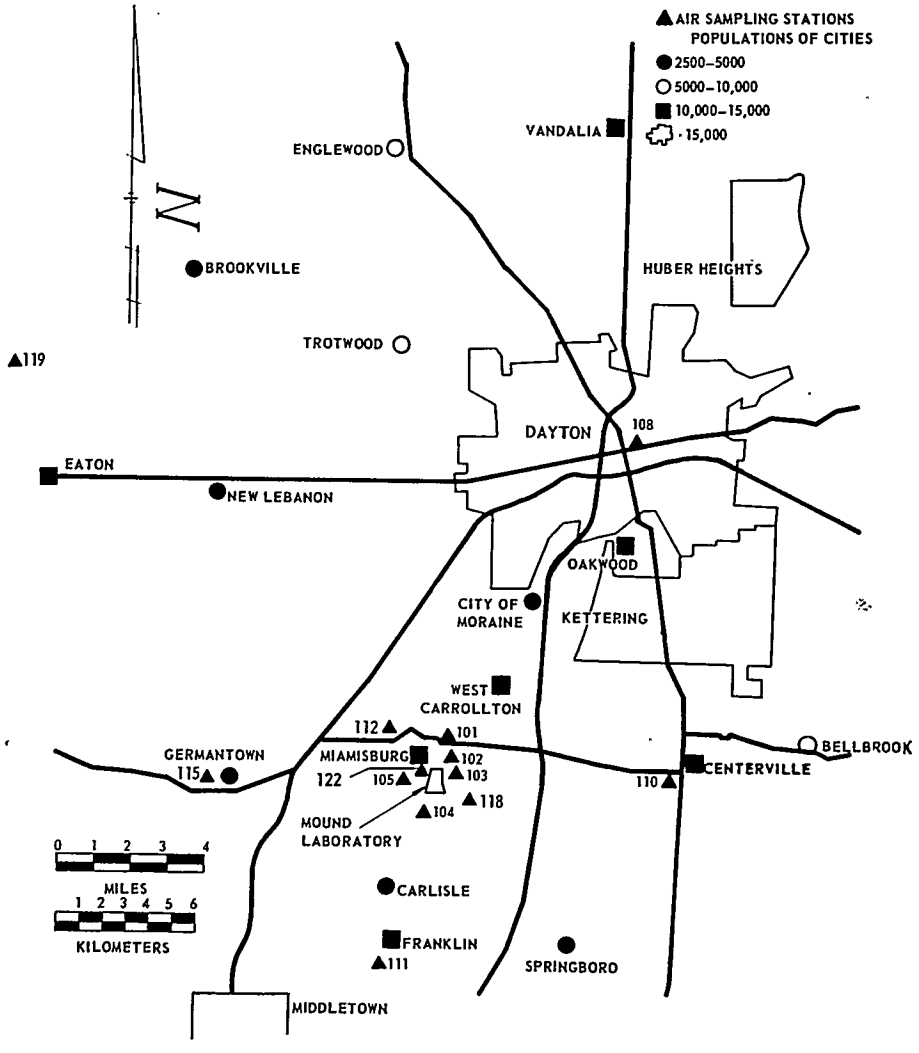

Figure 11 - Off-site air sampling stations.

of natural gas service during unusually cold weather. During such interruptions, fuel oil with less than 1% of sulfur content is burned to power plant operations. Sulfur dioxide emissions from the use of this oil are within standards governing the use of fuel oil. Furthermore, the emissions of carbon monoxides, photochemical oxidants, hydrocarbons, and other nonradioactive gases from other parts of the operation are quite low and have virtually no effect on the environment. While operations at Mound result in only small amounts of nonradioactive particles being released to the atmosphere, a sampling has been made to establish the background level of particulate concentrations at the Laboratory site. This sampling indicates Laboratory operations do not at this time have measurable effect on the ambient particulate level of the region.

VI. SUMMARY

Mound Laboratory has continuously operated well within local, state, and federal air and water quality standards. The effectiveness of our environmental program, as documented in this report, attests to our concern for the well-being of Mound employes and the surrounding communities.