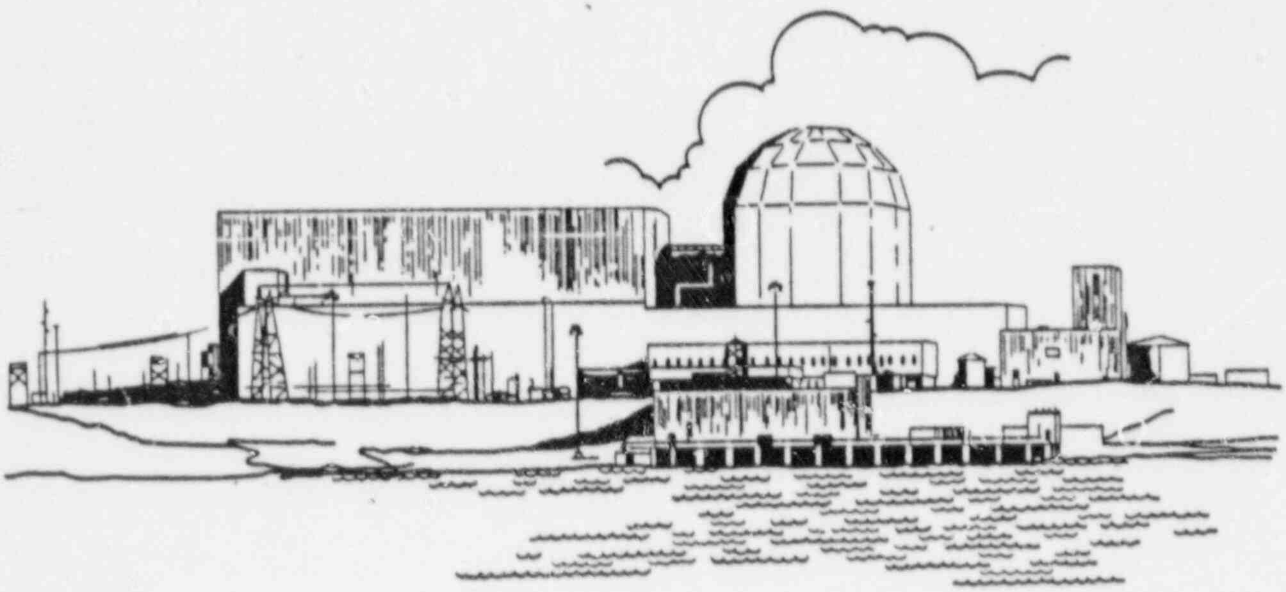
ILLINOIS POWER COMPANY
CLINTON POWER STATION

ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT

February 27, 1987 - December 31, 1987



RADIOLOGICAL
PROTECTION
DEPARTMENT
ILLINOIS POWER COMPANY

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RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT

FOR THE

CLINTON POWER STATION

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I. EXECUTIVE SUMMARY

The Radiological Environmental Monitoring Program was performed in 1987 as required by the Clinton Power Station Technical Specifications. This is the first annual operating report and covers the period from initial criticality (February 27, 1987) through the end of 1987.

No increases in either the environmental radiation dose rate or the radioactive material concentration in the environment due to operation of the Clinton Power Station were detected.

A total of over eleven hundred environmental samples representing atmospheric, terrestrial, and aquatic environs, as well as Lake Clinton and public drinking water supplies were collected. Results of the analyses showed that radioactivity levels were not significantly higher than preoperational levels.

The ambient radiation field was measured at 82 locations using Thermoluminescent Dosimeters. The average annual dose at indicator locations was 78 mrem per year. This dose was similar to the annual dose at control locations.

Releases of gaseous and liquid radioactive materials were accurately measured in the plant effluents. A total of 6.8 curies of short-lived noble gases and 0.26 curies of tritium was released to the atmosphere. The dominant radionuclide in the liquid effluent was tritium. A total of 1.87 curies of tritium was released as liquid effluent in 1987.

The Radiological Environmental Monitoring Program samples collected during 1987 were verified to be free of any measurable radioactivity due to the operation of the Clinton Power Station. This finding is consistent with known radioactive material releases. Environmental measurements verify that operational controls on the radioactive effluent functioned as designed in 1987.

II. INTRODUCTION

A. Objectives

This is a report on the Radiological Environmental Monitoring Program (REMP) for the Clinton Power Station (CPS), covering the period from initial criticality (February 27, 1987) through the end of 1987.

The Radiological Environmental Monitoring Program is an extensive program of sampling, measurements, and analysis that was instituted to monitor the radiological impact of reactor operation on the environment. Objectives of the program include:

- measurement of the amount of radiation and radioactive material in the environs surrounding the Clinton Power Station
- evaluation of the measurements to determine the impact of the Clinton Power Station operations on the local radiation environment
- demonstration of compliance with regulations and operating license requirements
- collection of data needed to refine environmental radiation transport models used in offsite dose calculations
- verification that radioactive material containment systems are functioning to minimize environmental releases to levels that are As Low As Reasonably Achievable (ALARA).

B. Characteristics of Radiation

The following background information regarding basic radiation characteristics, plant operations, radioactive effluent controls, and environmental monitoring is provided to assist the reader in reviewing this document.

Atoms whose nuclei contain an excess of energy are called radioactive atoms. They release this excess energy by expelling electromagnetic or particulate radiation from their atomic centers to become stable (non-radioactive). This process is called "radioactive decay". X-rays and gamma rays are similar in many ways to visible light, microwaves, and radio-waves. Particulate radiation may be either electrically charged such as alpha and beta particles, or have no charge, like neutrons. The term "half-life" refers to the time it takes for half of a given amount of a radionuclide to decay. Some radionuclides have a half-life as short as a fraction of a second, while others have a half-life as long as millions of years. Radionuclides may decay directly into stable elements or may undergo a series of decays which ultimately end up reaching a stable element. Radionuclides are found in nature (e.g. radioactive uranium, thorium, carbon and potassium), and may also be produced artificially in accelerators and nuclear reactors (e.g., I-131, Cs-137, and Co-60).

The activity of a radioactive source is the number of nuclear disintegrations (decays) of the source per unit of time. The unit of activity is the curie. A one curie radioactive source undergoes 2.2 trillion disintegrations per minute; but in the realm of nuclear power plant effluents and environmental radioactivity, this is a large unit. So, two fractional units, the microcurie and the picocurie, are more commonly used. The microcurie (uCi) is one millionth of a curie (Ci) and represents 2.2 million decays per minute. The picocurie (pCi) is one millionth of a microcurie and represents 2.2 decays per minute. Another way of comparing the pCi and the Ci is by analogy with distances. A pCi would be the width of a pencil mark while a curie would be 100 trips around the earth.

The mass of a radionuclide corresponding to the curie is directly proportional to the half-life and the atomic weight of the nuclide. For example, Uranium-235 (U-235) with a half-life of 704 million years requires about 462,400 grams to obtain an activity of one curie. But I-131 with a half-life of 8.04 days only requires about .003 grams to produce an activity of one curie.

Any mechanism that can supply the energy necessary to ionize an atom, break a chemical bond, or alter the chemistry of a living cell is capable of producing biological damage. Electromagnetic and particulate radiation can produce cellular damage by any of these mechanisms. In assessing the biological effects of radiation, the type, energy, and amount of radiation must be considered.

External total body radiation involves exposure of all organs. Most background exposures are of this form. When radioactive elements enter the body through inhalation or ingestion, their distribution is not uniform. For example, radioiodine selectively concentrates in the thyroid gland, whereas radiocesium collects in muscle and liver tissue, and radiostrontium in mineralized bone. The total dose to organs by a given radionuclide is also influenced by the quantity and the duration of time that the radionuclide remains in the body. Owing to radioactive decay and metabolism certain radionuclides stay in the body for very short times while others remain for years.

The amount of radiation dose which an individual receives is expressed in rem. Since human exposure to radiation usually involves very small exposures, the millirem (mrem) is most commonly used. One millirem is one thousandth of a rem.

C. Sources of Radiation Exposure

Many sources of radiation exposure exist. The most common and least controllable source is background radiation from cosmic rays and terrestrial radioactivity which mankind has always lived with and always will. There is no choice. Every second of our lives, over seven thousand atoms undergo radioactive decay in the body of the average adult.

Radioactive elements have always been a part of our planet and everything which has come from the earth including our own bodies is, therefore, naturally radioactive. Radioactive materials found in the earth's crust today consist of such radionuclides as Potassium-40 (K-40), Uranium-238 (U-238), Thorium-232 (Th-232), Radium-226 (Ra-226), and Radon-222 (Rn-222). These radionuclides are introduced into the water, soil, and air by such natural processes as volcanic activity, weathering, erosion, and radioactive decay.

Some of the naturally occurring radionuclides, such as radon, are a significant source of radiation exposure to the general public. Radioactive radon is a chemically inert gas produced naturally in the ground as a part of the uranium and thorium decay series. Radon continues to undergo radioactive decay, producing new naturally radioactive materials called "radon daughters". These new materials, which are solid particles, not gases, can stick to surfaces such as dust particles in the air. Concentrations of radon in air are variable and are affected by concentrations of uranium and thorium in soil, altitude, soil porosity, temperature, pressure, soil moisture, rainfall, snow cover, atmospheric conditions, and season. It can move through cracks and openings into basements of buildings and become trapped in a small air volume indoors. Thus, indoor radon concentrations are usually higher than those found outdoors. Building materials such as cinder blocks and concrete are radon sources. Radon can also be dissolved in well water and contribute to airborne radon in houses when released through showers or washing.

Dust containing radon daughter particles can be inhaled and deposited on the surface of an individual's lung. Radon daughters emit high energy alpha radiation dose to the lung lining.

About three hundred cosmic rays originating from outer space pass through each person every second. The interaction of cosmic rays with atoms in the earth's atmosphere produces radionuclides such as Beryllium-7 (Be-7), Beryllium-10 (Be-10), Carbon-14 (C-14), Tritium (H-3), and Sodium-22 (Na-22). Portions of these radionuclides become deposited on land or in water while the remainder stay suspended in the atmosphere.

Consequently, there are natural radioactive materials in the soil, water, air, and building materials which contribute to radiation doses to the human body. Natural drinking water contains trace amounts of uranium and radium; milk contains measurable amounts of K-40. Sources of natural radiation and their average contributing radiation doses are summarized in Table 1. Radiation exposure levels from natural radiation fluctuate with time and also can vary widely from location to location. The average individual in the United States receives approximately two hundred mrem per year from natural sources. In some areas of the country, the dose from natural radiation is significantly higher. Residents of Colorado, five thousand feet above sea level, receive additional dose due to the increase in cosmic and terrestrial radiation levels. In fact, for every one thousand feet in elevation above sea level, an individual will receive an additional one mrem per year from cosmic radiation. In several areas of the world, high concentrations of mineral deposits result in natural background radiation levels of several thousand mrem per year.

TABLE 1

COMMON SOURCES OF RADIATION

A. Estimated Annual Effective Dose Equivalent From Natural Sources in Normal Regions

	Annual effective dose equivalent (mrem)		
Source	External Irradiation	Internal Irradiation	Total
Cosmic	30	1.5	31.5
Terrestrial	35	132.6	167.6
TOTAL (Rounded)	65	134	199

(ICRP84)

B. Estimated Annual Dose to Man from Significant Manmade Sources of Radiation in the United States

Source	Annual effective dose equivalent (mrem)
Medical Diagnoses	100
Television Viewing	1
Airline Travel	3
Atmospheric Weapons tests (Fallout)	4
TOTAL	108

(NR80)

In addition to natural background radiation, the average individual is exposed to radiation from a number of man-made sources. The largest of these sources comes from medical diagnosis: X-rays, CAT-scans, fluoroscopic examinations and radio-pharmaceuticals. Approximately 160 million people in the United States are exposed to medical or dental X-rays in any given year. The annual dose to an individual from such irradiation averages 100 mrem, approximately one half of the sum total of natural radiation. Smaller doses from man-made sources come from consumer products (television, smoke detectors, fertilizer), fallout from prior nuclear weapons tests, and production of nuclear power and its associated fuel cycle.

Fallout commonly refers to the radioactive debris that settles to the surface of the earth following the detonation of nuclear weapons. Fallout can be washed down to the earth's surface by rain or snow and is dispersed throughout the environment. There are approximately two hundred radionuclides produced in the nuclear weapon detonation process; a number of these are detected in fallout. The radionuclides found in fallout which produce most of the fallout radiation exposures to man are I-131, Sr-89, Sr-90, and Cs-137.

III. DESCRIPTION OF THE CLINTON POWER STATION

A. General Information - The Clinton Power Station is located in Harp Township, DeWitt County, Illinois. It is approximately six miles east of the city of Clinton, Illinois. The map coordinates for the reactor are 40° 10' 19.5" North latitude, and 88° 50' 3" West longitude.

The station, its V-shaped cooling lake, and the surrounding Illinois Power Company-owned land encloses about 14,182 acres. This includes the 4,895 acre man-made cooling lake and about 90 acres of privately-owned property. The Clinton Power Station is sited on approximately 1500 acres on the northern arm of the lake. The cooling water discharge flume, which discharges to the eastern arm of the lake occupies an additional 130 acres. Although the nuclear reactor, supporting equipment, and associated electrical generation and distribution equipment lie in Harp Township, portions of the 14,182 acres lie in Wilson, Rutledge, DeWitt, Creek, Nixon and Santa Anna Townships.

The cooling lake was formed by constructing an earthen dam near the confluence of Salt Creek and the North Fork of Salt Creek. The resulting lake has an average depth of 15.6 feet, and includes an ultimate heat sink of about 590 acre feet. The ultimate heat sink provides sufficient water volume and cooling capacity for approximately thirty days of operation without makeup water.

Through arrangements with the Illinois Department of Conservation, Lake Clinton and much of the area immediately adjacent to the lake are used for public recreation activities, including swimming, boating, water skiing and fishing. Recreational facilities exist at Lake Clinton and accommodate up to 11,460 people per day. The outflow from Lake Clinton falls into Salt Creek and flows in a westerly direction for about 56 miles before joining the Sangamon River. The Sangamon River drains into the Illinois River which enters the Mississippi River near Grafton, Illinois. The nearest use of downstream water for drinking purposes is 242 river miles downstream of Lake Clinton at Alton, Illinois. Although some farms in the Salt Creek drainage area downstream of Lake Clinton use irrigation, the irrigation water is drawn from wells, not from the waters of Salt Creek.

An estimated 810,000 individuals live within 50 miles of the Clinton Power Station. Over half of these are located in the major metropolitan centers of Bloomington-Normal (located about 23 miles north northwest), Champaign-Urbana (located about 31 miles east), Decatur (located about 22 miles south southwest) and Springfield (located about 48 miles west southwest). The nearest city is Clinton, the county seat of DeWitt County, located about 6 miles west of the station. The estimated population of Clinton is about 8,000 people. Outside of the urban areas most of the land within 50 miles of the Clinton Power Station is used for farming. The principal crops are corn and soybeans.

The climate of central Illinois is typical of the midwest, with cold winters, warm summers, and frequent short-period fluctuations in temperature, humidity, cloudiness, and wind direction. The variability in central Illinois climate is due to its location in a confluence zone (particularly during the cooler months) between different air masses (BR66). The specific air masses which affect central Illinois include maritime tropical air which originates in the Gulf of Mexico; continental tropical air which originates in Mexico and the southern Rockies; Pacific air which originates in the eastern North Pacific Ocean; and continental polar and continental arctic air which originates in Canada.

Monthly streamline analyses of resultant surface winds suggest that air reaching central Illinois most frequently originates over the Gulf of Mexico from April through August, over the southeastern United States from September through November, and over both the Pacific Ocean and the Gulf of Mexico from December through March (BR66).

The major factors controlling the frequency and variation of weather types in central Illinois are distinctly different during two separate periods of the year.

During the fall, winter, and spring months, the frequency and variation of weather types are determined by the movement of storm systems which commonly follow paths along a major confluence zone between air masses. The confluence zone is usually oriented from southwest to northeast through the region and normally shifts in latitude during this period, ranging in position from the central states to the United States - Canadian border. The average frequency of passage of storm systems along this zone is about once every 5 to 8 days. These storm systems are most frequent during the winter and spring months, causing a maximum of cloudiness during these seasons. Winter is characterized by alternating periods of steady precipitation and periods of clear, crisp, and cold weather. Springtime precipitation is primarily showery in nature. The frequent passage of storm systems, presence of high winds, and frequent occurrence of unstable conditions caused by the close proximity between warm, moist air masses and cold, dry air masses, result in this season's relatively high frequency of thunderstorms. These thunderstorms on occasion are the source of hail, damaging winds, and tornados. Although storm systems also occur during the fall months, the frequency of occurrence during these months is less than that of the winter or spring months. Periods of dry weather characterize this season which ends rather abruptly with increasing storminess that usually begins in November.

In contrast, weather during the summer months is characterized by weaker storm systems which tend to pass to the north of Illinois. A major confluence zone is not present in the region, and the region's weather is characterized by much sunshine interspersed with thunderstorms. Showers and thunderstorms are usually of the air mass type, although occasional outbreaks of cold air bring precipitation and weather typical of that associated with the fronts and storm systems of the spring months.

When southeasterly and easterly winds are present in central Illinois, they usually bring mild and wet weather. Southerly winds are warm and showery, westerly winds are dry with moderate temperatures, and winds from the northwest and north are cool and dry.

The prevailing wind is southerly at the Clinton Power Station. The frequency of winds from other directions is relatively well distributed. The monthly average wind speed is lowest during late summer and highest during late winter and early spring.

Table 2 presents a summary of climatological data at meteorological stations surrounding the Clinton Power Station site. The annual average temperature at the Clinton Power Station is about 52°F. Monthly average temperatures in the region range from the middle twenties in January to the middle seventies in July. Extreme temperatures in the region range from a maximum of 103°F (Peoria) and -22°F (Springfield). Maximum temperatures in the Clinton Power Station region equal or exceed 90°F on an average between 17 and 28 times per year. Minimum temperatures in this region are less than or equal to 32°F on an average between 119 and 132 times per year.

Humidity varies with wind direction, lower with westerly or northwesterly winds and higher with easterly or southerly winds. The early morning relative humidity is highest during the late summer, with an average of 87% at both Peoria and Springfield. The relative humidity is highest throughout the day during December, ranging from 83% in early morning to 72% at noon at both Peoria and Springfield. Heavy fog with visibility less than 1/4 mile is rare, occurring an average of 21 times per year at Peoria and 18 times per year at Springfield and occurring most frequently during the winter months.

Annual precipitation in the Clinton Power Station area averages about 35 inches per year. On the average, about forty five percent of the annual precipitation in the Clinton Power Station region occurs in the 5 month period from April through August. However, in this region no month averages less than 4% of the annual total. Monthly precipitation totals have ranged from 0.03 to 13.09 inches (Peoria). The maximum 24-hour precipitation at either station was 5.52 inches, recorded at Peoria in May 1927. Snowfall commonly occurs from November through March, with an annual average of 23.4 inches at Peoria, and 22.3 inches at Springfield.

The monthly maximum snowfall of 18.9 inches at Peoria, and 22.7 inches at Springfield, occurred in December 1973. The 24-hour maximum snowfall, which also occurred in December 1973, was 10.2 inches at Peoria, and 10.9 inches at Springfield.

The terrain in central Illinois is relatively flat and differences in elevation have no significant impact on the general climate. However, the low hills and river valleys that exist cause a small effect upon nocturnal wind drainage patterns and fog frequency.

TABLE 2

CLIMATOLOGICAL DATA FROM WEATHER STATIONS SURROUNDING THE CLINTON POWER STATION

PARAMETER	STATION: PEORIA	STATION: SPRINGFIELD
Temperature (F°)		
Annual average	50.8	52.7
Maximum	103 (July 1940)	112 (July 1954)
Minimum	-20 (Jan. 1963)	-22 (Feb. 1963)
Relative Humidity (%)		
Annual average at:		
6 a.m.	83	82
12 noon	62	60
Wind		
Annual average speed (mph)	10.3	11.4
Prevailing Direction	S	S
Fastest mile:		
Speed (mph)	75 (July	75 (June
Direction	NW 1953)	SW 1957)
Precipitation (in.)		
Annual average	35.06	35.02
Monthly maximum	13.09 (Sept. 1961)	9.91 (Apr. 1964)
Monthly minimum	0.03 (Oct. 1964)	0.15 (Dec. 1955)
24-hour maximum	5.06 (Apr. 1950)	5.12 (Sept. 1959)
Snowfall (in.)		
Annual average	23.4	22.3
Monthly maximum	18.9 (Dec. 1973)	22.7 (Dec. 1973)
Maximum 24-hour	10.2 (Dec. 1973)	10.9 (Dec. 1973)
Mean Annual (no. of days)		
Precipitation $\geq$ 0.1 in.	111	112
Snow, sleet, hail $\geq$ 1.0 in.	8	8
Thunderstorms	49	50
Heavy fog (visibility ¼ m. or less)	21	18
Maximum temperature $\geq$90°F	17	28
Minimum temperature $\leq$32°F	132	119

The data presented in this table is based upon reference (DOC 76a) and (DOC 76b). These statistics are based on periods of record ranging from 17 to 39 years in length. The ranges span the years 1937 to 1976.

B. Climatological Summary - 1987

Temperatures in Decatur for the months of January, May, June, July, August and October 1987 averaged below normal, while temperatures for the months of February, March, April, September, November and December all averaged above normal. Over the year, the average monthly temperature ranged from 28.2°F in January to 77.8°F in July. The lowest hourly temperature of the year occurred on January 23 when it dropped to 2°F. On June 14, 100°F was recorded, marking the year's highest hourly temperature. (IPC 87)

In Springfield a total of 29.34 (water equivalent) inches of precipitation fell during 1987, which amounts to approximately 4.44 inches below the annual average. Monthly precipitation totals ranged from a low of 0.56 inches in May to a high of 5.00 inches in December. The largest precipitation event came on July 4th when 2.98 inches of rain fell. The year's heaviest snowfall, measuring 8.0 inches, occurred on January 9th. (NWS87)

Annual Joint Frequency Tables for the Clinton Power Station are provided in Appendix G. These were generated from on-site meteorological data.

C. Nuclear Reactor Operations

The fuel of a nuclear reactor is made of the element uranium in the form of uranium oxide. The fuel produces power by the process called "fission". In fission, the uranium absorbs a neutron (an atomic particle found in nature and produced by the fissioning of uranium in the reactor) and splits to produce fission products, heat, radiation, and free neutrons. The free neutrons travel in the core; further absorption of neutrons by uranium permits the fission process to continue. As the fission process continues, more fission products, radiation, heat, and neutrons are produced and a sustained reaction occurs. The heat produced is extracted from the fuel to produce steam which drives a turbine generator to produce electricity. The fission products are predominately radioactive; they are unstable elements which emit radiation as they change from unstable to stable elements. Neutrons which are not absorbed by the uranium fuel may be absorbed by stable atoms in the materials which make up the components and structures of the reactor. In such cases, stable atoms often become radioactive. This process is called "activation" and the radioactive atoms which result are called "activation products".

The reactor at the Clinton Power Station is a boiling water reactor (BWR). In this type of reactor the fuel is formed into small ceramic pellets which are loaded into sealed fuel rods. The fuel rods are arranged in arrays called bundles which are supported within a massive steel reactor vessel.

The spaces between the fuel rods are filled with water. The heat released during the fission of fuel atoms is transferred to the water surrounding the fuel rods. A type of pump which contains no moving parts (a jet pump), and recirculation pumps are used to force the water to circulate through the fuel bundles to assure even cooling of the fuel rods. As the water absorbs heat from the fuel rods some of it is changed to steam. The steam is used to drive a turbine which is coupled to a generator thereby completing the conversion of the energy released during fission to electricity.

After the steam passes through the turbine it is condensed back to water and returned to the reactor vessel to repeat the process. As the water circulates through the reactor pressure vessel, corrosion allows trace quantities of the component and structure surfaces to get into the water. The corroded material also contains radioactive substances known as activated corrosion products. Radioactive fission and activation products are normally confined to the primary system although small leaks from the primary system may occur. Figure 1 provides a basic plant schematic for the Clinton Power Station and shows the separation of the cooling water from plant systems. Figure 2 shows the plant schematic in more detail.

D. Containment of Radioactivity

Under normal operating conditions, essentially all radioactivity is contained within the first of several barriers of the primary system which collectively prevent escape of radioactivity to the environment.

The fuel cladding (metal tubes) provides the first barrier. The ceramic fuel pellets are sealed within Zircaloy metal tubes. There is a small gap between the fuel and the cladding in which the noble gases and other volatile nuclides collect.

The reactor vessel and the steel piping of the primary coolant system provide the second barrier. The reactor pressure vessel is a seventy-foot high vessel having steel walls approximately four to seven inches thick encasing the reactor core. This system provides containment for all radionuclides in the primary coolant.

The Containment Building provides the third barrier. The Containment Building has steel-lined, four foot thick reinforced concrete walls which completely enclose the reactor vessel and vital auxiliary equipment. This structure provides a third line of defense against the uncontrolled release of radioactive materials to the environment. The massive concrete walls also serve to absorb much of the radiation released during reactor operation or from radioactive materials created during reactor operation.

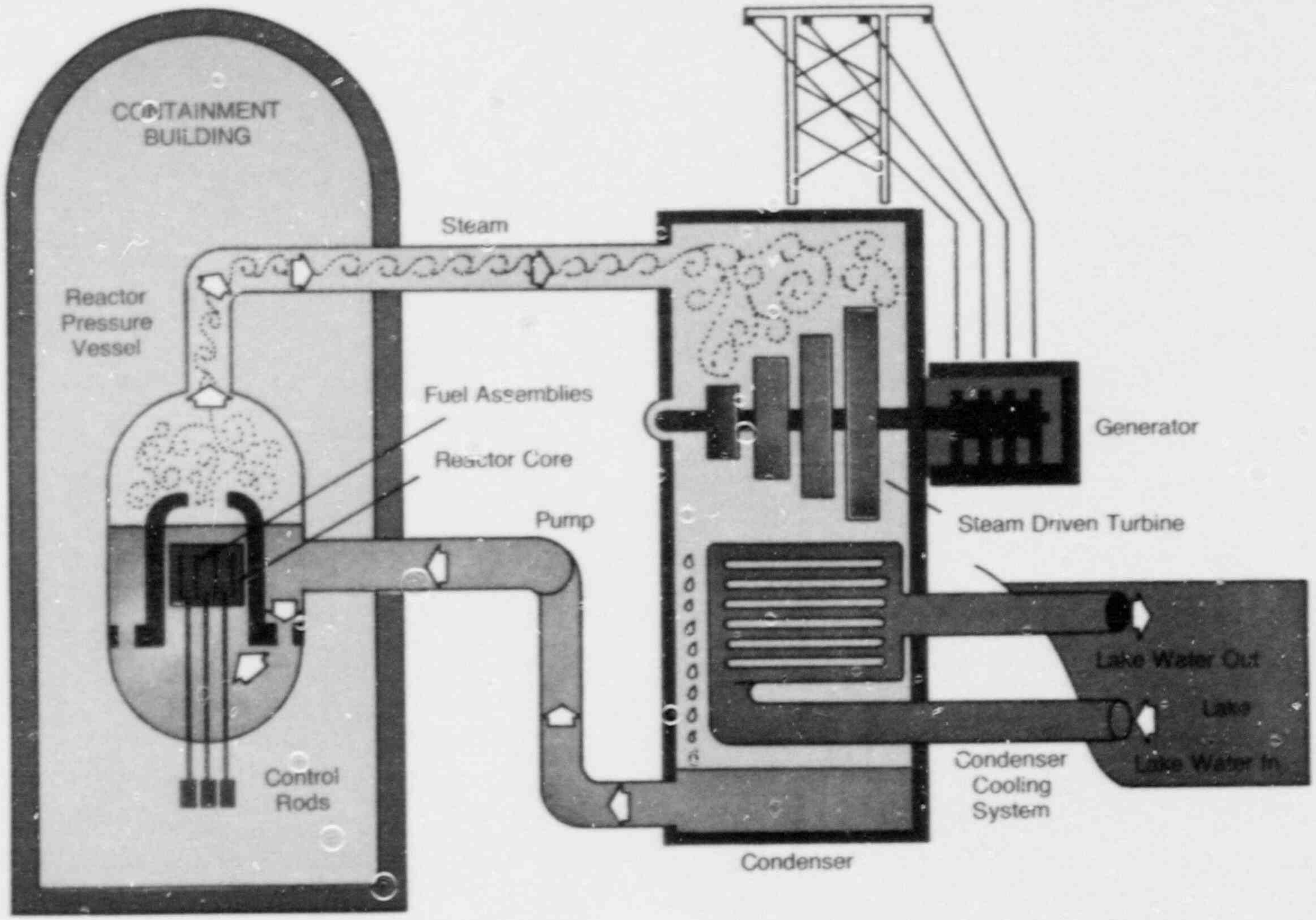

FIGURE 1: CLINTON POWER STATION BASIC PLANT SCHEMATIC
NOTE: The condenser cooling water (lake water) is separated from the reactor plant water systems by a physical barrier

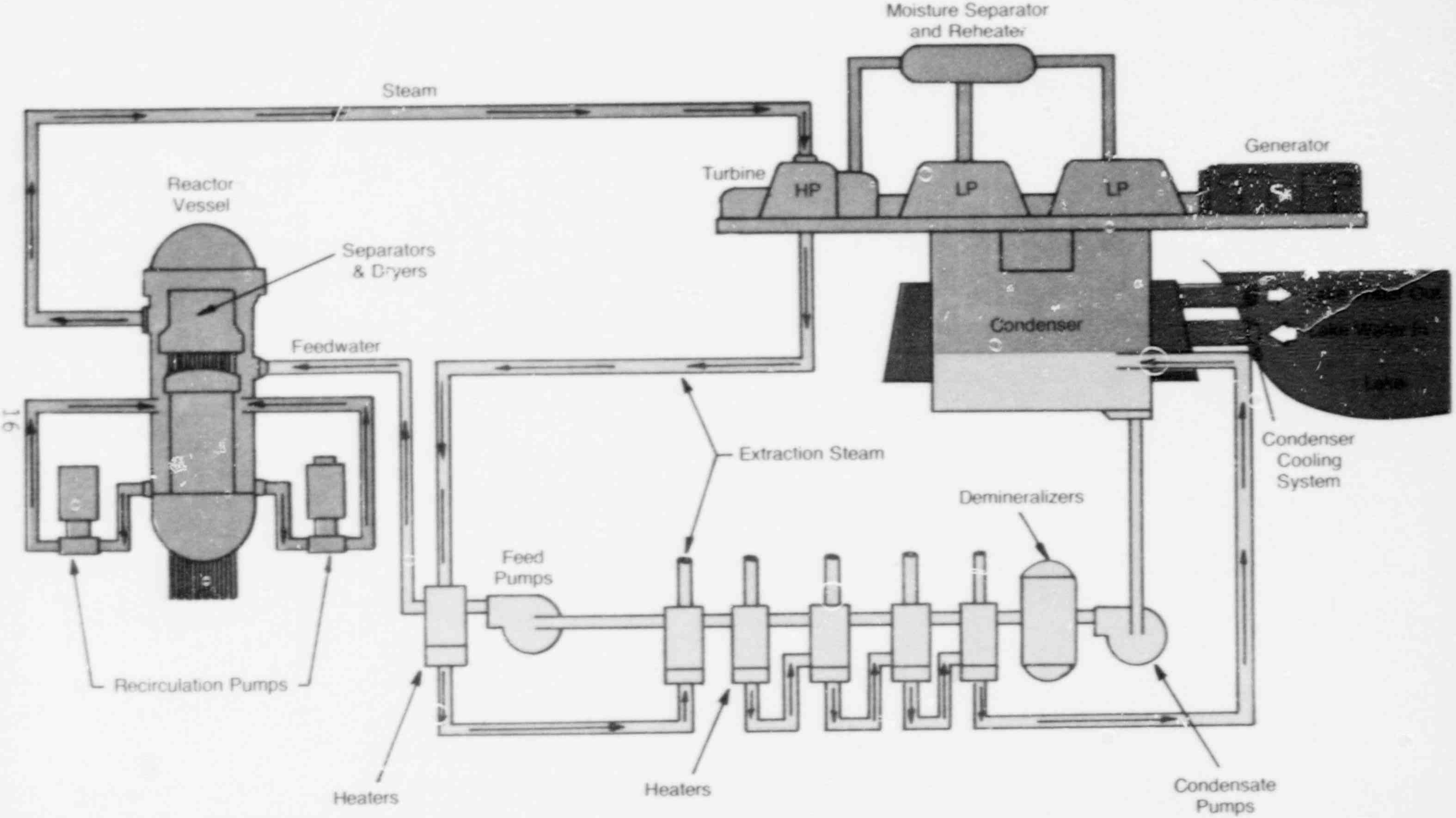

FIGURE 2: CLINTON POWER STATION PLANT SCHEMATIC
(See note on Figure 1)

Collectively, these three successive barriers provide in-depth protection against uncontrolled release of radioactivity, even in instances of accident conditions involving loss of primary coolant.

E. Sources of Radioactive Liquid and Gaseous Effluents

In a normal operating nuclear power plant, most of the fission products are retained within the fuel and fuel cladding. However, the fuel manufacturing process leaves traces of uranium on the exterior of the fuel tubes. Fission products from the eventual fission of these traces may be released to the primary coolant. Other small amounts of radioactive fission products are able to diffuse or migrate through the fuel cladding and into the primary coolant. Trace quantities of the corrosion products from component and structural surfaces which have been activated, also get into the primary coolant water. Many soluble fission and activation products such as radioactive iodines, strontiums, cobalts, and cesiums are removed by demineralizers in the purification systems. The noble gas fission products, activated atmospheric gases introduced with reactor feedwater, and some of the volatile fission products such as iodine and bromine, are carried from the reactor vessel to the condenser with the steam. The steam jet air ejectors or condenser vacuum pump remove the gases from the condenser and transfer them to the off-gas treatment system. In the off-gas treatment system the gases are held up, by adsorption on specially treated charcoal, to allow the radioactive gases to decay before they are released through the main ventilation exhaust stack.

Small releases of radioactive liquids from valves, piping, or equipment associated with the primary coolant system may occur in the Containment, Auxiliary, Turbine, RadWaste and Fuel Buildings. The noble gases become part of the gaseous wastes while the remaining radioactive liquids are collected in floor and equipment drains and sumps and are processed prior to release. Processed primary coolant water that does not meet chemical specifications for reuse may also become waste water. These represent the principal sources of liquid effluents.

F. Radioactivity Removal from Liquid and Gaseous Wastes

In a normal operating nuclear power plant, radioactive liquid and gaseous wastes are collected, stored, and processed through processing systems to remove or reduce most of the radioactivity (exclusive of tritium) prior to reuse within the plant or discharge to the environment. These processing systems are required by the Technical Specifications to be installed and operable and help to ensure all releases of radioactive liquid and gaseous effluents are As Low As Reasonably Achievable (ALARA).

The liquid waste processing system consists of filters, demineralizers, and evaporators so that liquid wastes are filtered, distilled, and demineralized. The liquid waste is routed through the waste evaporators to degas and distill the waste to reduce its volume and concentrate the radioactivity. The distillate is further processed through demineralizers and transferred to the waste evaporator condensate storage tanks. Liquid wastes are processed through the appropriate portions of the liquid waste treatment system to provide assurance that the releases of radioactive materials in liquid effluents will be kept ALARA. Liquid wastes are discharged into the plant cooling water stream which varies from 22,000 gallons per minute, when the plant is in cold shutdown, to 567,000 gallons per minute, when the plant is at full power. The liquid effluents are thoroughly mixed with, and diluted by, the plant cooling water as it travels the 3.4 miles of discharge canal before it enters Lake Clinton east of DeWitt County Road 14. Federal regulations (CFR) and the Technical Specifications (NUREG86) require that liquid effluents shall not contain a higher concentration of any radioisotope than that set for continuous exposure to the general public. This condition is satisfied at the point the liquid effluent is first introduced into the cooling water flow. The dilution which occurs in the cooling water canal reduces the concentrations of radioisotopes to between 1/73 (minimum flow) and 1/1890 of their original value before the water enters Lake Clinton.

The concentrated radioactive solids captured in the liquid waste treatment system are solidified and shipped off-site for disposal at one of the low-level waste disposal facilities.

The gaseous effluents from the main condenser are held up in the off-gas charcoal beds for at least 46 hours. This provides time for the decay of most of the radionuclides present since most have a half-life of less than 8 hours. If gaseous effluents in the ventilation exhaust system for the Containment Building and the Secondary Containment structure exceed conservatively set levels, they are processed through charcoal beds and high efficiency particulate air filters in the Standby Gas Treatment System before being discharged to the environment. This combination of filters and charcoal beds is rated to be 95% efficient for removing iodines and greater than 99% efficient for removing particulate material larger than one micron (one millionth of an inch) in diameter.

IV. EFFLUENTS

The Clinton Power Station releases small quantities of radioactive material in the course of normal operation. These releases are referred to as the effluent. Two kinds of effluent are generated, liquid and gaseous. The effluent is measured by an extensive network of radiation monitoring equipment, designed and calibrated to work both during normal and accident conditions.

Both liquid and gaseous radioactive effluent released from the Clinton Power Station during 1987 are listed in Table 3. These data were compiled from references CL87a and CL87b.

No release exceeded or even approached the limits specified in regulations or in the operating license. The releases made to the environment were so small that they were not detectable in the environmental samples collected in the Radiological Environmental Monitoring Program.

Radionuclides released in the gaseous effluent were predominantly noble gases with short half-lives. A total of 6.8 Ci of noble gases were released. Xenon-135 with a 9.1 hour half-life was the highest with 5.08 Ci released.

Tritium was the most prominent radionuclide in the liquid effluent. The quantity of tritium released was 1.87 curies.

TABLE 3

RADIONUCLIDE COMPOSITION OF CPS EFFLUENTS IN 1987

Radionuclide	Half-Life	Gaseous Effluents (Ci)	Liquid Effluents (Ci)
Tritium	12.3y	2.62E-1	1.87E+0
Fission and Activation Products:			
Krypton-85m	4.5h	5.77E-3	*
Xenon-133	5.2d	4.91E-1	*
Xenon-135	9.1h	5.08E+0	2.21E-6
Argon-41	1.8h	1.25E+0	*
Iodine-131	8.0d	4.08E-5	*
Iodine-133	20.8h	6.44E-5	*
Strontium-89	50.6d	*	6.73E-4
Strontium-90	28.6y	*	1.21E-4
Sodium 24	15.0h	1.24E-3	5.61E-5
Cerium-143	33.0h	6.32E-7	*
Chromium-51	27.7d	1.82E-4	1.14E-2
Manganese-54	312.7d	3.57E-5	1.47E-3
Technetium-99m	6.0h	1.01E-4	7.14E-5
Cesium-138	32.2m	4.11E-3	*
Barium-139	83.1m	2.29E-4	*
Yttrium-91m	49.7m	1.22E-5	*
Arsenic-76	23.3h	2.20E-5	*
Cobalt-58	70.8d	*	3.60E-4
Cobalt-60	5.3y	*	9.73E-5
Iron-59	44.6d	*	1.04E-4
Iron-55	2.7y	*	9.80E-4

*Isotopes not detected in effluents released from the Clinton Power Station

V. RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

A. Program Description

The Clinton Power Station is required to maintain a radiological environmental monitoring program in accordance with the Code of Federal Regulations (CFR) Title 10, Section 20.201 and Criterion 64 of CFR Title 10, Part 50, Appendix A. The program was developed using the following guidance published by the United States Nuclear Regulatory Commission (USNRC):

Regulatory Guide 4.1, "Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants"

USNRC Radiological Assessment Branch Technical Position on Radiological Environmental Monitoring (1979)

The basic purpose of the program is to assess the environmental radiological impact due to operation of the Clinton Power Station. Implicit in this purpose is the requirement to trend and assess radiation exposure rates and radioactivity concentrations that may contribute to human radiation exposure. The program consists of two phases, preoperational and operational. The preoperational portion of the program has established the baseline for the local radiation environment. Assessment of the operational impact of the Clinton Power Station on the radiation environment is based on data collected since the reactor started. The operational phase includes the objective of making confirmatory measurements to verify the in-station controls for the release of radioactive material are functioning as designed. Figure 3 shows the basic pathways of gaseous and liquid radioactive effluents to man.

Design

Current regulatory guidance recommends evaluating direct pathways, or the highest trophic level in a dietary pathway, that contribute to an individual's dose. The "important pathways" are selected based primarily on how radionuclides move through the environment and eventually expose individuals, as well as man's use of the environment. The scope of the program includes the monitoring of five environmental compartments: direct radiation, atmospheric, aquatic, terrestrial and groundwater. Each pathway is monitored at "indicator" and "control" locations. Indicator locations are generally within the 10-mile radius of the station. Control locations are located at least ten miles from the plant, far enough to be unaffected by plant operations. An increase in dose rate or radioactive material concentration at an indicator location may be due to plant operations. Locations of sampling stations are shown on maps in Figures 4 through 8. A key to the maps specifying exact locations is contained in Appendix A Table A-1.

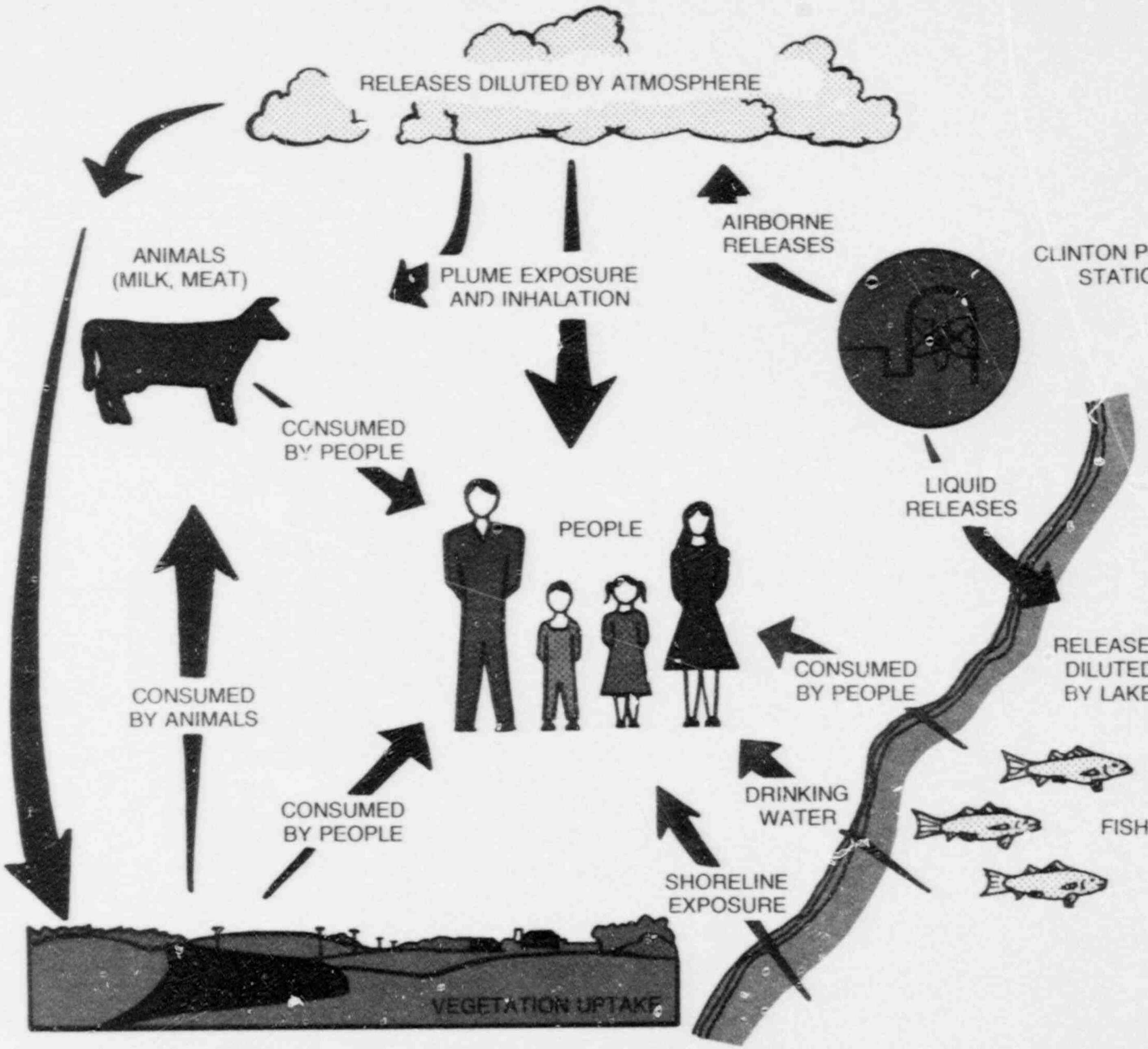

FIGURE 3: POTENTIAL EXPOSURE PATHWAYS OF MAN DUE TO RELEASES OF RADIOACTIVE MATERIAL TO THE ENVIRONMENT

An on-site meteorological tower collects information such as wind speed, wind direction and air temperature at various levels.

Meteorological conditions are measured every ten seconds and averaged over a ten minute period before data is transmitted to a computer for permanent record storage. Meteorological data are used in the atmospheric dispersion model for gaseous effluents.

Table 4 provides the summary of the Clinton Power Station Radiological Environmental Monitoring Program from initial criticality to the end of 1987.

Direct Radiation Compartment

Radionuclides present in the air, and those deposited in or on the ground cause human exposure by immersion in the atmosphere or by deposition on the ground. In general, TLDs are used to characterize direct radiation dose due to photons and electrons.

Atmospheric Compartment

The inhalation and ingestion of radionuclides present in the atmosphere is a direct exposure pathway to man. The program monitors this pathway by maintaining a network of nine active air samplers around the Clinton Power Station. Eight indicator air samplers are located in sectors around the station which can be affected by station operation. The ninth control sampler is located upwind, away from routine station influence. These mechanical air samplers continuously pump a known volume of air through two filters designed to collect particulates and radioiodine present in the local atmosphere. Analysis of the filters provides information regarding the concentration of radioactive material in the air.

Aquatic Compartment

Lake Clinton represents the primary pathway for radioactive material in water to expose individuals engaged in recreational activities. The exposure pathways monitored by the program are fish, aquatic organisms, periphyton, lake bottom sediment, shoreline sediment and lake water. An indicator and control location are sampled. Radionuclides present in lake water are concentrated by biological (fish and periphyton) and physical (sediment) processes which could eventually cause human exposure and dose equivalent by ingestion, immersion or ground plane exposure.

Terrestrial Compartment

In addition to the direct radiation compartment, radionuclides present in the atmosphere expose individuals when these radionuclides deposit on surfaces (such as plants and soil) and are subsequently ingested directly by man or indirectly by consumption of animal products such as meat and milk. To monitor this food pathway, control and indicator samples of green leafy vegetables, grass, milk (control only) and meat (indicator only) are analyzed. Surface soil samples are collected at three year intervals to monitor the potential buildup of atmospherically deposited radionuclides. No soil surface samples were collected in 1987.

Groundwater Compartment

Well water is sampled and analyzed to monitor the radionuclides being ingested by individuals consuming the water. The wells supplying water to the Village of DeWitt and the Mascoutin recreation area were the indicator sample locations. Surface water samples of the station liquid effluent discharge flume are obtained to monitor the quality of water being discharged to Lake Clinton. Control samples of surface water were also obtained.

The program sampling locations and results are described in Appendix A. A summary of program elements (sample types, assays performed, analysis frequency) is provided in Table A-2.

B. Quality Assurance Program

To establish confidence that data developed and reported in the Radiological Environmental Monitoring Program are accurate and precise, all Program activities are incorporated into the Illinois Power Company quality assurance (QA) program of audits and surveillances. The quality assurance program requires:

- The analysis laboratory to participate in intercomparison programs such as performance testing for TLDs with the EPA crosscheck program.
- An annual audit of the analysis laboratory functions and facilities.
- Biennial review of the Clinton Power Station procedures specifying sampling techniques.
- That the analysis laboratory perform duplicate analysis of every tenth sample assayed (not including TLDs). This requirement is to check laboratory precision.
- That quality control samples be routinely counted. Approximately ten percent of the total number of counts performed are to be quality control counts.

The analytical results were routinely reviewed by the Radiological Environmental Group of the Radiation Protection Department to ensure the required minimum sensitivities have been achieved and the proper analyses have been performed.

Teledyne Isotopes Midwest Laboratory (TIML) participates in the Environmental Protection Agency crosscheck program. The TIML participant code in the crosscheck program is CA. Participation in this program provides assurance that the laboratory is capable of meeting widely-accepted criteria for precision and accuracy needed to perform valid environmental radioactivity analysis. Results of the 1987 crosscheck program and other in-house quality programs are shown in Appendix E.

The results presented in Appendix E indicate that TIML is capable of routinely performing high quality analysis on environmental samples.

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Direct Radiation (mR/Qtr)	TLD 306	NA	19.5 (296/298)(a)(f) (11.3 - 27.6)	CL-34 0.8 miles WNW	23.2 (4/4)(a) (18.1 - 27.6)	18.8 (8/8)(a) (11.8 - 24.0)	0
Air Particulates (pCi/m^3)	Gross Beta 396	-	0.026 (348/352)(b) (0.008 - 0.054)	CL-11 16 miles S	0.028(44/44) (0.014 - 0.058)	0.028 (44/44) (0.014 - 0.058)	0
	Gamma Spec 36						
	Be-7	-	0.08 (32/32) (0.05 - 0.14)	CL-6 0.8 miles WSW	0.09 (4/4) (0.05 - 0.12)	0.08 (4/4) (0.07 - 0.09)	0
	K-40	0.05	0.04 (2/32) (0.03 - 0.05)	CL-2 0.7 miles NNE	0.05 (1/4)	LLD	0
	Co-60	0.003	LLD	-	LLD	LLD	0
	Nb-95	0.003	LLD	-	LLD	LLD	0
	Zr-95	0.005	LLD	-	LLD	LLD	0
	Ru-103	0.004	LLD	-	LLD	LLD	0
	Ru-106	0.020	LLD	-	LLD	LLD	0
	Cs-134	0.002	LLD	-	LLD	LLD	0
	Cs-137	0.007	LLD	-	LLD	LLD	0
	Ce-141	0.005	LLD	-	LLD	LLD	0
	Ce-144	0.010	LLD	-	LLD	LLD	0
Radioiodines (pCi/m^3)	I-131 396	0.07	LLD	-	LLD	LLD	0

<u>TABLE 4</u>

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Surface Water (pCi/1)	Gross Beta 62	1.6	2.3 (52/52) (1.1 - 5.0)	CL-93 0.4 miles SW	3.0 (2/2) (2.8 - 3.2)	2.2 (8/10) (1.3 - 3.4)	0
	Gross Alpha 20	2.0	1.4 (5/20) (1.0 - 2.6)	CL-91 6.4 miles ENE	2.6 (1/10)	N/A	0
	Tritium 38	190	152 (1/38)	CL-93 0.4 miles SW	152 (1/2)	LLD	0
	I-131 10	0.5	LLD	-	LLD	LLD	0
	Gamma Spec 62						
	Be-7	26.2	LLD	-	LLD	LLD	0
	K-40	48.6	LLD	-	LLD	LLD	0
	Mn-54	5.0	LLD	-	LLD	LLD	0
	Fe-59	12.0	LLD	-	LLD	LLD	0
	Co-58	5.0	LLD	-	LLD	LLD	0
	Co-60	5.0	LLD	-	LLD	LLD	0
	Zn-65	7.2	LLD	-	LLD	LLD	0
	Nb-95	10.0	LLD	-	LLD	LLD	0
	Zr-95	10.0	LLD	-	LLD	LLD	0
	Cs-134	5.0	LLD	-	LLD	LLD	0
	Cs-137	5.0	LLD	-	LLD	LLD	0
	Ba-140	60.0	LLD	-	LLD	LLD	0

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Surface Water (con't) (pCi/l)	La-140	15.0	LLD	-	LLD	LLD	0
	Ce-144	25.9	LLD	-	LLD	LLD	0
Drinking Water (pCi/l)	Gross Beta 10	0.4	1.6 (9/10) (0.6 - 1.9)	CL-14 0 miles	1.6 (9/10) (0.6 - 1.9)	N/A	0
	Gross Alpha 10	0.7	1.8 (1/10)	CL-14 0 miles	1.8 (1/10)	N/A	0
	Tritium 4	190	LLD	-	LLD	N/A	0
	Gamma Spec 10						
	Be-7	22.1	LLD	-	LLD	N/A	0
	K-40	42.0	LLD	-	LLD	N/A	0
	Mn-54	5.0	LLD	-	LLD	N/A	0
	Fe-59	12.0	LLD	-	LLD	N/A	0
	Co-58	5.0	LLD	-	LLD	N/A	0
	Co-60	5.0	LLD	-	LLD	N/A	0
	Zn-65	6.0	LLD	-	LLD	N/A	0
	Nb-95	10.0	LLD	-	LLD	N/A	0
	Zr-95	10.0	LLD	-	LLD	N/A	0
	Cs-134	5.0	LLD	-	LLD	N/A	0
	Cs-137	5.0	LLD	-	LLD	N/A	0

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Drinking Water (con't) (pCi/l)	Ba-140	60.0	LLD	-	LLD	N/A	0
	La-140	15.0	LLD	-	LLD	N/A	0
	Ce-144	22.1	LLD	-	LLD	N/A	0
Well Water (pCi/l)	Gross Beta 34	3.8	2.5(21/34) (1.0 - 3.2)	CL-12 (T) (c) 1.6 miles E	2.7 (7/10) (2.3 - 3.2)	N/A	0
	Gross Alpha 32	3.2	LLD	-	LLD	N/A	0
	I-131 54	0.5	LLD	-	LLD	N/A	0
	Tritium 12	190	LLD	-	LLD	N/A	0
	Gamma Spec 34						
	Be-7	29.0	LLD	-	LLD	N/A	0
	K-40	51.6	LLD	-	LLD	N/A	0
	Mn-54	5.0	LLD	-	LLD	N/A	0
	Fe-59	12.0	LLD	-	LLD	N/A	0
	Co-58	5.0	LLD	-	LLD	N/A	0
	Co-60	5.0	LLD	-	LLD	N/A	0
	Zn-65	6.0	LLD	-	LLD	N/A	0
	Nb-95	10.0	LLD	-	LLD	N/A	0

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Well Water (con't) (pCi/l)	Zr-95	10.0	LLD	-	LLD	N/A	0
	Cs-134	5.0	LLD	-	LLD	N/A	0
	Cs-137	5.0	LLD	-	LLD	N/A	0
	Ba-140	60.0	LLD	-	LLD	N/A	0
	La-140	15.0	LLD	-	LLD	N/A	0
	Ce-144	25.4	LLD	-	LLD	N/A	0
Milk (e) (pCi/l)	I-131 18	0.5	N/A	N/A	N/A	LLD	0
	Sr-90 (d) 5	-	N/A	N/A	N/A	2.4 (5/5) (2.3 - 2.5)	0
	Gamma Spec 18						
	Be-7	28.0	N/A	N/A	N/A	LLD	0
	K-40	-	N/A	N/A	N/A	1213 (18/18) (1110 - 1290)	0 0
	Mn-54	5.0	N/A	N/A	N/A	LLD	0
	Fe-59	12.0	N/A	N/A	N/A	LLD	0
	Co-58	5.0	N/A	N/A	N/A	LLD	0
	Co-60	5.0	N/A	N/A	N/A	LLD	0
	Zn-65	9.7	N/A	N/A	N/A	LLD	0
	Nb-95	10.0	N/A	N/A	N/A	LLD	0
	Zr-95	10.0	N/A	N/A	N/A	LLD	0
	Cs-134	5.0	N/A	N/A	N/A	LLD	0

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Milk (con't) (pCi/l)	Cs-137	5.0	N/A	N/A	N/A	LLD	0
	Ba-140	60.0	N/A	N/A	N/A	LLD	0
	La-140	15.0	N/A	N/A	N/A	LLD	0
	Ce-144	23.0	N/A	N/A	N/A	LLD	0
Fish (pCi/g wet)	Gamma Spec 16						
	Be-7	0.092	LLD	-	LLD	LLD	0
	K-40	-	2.60 (8/8) (2.24 - 2.88)	CL-19 3.4 miles E	2.60 (8/8) (2.24 - 2.88)	2.50 (8/8) (1.38 - 3.25)	0
	Mn-54	0.017	LLD	-	LLD	LLD	0
	Fe-59	0.048	LLD	-	LLD	LLD	0
	Co-58	0.018	LLD	-	LLD	LLD	0
	Co-60	0.017	LLD	-	LLD	LLD	0
	Zn-65	0.040	LLD	-	LLD	LLD	0
	Nb-95	0.018	LLD	-	LLD	LLD	0
	Zr-95	0.031	LLD	-	LLD	LLD	0
	Ru-103	0.017	LLD	-	LLD	LLD	0
	Ru-106	0.088	LLD	-	LLD	LLD	0
	Cs-134	0.013	LLD	-	LLD	LLD	0
	Cs-137	0.015	LLD	-	LLD	LLD	0
	Ba-140	0.035	LLD	-	LLD	LLD	0
	La-140	0.012	LLD	-	LLD	LLD	0
	Ce-141	0.023	LLD	-	LLD	LLD	0

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Fish (con't) (pCi/g)	Ce-144	0.63	LLD	-	LLD	LLD	0
Bottom Sediment (pCi/g dry)	Gross Beta 12	-	18.4 (10/10) (9.7 - 27.9)	CL-105 50 miles S	27.0 (2/2) (26.1 - 27.9)	27.0 (2/2) (26.1 - 27.9)	0
	Gross Alpha 12	-	6.2 (10/10) (2.6 - 9.0)	CL-105 50 miles S	11.2 (2/2) (8.8 - 13.5)	11.2 (2/2) (8.8 - 13.5)	0
	Sr-90 12	0.014	0.047 (6/10) (0.010 - 0.060)	CL-89 3.6 miles NNE	0.060 (1/2)	0.042 (2/2) (0.040 - 0.044)	0
	Gamma Spec 12						
	Be-7	0.62	0.31 (1/10)	CL-7c 1.3 miles SE	0.31 (1/2)	LLD	0
	K-40	-	13.64 (10/10) (8.17 - 17.26)	CL-105 50 miles S	17.44 (2/2) (15.80 - 19.08)	17.44 (2/2) (15.80 - 19.08)	0
	Mn-54	0.090	LLD	-	LLD	LLD	0
	Fe-59	0.080	LLD	-	LLD	LLD	0
	Co-58	0.054	LLD	-	LLD	LLD	0
	Co-60	0.039	LLD	-	LLD	LLD	0
	Zn-65	0.083	LLD	-	LLD	LLD	0
	Nb-95	0.069	LLD	-	LLD	LLD	0
	Zr-95	0.12	LLD	-	LLD	LLD	0

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Bottom Sediment (con't) (pCi/g dry)	Cs-134	0.037	LLD	-	LLD	LLD	0
	Cs-137	0.017	0.32 (8/10) (0.07 - 0.58)	CL-10 5.0 miles ENE	0.58 (2/2) (0.58 - 0.58)	0.50 (2/2) (0.40 - 0.59)	0
	Ba-140	0.12	LLD	-	LLD	LLD	0
	La-140	0.028	LLD	-	LLD	LLD	0
	Ce-144	0.29	LLD	-	LLD	LLD	0
	AC-228	0.061 (0.38 - 1.44)	0.95 (9/10) 5.0 mile ENE	CI-10 (1.22 - 1.44)	1.33 (2/2) (1.05 - 1.45)	1.25 (2/2)	0
	Bi-212	0.54	LLD	-	LLD	LLD	0
	Bi-214	0.56	0.65 (8/10) (0.23 - 0.93)	CL-10 5.0 miles ENE	0.83(2/2) (0.73 - 0.93)	0.74 (2/2) (0.66 - 0.82)	0
	Pb-212	-	1.04 (10/10) (0.34 - 1.85)	CL-10 5.0 miles ENE	1.78 (2/2) (1.71 - 1.85)	1.64 (2/2) (1.31 - 1.97)	0
	Pb-214	-	0.67 (10/10) (0.25 - 1.09)	CL-10 5.0 mile ENE	0.98 (2/2) (0.88 - 1.09)	0.84 (2/2) (0.73 - 0.96)	0
	Ra-226	-	1.64 (10/10) (0.61 - 2.48)	CL-10 5.0 miles ENE	2.38 (2/2) (2.29 - 2.48)	2.23 (2/2) (1.80 - 2.66)	0
	Tl-208	-	0.79 (10/10) (0.12 - 1.45)	CL-10 5.0 miles ENE	1.38 (2/2) (1.32 - 1.45)	1.24 (2/2) (0.98 - 1.50)	0

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Shoreline Sediment (pCi/g dry)	Gross Beta 14	-	10.0 (12/12) (3.9 - 13.2)	CL-89 3.6 miles NNE	13.1 (2/2) (13.0 - 13.2)	9.8 (2/2) (9.0 - 10.6)	0
	Gross Alpha 14	3.3	3.4 (6/12) (2.6 - 4.6)	CL-7d 2.3 miles SE	4.6 (1/2)	3.4 (1/2)	0
	Sr-90 14	0.017	0.010 (6/12) (0.002 - 0.018)	CL-89 3.6 miles NNE	0.018 (1/2)	LLD	0
	Gamma Spec 14						
	Be-7	0.13	0.31(1/12)	CL-89 3.6 miles NNE	0.31 (1/2)	LLD	0
	K-40	-	7.94 (12/12) (5.89 - 11.50)	CL-89 3.6 miles NNE	10.34 (2/2) (9.19 - 11.50)	8.69 (2/2) (7.23 - 10.15)	0
	Mn-54	0.021	LLD	-	LLD	LLD	0
	Fe-59	0.057	LLD	-	LLD	LLD	0
	Co-58	0.022	LLD	-	LLD	LLD	0
	Co-60	0.032	LLD	-	LLD	LLD	0
	Zn-65	0.066	LLD	-	LLD	LLD	0
	Nb-95	0.023	LLD	-	LLD	LLD	0
	Zr-95	0.035	LLD	-	LLD	LLD	0
	Cs-134	0.023	LLD	-	LLD	LLD	0
	Cs-137	0.021	0.025 (1/12)	CL-89	0.025 (1/2)	LLD	0

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Shoreline Sediment (con't) (pCi/g dry)	Ba-140	0.066	LLD	-	LLD	LLD	0
	La-140	0.026	LLD	-	LLD	LLD	0
	Ce-144	0.10	LLD	-	LLD	LLD	0
	Ac-228	0.098	0.26 (8/12) (0.19 - 0.36)	CL-89 3.6 miles NNE	0.35 (2/2) (0.34 - 0.36)	0.26 (1/2)	0
	Bi-212	0.27	LLD	-	LLD	LLD	0
	Bi-214	0.051	0.18 (6/12) (0.14 - 0.28)	CL-89 3.6 miles NNE	0.28 (1/2)	0.17 (1/2)	0
	Pb-212	-	0.26 (12/12) (0.13 - 0.45)	CL-89 3.6 miles NNE	0.44 (2/2) (0.42 - 0.45)	0.24 (2/2) (0.15 - 0.32)	0
	Pb-214	-	0.22 (12/12) (0.12 - 0.45)	CL-10 5.0 miles ENE	0.34 (2/2) (0.22 - 0.45)	0.16 (2/2) (0.13 - 019)	0
	Ra-226	0.32	0.54 (8/12) (0.39 - 0.84)	CL-89 3.6 miles NNE	0.73 (2/2) (0.62 - 0.84)	0.32 (2/2) (0.20 - 0.44)	0
	Tl-208	-	0.22 (12/12) (0.11 - 0.38)	CL-89 3.6 miles NNE	0.36 (2/2) (0.34 - 0.38)	0.18 (2/2) (0.13 - 0.24)	0

TABLE 4

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

Name of Facility Clinton Power Station Docket No. 50-461

Location of Facility Dewitt, Illinois (County, State) Reporting Period February 27 - December 31, 1987

Medium or Pathway Sampled (Unit of Measurement)	Type of Analysis Total Number Performed	Lower Limit of Detection (LLD)	All Indicator Locations: Mean f Range	Location with Highest Annual Mean: Name Distance Direction	Location with Highest Annual Mean: Mean f Range	Control Locations: Mean f Range	Number of Nonroutine Reported Measurements
Aquatic Vegetation (pCi/g wet)	Gamma Spec 8						
	Be-7	0.40	0.62 (2/6) (0.44 - 0.80)	CL-7c 1.3 miles SE	0.80 (1/2)	0.38 (1/2)	0
	K-40	-	1.19 (6/6) (0.58 - 2.21)	CL-105 50 miles S	2.14 (2.2) (1.67 - 2.62)	2.14 (2/2) (1.67 - 2.62)	0
	Mn-54	0.047	LLD	-	LLD	LLD	0
	Fe-59	0.12	LLD	-	LLD	LLD	0
	Co-58	0.048	LLD	-	LLD	LLD	0
	Co-60	0.042	LLD	-	LLD	LLD	0
	Zn-65	0.11	LLD	-	LLD	LLD	0
	Nb-95	0.060	LLD	-	LLD	LLD	0
	Zr-95	0.094	LLD	-	LLD	LLD	0
	Cs-134	0.051	LLD	-	LLD	LLD	0
	Cs-137	0.058	LLD	CL-105 50 miles S	0.034 (1/2)	0.034 (1/2)	0

TABLE 4

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Medium or Pathway Sampled (Unit of Measurement)	Type of Analysis Total Number Performed	Lower Limit of Detection (LLD)	All Indicator Locations: Mean f Range	Location with Highest Annual Mean: Name Distance Direction	Mean f Range	Control Locations: Mean f Range	Number of Nonroutine Reported Measurements
Aquatic Vegetation (pCi/g wet) (con't)	Ba-140	0.16	LLD	-	LLD	LLD	0
	La-140	0.044	LLD	-	LLD	LLD	0
	Ce-144	0.27	LLD	-	LLD	LLD	0
Green Leafy and Tuberous Vegetables (pCi/g wet)	Gross Beta 36	-	3.70 (23/23) (1.58 - 6.64)	CL-117 0.9 miles N	5.11 (2/2) (3.90 - 6.32)	3.89 (13/13) (1.98 - 7.17)	0
	Gamma Spec 36						
	Be-7	0.090	1.25 (19/23) (0.15 - 5.12)	CL-117 0.9 miles N	3.86 (2/2) (3.66 - 4.05)	1.16 (11/13) (0.21 - 4.35)	0
	K-40		3.41 (23/23) (1.41 - 13.10)	CL-18 1.6 miles E	4.44 (12/12) (2.39 - 13.10)	3.52 (13/13) (2.15 - 5.71)	0
	Mn-54	0.015	LLD	-	LLD	LLD	0
	Fe-59	0.037	LLD	-	LLD	LLD	0
	Co-58	0.014	LLD	-	LLD	LLD	0
	Co-60	0.016	LLD	-	LLD	LLD	0
	Zn-65	0.034	LLD	-	LLD	LLD	0

TABLE 4

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Location of Facility Dewitt, Illinois (County, State) Reporting Period February 27 - December 31, 1987

Medium or Pathway Sampled (Unit of Measurement)	Type of Analysis Total Number Performed	Lower Limit of Detection (LLD)	All Indicator Locations: Mean f Range	Location with Highest Annual Mean: Name Distance Direction	Mean f Range	Control Locations: Mean f Range	Number of Nonroutine Reported Measurements
Green Leafy and Tuberous Vegetables (pCi/g wet) (con't)	Nb-95	0.015	LLD	-	LLD	LLD	0
	Zr-95	0.027	LLD	-	LLD	LLD	0
	I-131	0.025	LLD	-	LLD	LLD	0
	Cs-134	0.015	LLD	-	LLD	LLD	0
	Cs-137	0.015	LLD	CL-114 12.5 miles SSE	0.021 (2/13) (0.016 - 0.026)	0.021 (2/13) (0.016 - 0.026)	0
	Ba-140	0.069	LLD	-	LLD	LLD	0
	La-140	0.088	LLD	-	LLD	LLD	0
	Ce-144	0.088	LLD	-	LLD	LLD	0
Grass (pCi/g wet)	Gamma Spec 68						
	Be-7	-	1.89 (51/51) (0.05 - 7.58)	CL-2 0.7 miles NNE	2.14 (17/17) (0.05 - 7.58)	1.51 (17/17) (0.49 - 4.17)	0

TABLE 4

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

Name of Facility Clinton Power Station Docket No. 50-461

Location of Facility Dewitt, Illinois (County, State) Reporting Period February 27 - December 31, 1987

Medium or Pathway Sampled (Unit of Measurement)	Type of Analysis Total Number Performed	Lower Limit of Detection (LLD)	All Indicator Locations: Mean f Range	Location with Highest Annual Mean: Name Distance Direction	Mean f Range	Control Locations: Mean f Range	Number of Nonroutine Reported Measurements
Grass (pCi/g wet) (con't)	K-40	-	6.58 (51/51) (3.12 - 17.90)	CL-2 0.7 miles NNE	6.99 (17/17) (3.88 - 17.90)	7.01 (17/17) (4.75 - 14.40)	0
	Mn-54	0.026	LLD	-	LLD	LLD	0
	Fe-59	0.077	LLD	-	LLD	LLD	0
	Co-58	0.030	LLD	-	LLD	LLD	0
	Co-60	0.030	LLD	-	LLD	LLD	0
	Zn-65	0.071	LLD	-	LLD	LLD	0
	Nb-95	0.028	LLD	-	LLD	LLD	0
	Zr-95	0.060	LLD	-	LLD	LLD	0
	I-131	0.046	LLD	-	LLD	LLD	0
	Cs-134	0.086	LLD	-	LLD	LLD	0
	Cs-137	0.087	LLD	CL-11 16 miles S	0.044 (4/17) (0.009 - 0.069)	0.044 (4/17) (0.009 - 0.069)	0
	Ba-140	0.120	LLD	-	LLD	LLD	0

TABLE 4

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

Name of Facility Clinton Power Station Docket No. 50-461

Location of Facility Dewitt, Illinois (County, State) Reporting Period February 27 - December 31, 1987

Medium or Pathway Sampled (Unit of Measurement)	Type of Analysis Total Number Performed	Lower Limit of Detection (LLD)	All Indicator Locations: Mean f Range	Location with Highest Annual Mean Name Distance Direction	Mean f Range	Control Locations: Mean f Range	Number of Nonroutine Reported Measurements
Grass (pCi/g wet) (con't)	La-140	0.039	LLD	-	LLD	LLD	0
	Ce-144	0.219	LLD	-	LLD	LLD	0
Column 1	Column 2	Column 3	Column 4	Column 5		Column 6	Column 7

TABLE EXPLANATIONS:

Column 1: The unit of Measurement describes all the numerical values for LLD, Mean and Range reported for a particular sample medium. Example: the Gross Beta LLD in AIR PARTICULATES is 0.010 pCi/m^3. Abbreviations used are: pCi/m^3 = picocurie per cubic meter of sampled air; mR/quarter = exposure measured for calendar quarter period (3 months); pCi/L = picocurie per liter of sample; pCi/g = picocurie per gram of sample.

Column 2: The Type of Analyses are described as follows: Gamma Spec. = measurement of each radioisotope in a sample using Gamma Spectroscopy; Gross Beta = measurement of the radioactivity in a sample by measurement of emitted betas - no determination of individual radioisotopes is possible; Tritium = measurement of tritium (H-3) in sample by liquid scintillation counting method; TLD = direct measurement of gamma exposure using thermoluminescence dosimeters.

Column 3: LLD reported is the highest of those reported for each type of analysis during the year; if all analyses reported positive values, no LLD is reported.

Column 4: Samples taken at Indicator Locations during an operational radiological environmental monitoring program (REMP) reliably measure the quantities of any radioisotopes cycling through the pathways to man from the nuclear station. The reported values are the mean or average for the year of all samples of that type which had values greater than the LLD. "f" if the fraction of all the samples taken at all indicator locations for the medium which reported values greater than the LLD. Example: 7 results greater than LLD out of 15 samples taken would be reported 7/15. The Range is th values of the lowest to highest sample results greater than LLD reported at all the indicator locations for that medium.

TABLE 4 (cont'd)

Column 5: The Mean, f-fraction and Range along with the name of the location, distance from the CPS gaseous effluent stack in miles, and the letter(s) name of the compass sector in the direction of the sample location from the CPS gaseous effluent stack. The location with the highest annual mean is compared to both indicator and control locations of the medium samples.

Column 6: Control locations are sited in areas with low relative deposition and/or dispersion factors. Sample results are used as reference for the control location.

Column 7: NRC Regulations (Branch Technical Position, Rev. 1, November 1979) include a table of radioisotope concentrations that, if exceeded by confirmed sample measurements, indicate that a Nonroutine Reported Measurement exists. Such measurements require further investigation to validate the source.

(a) Highest quarterly mean
(b) Values excluded from mean due to incorrect sample volume due to sample pump failure
(c) Treated well water sample
(d) Analysis added to program in Oct., 1987
(e) No indicator sample location exists, no milk producing animals within 10 miles of CPS
(f) Two analyses excluded from mean due to unreliable results from TLD's found on ground biasing results

FIGURE 4

LOCATION OF REMP STATIONS
WITHIN 2 MILES

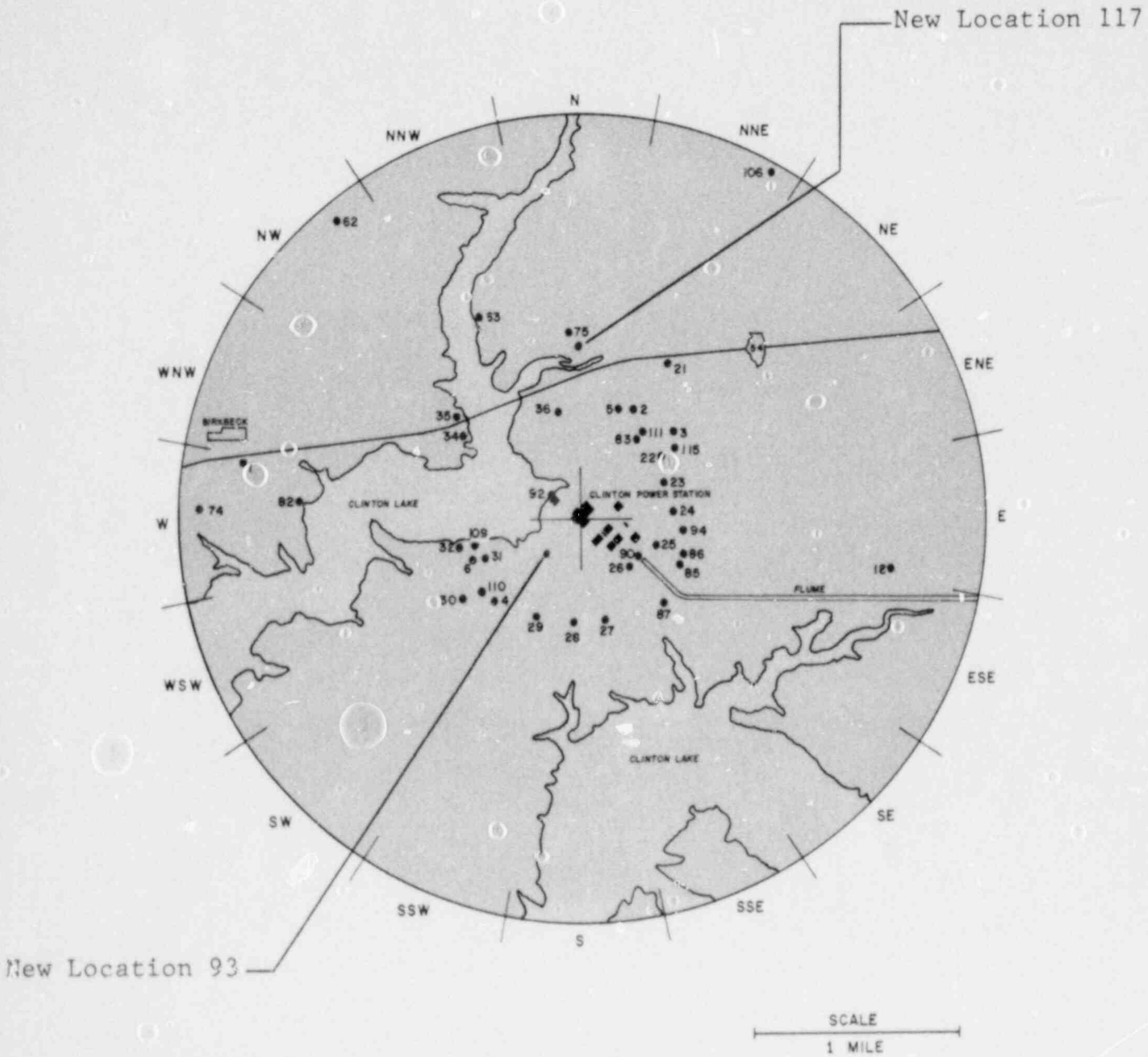


FIGURE 5

LOCATION OF REMP STATIONS
FROM 2 - 6 MILES

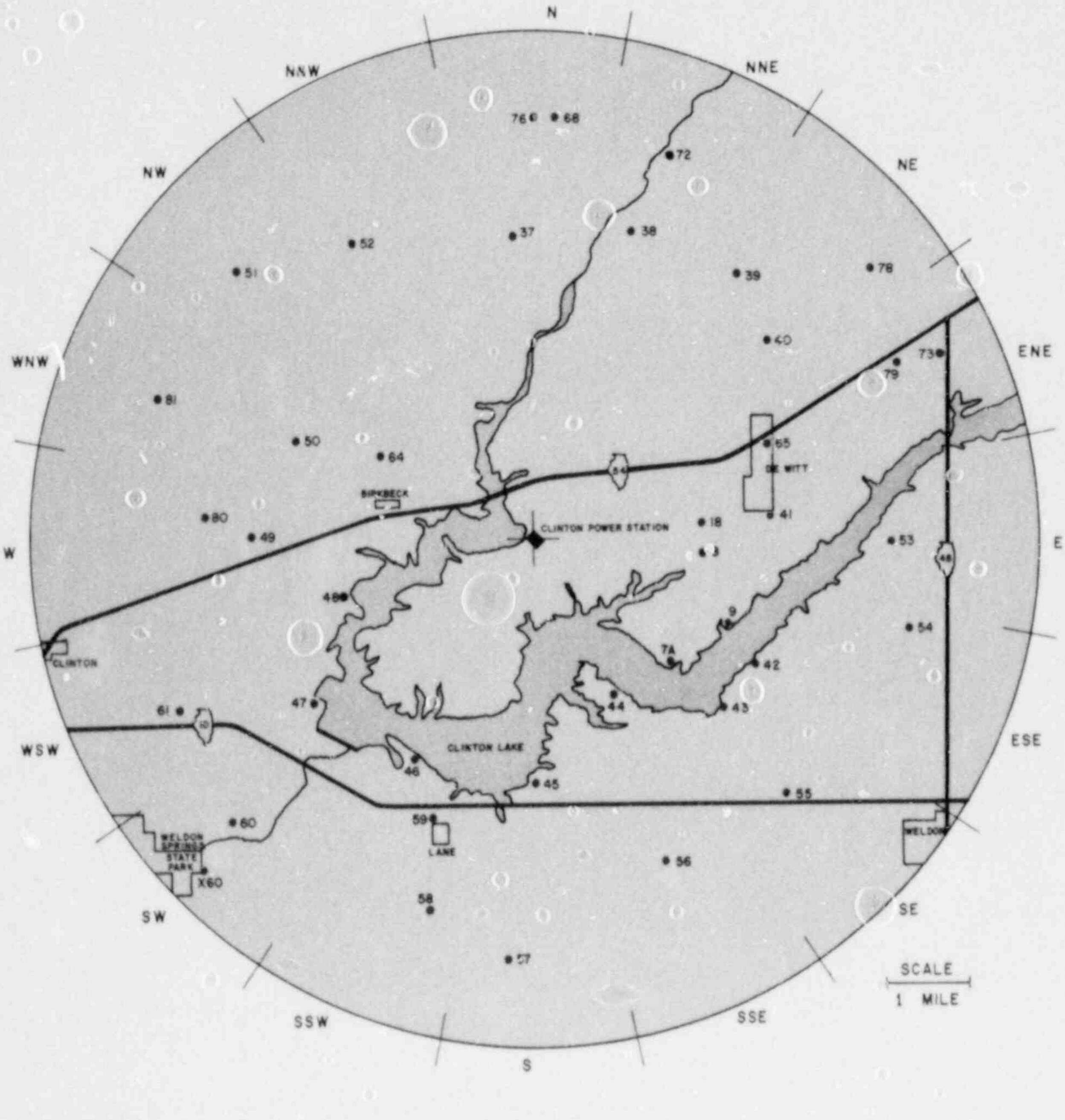


FIGURE 6

LOCATION OF REMP STATIONS
FROM 6 - 50 MILES

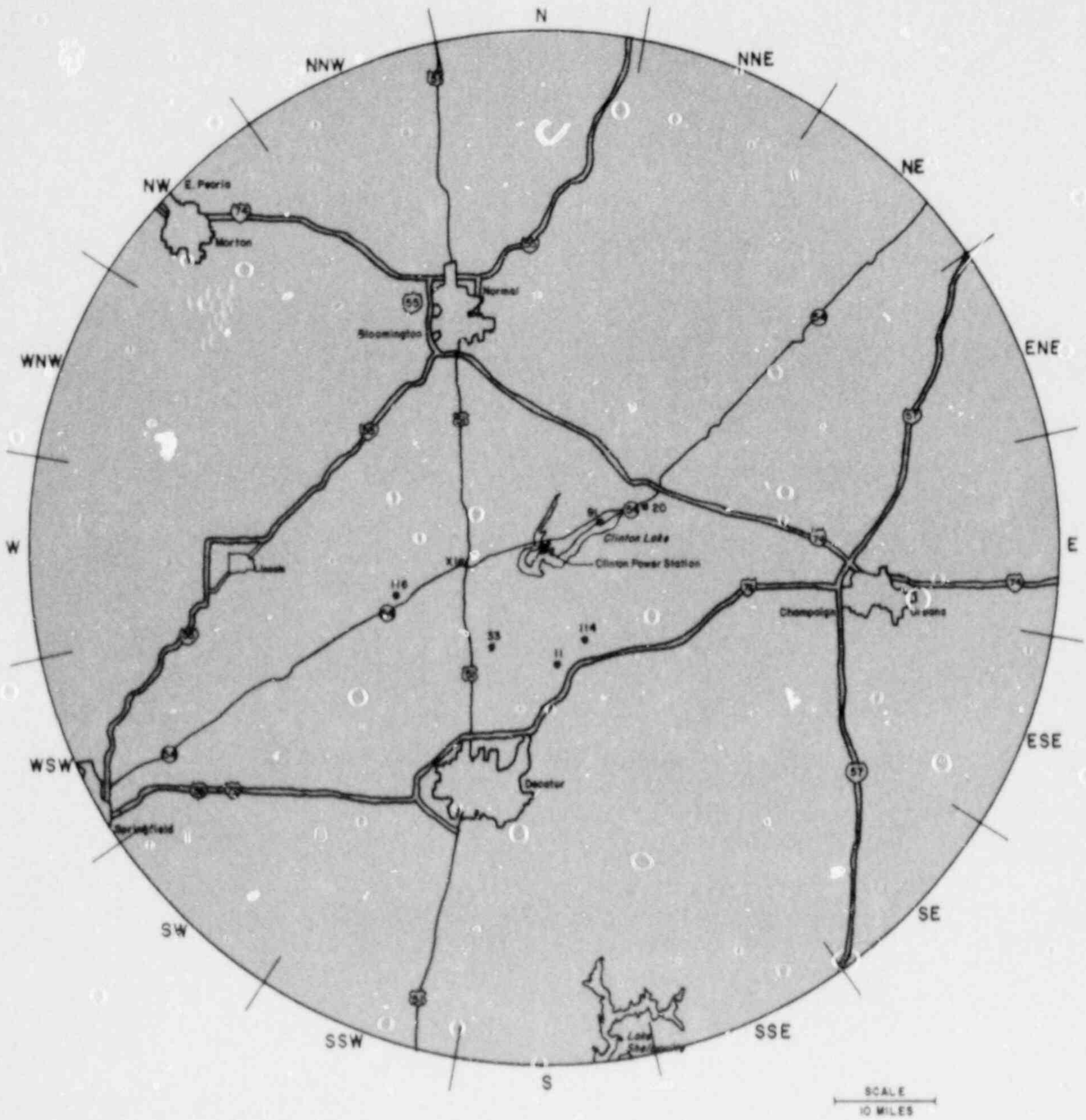


FIGURE 7

LOCATION OF REMP STATIONS
FOR AQUATIC MONITORING

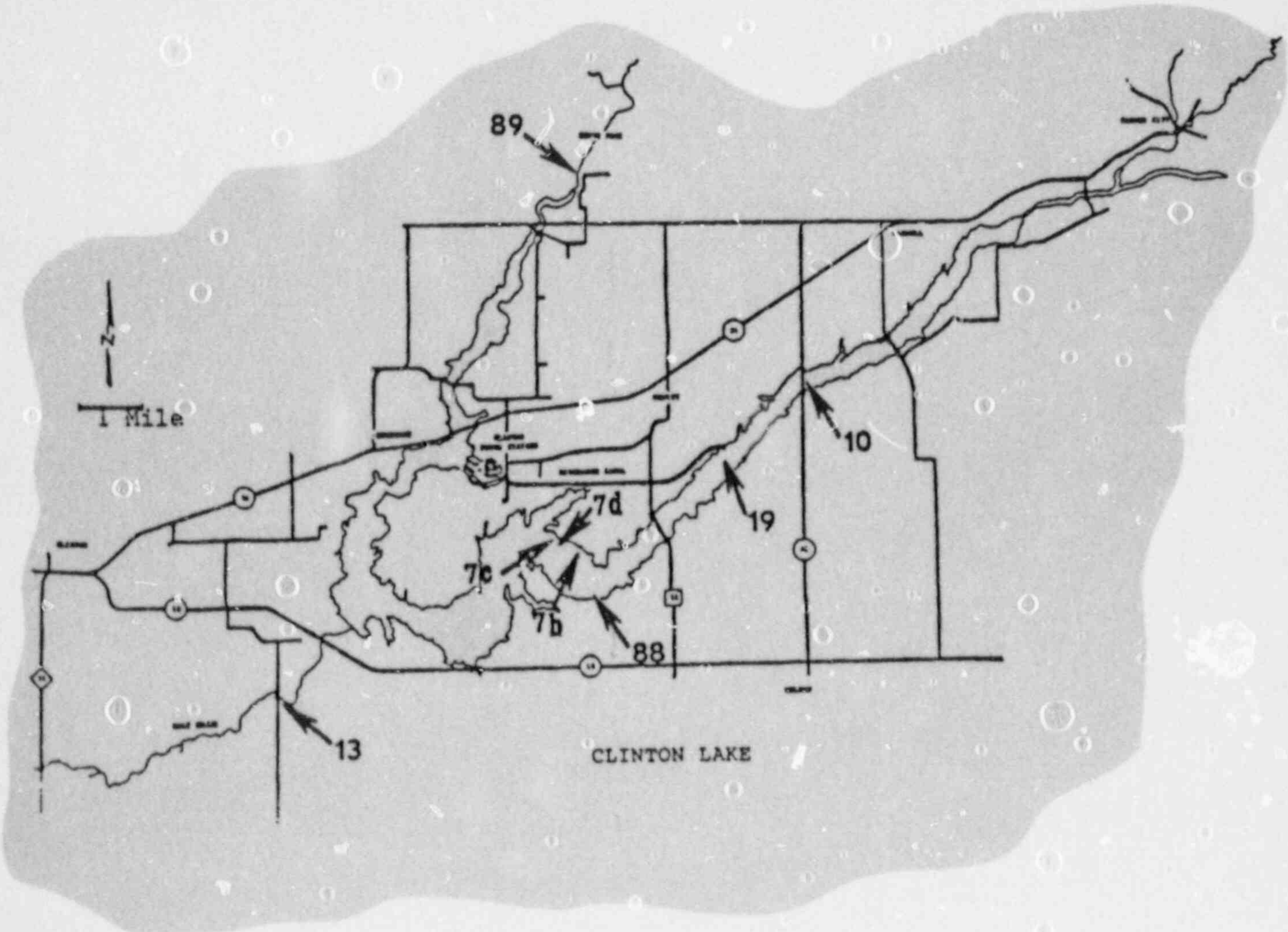
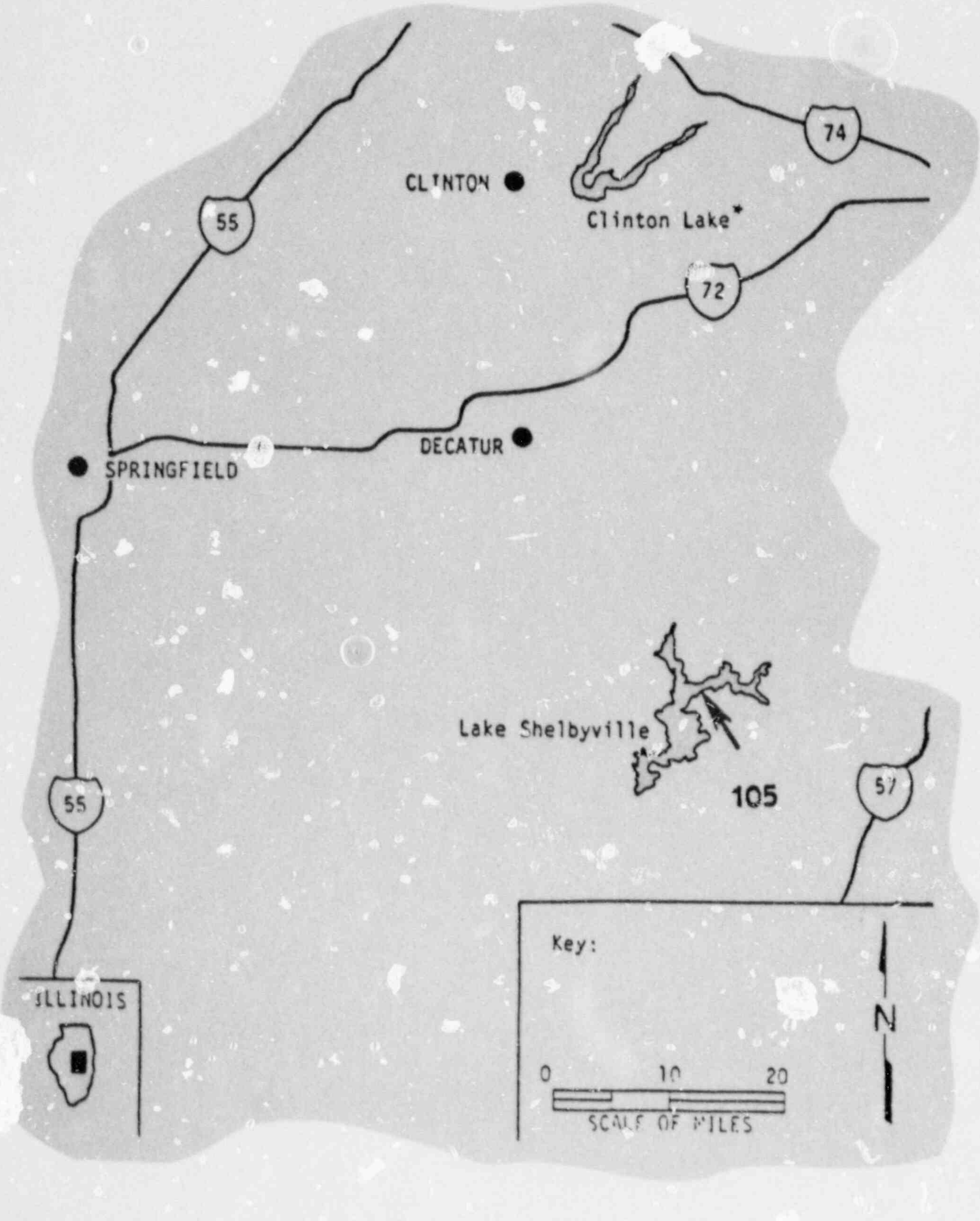


FIGURE 8

CONTROL LOCATION OF REMP STATION
FOR AQUATIC MONITORING



VI. DIRECT RADIATION MONITORING

A. Description

TLDs (thermoluminescent dosimeters) are used to measure the ambient gamma radiation field at many locations around the Clinton Power Station. TLDs are crystalline devices that store energy when they are exposed to radiation. They can be processed months after exposure with minimal loss of information. This makes them well suited for quarterly environmental radiation measurements. During processing, the stored energy is released as light and measured by a TLD reader. The light intensity is proportional to the radiation dose the TLD received. The TLDs used in monitoring around the Clinton Power Station are easily capable of measuring environmental levels of radiation, approximately 20 mrem per quarter.

Monitoring stations are placed near the site boundary and approximately five miles from the reactor, in locations representing the sixteen compass sectors. Other locations are chosen to measure the radiation field at places of special interest such as nearby residences, meeting places, and population centers. Control sites are located further than ten miles from the site, in areas that should be unaffected by plant operations.

TLD measurements register the gamma ray exposure in milliRoentgen (mR). For reporting purposes mR is numerically equivalent to mrem. Consequently the terms are used interchangeably.

B. Results

Results of the annualized TLD dose measurements are summarized by location in Table 5. Appendix I, Table I-5 breaks this down further to dose at each location during each calendar quarter. A total of 306 TLD measurements were made. The average quarterly dose at indicator locations was 19.5 ± 1.6 mrem. This is equivalent to 8.9 microrem per hour. The quarterly measurements ranged from 11.3 ± 0.6 mrem to 27.6 ± 0.9 mrem.

Figure 9 shows the average quarterly gamma dose rates for 1987 control and indicator locations, superimposed on similar historic data from 1985 to 1986. Figure 10 shows quarterly control and indicator dose rates in historical perspective.

At control locations the average quarterly dose was 19.9 ± 2.6 mrem. In determining the average control dose for 1987, data from the first quarter at control site CL-11 was discarded because it was more than 5 standard deviations from the mean at the same location during eight prior and three subsequent quarters.

Average doses, broken down by calendar quarter, are shown below for both indicator and control locations. The ability to characterize the error in the actual doses is due to the limited number of control TLDs (2 control TLD locations).

	Indicator	Control
First quarter	16.4 ± 1.5	16.2
Second quarter	21.6 ± 3.6	21.4
Third quarter	18.4 ± 2.2	18.3
Fourth quarter	21.4 ± 2.4	21.8

Site CL-34, located 0.8 miles WNW of the station, registered both the highest quarterly and highest annualized dose: 92.7 mrem for 1987. Preoperational data indicate that the dose at this location has been among the highest measured. Between 1980 and 1984 CL-34 registered, on the average, the highest annual dose. In 1985 and 1986 its dose was in the top 20% of all locations monitored.

C. Analysis

No increase in environmental gamma radiation level resulting from operation of the Clinton Power Station in 1987 was detected.

TABLE 5

1987 CPS REMP ANNUAL TLD RESULTS

Station Code (a)	Annual Total (± 2 s.d.), mR(b)
CL-1	76.9 ± 3.0
CL-2	80.9 ± 3.0
CL-3	82.0 ± 5.0
CL-4	75.7 ± 2.2
CL-5	73.6 ± 2.8
CL-6	71.7 ± 4.2
CL-7	79.9 ± 2.6
CL-8	78.1 ± 2.0
CL-11(c)	77.1 ± 0.9
CL-20	75.6 ± 3.4
CL-21	82.4 ± 2.8
CL-22	75.9 ± 3.6
CL-23	67.9 ± 1.8
CL-24	67.8 ± 3.2
CL-25	60.7 ± 2.8
CL-26	67.8 ± 4.2
CL-27	74.3 ± 5.2
CL-28	81.9 ± 4.2
CL-29	81.4 ± 6.8
CL-30	83.8 ± 8.8
CL-31	71.4 ± 5.8
CL-32	77.1 ± 7.2
CL-33(c)	81.2 ± 7.6
CL-34	92.7 ± 9.0
CL-35	74.3 ± 5.6
CL-36	75.2 ± 5.8
CL-37	80.8 ± 6.4
CL-38	78.1 ± 6.2
CL-39	70.4 ± 5.4
CL-40	76.4 ± 5.8
CL-41	69.6 ± 3.4
CL-42	75.4 ± 5.8
CL-43	82.2 ± 6.0
CL-44	74.9 ± 6.0
CL-45	89.6 ± 6.2
CL-46	75.0 ± 5.4
CL-47	83.9 ± 7.6
CL-48	87.9 ± 4.8
CL-49	81.5 ± 7.4
CL-50	78.2 ± 9.0
CL-51	81.0 ± 7.0
CL-52	78.4 ± 7.0
CL-53	73.2 ± 7.2
CL-54	75.7 ± 8.6
CL-55	75.8 ± 5.8
CL-56	81.7 ± 5.8
CL-57	81.4 ± 5.4

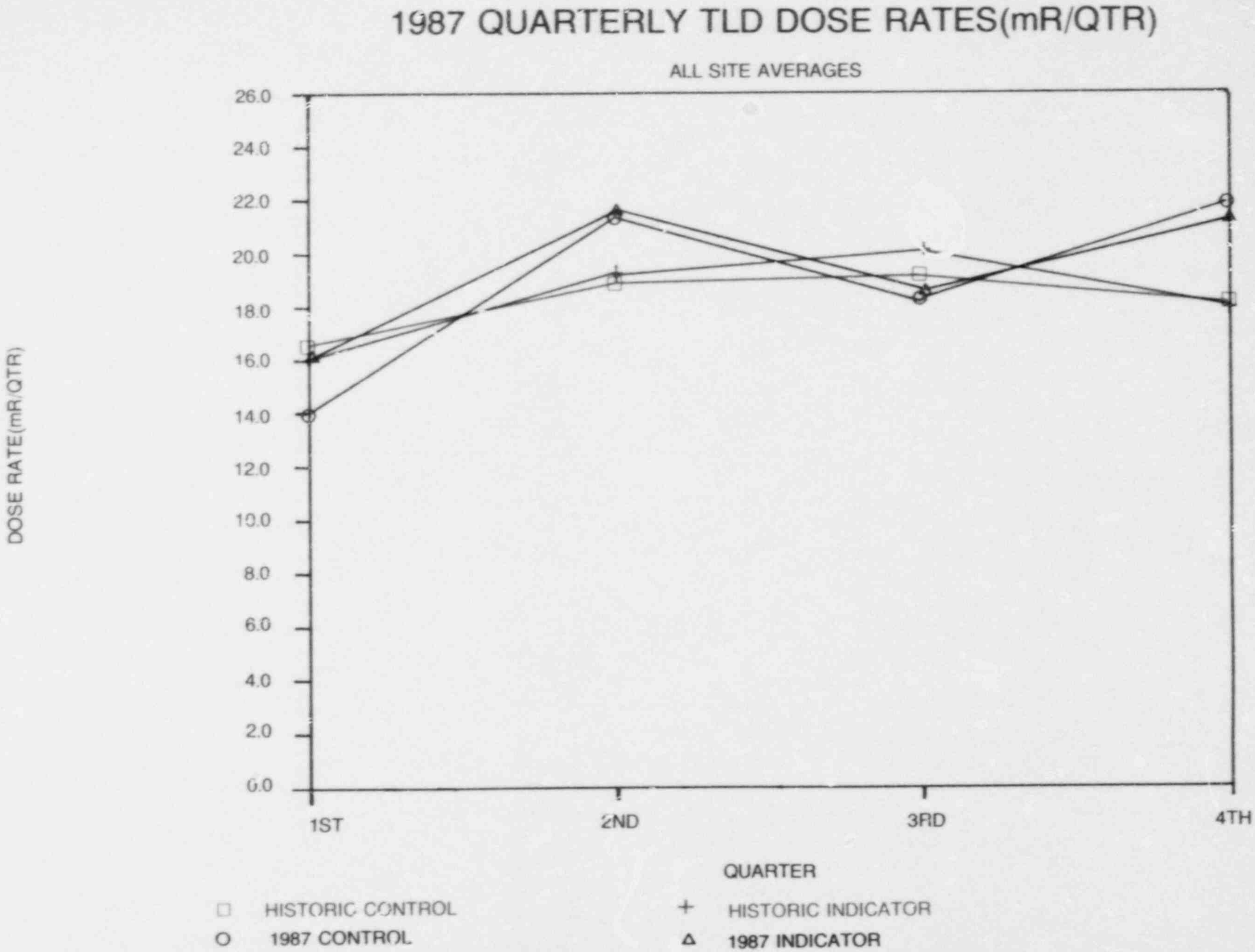
TABLE 5 (continued)

1987 CPS REMP ANNUAL TLD RESULTS

Station Code (a)	Annual Total (± 2 s.d.), mR(b)
CL-58	76.7 ± 5.6
CL-59	83.2 ± 3.2
CL-60	86.0 ± 6.2
CL-61	79.8 ± 7.2
CL-62	81.3 ± 12.4
CL-63	87.1 ± 9.2
CL-64	79.3 ± 7.4
CL-65	81.7 ± 7.6
CL-66	72.5 ± 6.0
CL-67	81.1 ± 5.2
CL-68	70.4 ± 6.6
CL-69	88.8 ± 6.8
CL-70	79.9 ± 7.6
CL-71	84.5 ± 5.8
CL-72	75.6 ± 2.8
CL-73	84.8 ± 6.4
CL-74	78.5 ± 3.0
CL-75	80.2 ± 3.0
CL-76	80.3 ± 5.2
CL-77	70.0 ± 2.2
CL-78	77.1 ± 5.2
CL-79	76.6 ± 6.2
CL-80	79.7 ± 7.2
CL-81	78.8 ± 6.2
CL-82	68.8 ± 0.6
CL-83	82.8 ± 4.8
CL-84	81.3 ± 6.0
CL-85	81.5 ± 4.6
CL-86	87.9 ± 4.6
CL-87	86.9 ± 5.2
CL-109	79.8 ± 6.2
CL-110	77.1 ± 2.2
CL-111	53.7 ± 6.2
CL-112	67.6 ± 2.6
CL-113	81.1 ± 3.6

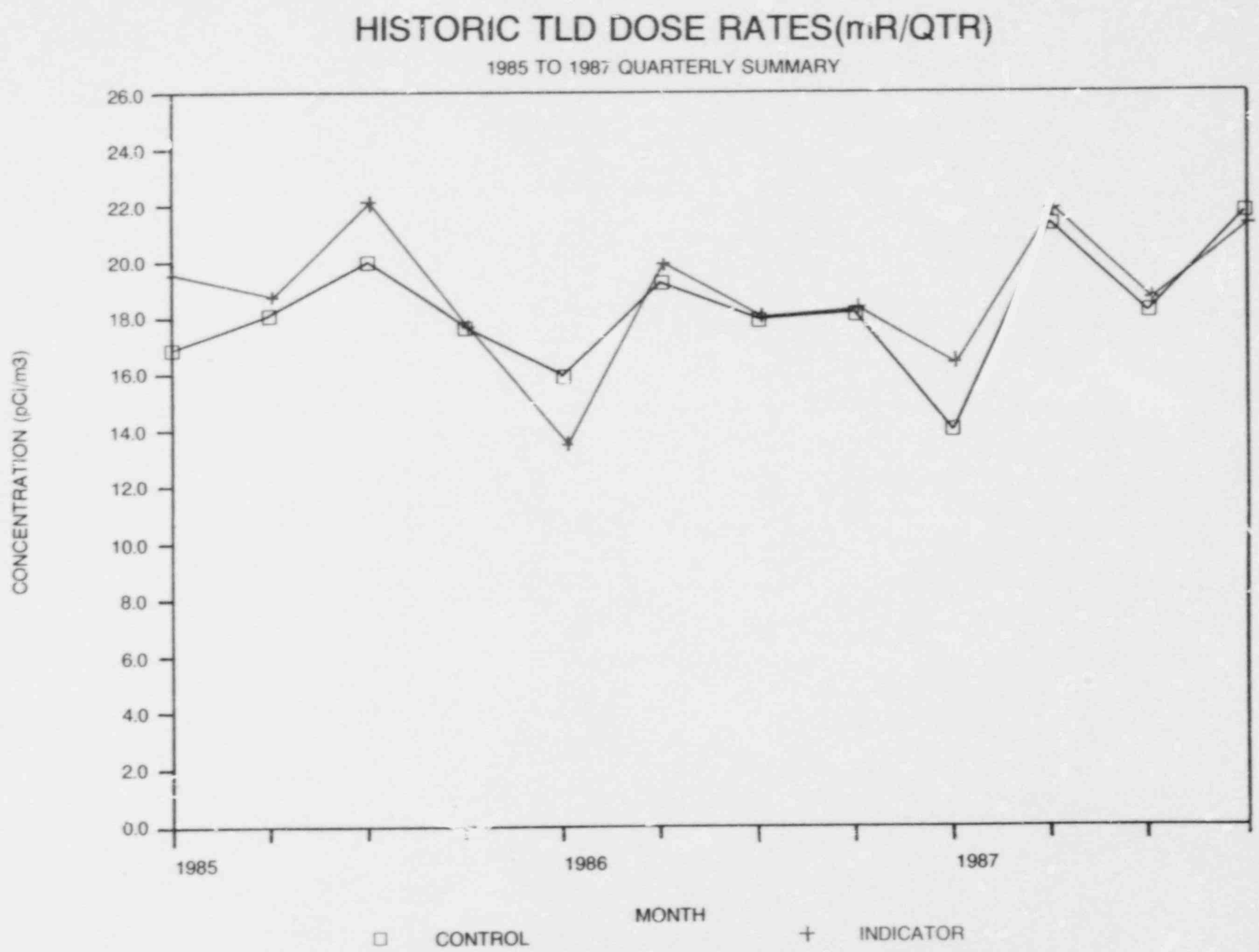
(a) - For station location description refer to Table A-1
(b) - Annual TLD results are the total of the quarterly dose at each station
(c) - Control Station all other indicators

FIGURE 9



1987 QUARTERLY TLD DOSE RATES(mR/QTR)
ALL SITE AVERAGES
DOSE RATE(mR/QTR)
26.0
24.0
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
1ST
2ND
3RD
4TH
QUARTER
HISTORIC CONTROL
HISTORIC INDICATOR
1987 CONTROL
1987 INDICATOR

FIGURE 10


HISTORIC TLD DOSE RATES(mR/QTR)
1985 TO 1987 QUARTERLY SUMMARY
26.0
24.0
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
CONCENTRATION (pCi/m3)
1985
1986
1987
MONTH
CONTROL
INDICATOR

VII. ATMOSPHERIC MONITORING

A direct and important exposure pathway to man is the inhalation and ingestion of radionuclides released to the atmosphere. Radioactivity in the air was measured by a network of nine continuously operating air samplers. Eight of the air sampling stations are strategically located in areas which are most likely to indicate effects due to the release of radioactive effluents from the Clinton Power Station. The control location is located approximately 16 miles south of the plant in an area which is most likely to be independent of station operations. Historical meteorological data indicates the north and north-northeast sectors are the prevailing downwind directions.

No contribution to the general level of airborne particulate radioactivity could be identified as a result of station operations during 1987. The radioactivity that was detected is normally found in the environment and is consistent with expected concentrations of natural radioactivity and fallout from prior nuclear weapons testing.

A. Sample Collection

Mechanical air samplers are used to continuously draw a known volume of air through particulate filters and charcoal cartridges. The samplers are equipped with a pressure-sensing flow regulator to maintain a constant sampling flow rate. The air sampling equipment is maintained and calibrated by the Clinton Power Station personnel using standards traceable to the National Bureau of Standards as references.

At each sampling station, a filter paper is used to collect particulates and charcoal cartridges are used to collect iodines. Air samples are collected weekly and analyzed for gross beta-emitting radioactivity and Iodine-131. Quarterly all air particulate filters collected during that period are composited and counted for gamma-emitting radioisotopes. Since the intent of particulate sampling is to measure airborne radioactivity released from the plant, the counting of short-lived daughters produced by the decay of natural radon and thoron may mask plant contributions. Therefore, the filters are not analyzed for at least five days after their collection to allow for the decay of the short-lived daughters, thereby reducing their contribution to the gross beta activity.

B. Results and Analysis

Results of the gross beta airborne particulate analyses provided comparisons between indicator and control stations for the year, as well as comparisons between locations in relation to spatial and temporal differences. The calculated annual averages for indicator and control stations were 0.026 pCi/m^3 and 0.028 pCi/m^3 respectively. These values are consistent with the 1982 through 1987 averages of 0.027 pCi/m^3 for both indicator and control stations. The station with the highest annual average was indicator station CL-8 located 2.2 miles east of the station. This station had an average concentration of 0.027 pCi/m^3, which is equal to the preoperational mean of 0.027 pCi/m^3. Individual station averages for the year are presented in Table 6.

Fluctuations in the gross beta concentrations were noted throughout the year. The general trend for average weekly gross beta concentrations in the indicator stations showed good correlation with control stations throughout the monitoring period. Statistical analysis of the detectable gross beta concentrations indicated no significant difference between indicator and control stations. Only in April were the concentrations noticeably different with the one control station higher than the indicators. This can be attributed to statistical fluctuations. Evidence for this fact may be seen from the similarity of the trends in the average monthly gross beta concentrations displayed in Figure 11. No significant difference was indicated between individual stations. Monthly averages for indicator and control stations for the year are presented in Table 7.

Generally, the gross beta activity for both indicator and control stations remained constant throughout the monitoring period. A gradual rise occurred beginning in June and peaking in September. The increase noted in the third quarter was unrelated to the Clinton Power Station operations since both indicator and control stations were affected. All gross beta concentrations for 1987 were within normal background levels and no increases were noted as a result of the operation of the Clinton Power Station.

Historical trends in gross beta activity from 1982 through 1987 are depicted in Figure 12. Generally, the level of gross beta activity has remained relatively constant with time. Trends for indicator and control stations were similar.

Analysis of particulate filters for gamma-emitting radionuclides indicated naturally occurring isotopes Be-7 and K-40 were the only nuclides detected.

TABLE 6

1987 AVERAGE GROSS BETA CONCENTRATIONS IN AIR PARTICULATES

Station	Description	Average Concentration ± 2 s.d., pCi/m^3
CL-1 (I)	Camp Quest (Birkbeck)	0.027 ± 0.010
CL-2 (I)	CPS Main Access Road	0.025 ± 0.012
CL-3 (I)	CPS Secondary Access Road	0.027 ± 0.010
CL-4 (I)	0.8 Miles SW	0.026 ± 0.010
CL-6 (I)	IP Recreation Area	0.027 ± 0.010
CL-7 (I)	Mascoutin Recreation Area	0.026 ± 0.010
CL-8 (I)	Dewitt Cemetery	0.027 ± 0.012
CL-11 (C)	IP Substation (Argenta)	0.028 ± 0.008
CL-94 (I)	Old Clinton Road (0.6 miles E)	0.025 ± 0.012

(I) = Indicator Station

(C) = Control Station

TABLE 7

1987 AVERAGE MONTHLY GROSS BETA CONCENTRATIONS

IN AIR PARTICULATES FROM CONTROL AND INDICATOR STATIONS

Month	Indicator, pCi/m^3 (Mean ± 2 s.d.)	Control, pCi/m^3 (Mean ± 2 s.d.)
March	0.022 ± 0.004	0.022 ± 0.016
April	0.022 ± 0.006	0.030 ± 0.038
May	0.020 ± .004	0.022 ± 0.010
June	0.025 ± .008	0.027 ± 0.008
July	0.027 ± .004	0.028 ± 0.012
August	0.028 ± .007	0.030 ± 0.008
September	0.036 ± .004	0.035 ± 0.024
October	0.024 ± .002	0.026 ± 0.012
November	0.032 ± .002	0.034 ± 0.026
December	0.027 ± .002	0.025 ± 0.010

FIGURE 11

AIR PARTICULATE GROSS BETA ACTIVITY

1987 MONTHLY SITE SAMPLE SUMMARY

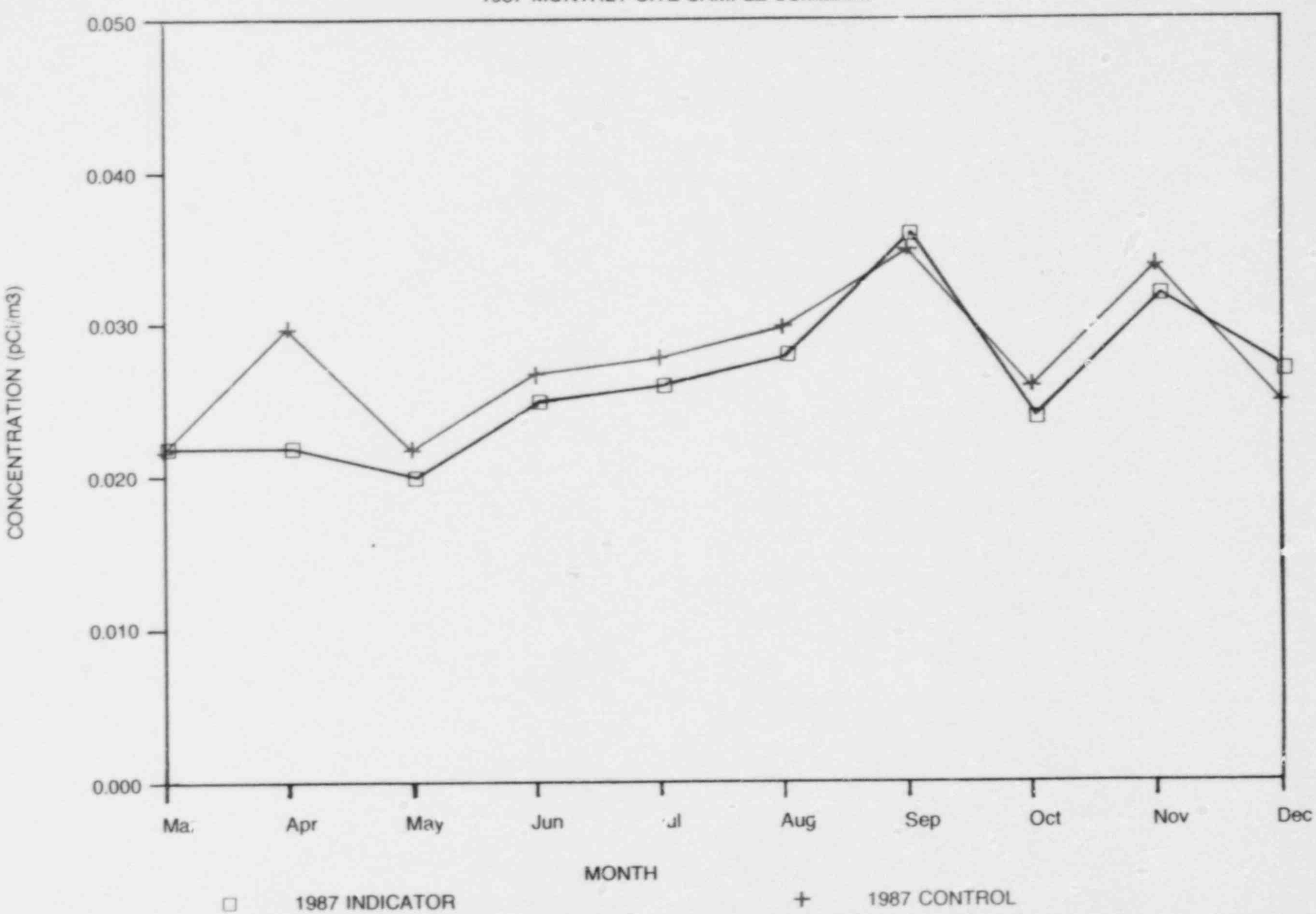
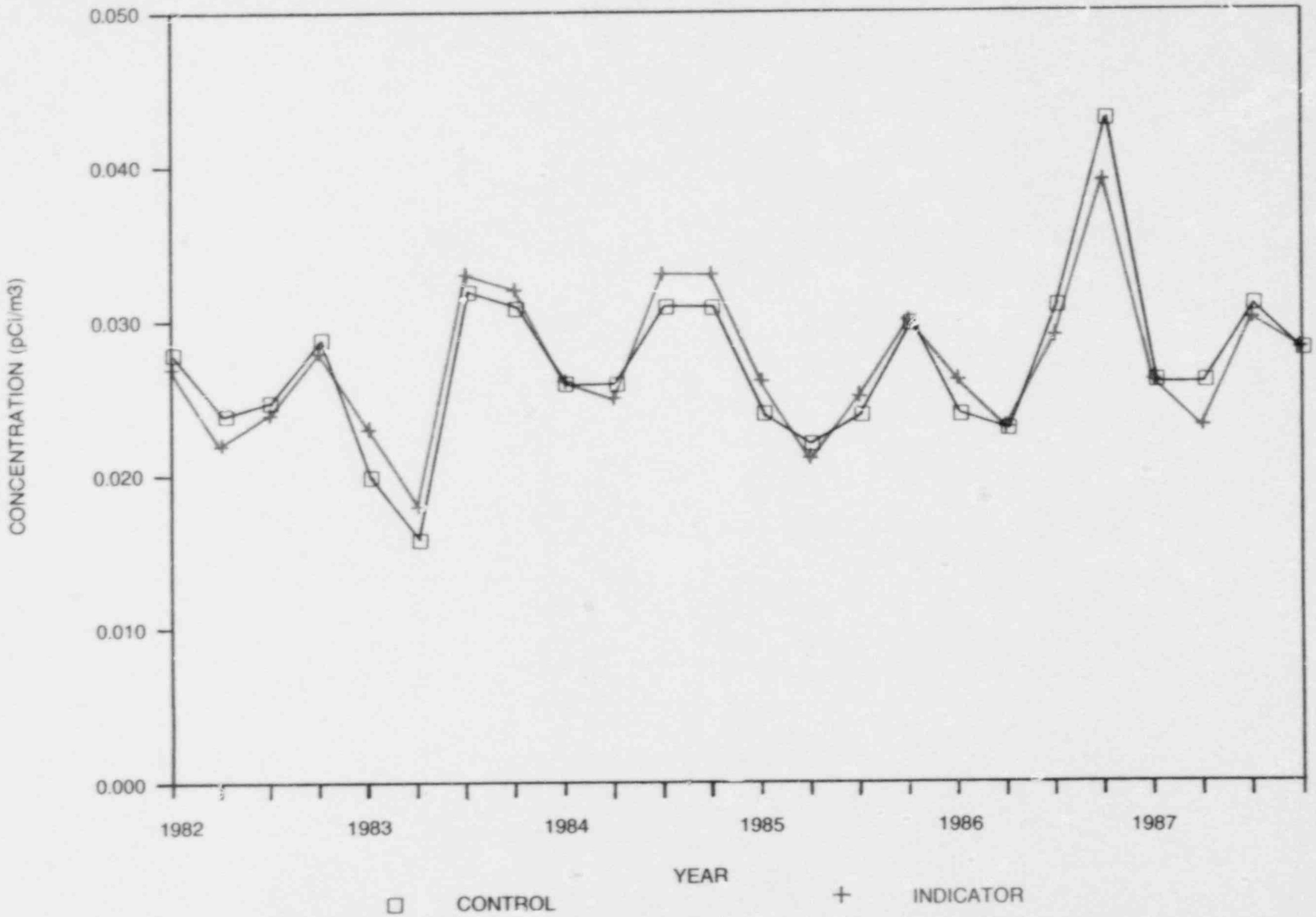


FIGURE 12

QUARTERLY GROSS BETA AIR PARTICULATE

1982-87 SITE SUMMARY



VIII. AQUATIC MONITORING

The Clinton Power Station utilizes an artificial lake as the source of cooling water and returns the used cooling water to the same lake while most nuclear power stations use once-through flow from a river, the ocean, or a body of water much larger than Lake Clinton. Since the radioactive liquid effluents from the Clinton Power Station are discharged into the cooling water outfall, radioisotopes with long half-lives could build up as the same water is reused on successive trips through the plant. (This water travels from the plant, into the eastern arm of the lake, then into the northern arm of the lake and back into the plant.) Although the only user of Lake Clinton as a source of drinking water is the Clinton Power Station, the lake is a major recreational facility, used for fishing, swimming, water skiing, boating and hunting.

Lake Clinton constitutes the primary environmental exposure pathway for radioactive materials in liquid effluents. Aquatic Monitoring provides for the collection of fish, shoreline and bottom sediments, and periphyton samples to detect the presence of any radioisotopes related to operation of the Clinton Power Station. These samples are analyzed for naturally-occurring and man-made radioactive materials.

A. Aquatic Biota Collection

1. Bottom and Shoreline Sediment - Samples of bottom and shoreline sediment are collected from Lake Clinton and Lake Shelbyville. These samples are collected from five locations on Lake Clinton for bottom sediment and from six locations on Lake Clinton for shoreline sediment. One bottom sediment and one shoreline sediment sample is collected from Lake Shelbyville. Lake Shelbyville is about 50 miles south of the Clinton Power Station and was used as the "control" site. These samples were collected semiannually and analyzed for gross alpha, gross beta, gamma isotopic and Sr-90.

2. Periphyton - Samples of periphyton are collected from three locations in Lake Clinton and one location in Lake Shelbyville. Periphyton (attached algae), was collected from permanently anchored buoys below the water surface. Periphyton absorb trace elements and radionuclides directly from water, often concentrating them to levels much higher than the dilute concentrations that occur in the aquatic environment. This is because algae are coated with a carbohydrate jelly and have a large surface to volume ratio. Cell division usually occurs once every one or two days, and as a result, half of the cell wall is a new surface for sorption. Periphyton represent one of

the earliest links in the food chain and provide information about the amounts of radionuclides available to predators further up the food chain. These samples were collected semiannually and analyzed by gamma spectroscopy.

3. Fish - Samples of fish are collected from Lake Clinton and from Lake Shelbyville. In both lakes the samples include large mouth bass, white crappie, carp and bluegill. These species are the most commonly harvested fish from the lakes by sportsfishermen. Fish ingest sediments during bottom feeding, or prey on other organisms which ingest sediments or otherwise retain radionuclides. Radiological analyses of these fish samples provides information on the potential intake of radionuclides by humans via the aquatic pathway. These samples were collected semiannually and analyzed using gamma spectroscopy.

Aquatic monitoring samples are collected by the Field Biology Laboratory of the Environmental Affairs Department of Illinois Power Company.

B. Results of Aquatic Biota Samples and Analysis

Bottom and shoreline sediment samples are dried before analysis. Results are reported in units of pCi/g. Naturally-occurring K-40 was reported to range between 5.89 pCi/g and 19.08 pCi/g in samples from both Lake Clinton and Lake Shelbyville. Naturally-occurring Be-7, produced by cosmic radiation, was also reported to be present in one sample collected from Lake Clinton and indicated to be 0.31 pCi/g. This is only slightly above the lower limit of detection.

Two fission products, Sr-90 and Cs-137, were detected in samples from Lake Clinton's bottom and shoreline sediments. Lake Clinton's bottom sediment concentrations for Sr-90 ranged from 0.01 to 0.06 pCi/g and Cs-137 concentrations ranged from 0.07 to 0.58 pCi/g. Lake Shelbyville Sr-90 concentrations ranged from 0.04 to 0.044 pCi/g and Cs-137 concentrations ranged from 0.40 to 0.59 pCi/g.

Lake Clinton's shoreline sediment concentrations for Sr-90 ranged from 0.002 to 0.018 pCi/g, and only one Cs-137 sample result was reported above the lower limit of detection with a concentration of 0.025 pCi/g. Lake Shelbyville's shoreline sediment results were all less than the lower limit of detection for Sr-90 and Cs-137.

Concentrations reported above the lower limit of detection for bottom and shoreline sediment are not substantially different than those measured during the Preoperational Program. Preoperational bottom sediment concentrations ranged from 0.008 to 1.39 pCi/g for Cs-137 and 0.011 to 0.056 pCi/g for Sr-90. Shoreline sediment concentrations ranged from 0.009 to 0.087 pCi/g for Sr-90, and 0.015 to 0.045 pCi/g for Cs-137.

Gross alpha analysis results showed activities of 2.6 to 13.5 pCi/g in samples from both lakes. These are attributed to naturally-occurring radium isotopes and decay products present in the soil. These values are similar to the preoperational range of 4.4 to 14.7 pCi/g for bottom and shoreline sediment, and 6.2 to 10.4 pCi/g found in soil samples collected away from the lakes.

Gross beta analysis results showed activities ranging from 3.9 to 27.9 pCi/g. The majority of this activity is contributed by the naturally-occurring isotope K-40 (5.89 to 19.80 pCi/g). These values compare closely with the range 8.3 to 27.7 pCi/g established during the preoperational program for gross beta.

Six periphyton samples were collected from three locations in Lake Clinton. Gamma isotopic analyses performed on these samples showed the presence of naturally occurring Be-7 concentrations in two samples which were 0.44 and 0.80 pCi/g. Naturally-occurring K-40 concentrations were detected in all samples ranging from 0.58 to 2.21 pCi/g. All fission products concentrations were less than the lower limit of detection.

Two periphyton samples were collected from one location at Lake Shelbyville. Gamma isotopic analyses performed on these samples showed concentrations for naturally-occurring K-40 of 1.67 and 2.62 pCi/g, and one Be-7 concentration of 0.38 pCi/g. One fission product Cs-137 was found in one sample at 0.034 pCi/g. The presence of Cs-137 is attributed to previous nuclear weapons testing and atmospheric fallout from the accident at Chernobyl in the Soviet Union in 1986.

Gamma isotopic analyses performed on fish samples showed K-40 in all samples ranging from 1.38 to 3.25 pCi/g. All other results were less than the lower limit of detection for each radionuclide.

These results reveal no measurable changes in the radioactive material concentration in the aquatic environment due to operation of the Clinton Power Station.

IX. TERRESTRIAL MONITORING

Radionuclides released to the atmosphere may be deposited on soil and vegetation and become incorporated into milk or food products. To assess the impact of dose to man via the terrestrial environment and ingestion pathway, food products (meat, milk, cabbage, lettuce, and swiss chard) were collected from several locations near the Clinton Power Station in 1987.

Surface vegetation samples were collected from a number of locations for the purpose of monitoring the potential buildup of atmospherically deposited radionuclides. Because the radionuclides of interest, with respect to the Clinton Power Station operations, are also present in the environment as a result of several decades of worldwide fallout or because they are naturally occurring, the presence of these radionuclides was expected to some extent in all of the samples collected. Milk samples were analyzed for Sr-90, I-131 and gamma-emitting isotopes such as Cs-137. Food product samples were analyzed for gross beta-emitting radionuclides and gamma-emitting radionuclides.

The possible contributions of radionuclides from operation of the Clinton Power Station were assessed by comparing the results of samples collected in prevalent downwind locations (north to north east of the plant) with control samples and samples collected in locations generally upwind of the plant. In addition, the results of samples collected in 1987 were compared with the results of samples collected during the preoperational program.

An Annual Land Use Census was performed to determine the location of the nearest milk cow or goat in each of the 16 geographical sections and within five miles of the station. The results of the 1987 Land Use Census are in Appendix F. There are currently no milk animals within three miles of the Clinton Power Station and only one within five miles. The annual Land Use Census also identifies all gardens of greater than fifty square meters producing broad leaf vegetation within five miles of the Clinton Power Station.

Terrestrial samples collected during 1987 indicate operation of the Clinton Power Station resulted in no apparent contribution to environmental radioactivity.

A. Sample Collection

There is no known commercial production of milk for human consumption in the immediate vicinity of the Clinton Power Station. The Radiological Environmental Monitoring Program regularly collects milk samples from a dairy located about 14 miles west southwest of the station (twice a month during May through October and once a month during November through April). In addition, the grass samples taken in place of milk samples are collected in three sectors near the plant and one control station located about 16 miles south of the plant. Milk and grass samples are analyzed for gross gamma-emitting activity and for I-131 activity.

The Clinton Power Station maintains contracts with three local farmers to establish and maintain gardens of greater than fifty square meters which contain cabbage, lettuce, and swiss chard. These gardens appear in Figures 4, 5 and 6 as stations CL-18, CL-114 and CL-115. A new sample location at CL-117 was established near the end of the growing season to replace CL-18.

Soil samples are collected triennially from eight stations located within three miles of the plant and one control station located about 16 miles from the plant. The locations of these stations are shown in Figures 4, 5 and 6. Soil samples are analyzed for gross beta activity and gamma-emitting isotopes.

As an additional check on the presence of radioactive materials in terrestrial exposure pathways, the Clinton Power Station collects annual samples of beef liver, beef thyroid, and ground beef from an animal raised near the plant. These samples are analyzed for all gamma-emitting isotopes.

B. <u>Results of Terrestrial Monitoring and Analysis</u>

Naturally-occurring radioisotopes, Sr-90, and Cs-137, were found in a number of samples. However, the concentrations of radionuclides in samples collected near the Clinton Power Station were comparable to the concentrations in samples collected at locations remote from the station. The presence of these fission products are attributable to previous nuclear weapons tests and the 1986 Russian reactor accident.

During the period which began February 27, 1987 and ended December 31, 1987, 18 milk samples were collected. These samples were analyzed for I-131, Sr-90 and other gamma-emitting radioisotopes. Naturally-occurring K-40 was found in all samples analyzed with concentrations of 1110 to 1290 pCi/l. Sr-90 analyses were added to the program in October of 1987; all 5 samples taken indicated low levels of Sr-90 at concentrations of 2.3 to 2.5 pCi/l.

In addition to the milk samples, 51 samples of grass were collected from the three sectors most likely to be affected by operation of the Clinton Power Station. These samples were analyzed for I-131 and other gamma-emitting isotopes. Naturally-occurring Be-7 and K-40 were found in all 51 samples. Four samples showed Cs-137 concentrations 0.009 to 0.069 pCi/g only at the control location which is located close to a field where farming operations result in soil suspension. The presence of these fission product radioisotopes is attributed to previous nuclear weapons testing and the 1986 Russian reactor accident. The levels of fission products detected in 1987 samples were about the same as the levels reported in 1986, indicating these radioisotopes are from sources not related to the operation of the Clinton Power Station.

During the period February 27, 1987 through December 31, 1987, 36 samples of garden produce were collected from the three contracted vegetable gardens. Gamma-isotopic analysis showed concentrations of naturally-occurring Be-7 and K-40 ranging from 0.15 to 5.12 pCi/g of wet sample (for Be-7) and 1.41 to 13.10 pCi/g of wet sample (for K-40). Two of the samples showed positive results for fission product Cs-137 at the control location with results of 0.016 and 0.026 pCi/g. Gross beta analysis of these samples showed 1.58 to 7.17 pCi/g of wet sample. These results are attributed to the presence of naturally-occurring K-40 in the vegetation and in deposits on the exterior of the vegetation.

I-131 analysis results were less than the lower limits of detection for all samples.

X. Ground and Surface Water Monitoring

Section 2.4 of the Final Safety Analysis Report for the Clinton Power Station provides a technical description of the geologic and hydrologic conditions in the vicinity of the station, and the locations of public and private wells. The most rapid vertical diffusion of surface water into the sub-surface aquafer suppling local wells is about 10.5 feet per year. The only identified user of water from Lake Clinton for domestic purposes is the Clinton Power Station; all others potentially exposed to any radioisotopes released into surface or groundwater would not be affected for several years.

The Radiological Environmental Monitoring Program provided for the collection of samples of raw and treated well water from 2 nearby wells. Surface water is collected from seven locations and drinking water has one sample location. Average tritium and gross beta concentrations in surface, drinking and well water are presented in Table 8 and Table 9 respectively.

A. Sample Collection

(1) Drinking Water - The Clinton Power Station domestic water system is the only known direct user of water from Lake Clinton for human consumption. A composite water sampler located in the Service Building collects a small, fixed - volume sample at regular intervals. The sampler discharges each sample into a common sample collection bottle. Therefore the monthly sample analyzed by the contracted laboratory service is a composite of the individual samples collected throughout the month. The monthly composite sample is analyzed for gross alpha activity, gross beta activity and specific gamma-emitting isotopes. A portion of each monthly sample is mixed with the other monthly samples collected during each calendar quarter. The quarterly composite sample is analyzed for tritium.

(2) Surface Water - Composite water samplers have been installed east of DeWitt County Road 14, in the Plant Screen House, and at the plant end of the Discharge flume. These compositors collect a small volume of water at regular intervals and discharge it to a large sample collection bottle. These bottles are emptied monthly and the composite monthly sample is shipped to the contracted analysis laboratory. Monthly grab samples are also collected from four other locations on Lake Clinton and shipped to the contracted analysis laboratory.

The surface water samples are analyzed for gross alpha activity, gross beta activity, and specific gamma-emitting radioisotopes. In addition, a portion of each monthly sample collected in each calendar quarter is added to portions from the other 2 months to create a quarterly composite sample. The quarterly composite sample is analyzed for tritium.

(3) Wellwater - Every two weeks samples are collected from the well serving the Village of Dewitt and from the well serving the Mascoutin Recreation Area. Each sample is analyzed for I-131. All the samples drawn from the same well during a particular month are combined and analyzed for gross alpha activity, gross beta activity and specific gamma-emitting radioisotopes. In addition, a portion of each monthly composite is added to the quarterly composite sample and each quarterly composite is analyzed for tritium.

B. Results and Analysis of Drinking Water Sampling

Gross alpha activity above the lower limit of detection was reported in one of the 10 monthly samples which showed a concentration of 1.8 pCi/l. These results are attributed to the presence of naturally-occurring traces of uranium, thorium, and their decay products in the water.

Gross beta activities ranged from 0.6 to 1.9 pCi/l. These levels are attributed to very fine particles of sediment containing K-40 which are not removed during the chlorination and filtration process. Monthly drinking water gross beta concentrations are presented in Figure 15 and Figure 16.

Specific gamma-emitting radioisotopes were all below the lower limits of detection. Specific searches were made for activated corrosion products (manganese, iron, cobalt and zinc) and fission products (niobium, zirionium, cesium, barium and lanthanum).

The results of all analyses for tritium were less than the lower limit of detection. The lower limit of detection ranged from 174 to 190 pCi/l.

These results show no measurable effects on drinking water resulting from operation of the Clinton Power Station in 1987.

FIGURE 13

1987 SURFACE WATER GROSS BETA ACTIVITY

1987 MONTHLY SITE SAMPLE SUMMARY

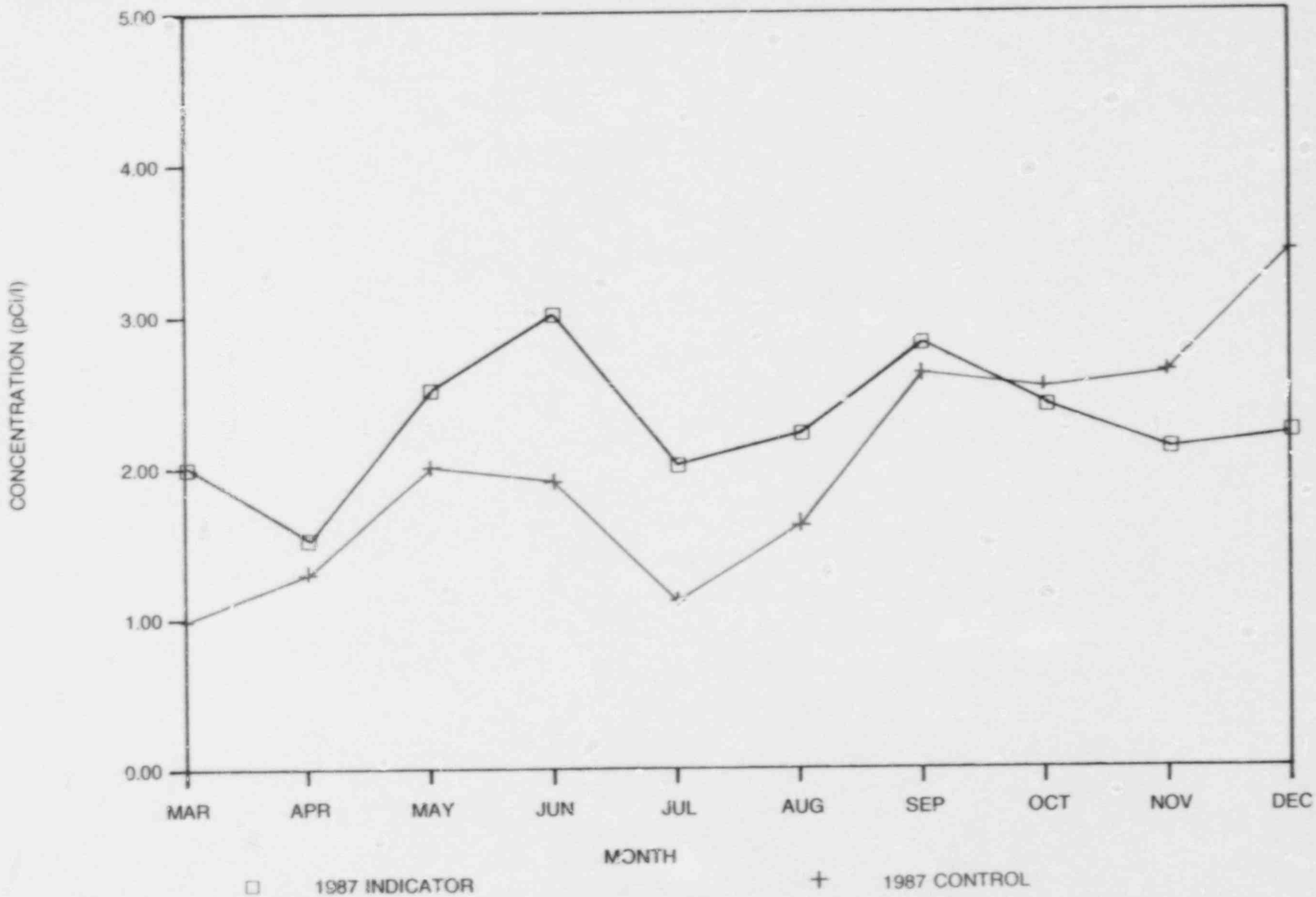


FIGURE 14

HISTORIC SURFACE WATER GROSS BETA

1985-87 SITE SUMMARY

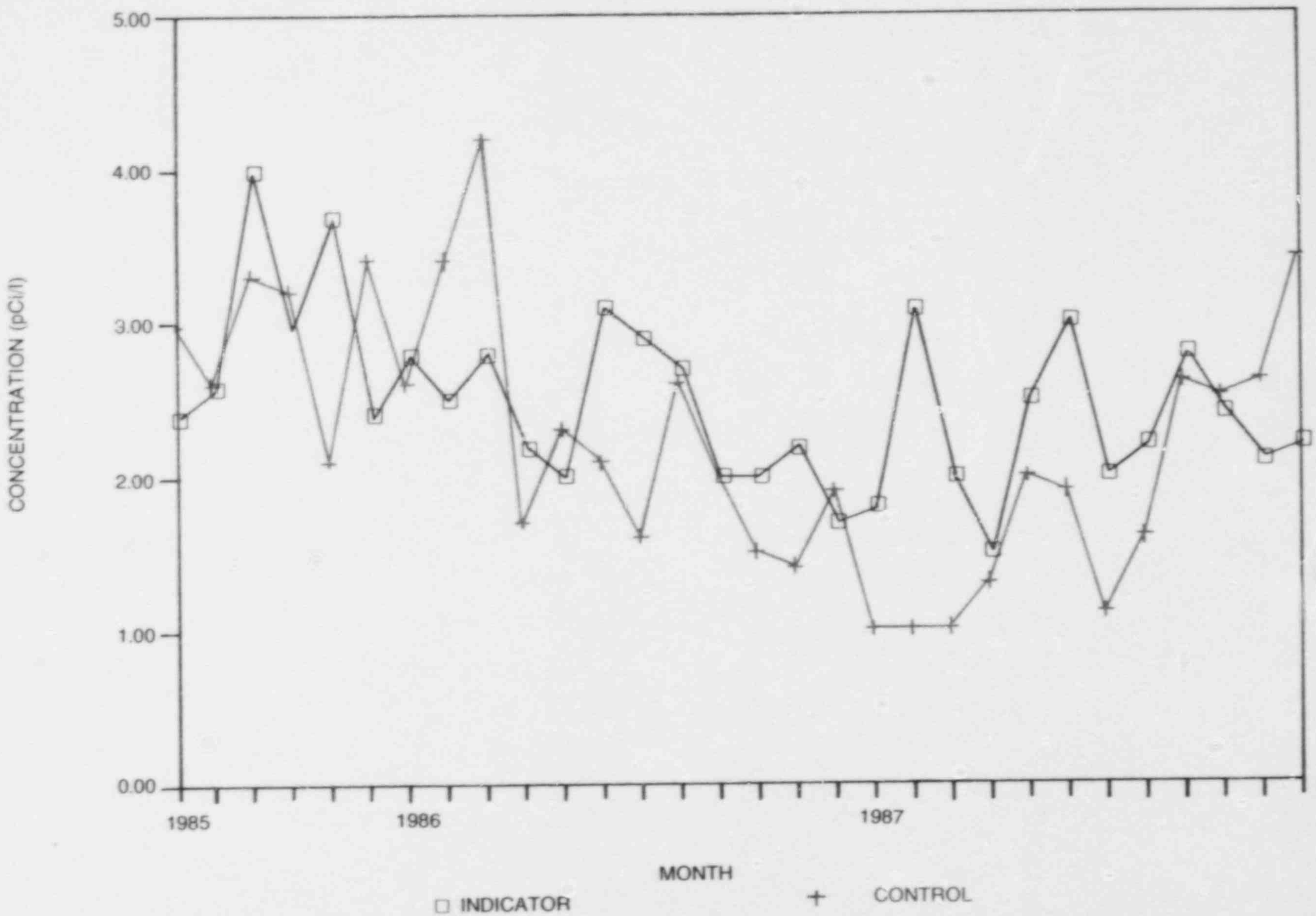


FIGURE 15

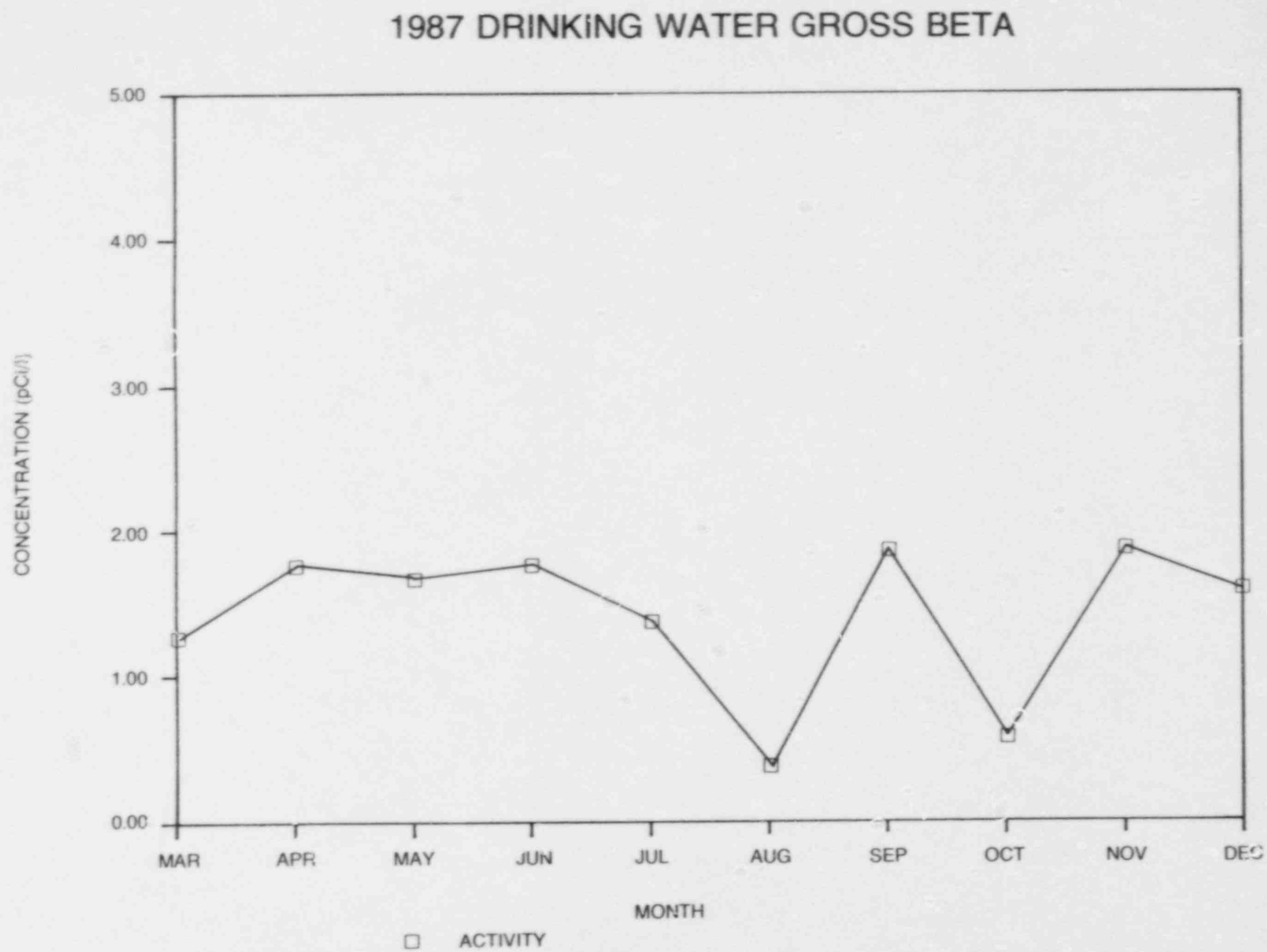
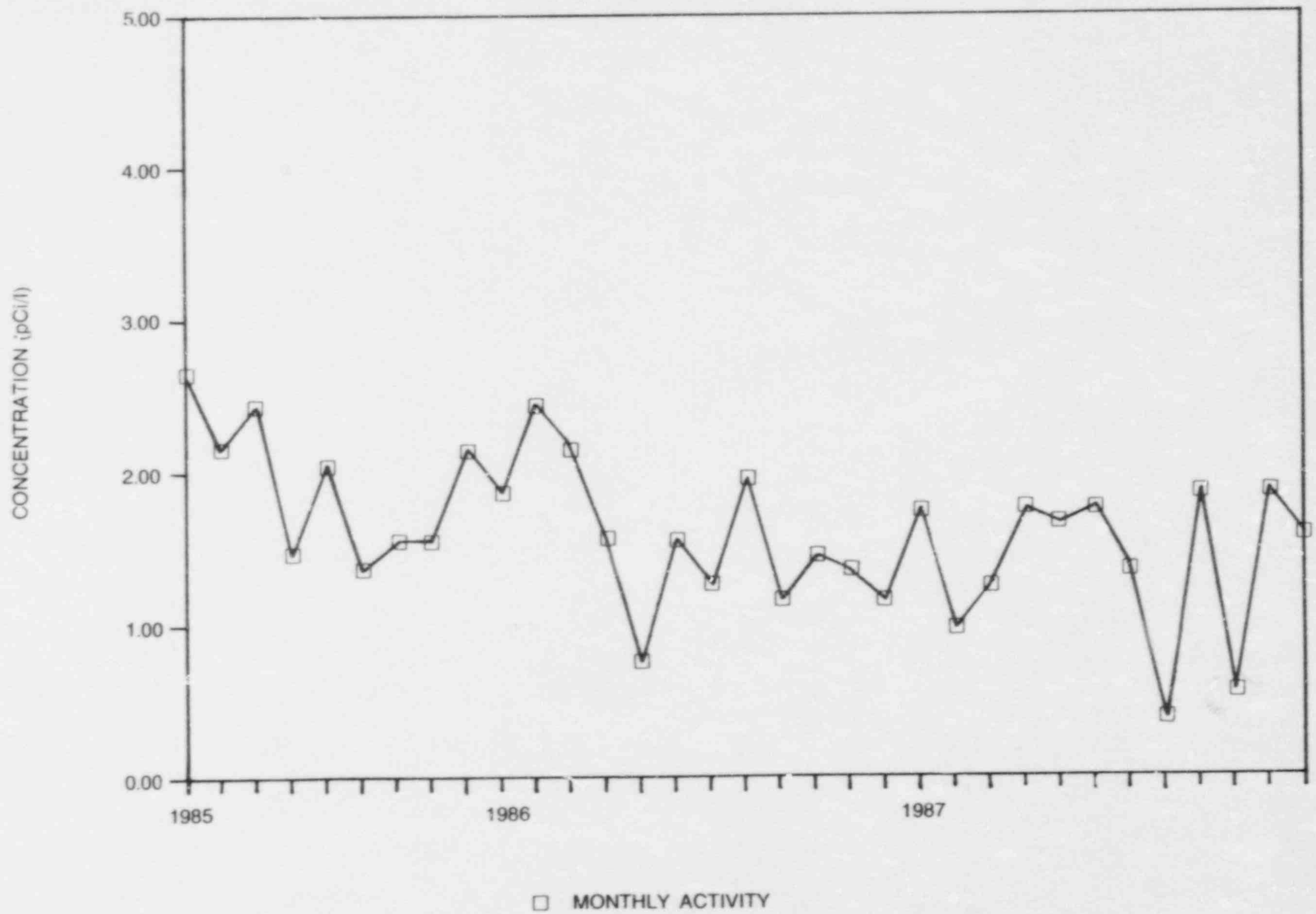

1987 DRINKING WATER GROSS BETA
CONCENTRATION (pCi/l)
5.00
4.00
3.00
2.00
1.00
0.00
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTH
ACTIVITY

FIGURE 16

HISTORIC DRINKING WATER GROSS BETA

1985-87 SITE SUMMARY



C. <u>Results and Analysis of Surface Water Sampling</u>

All the various water samples were analyzed for gross alpha, gross beta, gross gamma, tritium (H-3), Iodine-131 (I-131), and specific nuclear power plant related isotopes such as manganese, iron, cobalt and zinc (released as activated corrosion products) and niobium, zirconium, cesium, barium, and lanthanum (predominant fission products). All I-131 and specific gamma isotopic analyses were less than the lower limits of detection. Gross beta analysis results ranged from 1.1 to 5.0 pCi/l. All others were less than the lower limits of detection. The positive gross beta results are attributable to naturally-occurring K-40 included in the fine sediment particles present in the water. Other types of samples have confirmed the presence of K-40 in Lake Clinton shoreline and bottom sediments. Monthly surface water gross beta concentrations for indicator and control stations are presented in Figure 12 and Figure 13.

Tritium analyses performed on samples indicated one sample at 152 pCi/l. All other concentrations were less than the lower limit of detection which ranged from 112 to 200 pCi/l. As noted in reference (Ei87) previous nuclear weapons testing increased the normal levels of tritium (6-24 pCi/l) by a factor of approximately fifty (300-1200 pCi/l). Since the levels of tritium reported in some samples fall in the low end of the existing, non-reactor-related, natural inventory of tritium it is considered these positive results are not associated with operation of the Clinton Power Station.

Gross alpha results indicated 6 positive results ranging from 1.0 to 2.6 pCi/l; the remaining results were all less than the corresponding lower limit of detection. The gross alpha activity in the samples was attributed to sediment particles present in the sample containing naturally-occurring Uranium-238 and Radium-226, both alpha emitters.

These results show no measurable change in radioactive material concentration in surface water due to operation of the Clinton Power Station in 1987.

D. <u>Results and Analysis of Well Water Sampling</u>

Well water results for gamma, gross alpha, tritium and Iodine-131 were all less than the corresponding lower limit of detection. Gross beta activity of 1.0 to 3.2 pCi/l were attributed to naturally occurring K-40 which is present in fine sediment particles present in the water.

These results show no measurable change in radioactive material concentration in well water resulting from operation of the Clinton Power Station in 1987.

TABLE 8

1987 AVERAGE TRITIUM CONCENTRATIONS

IN SURFACE, DRINKING AND WELL WATER

Station	Description	Average Concentration ± 2 s.d, pCi/l
	Surface Water	
CL-9(I)	Dewitt Road Bridge	< 190
CL-10(C)	Ill. 48 Bridge	< 190
CL-13(I)	Salt Creek (below dam)	< 190
CL-90(I)	CPS Discharge Flume	< 190
CL-91(I)	Parnell Boat Access	< 189
CL-92(I)	CPS Intake Screenhouse	< 189
*CL-93(I)	CPS Settling Ponds	152 ± 168
	Drinking Water	
CL-14(I)	CPS (Service Building)	< 190
	Well Water	
CL-7(I)	Mascoutin Recreation Area	< 190
CL-12 Treated (I)	Dewitt Pump Station	< 189
CL-12 Untreated (I)	Dewitt Pump Station	< 189

*Station added November 1987; only 2 samples taken

(C) = Control

(I) = Indicator

TABLE 9

1987 AVERAGE GROSS BETA CONCENTRATIONS IN SURFACE, DRINKING AND WELL WATER

Station	Description	*Average Concentration ± 2 s.d, pCi/l
	Surface Water	
CL-9(I)	Dewitt Road Bridge	2.3 ± 1.2
CL-10(C)	Ill. 48 Bridge	2.2 ± 1.3
CL-13(I)	Salt Creek (below dam)	2.2 ± 1.2
CL-90(I)	CPS Discharge Flume	2.9 ± 2.6
CL-91(I)	Parnell Boat Access	2.0 ± 1.2
CL-92(I)	CPS Intake Screenhouse	1.9 ± 0.9
**CL-93(I)	CPS Settling Ponds	3.0 ± 0.6
	Drinking Water	
CL-14(I)	CPS (Service Building)	1.6 ± 0.8
	Well Water	
CL-7(I)	Mascoutin Recreation Area	2.5 ± 1.3
CL-12 Treated(I)	Dewitt Pump Station	2.7 ± 0.7
CL-12 Untreated(I)	Dewitt Pump Station	2.0 ± 2.8

*Based on detectable activities only

**Station added November 1987; only 2 samples taken

(C) = Control

(I) = Indicator

LIST OF REFERENCES

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DOC76a	"Local Climatological Data, Annual Summary with Comparative Data, Peoria, Illinois, 1976," U.S. Department of Commerce, NOAA, Asheville, North Carolina.
DOC76b	"Local Climatological Data, Annual Summary with Comparative Data, Springfield, Illinois, 1976," U.S. Department of Commerce, NOAA, Asheville, North Carolina.
EI87	"Environmental Radioactivity," M. Eisenbud, 1987.
EPA72	"Natural Radiation Exposure in the United States", Donald T. Oakley, U.S. Environmental Protection Agency. ORP/SID 72-1, June 1972.
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ICRP84 International Commission on Radiation Protection, Publication No. 39, 1984 "Principles of Limiting Exposure to the Public to Natural Sources of Radiation".

IPC87 Illinois Power Company, North Decatur Dispatch Office, 1987.

KA84 "Radioactivity in the Environment: Sources, Distribution and Surveillance," Ronald L. Kathren, 1984.

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NR80 National Research Council, 1980, Committee on Biological Effects of Ionizing Radiations, Division of Medical Services, "The Effects of Populations of Exposure to Low Levels of Ionizing Radiation: 1980".

NRC75 United States Nuclear Regulatory Commission. Regulatory Guide 4.1, "Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants," Revision 1, April 1975.

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NRC79a United States Nuclear Regulatory Commission Branch Technical Position, "An Acceptable Radiological Environmental Monitoring Program," Revision 1, November 1979.

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APPENDIX A

REMP Sample Locations, Synopsis
of the REMP, and Sampling and Analysis Exceptions
for 1987

Appendix A provides information for the REMP sample locations, a synopsis of the 1987 operational REMP, and any sampling and analysis exceptions during the monitoring period.

Table A-1, REMP Sample Locations, provides information on the sample medium, the station code, the map number, location azimuth, and a brief description of each location where samples are taken. The code for each sample medium are as follows: Air Particulate (AP), Air Iodine (AI), Thermoluminescent Dosimeter (Direct Radiation) (TLD), Milk (M), Drinking Water (DW), Surface Water (SW), Well Water (WW), Green Leafy Vegetables and Tuberous Vegetables (VE), Grass (G), Fish (F), Periphyton, Slime, Bottom Organisms and Aquatic Vegetation (SL), Bottom Sediments (BS), Shoreline Sediments (SS), Soil (SO), and Meat (ME). The station codes are listed by Clinton (CL) - number (location number). The map number corresponds to the number listed on the maps provided in Figures 4 through 8. The location listed is the distance (in miles) and direction each location is from the station heating, ventilation, and air conditioning stack.

Table A-2, Synopsis of the 1987 Operational REMP for the Clinton Power Station, provides each type of sample taken, the number of locations sampled, the collection frequency, the number of samples collected, the types of analysis performed, the analysis frequency and total number of analyses performed.

Table A-3, Sampling and Analysis Exceptions for 1987, provides information concerning problems encountered during the performance of the Program, including any assumptions made for that problem.

TABLE A-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLE LOCATIONS

Sample Medium	Station Code	Map Number	Location	Azimuth	Description
AP, TLD, AI, SO, G	CL-1	1	1.8 miles W	258.75^{o} - 281.25^{o}	Near the gate to Camp Quest, south of Birkbeck
AP, TLD, AI, SO, G	CL-2	2	0.7 miles NNE	11.25^{o} - 33.75^{o}	Located on site's main access road
AP, TLD, AI, SO	CL-3	3	0.7 miles NE	33.75^{o} - 56.25^{o}	Located on site's secondary access road
AP, TLD, AI, SO	CL-4	4	0.8 miles SW	213.75^{o} - 236.25^{o}	Located on farm left of Illinois Power Recreation Area
TLD	CL-5	5	0.7 miles NNE	11.25^{o} - 33.75^{o}	Located on site's main access road
AP, TLD, AI, SO	CL-6	6	0.8 miles WSW	236.25^{o} - 258.75^{o}	Located near the Illinois Power Recreation Area softball field
AP, AI, TLD, SO	CL-7A	7A	2.3 miles SE	123.75^{o} - 146.25^{o}	Located in the Mascoutin Recreation Area
SS	CL-7B	7B	2.1 miles SE	123.75^{o} - 146.25^{o}	SE of site
BS, SL	CL-7C	7C	1.3 miles SE	123.75^{o} - 146.25^{o}	SE of site
WW, SS	CL-7D	7D	2.3 miles SE	123.75^{o} - 146.25^{o}	SE of site
AP, TLD, AI, SO, G	CL-8	8	2.2 miles E	78.75^{o} - 101.25^{o}	Located on Old Clinton Road in Dewitt Cemetery
SW	CL-9	9	2.7 miles ESE	101.25^{o} - 123.75^{o}	Located on NE side of Rt. 14 bridge
*SW, BS, SS, SL	CL-10(C)	10	5.0 miles ENE	56.25^{o} - 78.75^{o}	Located on SE side of Rt. 48 bridge

TABLE A-1 (continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLE LOCATIONS

Sample Medium	Station Code	Map Number	Location	Azimuth	Description
AP, TLD, AI, SO, G	CL-11(C)	11	16 miles S	168.75° - 191.25°	Located in Argenta near Illinois Power Substation
WW	CL-12	12	1.6 miles E	78.75° - 101.25°	Located at the Dewitt pumphouse
SW, BS	CL-13	13	3.6 miles SW	213.75° - 267.25°	Located near the Salt Creek bridge on Rt. 10
DW	CL-14	at CPS	Plant Service Building	N/A	Located in the Service Building
VE	CL-18	18	1.6 miles E	78.75° - 101.25°	Located at family residence off Old Clinton Road
F, BS, SS, SL	CL-19	19	3.4 miles E	78.75° - 101.25°	E of site at end of discharge flume
TLD	CL-20	20	12.2 miles ENE	56.25° - 78.75°	Located at the Farmer City cemetery
TLD	CL-21	21	0.9 miles NNE	11.25° - 33.75°	Located at intersection of Rt. 54 and 1675E
TLD	CL-22	22	0.6 miles NE	33.75° - 56.25°	Located on site's secondary access road
TLD	CL-23	23	0.5 miles ENE	56.25° - 78.75°	Located on site's secondary access road
TLD	CL-24	24	0.5 miles E	78.75° - 101.25°	Located on site's secondary access road
TLD	CL-25	25	0.4 miles ESE	101.25° - 123.75°	Located on Restricted Area Fence
TLD	CL-26	26	0.3 miles SE	123.75° - 146.25°	Located on Restricted Area Fence

TABLE A-1 (continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLE LOCATIONS

Sample Medium	Station Code	Map Number	Location	Azimuth	Description
TLD	CL-27	27	0.6 miles SSE	146.25° - 168.75°	Located on Restricted Area Fence near driveway to Met Tower
TLD	CL-28	28	0.5 miles S	168.75° - 191.25°	Located on Restricted Area Fence
TLD	CL-29	29	0.6 miles SSW	191.25° - 213.75°	Located on Restricted Area Fence
TLD	CL-30	30	0.7 miles SW	213.75° - 236.25°	Located on Restricted Area Fence at entrance to Illinois Power Recreation Area
TLD	CL-31	31	0.8 miles WSW	236.25° - 258.75°	Located on Restricted Area Fence near Illinois Power Recreation Area softball field
TLD	CL-32	32	0.7 miles WSW	236.25° - 258.75°	Located on Restricted Area Fence near Clinton lake
TLD	CL-33(C)	33	11 miles SSW	191.25° - 213.75°	Located in Maroa at family residence
TLD	CL-34	34	0.8 miles WNW	281.25° - 303.75°	Located at CPS Visitor Center
TLD	CL-35	35	0.7 miles NW	303.75° - 326.25°	Located at CPS Visitor Center near Rt. 54 Bridge
TLD	CL-36	36	0.6 miles N	348.75° - 11.25°	Located near Rt. 54 and Main Access Road
TLD	CL-37	37	3.4 miles N	348.75° - 11.25°	Located in rural Birkbeck
TLD	CL-38	38	3.6 miles NNE	11.25° - 33.75°	Located near microwave tower north of plant

TABLE A-1 (continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLE LOCATIONS

Sample Medium	Station Code	Map Number	Location	Azimuth	Description
TLD	CL-39	39	3.8 miles NE	33.75° - 56.25°	Located 2 miles N of Dewitt
TLD	CL-40	40	3.5 miles NE	33.75° - 56.25°	Located 0.6 miles N of Dewitt
TLD	CL-41	41	2.4 miles E	78.75° - 101.25°	Located at S Dewitt city limit
TLD	CL-42	42	2.8 miles ESE	101.25° - 123.75°	Located S of Rt. 14 bridge
TLD	CL-43	43	2.8 miles SE	123.75° - 146.25°	Located [illegible] Clinton Marina access road
TLD	CL-44	44	2.3 miles SSE	146.25° - 168.75°	Located near Clinton Marine Boat Sales
TLD	CL-45	45	2.8 miles S	168.75° - 191.25°	Located at Lane Day Use Area
TLD	CL-46	46	2.8 miles SSW	191.25° - 213.75°	Located at Peninsula Day Use Area
TLD	CL-47	47	3.3 miles SW	213.75° - 236.25°	Located near Clinton Lake Dam Access Road
TLD	CL-48	48	2.3 miles WSW	236.25° - 258.75°	Located at residence on West Side Access Road
TLD	CL-49	49	3.5 miles W	258.75° - 281.25°	Located W of site along Rt. 54
TLD	CL-50	50	3.2 miles WNN	281.25° - 303.75°	Located WNN of site
TLD	CL-51	51	4.4 miles NW	303.75° - 326.25°	Located NW of site
TLD	CL-52	52	4.3 miles NNW	326.25° - 348.75°	Located NNW of site
TLD	CL-53	53	4.3 miles E	78.75° - 101.25°	Located near Weldon Boat Access

TABLE A-1 (continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLE LOCATIONS

Sample Medium	Station Code	Map Number	Location	Azimuth	Description
TLD	CL-54	54	4.6 miles ESE	101.25° - 123.75°	Located near subdivision in rural Weldon
TLD	CL-55	55	4.1 miles SE	123.75° - 146.25°	Located in rural Weldon
TLD	CL-56	56	4.1 miles SSE	146.25° - 168.75°	Located in rural between Weldon and Lane
TLD	CL-57	57	4.6 miles S	168.75° - 191.25°	Located in rural Lane
TLD	CL-58	58	4.3 miles SSW	191.25° - 213.75°	Located in rural Lane
TLD	CL-59	59	3.3 miles SSW	191.25° - 213.75°	Located near Lane city limit
TLD	CL-60	60	4.5 miles SW	213.75° - 236.25°	Located SW of Clinton Lake dam near Salt Creek
TLD	CL-61	61	4.5 miles WSW	236.25° - 258.75°	WSW of site
TLD	CL-62	62	1.9 miles NW	303.75° - 326.25°	Located in rural Birkbeck
TLD	CL-63	63	1.3 miles NNW	326.25° - 348.75°	Located at North Fork Boat Access
TLD	CL-64	64	2.1 miles WNW	281.25° - 303.75°	Located in rural Birkbeck
TLD	CL-65	65	2.6 miles ENE	56.25° - 78.75°	Located at residence in Dewitt
TLD	CL-66	6	0.8 miles WSW	236.25° - 258.75°	Located near the Illinois Power Recreation Area Softball Field
TLD	CL-67	4	0.7 miles SW	213.75° - 236.25°	Located on farm left of Illinois Power Recreation Area
TLD	CL-68	68	4.6 miles N	348.75° - 11.25°	Located N of site

TABLE A-1 (continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLE LOCATIONS

Sample Medium	Station Code	Map Number	Location	Azimuth	Description
TLD	CL-69	3	0.7 miles NE	33.75° - 56.25°	Located on site secondary access road
TLD	CL-70	2	0.7 miles NNE	11.25° - 33.75°	Located on site main access road
TLD	CL-71	2	0.7 miles NNE	11.25° - 33.75°	Located on site main access road
TLD	CL-72	72	4.5 miles NNE	11.25° - 33.75°	Located NNE of site
TLD	CL-73	73	5.1 miles ENE	56.25° - 78.75	Located near soybean processing plant north of Rt. 48
TLD	CL-74	74	1.9 miles W	258.75° - 281.25°	Located at Camp Quest
TLD	CL-75	75	0.94 miles N	348.75° - 11.25°	Located N of site
TLD	CL-76	76	4.6 miles N	348.75° - 11.25°	Located N of site
TLD	CL-77	72	4.5 miles NNE	11.25° - 33.75°	Located NNE of site
TLD	CL-78	78	4.6 miles NE	33.75° - 56.25°	Located NE of site
TLD	CL-79	79	4.5 miles ENE	56.25° - 78.75°	Located ENE of site
TLD	CL-80	80	4.1 miles W	258.75° - 281.25°	Located W of site
TLD	CL-81	81	4.5 miles WNW	281.25° - 303.75°	Located WNW of site
TLD	CL-82	82	1.4 miles W	258.75° - 281.25°	Located at Illinois Power Recreation Area
TLD	CL-83	83	0.5 miles NNE	11.25° - 33.75°	Located near Old Rt. 54
TLD	CL-84	94	0.6 miles E	78.75° - 101.25°	Located on Old Clinton Road between Dewitt and site

TABLE A-1 (continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLE LOCATIONS

Sample Medium	Station Code	Map Number	Location	Azimuth	Description
TLD	CL-85	85	0.6 miles ESE	101.25° - 123.75°	Located ESE of site
TLD	CL-86	86	0.6 miles E	78.75° - 101.25°	Located on Old Clinton Road between Dewitt and site
TLD	CL-87	87	0.6 miles SE	123.75° - 146.25°	Located near flume access road
SS	CL-88	88	2.4 miles SE	123.75° - 146.25°	Located SE of site
BS, SS	CL-89	89	3.6 miles NNE	11.25° - 33.75°	Located NNE of site
SW	CL-90	90	0.4 miles ESE	101.25° - 123.75°	Located at start of discharge flume
SW	CL-91	91	6.4 miles ENE	56.25° - 78.75°	Located at Parnell Boat Access
SW	CL-92	92	0.1 miles NW	303.75° - 326.25°	Located at CPS Intake Screenhouse
SW	CL-93	93	0.4 miles SW	213.75° - 236.25°	Located at CPS Settling Pond
AP, AI, SO	CL-94	94	0.6 miles E	78.75° - 101.25°	Located on Old Clinton Road between Dewitt and site
F, SS, BS, SL	CL-105 (C)	105	50.0 miles S	168.75° - 191.25°	Located at Lake Shelbyville
ME	CL-106	106	2.0 miles NNE	11.25° - 33.75°	Located NNE of site
TLD	CL-109	109	0.7 miles WSW	236.25° - 258.75°	Located on Restricted Area Fence near Shooting Range
TLD	CL-110	110	0.8 miles SW	213.75° - 236.25°	Located on Restricted Area Fence
TLD	CL-111	111	0.6 miles NE	33.75° - 56.25°	Located near site secondary access road

TABLE A-1 (continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLE LOCATIONS

Sample Medium	Station Code	Map Number	Location	Azimuth	Description
TLD	CL-112	68	4.6 miles N	348.75^{o} - 11.25^{o}	Located N of site
TLD	CL-113	73	5.1 miles ENE	56.25^{o} - 78.75^{o}	Located near soybean processing plant north of Rt. 48
VE	CL-114 (C)	114	12.5 miles SSE	146.25^{o} - 168.75^{o}	Located SSE of site
VE	CL-115	115	0.7 miles NE	33.75^{o} - 56.25^{o}	Located NE of site
M	CL-116 (C)	116	14.0 miles WSW	236.25^{o} - 258.75^{o}	Located in rural Kenney
VE	CL-117	117	0.9 miles N	348.75^{o} - 11.25^{o}	Located N of site

(C) Control location all other locations indicator
* Control location for surface water only

TABLE A-2

SYNOPSIS OF THE 1987 OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

FOR THE CLINTON POWER STATION

Sample Type	Number of Sampling Locations	Collection Frequency	Number of Samples Collected	Type of Analysis	Analysis Frequency	Number of Samples Analyzed *
Air Particulate	9	Weekly	396	Gross Beta	Weekly	396
				Gamma Isotopic	Quarterly Composite	36
Air Iodine	9	Weekly	396	Iodine-131	Weekly	396
TLD	82	Quarterly (continuous)	306	Gamma Exposure	Quarterly	306
Surface Water(e)	4	Monthly	32	Gamma Isotopic	Monthly	32
				Tritium	Quarterly Composite	12
				Gross Beta	Monthly	32
				Tritium	Monthly	2
Surface Water (Intake)	2	Monthly	20	Gamma Isotopic	Monthly	20
				Tritium	Monthly	20
				Gross Beta	Monthly	20
				Gross Alpha (b)	Monthly (b)	10
Well Water (a)	1	Monthly	17	Gamma Isotopic	Monthly	14
				Gross Alpha	Bimonthly	12
				Gross Beta	Monthly	14
				Tritium	Quarterly Composite	4

TABLE A-2

SYNOPSIS OF THE 1987 OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

FOR THE CLINTON POWER STATION

Sample Type	Number of Sampling Locations	Collection Frequency	Number of Samples Collected	Type of Analysis	Analysis Frequency	Number of Samples Analyzed *
Well Water	2	Semi-monthly	46	Iodine-131	Semi-monthly	46
				Gross Alpha	Monthly Composite	20
				Gross Beta	Monthly Composite	20
				Gamma Isotopic	Monthly Composite	20
				Tritium	Quarterly Composite	8
Drinking Water	1	Monthly	10	Gross Alpha	Monthly	10
				Gross Beta	Monthly	10
				Gamma Isotopic	Monthly	10
				Tritium	Quarterly Composite	4
Effluent Water	1	Monthly	10	Gamma Isotopic	Monthly	10
				Gross Alpha	Monthly	10
				Iodine-131	Monthly	10
				Gross Beta	Monthly	10
				Tritium	Quarterly Composite	4
Bottom Sediments	6	Semi-annually	12	Gross Alpha	Semi-annually	12
				Gross Beta	Semi-annually	12
				Gamma Isotopic	Semi-annually	12
				Sr-90	Semi-annually	12

TABLE A-2

SYNOPSIS OF THE 1987 OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

FOR THE CLINTON POWER STATION

Sample Type	Number of Sampling Locations	Collection Frequency	Number of Samples Collected	Type of Analysis	Analysis Frequency	Number of Samples Analyzed *
Shoreline Sediments	7	Semi-annually	14	Gross Alpha	Semi-annually	14
				Gross Beta	Semi-annually	14
				Gamma Isotopic	Semi-annually	14
				Sr-90	Semi-annually	14
Aquatic Sediments	4	Semi-annually	8	Gamma Isotopic	Semi-annually	8
Grass	4	Monthly/Semi-monthly (May-October)	68	Gamma Isotopic (with Iodine-131)	Monthly/Semi-monthly	68
Vegetables (c)	4	Monthly (during growing season)	36	Gross Beta	Monthly	36
				Gamma Isotopic (I-131 required for green leafy vegetables)	Monthly (during growing season)	36
Fish	2	Semi-annual	16	Gamma Isotopic	Semi-annually	16
Milk	1	Monthly/Semi-Monthly (May-October)	18	Gamma Isotopic (with Iodine-131)	Monthly/Semi-monthly	18
				Sr-90 (d)	Monthly/Semi-monthly	5

TABLE A-2

SYNOPSIS OF THE 1987 OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

FOR THE CLINTON POWER STATION

Sample Type	Number of Sampling Locations	Collection Frequency	Number of Samples Collected	Type of Analysis	Analysis Frequency	Number of Samples Analyzed *
Soil	9	Triennially	0	Gamma Isotopic Gross Alpha Gross Beta	0	0
Meat	1	Annually (when available)	0	Gamma Isotopic	0	0

(a) Sample frequency changed in September 1987 to Semi-monthly, added I-131 analysis semi-monthly, changed analyses frequency on gross beta, gross alpha, and gamma isotopic to monthly composite of semi-monthly samples. Analysis for gross alpha was changed on samples from second month of each quarter to on all monthly composites.

(b) Samples taken at location CL-92 not analyzed for gross alpha.

(c) New sample location CL-117 and CL-18 deleted after the growing season.

(d) Sr-90 added to program in October, 1987.

(e) New sample location added in November, 1987 at location CL-93.

* - Number of samples analyzed does not include duplicate analysis, recounts, or reanalyses

TABLE A-3
SAMPLING AND ANALYSIS EXCEPTIONS FOR 1987

	Dates	Description
1.	February 25 to April 8, 1987	Elapsed timers at air sample stations CL-4 and CL-6 were inoperable during this time period. Air sampler was assumed operable during the entire time period for volume calculations. Inoperability was due to a failed elapsed timer and was replaced with a new timer when received.
2.	February 25 to March 4, 1987	A difference of 0.3 hours existed between the elapsed timer and actual time at air sample station CL-1 for this timer period. Actual time was used for volume calculations.
3.	March 18, 1987	Air sample station CL-7 had a blown fuse. Elapsed time of 99.7 hours was recorded. Fuse was replaced and normal operation resumed.
4.	March 25, 1987	Composite water samplers located at stations CL-14, CL-90 and CL-91 were inoperable during month of March. A composite of daily grab samples provided samples for the month.
5.	March 25, 1987	Grass samples required at sample stations CL-1, CL-2, CL-8 and CL-94 were not collected due to adverse weather conditions.
6.	March 31, 1987	TLD's from stations CL-7 and CL-59 were not found. This was due to vandalism of the cages which held the TLD's in place. (See note 1 on page A-19) The calculated dose for the quarter at station CL-7 is 20.0 mR and station CL-59 is 20.8 mR.
7.	April 1 to May 27, 1987	Elapsed timer at air sample station CL-7 was inoperable during this time period. Air sampler was assumed operable during the entire time period for volume calculations. Inoperability was due to a failed timer which was replaced when a new timer was received.
8.	April 22, 1987	The bottom of the air sample station shelter at CL-4 fell out of place due to termite and/or dryrot damage causing the sampler to become disconnected after 160.7 hours of operation. A sample flow rate of 60 scfh was assumed for volume calculation. The shelter failure also caused the elapsed timer wiring to break. The bottom of the sample station shelter was repaired and normal sample operation resumed later on this date.

TABLE A-3 (continued)
SAMPLING AND ANALYSIS EXCEPTIONS FOR 1987

	Dates	Description
9.	April 22 to June 10, 1987	Elapsed timer at air sample station CL-4 was inoperable during this time period. Air sampler was assumed operable during the entire time period for volume calculations. Inoperability was due to the problem described in item 8 above.
10.	April 29, 1987	Composite water sampler located at station CL-91 was inoperable during the month of April. A composite of daily grab samples provided samples for the month.
11.	May 27, 1987	Composite water sampler located at station CL-91 was inoperable during the month of May. A composite of daily grab samples provided samples for the month.
12.	May 27 to June 3, 1987	Particulate filter paper found damaged at air sample station CL-94. Filter was damaged due to the station shelter being damaged by adverse weather. Sample results were disregarded as unreliable. The sample shelter was repaired and the station returned to normal operation.
13.	June 17, 1987	Air sample stations CL-2, CL-4 and CL-8 had blown fuses. Elapsed times of 66.1 hours (CL-2), 66.1 hours (CL-4) and 148.5 hours (CL-8) were recorded. The fuses were replaced and normal operations resumed. CL-4 elapsed timer had been removed for maintenance and the sample time was assumed to be the same as CL-2. The likely cause of fuse failure was severe electrical storms which occurred at the approximate time of failures.
14.	June 14, 1987	Composite water sample stations CL-91 and CL-90 were inoperable for portions of month. Samples consisted of 19 days of daily grab samples of 250 ml and 6 days of samples collected by compositor at 20 ml per hour.
15.	June 24 to July 9, 1987	Elapsed timer at air sample station CL-4 removed for maintenance during this time period. Assumed continuous operations at the sample station for the entire time period for volume calculations.

TABLE A-3 (continued)
SAMPLING AND ANALYSIS EXCEPTIONS FOR 1987

Dates	Description
16. June 24, 1987	Corn and soybean leaves were collected at sample station CL-115 instead of lettuce, swiss chard and cabbage, due to poor garden conditions. Cabbage, swiss chard and lettuce transplants were added on 6/22/87 to provide for further samples during growing season.
17. June 30, 1987	TLD's from stations CL-23, CL-35, CL-41, CL-58, CL-59, CL-72, CL-74, CL-77 and CL-82 were not found. This was due to the vandalism of the cages which held the TLD's in place. (Note 1) The calculated dose for the quarter at stations CL-23 is 17.0 mR, CL-35 is 18.6 mR, CL-41 is 17.4 mR, CL-58 is 19.2 mR, CL-59 is 20.8 mR, CL-72 is 18.9 mR, CL-74 is 19.6 mR, CL-77 is 17.5 mR and CL-82 is 17.2 mR.
18. July 15, 1987	Air sample station CL-4 had a blown fuse. Elapsed time of 99.5 hours was recorded. Fuse was replaced and normal operation resumed.
19. July 22, 1987	Air sample station CL-4 had a blown fuse. Elapsed time of 53.0 hours was recorded. Fuse was replaced and normal operation resumed.
20. July 29, 1987	Soybean leaves were collected at sample stations CL-18, CL-114 and CL-115 instead of lettuce, due to poor growth. In addition, corn leaves at station CL-114 were collected. Station CL-117 was added, soybean and corn leaves were sampled instead of the regular broad leaf vegetation.
21. August 19, 1987	Air sample station CL-8 had a blown fuse. The elapsed timer showed 101.1 hours. The fuse was replaced and normal operation resumed.
22. August 26, 1987	Air sample station CL-8 had a blown fuse. Elapsed time of 23.7 hours was recorded. Fuse was replaced and normal operation resumed.

TABLE A-3 (continued)
SAMPLING AND ANALYSIS EXCEPTIONS FOR 1987

23.	September 23, 1987	Air sample station CL-8 had a pump motor failure. Elapsed time of 9 hours was recorded. Replaced unit and normal operation resumed.
24.	September 29, 1987	TLD's from stations CL-41, CL-62, CL-72, CL-74, CL-77, CL-82 and CL-111 were not found. This was due to the vandalism of the cages which held the TLD's in place. In addition, TLD's from stations CL-23, CL-24 and CL-58 were found on the ground due to vandalism of cages. Results from CL-23 and CL-58 were disregarded because moisture found in TLD cases caused biased readings (approx. 50% low) (Note 1). The calculated dose for the quarter at stations CL-41 is 17.4 mR, CL-62 is 20.3 mR, CL-72 is 18.9 mR, CL-74 is 19.6 mR, CL-77 is 17.5 mR, CL-82 is 17.2 mR, CL-23 is 17.0 mR, CL-58 is 19.2 mR, and CL-111 is 13.4 mR.
25.	September 29, 1987	TLD from station CL-45 was lost in the shipping process. No analysis was performed (Note 1). The calculated dose for the quarter at station CL-45 is 22.4 mR.
26.	September 30, 1987	Lettuce samples were unavailable at sample stations CL-18, CL-114, CL-115 or CL-117 because the growing season had past. In addition, swiss chard was unavailable at CL-115. Soybean or corn leaves were not available at all sites as substitutes due to harvest.
27.	November 25, 1987	Insufficient sample volume collected by water compositor at sample station CL-91. A grab sample was obtained at the location and added to the composite sample to meet required sample volume (approximately 50% by grab and 50% by composite).
28.	December 2, 1987	Elapsed timer at air sample station CL-3 was found inoperable. Air sampler was assumed operable for entire week of November 25, 1982 to December 2, 1987 and a calculated time of 168.0 hours was used for volume calculations. Timer was replaced and normal operation was resumed.

TABLE A-3 (continued)
SAMPLING AND ANALYSIS EXCEPTIONS FOR 1987

29. December 29, 1987 — TLD's from stations CL-41, CL-76 and CL-80 were not found. This was due to the vandalism of the cages which held the TLD's in place. Theft proof cages were installed at these locations to prevent recurrence. In addition, TLD's from stations CL-30, CL-44, CL-59, CL-62 and CL-110 were found on the ground due to vandalism of cages. Results from TLD's found on ground were accepted and included in this report (Note 1). The calculated dose for the quarter at stations CL-41 is 17.4 mR, CL-76 is 20.1 mR and CL-80 is 19.9 mR.

NOTE 1: Missing TLD data or TLD data found unacceptable were calculated in the following manner. The average quarterly dose found at the same location for the other quarters collected in the year (i.e., Quarter 1 missing at site x, Quarters 2, 3 and 4 had readings of 21.2 mR, 18.1 mR and 20.6 mR respectively. Quarter 1 = Quarter 2 + Quarter 3 + Quarter 4 divided by 3, 21.2 + 18.1 + 20.6 / 3 = 20.0 mR).

APPENDIX B

LLD Exceptions in 1987
and Required Detection Capabilities

The U.S. NRC establishes minimum acceptable detection capabilities for analyses conducted by the radiological environmental monitoring program. This value is expressed as the Lower Limit of Detection (LLD) and corresponds to a level of activity concentration that is practically achievable with a given instrument, method and type of sample.

Table B-1, Analytical Results which Failed to Meet the Required LLD during 1987, lists the exceptions to the required LLD's during the monitoring period and the reason the exceptions were taken.

Table B-2, Detection Capabilities for Environmental Sample Analysis, lists the minimum required LLD's required by the Clinton Power Station Technical Specifications.

TABLE B-1
ANALYTICAL RESULTS WHICH
FAILED TO MEET THE REQUIRED LLD DURING 1987

	Date	Sample Medium	Analysis	Required LLD	Obtained LLD	Location(a)	Comments
1.	3/18/87	Air Iodine	I-131	0.07 pCi/m^3	0.08 pCi/m^3	CL-7	Sampler malfunction due to blown fuse reducing sample volume.
2.	7/8/87	Air Iodine	I-131	0.07 pCi/m^3	0.11 pCi/m^3	CL-2	Sampler malfunction due to blown fuse reducing sample volume.
3.	7/22/87	Air Iodine	I-131	0.07 pCi/m^3	0.15 pCi/m^3	CL-4	Sampler malfunction due to blown fuse reducing sample volume.
4.	8/26/87	Air Iodine	I-131	0.07 pCi/m^3	0.09 pCi/m^3	CL-6	Sampler malfunction due to blown fuse reducing sample volume.
5.	9/23/87	Air Iodine	I-131	0.07 pCi/m^3	0.80 pCi/m^3	CL-8	Sampler malfunction due to sample pump motor failure reducing sample volume.
6.	9/23/87	Air Particulate	Gross Beta	0.01 pCi/m^3	0.08 pCi/m^3	CL-8	Sampler malfunction due to sample pump motor failure reducing sample volume.

(a) Refer to Table A-1 for location descriptions

TABLE B-2
DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS (a)(b)
LOWER LIMIT OF DETECTION (LLD)

Analysis	Water (pCi/l)	Airborne Particulate or Gas (pCi/m³)	Fish (pCi/kg, wet)	Milk (pCi/l)	Food Products (pCi/kg, wet)	Sediment (pCi/kg, dry)
Gross Beta	4	0.01	--	--	--	--
H-3	2000*	--	--	--	--	--
Mn-54	15	--	130	--	--	--
Fe-59	30	--	260	--	--	--
Co-58,60	15	--	130	--	--	--
Zn-65	30	--	260	--	--	--
Zr-95	30	--	--	--	--	--
Nb-95	15	--	--	--	--	--
I-131	1**	0.07	--	1	60	--
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-140	60	--	--	60	--	--
La-140	15	--	--	15	--	--

Table Notations

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

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

(a) This list does not mean that only these nuclides are to be considered. Other peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported.

(b) Required detection capabilities for TLD's used for environmental measurements shall be in accordance with the recommendations of Regulatory Guide 4.13, Revision 1, July 1977.

APPENDIX C

Changes to REMP in 1987

The following permanent changes were made in the Radiological Environmental Monitoring Program during 1987.

1.	August, 1987	Indicator vegetation station CL-117 was initiated and the site was selected in highest D/Q sector to replace station CL-18 at the end of the growing season.
2.	September, 1987	Added iodine-131 analysis for well water sample station CL-7. Collection frequency was changed from monthly samples to monthly composites of semi-monthly collections. Analysis for gross alpha was changed on samples from second month of each quarter to all monthly samples.
3.	October, 1987	Analysis for strontium-90 added to milk sample station CL-116.
4.	October, 1987	Indicator vegetation station CL-18 replaced by station CL-117.
5.	November, 1987	Indicator surface water station CL-93 initiated, bringing total number of surface water grab sample locations to four.

APPENDIX D

Determination of Investigation Levels and Subsequent Actions

Data from the radiological analysis of environmental samples were routinely reviewed and evaluated by the Clinton Power Station Radiological Environmental Group. The data was checked for LLD violations, anomalous values, Technical Specification reporting levels, main sample and quality control sample agreement (Appendix E) and action levels.

Action levels established in the Clinton Power Station Technical Specifications, are defined as the level of radioactivity resulting from plant effluents in an environmental sampling medium at a specified location is detected exceeding those concentrations as listed in Table D-1 when averaged over a calendar quarter or when radionuclides other than those listed in Table D-1 are detected as a result of plant effluents.

If an action level is reached, an investigation is initiated which consists of some or all of the following actions:

1. Examine the collection data sheets for any indication of equipment malfunctions, collection or delivery errors.

2. Examine previous data for trends.

3. Review control station data.

4. Review quality control or duplicate sample data.

5. Review CPS effluent reports.

6. Recount and/or reanalyze the sample.

7. Collect additional samples as necessary.

The results of any investigation are documented in this report. During 1987 no investigations were performed as a result of reaching any technical specification action level. Six LLD violations occurred during 1937 and are documented in Appendix B. All other sampling and analysis exceptions are listed in Table A-3 of Appendix A.

TABLE D-1

CPS REMP ACTION LEVELS FOR POSITIVE RADIOACTIVITY

CONCENTRATIONS IN ENVIRONMENTAL SAMPLES(a)

Analysis	Water (pCi/l)	Airborne Particulates or Gases (pCi/m^3)	Fish (pCi/kg, Wet)	Milk (pCi/l)	Food Products (pCi/kg, wet)
H-3	20,000*	---	---	---	---
Mn-54	1,000	---	30,000	---	---
Fe-59	400	---	10,000	---	---
Co-58	1,000	---	30,000	---	---
Co-60	300	---	10,000	---	---
Zn-65	300	---	20,000	---	---
Zr-Nb-95	400#	---	---	---	---
I-131	2**	0.9	---	3	100
Cs-134	30	10	1,000	60	1,000
Cs-137	50	20	2,000	70	2,000
Ba-La-140	200#	---	---	300#	---

* For drinking water samples. This is the 40 CFR Part 141 value. If no drinking water pathway exists, a value of 30,000 pCi/l may be used.

** If no drinking water pathway exists, a value of 20 pCi/l may be used.

\# Total for parent and daughter

(a) This list does not mean these nuclides are the only ones considered. Other nuclides identified are also analyzed and reported when applicable.

APPENDIX E

1987 Quality Assurance Results

The Radiological Environmental Monitoring Program includes several features that assure high quality results. One feature is the requirement that the contractor analysis laboratory, Teledyne Isotopes Midwest Laboratory (TIML), participate in the U.S. Environmental Protection Agency laboratory crosscheck program. Table E-1 shows the crosscheck results obtained between May 1984 and December 1987. During the period 333 crosscheck analysis were reported. Ten of the reported results (i.e. the result plus or minus 2 times the standard deviation of the result) fell out of the control limits. The control limits were set at the known value plus or minus 1.71 times the standard deviation of the known value. In 1987, ninety-two crosscheck results were reported. None of these ninety-two fell outside the control limits.

TLD intercomparisons are not held every year. Pertinent data from the Seventh International Intercomparison (1984) and the Eighth International Intercomparison (1985-6) are presented in Table E-2. Reasonable good agreement is seen in each sample. TIML tended to overestimate the known value by about 4% (+1.3% to +8.8%).

Another aspect of quality assurance is the in-house program of testing, in which samples spiked with known amounts of radioactive material, or blanks containing no additional radioactive material are submitted for analysis. Table E-3 shows the results of the in-house spiked sample program. Good agreement between known and reported values was obtained. In all cases except four the error bands of the known and reported values overlapped. In the four cases when they did not overlap, the error was due to reporting a small positive result when the known value was zero. Table E-4 presents the results of the in-house blank sample program. The only activity expected in these samples is due to naturally-occurring and fallout-related radionuclides. No anomalous results were reported. Table E-5 shows the acceptance criteria for the spiked samples program.

The results presented in these tables indicated that TIML is capable of routinely performing high quality analysis on environmental samples.

TABLE E-1

U.S. EPA CROSSCHECK PROGRAM (a)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l (b) TIML Result ±2 s.d.(c)	EPA Result (d) 1s, N=1	Control Limits
STW-358	Water	May 1984	Gr. alpha	3.0±0.6	3±5.0	0.0-11.7
			Gr. beta	6.7±1.2	6±5.0	0.0-14.7
STM-366	Milk	June 1984	Sr-89	21±3.1	25±5.0	16.3-33.7
			Sr-90	13±2.0	17±1.5	14.4-19.6
			I-131	46±5.3	43±6.0	32.6-53.4
			Cs-137	38±4.0	35±5.0	26.3-43.7
			K-40	1577±172	1496±75	1336-1626
STW-368	Water	July 1984	Gr. alpha	5.1±1.1	6±5.0	0.0-14.7
			Gr. beta	11.9±2.4	13±5.0	4.3-21.7
STW-369	Water	Aug. 1984	I-131	34.3±5.0	34.0±6.0	23.6-44.4
STW-370	Water	Aug. 1984	H-3	3003±253	2817±356	2200-3434
STF-371	Food	July 1984	Sr-89	22.0±5.3	25.0±5.0	14.3-33.7
			Sr-90	14.7±3.1	20.0±1.5	17.4-22.6
			I-131	< 172	39.0±6.0	28.6-49.4
			Cs-137	24.0±5.3	25.0±5.0	14.3-33.7
			K-40	2503±132	2605±130	2379-2831
STAF-372	Air Filter	Aug. 1984	Gr. alpha	15.3±1.2	17±5.0	8.3-25.7
			Gr. beta	56.0±0.0	51±5.0	42.3-59.7
			Sr-90	14.3±1.2	18±1.5	15.6-20.4
			Cs-137	21.0±2.0	15±5.0	6.3-23.7
STW-375	Water	Sept 1984	Ra-226	5.1±0.4	4.9±0.7	3.6-6.2
			Ra-228	2.2±0.1	2.3±0.4	1.7-2.9
STW-377	Water	Sept 1984	Gr. alpha	3.3±1.2	5.0±5.0	0.0-13.7
			Gr. beta	12.7±2.3	16.0±5.0	7.3-24.7
STW-379	Water	Oct 1984	H-3	2860±312	2810±205	2454-3166
STW-380	Water	Oct 1984	Cr-51	< 36	40±5.0	31.3-48.7
			Co-60	20.3±1.2	20±5.0	11.3-28.7
			Zn-65	150±8.1	147±5.0	138.3-155.7
			Ru-106	< 30	47±5.0	36.3-55.7
			Cs-134	31.3±7.0	31±5.0	22.3-39.7
			Cs-137	26.7±1.2	24±5.0	15.3-32.7

TABLE E-1 (continued)

U.S. EPA CROSSCHECK PROGRAM (a)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l (b) TIML Result ±2 s.d.(c)	EPA Result (d) 1s, N=1	Control Limits
STM-382	Milk	Oct 1984	Sr-89	15.7±4.2	22±5.0	13.3-30.7
			Sr-90	12.7±1.2	16±1.5	13.4-18.6
			I-131	41.7±3.1	42±6.0	31.6-42.4
			Cs-137	31.3±6.1	32±5.0	23.3-40.7
			K-40	1447±66	1517±76	1386-1648
STW-384	Water (Blind)	Oct 1984 Sample A	Gr. alpha	9.7±1.2	14±5.0	5.3-22.7
			Ra-226	3.3±0.2	3.0±0.5	2.2-3.8
			Ra-228	3.4±1.6	2.1±0.3	1.6-2.6
			Uranium	NA (e)		0.0-15.4
		Sample B	Gr. beta	48.3±5.0	64±5.0	55.3-72.7
			Sr-89	10.7±4.6	11±5.0	2.3-19.7
			Sr-90	7.3±1.2	12±1.5	9.4-14.6
			Co-60	16.3±1.2	14±5.0	5.3-22.7
			Cs-134	<2	2±5.0	0.0-10.7
			Cs-137	16.7±1.2	14±5.0	5.3-22.7
STAF-387	Air Filter	Nov 1984	Gr. alpha	18.7±1.2	15±5.0	6.3-23.7
			Gr. beta	59.0±5.3	52±5.0	43.3-60.7
			Sr-90	18.3±1.2	21±1.5	18.4-23.6
			Cs-137	10.3±1.2	10±5.0	1.3-18.7
STW-388	Water	Dec 1984	I-131	28.0±2.0	36±6.0	25.6-36.4
STW-389	Water	Dec 1984	H-3	3583±110	3182±360	2558-3806
STW-391	Water	Dec 1984	Ra-226	8.4±1.7	8.6±1.3	6.4-10.8
			Ra-228	3.1±0.2	4.1±0.6	3.0-5.2
STW-392	Water	Jan 1985	Sr-89	<3.0	3.0±5.0	0.0-11.7
			Sr-90	27.3±5.2	30.0±1.5	27.4-32.6
STW-393	Water	Jan 1985	Gr. alpha	3.3±1.2	5±5.0	0.0-13.7
			Gr. beta	17.3±3.0	15±15.0	6.3-23.7
STS-395	Food	Jan 1985	Gr. alpha	4.7±2.3	6.0±5.0	0.0-14.7
			Gr. beta	11.3±1.2	15.0±5.0	6.3-23.7
			Sr-89	25.3±6.4	34.0±5.0	25.3-42.8
			Sr-90	27.0±8.8	26.0±1.5	23.4-28.6
			I-131	38.0±2.0	35.0±6.0	24.6-45.4
			Cs-137	32.7±2.4	29.0±5.0	20.3-37.7
			K-40	1410±212	1382±120	1174-1590

TABLE E-1 (continued)

U.S. EPA CROSSCHECK PROGRAM (a)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l (b) TIML Result ±2 s.d.(c)	EPA Result (d) 1s, N=1	Control Limits
STW-397	Water	Feb 1985	Cr-51	< 29	48±5.0	39.3-56.7
			Co-60	21.3±3.0	20±5.0	11.3-28.7
			Zn-65	53.7±5.0	55±5.0	46.3-63.7
			Ru-106	< 23	25±5.0	16.3-33.7
			Cs-134	32.3±1.2	35±5.0	26.3-43.7
			Cs-137	25.3±3.0	25±5.0	16.3-33.7
STW-398	Water	Feb 1985	H-3	3869±19	3796±634	3162-4430
STM-400	Milk	March 1985	I-131	7.3±2.4	9.0±0.9	7.4-10.6
STW-402	Water	March 1985	Ra-226	4.6±0.6	5.0±0.8	3.7-6.3
			Ra-228	<0.8	9.0±1.4	6.7-11.3
		Reanalysis	Ra-228	9.0±0.4		
STW-404	Water	March 1985	Gr. alpha	4.7±2.3	6±5.0	0.0-14.7
			Gr. beta	11.3±1.2	15±5.0	6.3-23.7
STAF-405	Air Filter	March 1985	Gr. alpha	9.3±1.0	10.0±5.0	1.3-18.7
			Gr. beta	42.0±1.1	36.0±5.0	27.3-44.7
			Sr-90	13.3±1.0	15.0±1.5	12.4-17.6
			Cs-137	6.3±1.0	6.0±5.0	0.0-14.7
STW-407	Water	April 1985	I-131	8.0±0.0	7.5±0.8	6.2-8.8
STW-408	Water	April 1985	H-3	3399±150	3559±630	2929-4189
STW-409	Water (Blind) Sample A	April 1985	Gr. alpha	29.7±1.8	32.0±5.0	23.3-40.7
			Ra-226	4.4±0.2	4.1±0.6	3.1-5.1
			Ra-228	NA (e)	6.2±0.9	4.6-7.8
			Uranium	NA (e)	7.0±6.0	0.0-17.4
	Sample B		Gr. beta	74.3±11.8	72.0±5.0	63.3-80.7
			Sr-89	12.3±7.6	10.0±5.0	1.3-18.7
			Sr-90	14.7±2.4	15.0±1.5	12.4-17.6
			Co-60	14.7±2.4	15.0±5.0	6.3-23.7
			Cs-134	12.0±2.0	15.0±5.0	6.3-23.7
			Cs-137	14.0±2.0	12.0±5.0	3.3-20.7

TABLE E-1 (continued)

U.S. EPA CROSSCHECK PROGRAM (a)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l (b) TIML Result ±2 s.d.(c)	EPA Result (d) 1s, N=1	Control Limits
STW-413	Water	May 1985	Sr-89	36.0±12.4	39.0±5.0	30.3-47.7
			Sr-90	14.3±4.2	15.0±1.5	12.4-17.6
STW-414	Water	May 1985	Gr. alpha	8.3±4.1	12.0±5.0	3.3-20.7
			Gr. beta	8.7±1.2	11.0±5.0	2.3-19.7
STW-416	Water	June 1985	Cr-51	44.7±6.0	44.0±5.0	45.3-52.7
			Co-60	14.3±1.2	14.0±5.0	5.3-22.7
			Zn-65	50.3±7.0	47.0±5.0	38.3-55.7
			Ru-106	55.3±5.8	62.0±5.0	53.3-70.7
			Cs-134	32.7±1.2	35.0±5.0	26.3-43.7
			Cs-137	22.7±2.4	20.0±5.0	11.3-28.7
STW-418	Water	June 1985	H-3	2446±132	2416±351	1807-3025
STM-421	Milk	June 1985	Sr-89	10.3±4.6	11.0±5.0	2.3-19.7
			Sr-90	9.0±2.0	11.0±1.5	8.4-13.6
			I-131	11.7±1.2	11.0±6.0	0.6-21.4
			Cs-137	12.7±1.2	11.0±5.0	2.3-19.7
			K-40	1512±62	1525±132	1393-1657
STW-423	Water	July 1985	Gr. alpha	5.0±0.0	11.0±5.0	2.3-19.7
			Gr. beta	5.0±2.0	8.0±5.0	0.0-16.7
STW-425	Water	August 1985	I-131	25.7±3.0	33.0±6.0	22.6-43.4
STW-426	Water	August 1985	H-3	4363±83	4480±447	3704-5256
STAF-427	Air Filter	August 1985	Gr.alpha	11.3±0.6	13.0±5.0	4.3-21.7
			Gr.beta	46.0±1.0	44.0±5.0	35.3-52.7
			Sr-90	17.7±0.6	18.0±1.5	15.4-20.6
			Cs-137	10.3±0.6	8.0±5.0	0.0-16.7
STW-429	Water	Sept 1985	Sr-89	15.7±0.6	20.0±5.0	11.3-28.7
			Sr-90	7.0±0.0	7.0±1.5	4.4-9.6
STW-430	Water	Sept 1985	Ra-226	8.2±0.3	8.9±1.3	6.6-11.1
			Ra-228	4.1±0.3	4.6±0.7	3.4-5.8
STW-431	Water	Sept 1985	Gr.alpha	4.7±0.6	8.0±5.0	0.0-16.7
			Gr.beta	4.7±1.2	8.0±5.0	0.0-16.7

TABLE E-1 (continued)

U.S. EPA CROSSCHECK PROGRAM (a)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l (b) TIML Result ±2 s.d.(c)	EPA Result (d) 1s, N=1	Control Limits
STW-433	Water	Oct 1985	Cr-51	<13	21.0±5.0	12.3-29.7
			Co-60	19.3±0.6	20.0±5.0	11.3-28.7
			Zn-65	19.7±0.6	19.0±5.0	10.3-27.7
			Ru-106	<19	20.0±5.0	11.3-28.7
			Cs-134	17.0±1.0	20.0±5.0	11.3-28.7
			Cs-137	19.3±1.2	20.0±5.0	11.3-28.7
STW-435	Water	Oct 1985	H-3	1957±50	1974±345	1376-2572
STW-436 437	Water (Blind)	Oct 1985				
	Sample A		Gr. alpha	53.0±1.0	52.0±13	29.4-74.6
			Ra-226	5.9±0.1	6.3±1.0	4.1-7.9
			Ra-228	8.2±0.1	10.1±1.5	7.5-12.7
			Uranium	NA[e]	8.0±10.4	0.0-18.4
	Sample B		Gr. beta	85.7±2.5	75.0±5.0	76.3-83.7
			Sr-89	21.3±1.5	27.0±5.0	18.3-35.7
			Sr-90	10.3±0.6	9.0±1.5	6.4-11.6
			Co-60	18.3±1.2	18.0±5.0	9.3-26.7
			Cs-134	16.3±1.2	18.0±5.0	9.3-26.7
			Cs-137	19.0±1.0	18.0±5.0	9.3-26.7
STM-439	Milk	Oct 1985	Sr-89	50.3±0.6	48.0±5.0	39.3-56.7
			Sr-90	23.3±0.6	26.0±1.5	23.4-28.6
			I-131	45.7±3.2	42.0±6.0	31.6-52.4
			Cs-137	60.7±0.6	56.0±5.0	47.3-64.7
			K-40	1547±29	1540±77	1406-1674
STW-441	Water	Nov 1985	Gr. alpha	5.3±0.6	10.0±5.0	1.3-18.7
			Gr. beta	11.7±1.2	13.0±5.0	4.3-21.7
STW-443	Water	Dec 1985	I-131	46.7±2.1	45.0±6.0	34.6-55.4
STW-444	Water	Dec 1985	Ra-226	6.5±0.1	7.1±1.1	5.2-9.0
			Ra-228	6.1±0.1	7.3±1.1	5.4-9.2
STW-445	Water	Jan 1986	Sr-89	29.7±2.5	31.0±5.0	22.3-39.7
			Sr-90	13.7±0.6	15.0±1.5	12.4-17.6
STW-446	Water	Jan 1986	Gr. alpha	3.0±0.0	3.0±5.0	0.0-11.7
			Gr. beta	5.3±0.6	7.0±5.0	0.0-15.7

TABLE E-1 (continued)

U.S. EPA CROSSCHECK PROGRAM (a)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l (b)		
				TIML Result ±2 s.d.(c)	EPA Result (d) 1s, N=1	EPA Result (d) Control Limits
STF-447	Food	Jan 1986	Sr-89	24.3±.2.5	25.0±5.0	16.3-33.7
			Sr-90	17.3±0.6	10.0±1.5	7.4-12.6
			I-131	22.7±2.3	20.0±6.0	9.6-30.4
			Cs-137	16.3±0.6	15.0±5.0	6.3-23.7
			K-40	927±46	950±144	701-1199
STW-448	Water	Feb 1986	Cr-51	45.0±3.6	38.0±5.0	29.3-46.7
			Co-60	19.7±1.5	18.0±5.0	9.3-26.7
			Zn-65	44.0±3.5	40.0±5.0	31.3-48.7
			Ru-106	<9.0	0.0±5.0	0.0-8.7
			Cs-134	28.3±2.3	30.0±5.0	21.3-38.7
			Cs-137	23.7±0.6	22.0±5.0	13.3-30.7
STW-449	Water	Feb 1986	H-3	5176±48	5227±525	4317-6137
STW-450	Water	Feb 1986	U total	8.0±0.0	9.0±6.0	0.0-19.4
STM-451	Milk	Feb 1986	I-131	7.0±0.0	9.0±6.0	0.0-19.4
STW-452	Water	March 1986	Ra-226	3.8±0.1	4.1±0.6	3.0-5.2
			Ra-228	11.0±0.5	12.4±1.8	9.2-15.5
STW-453	Water	March 1986	Gr.alpha	6.7±0.6	15.0±5.0	6.3-23.7
			Gr.beta	7.3±0.6	8.0±5.0	0.0-16.7
STW-454	Water	April 1986	I-131	7.0±0.0	9.0±6.0	0.0-19.4
STW-455 456	Water (Blind)	April 1986				
	Sample A		Gr.alpha	15.0±1.0	17.0±5.0	8.3-25.7
			Ra-226	3.1±0.1	2.9±0.4	2.1-3.7
			Ra-228	1.5±0.2	2.0±0.3	1.5-2.5
			Uranium	4.7±0.6	5.0±6.0	0.0-15.4
	Sample B		Gr.beta	28.7±1.2	35.0±5.0	26.3-43.7
			Sr-89	5.7±0.6	7.0±5.0	0.0-15.7
			Sr-90	7.0±0.0	7.0±1.5	4.4-9.6
			Co-60	10.7±1.5	10.0±5.0	1.3-18.7
			Cs-134	4.0±1.7	5.0±5.0	0.0-13.7
			Cs-137	5.3±0.6	5.0±5.0	0.0-13.7

TABLE E-1 (continued)
U.S. EPA CROSSCHECK PROGRAM (a)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l (b) TIML Result ±2 s.d.(c)	EPA Result (d) 1s, N=1	Control Limits
STAF-457	Air Filter	April 1986	Gr. alpha	13.7±0.6	15.0±5.0	6.3-23.7
			Gr. beta	46.3±0.6	47.0±5.0	38.3-55.7
			Sr-90	14.7±0.6	18.0±1.5	15.4-20.6
			Cs-137	10.7±0.6	10.0±5.0	1.3-18.7
STU-458	Urine	April 1986	Tritium	4313±70	4423±189	4096-4750
STW-459	Water	May 1986	Sr-89	4.3±0.6	5.0±5.0	0.0-13.7
			Sr-90	5.0±0.0	5.0±1.5	2.4-7.6
STW-460	Water	May 1986	Gr. alpha	5.3±0.6	8.0±5.0	0.0-16.7
			Gr. beta	11.3±1.2	15.0±5.0	6.3-23.7
STW-461	Water	June 1986	Cr-51	<9.0	0.0±5.0	0.0-8.7
			Co-60	66.0±1.0	66.0±5.0	57.3-74.7
			Zn-65	87.3±1.5	86.0±5.0	77.3-94.7
			Ru-106	39.7±2.5	50.0±5.0	41.3-58.7
			Cs-134	49.3±2.5	49.0±5.0	40.3-57.7
			Cs-137	10.3±1.5	10.0±5.0	1.3-18.7
STW-462	Water	June 1986	Tritium	3427±25	3125±361	2499-3751
STM-464	Milk	June 1986	Sr-89	<1.0	0.0±5.0	0.0-8.7
			Sr-90	15.3±0.6	16.0±1.5	13.4-18.6
			I-131	48.3±2.3	41.0±6.0	30.6-51.4
			Cs-137	43.7±1.5	31.0±5.0	22.3-39.7
			K-40	1567±114	1600±80	1461-1739
STW-465	Water	July 1986	Gr. alpha	4.7±0.6	6.0±5.0	0.0-14.7
			Gr. beta	18.7±1.2	18.0±5.0	9.3-26.7
STW-467	Water	August 1986	I-131	30.3±0.6	45.0±6.0	34.4-55.4
STW-468	Water	August 1986	Pu-239	11.3±0.6	10.1±1.0	8.3-11.9
STW-469	Water	August 198[illegible]	Uranium	4.0±0.0	4.0±6.0	0.0-14.4
STAF-470 471 472	Air Filter	Sept 1986	Gr. alpha	19.3±1.5	22.0±5.0	13.3-30.7
			Gr. beta	64.0±2.6	66.0±5.0	57.3-74.7
			Sr-90	22.0±1.0	22.0±5.0	19.4-24.6
			Cs-137	25.7±1.5	22.0±5.0	13.3-30.7
STW-473	Water	Sept 1986	Ra-226	6.0±0.1	6.1±0.9	4.5-7.7
			Ra-228	8.7±1.1	9.1±1.4	6.7-11.5

TABLE E-1 (continued)
U.S. EPA CROSSCHECK PROGRAM (a)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l (b): TIML Result ±2 s.d.(c)	EPA Result (d): 1s, N=1	EPA Result (d): Control Limits
STW-474	Water	Sept 1986	Gr. alpha	16.3±3.2	15.0±5.0	6.3-23.7
			Gr. beta	9.0±1.0	8.0±5.0	0.0-16.7
STW-475	Water	Oct 1986	Cr-51	63.3±5.5	59.0±5.0	50.3-67.7
			Co-60	31.0±2.0	31.0±5.0	22.3-39.7
			Zn-65	87.3±5.9	85.0±5.0	76.3-93.7
			Ru-106	74.7±7.4	74.0±5.0	65.3-82.7
			Cs-134	25.7±0.6	28.0±5.0	19.3-36.7
			Cs-137	46.3±1.5	44.0±5.0	35.3-52.7
STW-476	Water	Oct 1986	H-3	5918±60	5973±597	4938-7008
SPW-477 478	Water (Blind)	Oct 1986				
	Sample A		Gr. alpha	34.0±6.0	40.0±5.0	31.3-48.7
			Ra-226	5.8±0.2	6.0±0.9	4.4-7.6
			Ra-228	2.7±1.0	5.0±0.8	3.7-6.3
			Uranium	11.0±0.0	10.0±6.0	0.0-20.4
	Sample B		Gr. beta	38.7±1.2	51.0±5.0	42.3-59.7
			Sr-89	5.0±0.0	10.0±5.0	1.3-18.7
			Sr-90	3.0±0.0	4.0±1.5	1.4-6.6
			Co-60	24.7±1.2	24.0±5.0	15.3-32.7
			Cs-134	11.0±2.0	12.0±5.0	3.3-20.7
			Cs-137	9.3±1.2	8.0±5.0	0.0-16.7
STM-479	Milk	Nov 1986	Sr-89	7.7±1.2	9.0±5.0	0.3-17.7
			Sr-90	1.0±0.0	0.0±1.5	0.0-2.6
			I-131	52.3±3.1	49.0±6.0	38.6-59.4
			Cs-137	45.7±3.1	39.0±5.0	30.3-47.7
			K-40	1489±104	1565±78	1430-1700
STU-480	Urine	Nov 1986	H-3	5540±26	5257±912	4345-6169
STW-481	Water	Nov 1986	Gr. alpha	12.0±4.0	20.0±5.0	11.3-28.7
			Gr. beta	20.0±3.5	20.0±5.0	11.3-28.7
STW-482	Water	Dec 1986	Ra-226	6.7±0.2	6.8±1.0	5.0-8.6
			Ra-228	5.2±0.2	11.1±1.7	8.2-14.0
STW-483	Water	Jan 1987	Sr-89	19.7±5.0	25.0±5.0	16.3-33.7
			Sr-90	21.0±2.0	25.0±1.5	22.4-27.6

TABLE E-1 (continued)
U.S. EPA CROSSCHECK PROGRAM (a)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l (b): TIML Result ±2 s.d.(c)	EPA Result (d): 1s, N=1	EPA Result (d): Control Limits
STW-484	Water	Jan 1987	Pu-239	17.0±2.3	16.7±1.7	13.8-19.6
STF-486	Food	Jan 1987	Sr-90	36.0±4.0	49.0±10.0	31.7-66.3
			I-131	78.0±3.4	78.0±8.0	64.1-91.9
			Cs-137	89.7±3.0	84.0±5.0	75.3-92.7
			K-40	942±56	980±49	895-1065
STF-487	Food (Blank)	Jan 1987	Sr-90	2.0±0.0	---	
			I-131	<3	---	
			Cs-137	<2	---	
			K-40	993±102	---	
STW-488	Water	Feb 1987	Co-60	49.0±0.0	50.0±5.0	41.3-58.7
			Zn-65	96.0±7.2	91.0±5.0	82.3-99.7
			Ru-106	92.0±20.2	100.0±5.0	91.3-108.7
			Cs-134	53.0±3.4	59.0±5.0	50.3-67.7
			Cs-137	89.3±4.6	87.0±5.0	78.3-95.7
STW-489	Water	Feb 1987	H-3	4130±140	4209±420	3479-4939
STW-490	Water	Feb 1987	Uranium	8.3±1.2	8.0±6.0	0.0-18.4
STM-491	Milk	Feb 1987	I-131	10.0±0.0	9.0±0.9	7.4-10.6
STW-492	Water	Mar 1987	Gr. alpha	3.7±1.2	3.0±5.0	0.0-11.7
			Gr. beta	11.3±1.2	13.0±5.0	4.3-21.7
STW-493	Water	Mar 1987	Ra-226	7.0±0.1	7.3±1.1	5.4-9.2
			Ra-228	7.1±2.3	7.5±1.1	5.5-9.5
STW-494	Water	Apr 1987	I-131	8.0±0.0	7.0±0.7	5.8-8.2
STAF-495	Air Filter	Apr 1987	Gr. alpha	15.0±0.0	14.0±5.0	5.3-22.7
			Gr. beta	41.0±2.0	43.0±5.0	34.3-51.7
			Sr-90	16.3±1.2	17.0±1.5	14.4-19.6
			Cs-137	7.0±0.0	8.0±5.0	0.0-16.7
STW-496 497	Water (Blind)	Apr 1987				
	Sample A		Gr. alpha	30.7±1.2	30.0±8.0	16.1-43.9
			Ra-226	3.9±0.2	3.9±0.6	2.9-4.9
			Ra-228	4.9±0.9	4.0±0.6	3.0-5.0
			Uranium	5.0±0.0	5.0±6.0	0.0-15.4

TABLE E-1 (continued)
U.S. EPA CROSSCHECK PROGRAM (a)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l (b) TIML Result ±2 s.d.(c)	EPA Result (d) 1s, N=1	Control Limits
STW-496 497	Water (Blind)	Apr 1987				
	Sample B		Gr. Beta	69.3±9.4	66.0±5.0	57.3-74.7
			Sr-89	16.3±3.0	19.0±5.0	10.3-27.7
			Sr-90	10.0±0.0	10.0±1.5	7.4-12.6
			Co-60	8.3±3.0	8.0±5.0	0.0-16.7
			Cs-134	19.0±2.0	20.0±5.0	11.3-28.7
			Cs-137	14.7±1.2	15.0±5.0	6.3-23.7
STU-498	Urine	Apr 1987	H-3	6017±494	5620±795	4647-6593
STW-499	Water	May 1987	Sr-89	38.0±6.0	41.0±5.0	32.3-49.7
			Sr-90	21.0±2.0	20.0±1.5	17.4-22.6
STW-500	Water	May 1987	Gr. alpha	9.0±3.4	11.0±5.0	2.3-19.7
			Gr. beta	10.3±1.2	7.0±5.0	0.0-15.7
STW-501	Water	June 1987	Cr-51	40.0±8.0	41.0±5.0	32.3-49.7
			Co-60	60.3±3.0	64.0±5.0	55.3-72.7
			Zn-65	11.3±5.0	10.0±5.0	1.3-18.7
			Ru-106	78.3±6.4	75.0±5.0	66.3-83.7
			Cs-134	36.7±3.0	40.0±5.0	31.3-48.7
			Cs-137	80.3±4.2	80.0±5.0	71.3-88.7
STW-502	Water	June 1987	H-3	2906±86	2895±357	2277-3513
STW-503	Water	June 1987	Ra-226	6.9±0.1	7.3±1.1	5.4-9.2
			Ra-228	13.3±1.0	15.2±2.3	11.2-19.2
STW-504	Milk	June 1987	Sr-89	57.0±4.3	69.0±5.0	60.3-77.7
			Sr-90	32.0±1.0	35.0±1.5	32.4-37.6
			I-131	64.0±2.0	59.0±6.0	48.6-69.4
			Cs-137	77.7±0.6	74.0±5.0	65.3-82.7
			K	1383±17	1525±76	1393-1657
STW-505	Water	July 1987	Gr. alpha	2.3±0.7	5.0±5.0	0.0-13.7
			Gr. beta	4.0±1.0	5.0±5.0	0.0-13.7
STF-506	Food	July 1987	I-131	82.7±4.6	80.0±8.0	66.1-93.9
			Cs-137	53.7±3.0	50.0±5.0	41.3-58.7
			K	1548±57	1680±84	1534-1826
STW-507	Water	Aug 1987	I-131	45.7±4.2	48.0±6.0	37.6-58.4
STW-508	Water	Aug 1987	Pu-239	5.8±0.2	5.3±0.5	4.4-6.2

TABLE E-1 (continued)

U.S. EPA CROSSCHECK PROGRAM (a)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l (b) TIML Result ±2 s.d.(c)	EPA Result (d) 1s, N=1	Control Limits
STW-509	Water	Aug 1987	Uranium	13.3±0.3	13.0±6.0	2.6-23.4
STAF-510	Air Filter	Aug 1987	Gr. alpha	9.7±0.4	10.0±5.0	1.3-18.7
			Gr. beta	28.3±0.6	30.0±5.0	21.3-38.7
			Sr-90	10.0±0.9	10.0±1.5	7.4-12.6
			Cs-137	10.0±1.0	10.0±5.0	1.3-18.7
STW-511	Water	Sept 1987	Ra-226	9.9±0.1	9.7±1.5	7.2-12.2
			Ra-228	8.1±1.4	6.3±1.0	4.6-8.0
STW-512	Water	Sept 1987	Gr. alpha	2.0±0.6	4.0±5.0	0.0-12.7
			Gr. beta	11.3±1.3	12.0±5.0	3.3-20.7
STW-513	Water	Oct 1987	H-3	4473±100	4492±449	3714-5270
STW-514	Water A	Oct 1987	Gr. alpha	29.3±2.6	28.0±7.0	15.9-40.1
			Ra-226	4.9±0.1	4.8±0.7	3.6-6.1
			Ra-228	4.2±1.0	3.6±0.5	2.7-4.5
			Uranium	3.0±0.1	3.0±6.0	0.0-13.4
STW-515	Water B	Oct 1987	Gr. beta	72.3±2.7	72.0±5.0	63.3-80.7
			Sr-89	14.3±1.3	16.0±5.0	7.3-24.7
			Sr-90	9.7±0.4	10.0±1.5	7.4-12.6
			Co-60	16.7±3.0	16.0±5.0	7.3-24.7
			Cs-134	16.7±2.3	16.0±5.0	7.3-24.7
			Cs-137	24.3±3.3	24.0±5.0	15.3-32.7
STW-516	Water	Oct 1987	Cr-51	80.3±17.5	70.0±5.0	61.3-78.7
			Co-60	16.0±2.3	15.0±5.0	6.3-23.7
			Zn-65	46.3±5.6	46.0±5.0	37.3-54.7
			Ru-106	57.3±15.4	61.0±5.0	52.3-69.7
			Cs-134	23.7±2.5	25.0±5.0	16.3-33.7
			Cs-137	51.7±3.2	51.0±5.0	42.3-59.7
STU-517	Urine	Nov 1987	H-3	7267±100	7432±743	6145-8719
STW-519	Water	Dec 1987	I-131	26.0±3.0	26.0±6.0	15.6-36.4

(a) Results obtained by Teledyne Isotopes Midwest Laboratory as a participant in the environmental sample crosscheck program operated by the Intercomparison and Calibration Section, Quality Assurance Branch, Environmental Monitoring and Support Laboratory, U.S. Environmental Protection Agency (EPA), Las Vegas, Nevada.

(b) All results are in the pCi/l, except for elemental potassium (K) data, which are in mg/l; air filter samples, which are in pCi/filter; and food, which is in pCi/kg.

(c) Unless otherwise indicated, the TIML results are given as the mean ±2 standard deviations for three determinations.

(d) USEPA results are presented as the known values and expected laboratory precision (1s, 1 determination) and control limits as defined by EPA.

(e) NA = Not analyzed.

TABLE E-2

CROSSCHECK PROGRAM RESULTS, THERMOLUMINESCENT DOSIMETERS (TLDs)

			mR		
Lab Code	TLD Type	Measurement	Teledyne Result ±2 s.d. (a)	Known Value (b)	Average ±2 s.d. (c) (all participants)
7th International Intercomparison (d)					
115-7C	$CaSO_4$:Dy Cards	Field	76.8±2.7	75.8±6.0	75.1±29.8
		Lab (Co-60)	82.5±3.7	79.9±4.0	77.9±27.6
		Lab (Cs-137)	79.0±3.2	75.0±3.8	73.0±22.2
8th International Intercomparison (e)					
115-8C	$CaSO_4$:Dy Cards	Field Site 1	32.3±0.7	29.7±1.5	28.9±12.4
		Field Site 2	10.6±0.6	10.4±0.5	10.1±9.0
		Lab (Cs-137)	18.1±0.8	17.2±0.9	16.2±6.8

(a) Lab result given is the mean ±2 standard deviations of three determinations.

(b) Value determined by sponsor of the intercomparison using continuously operated pressurized ion chamber.

(c) Mean ±2 standard deviations of results obtained by all laboratories participating in the program.

(d) Seventh International Intercomparison of Environmental Dosimeters conducted in the spring and summer of 1984 at Las Vegas, Nevada, and sponsored by the U.S. Department of Energy, the U.S. Nuclear Regulatory Commission, and the U. S. Environmental Protection Agency.

(e) Eighth International Intercomparison of Environmental Dosimeters conducted in the fall and winter of 1985-1986 at New York, New York, and sponsored by the U.S. Department of Energy.

TABLE E-3

In-House Spiked Samples

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l TIML Result n=3	Known Activity	Expected Precision 1s, n=3[a]
QC-MI-6	Milk	Feb. 1986	Sr-89	6.0±1.9	6.4±3.0	8.7
			Sr-90	14.2±1.7	12.9±2.0	5.2
			I-131	34.2±3.8	35.2±3.5	10.4
			Cs-134	32.0±1.8	27.3±5.0	8.7
			Cs-137	35.8±2.1	35.0±5.0	8.7
QC-W-14	Water	Mar. 1986	Sr-89	1.6±0.4	1.6±1.0	7.1
			Sr-90	2.4±0.2	2.4±2.0	4.2
QC-W-15	Water	Apr. 1986	I-131	44.9±2.4	41.5±7.0	10.6
			Co-60	10.6±1.7	12.1±5.0	7.1(b)
			Cs-134	30.2±2.4	25.8±8.0	7.1(b)
			Cs-137	21.9±1.9	19.9±5.0	7.1(b)
QC-MI-7	Milk	Apr. 1986	I-131	39.7±3.3	41.5±7.0	10.4
			Cs-134	28.7±2.8	25.8±8.0	8.7
			Cs-137	21.2±2.8	19.9±5.0	8.7
SPW-1	Water	May 1986	Gross alpha	15.8±1.8	18.0±5.0	5(c)
QC-W-16	Water	June 1986	Gross alpha	16.2±0.7	16.9±2.5	8.7
			Gross beta	38.4±3.5	30.2±5.0	8.7
QC-MI-9	Milk	June 1986	Sr-89	< 1.0	0.0	7.1(b)
			Sr-90	12.6±1.8	13.3±3.0	4.2(b)
			I-131	38.9±7.0	34.8±7.0	10.4
			Cs-134	33.0±3.4	36.1±5.0	8.7
			Cs-137	38.5±2.8	39.0±5.0	8.7
SPW-2	Water	June 1986	Gross alpha	16.8±1.8	18.0±5.0	5(c)
SPW-3	Water	June 1986	Gross alpha	17.7±0.8	18.0±5.0	5(c)
QC-W-18	Water	Sep. 1986	Cs-134	34.7±5.6	31.3±5.0	8.7
			Cs-137	51.1±7.0	43.3±8.0	8.7
QC-W-19	Water	Sep. 1986	Sr-89	13.6±4.1	15.6±3.5	7.1(b)
			Sr-90	6.4±1.6	6.2±2.0	4.2(b)

TABLE E-3 (cont.)

In-House Spiked Samples

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l TIML Result n=3	Known Activity	Expected Precision 1s, n=3[a]
QC-W-21	Water	Oct 1986	Co-60	19.2±2.2	18.5±3.0	8.7
			Cs-134	31.7±5.2	25.6±8.0	8.7
			Cs-137	23.8±1.0	21.6±5.0	8.7
QC-MI-11	Milk	Oct 1986	Sr-89	12.3±1.8	14.3±3.0	8.7
QC-W-20	Water	Nov 1986	H-3	3855±180	3960±350	520[(b)]
QC-W-22	Water	Dec 1986	Gross alpha	9.8±1.4	11.2±4.0	8.7
			Gross beta	21.7±2.0	23.8±5.0	8.7
QC-W-23	Water	Jan 1987	I-131	29.8±2.5	27.9±3.0	10.4
QC-MI-12	Milk	Jan 1987	I-131	36.5±1.3	32.6±5.0	10.4
			Cs-137	32.6±4.2	27.4±8.0	8.7
SPM-13	Milk	Jan 1987	Sr-89	10.4±2.1	12.2±4.0	8.7
			Sr-90	14.6±1.6	12.6±3.0	5.2
			I-131	49.5±1.2	54.9±8.0	10.4
			Cs-134	< 1.6	0.0	8.7
			Cs-137	33.3±0.6	27.4±8.0	8.7
SPW-24	Water	Mar 1987	Sr-89	24.7±3.6	25.9±5.0	8.7
			Sr-90	23.9±3.8	22.8±8.0	5.2
SPW-25	Water	Apr 1987	I-131	28.0±1.9	29.3±5.0	10.6
SPM-14	Milk	Apr 1987	I-131	25.0±2.2	23.9±5.0	10.4
			Cs-134	< 2.1	0.0	8.7
			Cs-137	34.2±2.0	27.2±7.0	8.7
SPW-26	Water	Jun 1987	H-3	3422±100	3362±300	520
			Co-60	24.8±1.4	26.5±7.0	8.7
			Cs-134	< 2.0	0.0	8.7
			Cs-137	21.2±0.5	21.6±7.0	8.7
SPW-27	Water	Jun 1987	Gr. alpha	8.5±1.9	10.1±4.0	8.7
			Gr. beta	22.6±1.9	21.2±5.0	8.7
SPW-28	Water	Jun 1987	Gr. alpha	8.7±1.3	10.1±4.0	8.7
			Gr. beta	12.2±5.2	9.4±3.0	8.7

TABLE E-3 (cont.)

In-House Spiked Samples

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l TIML Result n=3	Known Activity	Expected Precision 1s, n=3[a]
SPW-29	Water	Jun 1987	Gr. alpha	16.4±1.3	18.9±5.0	8.7
			Gr. beta	15.9±4.0	11.8±4.0	8.7
SPM-15	Milk	Jul 1987	Sr-89	19.4±1.6	18.8±3.5	5.2
			I-131	43.5±0.7	45.3±7.0	10.4
			Cs-134	17.9±2.2	16.0±5.3	8.7
			Cs-137	25.4±1.8	22.7±5.0	8.7
SPW-30	Water	Sep 1987	Sr-89	17.5±3.0	14.3±5.0	8.7
			Sr-90	18.4±2.2	17.5±2.2	5.2
SPW-31	Water	Oct 1987	H-3	2053±93	2059±306	520

a n=3 unless noted otherwise

b n=2.

c n=1.

TABLE E-4

In-House Blank Samples

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l	
				Results (4.66 s.d.)	Acceptance Criteria (4.66 s.d.)
BL-1	D.I. Water	Nov 1985	Gross alpha	< 0.1	< 1
			Gross beta	< 0.4	< 4
BL-2	D.I. Water	Nov 1985	Cs-137 (gamma)	< 1.9	< 10
BL-3	D.I. Water	Nov 1985	Sr-89	< 0.5	< 5
			Sr-90	< 0.6	< 1
BL-5	D.I. Water	Nov 1985	Ra-226	< 0.4	< 1
			Ra-228	< 0.4	< 1
SPW-2265	D.I. Water	Apr 1985	Gross alpha	< 0.6	< 1
			Gross beta	< 2.2	< 4
			Sr-89	< 0.2	< 5
			Sr-90	< 0.4	< 1
			I-131	< 0.2	< 1
			Cs-137 (gamma)	< 7.4	< 10
BL-6	D.I. Water	Apr 1986	Gross alpha	< 0.4	< 1
BL-7	D.I. Water	Apr 1986	Gross alpha	< 0.4	< 1
BL-8	D.I. Water	June 1986	Gross alpha	< 0.4	< 1
BL-9	D.I. Water	June 1986	Gross alpha	< 0.3	< 1
SPW-3185	D.I. Water	Jan 1987	Ra-226	< 0.1	< 1
			Ra-228	< 0.9	< 1
SPS-3292	Milk	Jan 1987	I-131	< 0.1	< 1
			Cs-134	< 6.2	<10
			Cs-137	< 6.4	<10
SPW-3554	D.I. Water	Feb 1987	H-3	< 180	<300
			Gross beta	< 2.6	< 4
SPS-3555	Milk	Feb 1987	Sr-89	< 0.6	< 5
			Sr-90	1.9±0.4[a]	< 1
SPS-3731	Milk	Mar 1987	Cs-134	< 2.2	<10
			Cs-137	< 2.5	<10

TABLE E-4 (cont.)

In-House Blank Samples

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l Results (4.66 s.d.)	Acceptance Criteria (4.66 s.d.)
SPS-3732	D.I. Water	Mar 1987	Sr-89	< 0.9	< 5
			Sr-90	< 0.8	< 1
			I-131	< 0.3	< 1
			Co-60	< 2.3	< 10
			Cs-134(G)	< 2.2	< 10
			Cs-137(G)	< 2.4	< 10
			Ra-226	< 0.1	< 1
			Ra-228	< 1.0	< 1
			Np-237	< 0.04	< 1
			Th-230	< 0.05	< 0.1
			Th-232	< 0.02	< 0.1
			U-234	< 0.05	< 0.1
			U-235	< 0.03	< 0.1
			U-238	< 0.03	< 0.1
SPS-4023	Milk	May 1987	I-131	< 0.1	< 1
SPS-4203	D.I. Water	May 1987	Gross alpha	< 0.7	< 1
			Gross beta	< 1.7	< 4
SPS-4204	Milk	May 1987	Sr-89	< 0.5	< 5
			Sr-90	2.4±0.6 [a]	< 1
SPS-4390	Milk	Jun 1987	Cs-134	< 4.7	< 10
			Cs-137	< 5.2	< 10
SPS-4391	D.I. Water	Jun 1987	Sr-89	< 0.4	< 5
			Sr-90	< 0.4	< 1
			I-131	< 0.1	< 1
			Co-60	< 3.8	< 10
			Cs-137	< 5.7	< 10
			Ra-226	< 0.1	< 1
			Ra-228	< 0.9	< 1
SPW-4627	D.I. Water	Aug 1987	Gross alpha	< 0.6	< 1
			Gross beta	< 1.4	< 4
			Tritium	< 150	
SPS-4628	Milk	Aug 1987	Sr-89	< 0.6	< 5
			Sr-90	2.4±0.6	< 1
SPS-4847	Milk	Sep 1987	Cs-134	< 4.4	< 10
			Cs-137	< 5.3	< 10

TABLE E-4 (cont.)

In-House Blank Samples

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l: Results (4.66 s.d.)	Concentration in pCi/l: Acceptance Criteria (4.66 s.d.)
SPS-4848	D.I. Water	Sep 1987	I-131	< 0.2	< 1
SPW-4849	D.I. Water	Sep 1987	Co-60	< 4.1	< 10
			Cs-134	< 4.8	< 10
			Cs-137	< 4.0	< 10
			Sr-89	< 0.7	< 5
			Sr-90	< 0.7	< 1
SPW-4850	D.I. Water	Sep 1987	Th-228	<0.04	< 1
			Th-232	< 0.8	< 1
			U-234	<0.03	< 1
			U-235	<0.03	< 1
			U-238	<0.02	< 1
			Am-241	<0.06	< 1
			Cm-242	<0.04	< 1
			Ra-226	< 0.1	< 1
			Ra-228	< 1.0	< 2
SPW-4859	D.I. Water	Oct 1987	Fe-55	< 0.5	< 1
SPS-5348	Milk	Dec 1987	Cs-134	< 2.3	<10
			Cs-137	< 2.5	<10
SPW-5384	Water	Dec 1987	Co-60	< 2.8	<10
			Cs-134	< 2.6	<10
			Cs-137	< 2.8	<10
			I-131	< 0.2	< 1
			Ra-226	< 0.1	< 1
			Ra-228	< 1.2	< 2
			Sr-89	< 0.5	< 1
			Sr-90	< 0.4	< 1
SPW-5385	Water	Nov 1987	Gross alpha	< 0.4	< 1
			Gross beta	< 2.2	< 4
			Fe-55	< 0.3	< 1
SPS-5386	Milk	Jan 1988	I-131	< 0.1	< 1
SPW-5448	"Dead" Water	Jan 1988	H-3	< 177	<300

(a) Low level (1-4 pCi/l) of Sr-90 concentration in milk is not unusual.

TABLE E-5

ACCEPTANCE CRITERIA FOR "SPIKED" SAMPLES

LABORATORY PRECISION: ONE STANDARD DEVIATION VALUES FOR VARIOUS ANALYSES(a)

Analysis	Level	One Standard Deviation for Single Determination
Gamma Emitters	5 to 100 pCi/liter or kg >100 pCi/liter or kg	5 pCi/liter 5% of known value
Strontium-89(b)	5 to 50 pCi/liter or kg >50 pCi/liter or kg	5 pCi/liter 10% of known value
Strontium-90(b)	2 to 30 pCi/liter or kg >30 pCi/liter of kg	3.0 pCi/liter 10% of known value
Potassium	>0.1 g/liter or kg	5% of known value
Gross Alpha	<20 pCi/liter >20 pCi/liter	5 pCi/liter 25% of known value
Gross Beta	<100 pCi/liter >100 pCi/liter	5 pCi/liter 5% of known value
Tritium	<4,000 pCi/liter >4,000 pCi/liter	$1s = (pCi/liter) = 169.85 \times (known)^{.0933}$ 10% of known value
Radium-226 Radium-228	<0.1 pCi/liter	15% of known value
Plutonium	0.1 pCi/liter, gram, or sample	10% of known value
Iodine-131, Iodine-129(b)	<55 pCi/liter >55 pCi/liter	6 pCi/liter 10% of known value
Uranium-238, Nickel-63(b), technetium-99(b)	<35 pCi/liter >35 pCi/liter	6 pCi/liter 15% of known value
Iron-55(b)	50 to 100 pCi/liter	10 pCi/liter 10% of known value

(a) From EPA publication, "Environmental Radioactivity Laboratory Intercomparison Studies Program, Fiscal Year 1981-1982, EPA-600/4-81-004.

(b) TIML limit.

APPENDIX F

1987 Land Use Census

The 1987 Land Use Census was conducted during the growing season period from July 22nd through August 13th. A land use census is required at least once every 12 months to satisfy the Clinton Power Station Technical Specifications.

The land use census is performed to identify within a distance of 8 km (5 miles), the locations in each of the 16 meteorological sectors of the nearest milk animals, the nearest residence and the nearest garden of greater than 50 square meters producing broadleaf vegetation. Also, the census shall identify within a distance of 5 km (3 miles), the location in each of the 16 meteorological sectors of all milk animals and all gardens of greater than 50 square meters producing broadleaf vegetation.

The 1987 census results are examined to ensure that the Radiological Environmental Monitoring Program will provide representative measurements of radiation and radioactive materials in those exposure pathways and for those radionuclides that lead to the highest potential radiation exposures to the general public resulting from the operation of the Clinton Power Station.

The following changes were made as a result of the 1987 Land Use Census:

1. A new vegetation sample site CL-117 was established in October 1987 at 0.9 miles in the north sector and sample site CL-18 was deleted.

2. A new cow milk sample site was identified at 3.2 miles in the northeast sector but is unavailable for sampling. Samples of vegetation at sample site CL-115 at 0.9 miles northeast are taken due to the unavailability of milk samples.

The results of the 1987 Land Use Census are presented in tabulated form. Table F-1 provides the nearest residence in each sector, Table F-2 provides the dairy and/or livestock results and Table F-3 provides the garden census results within a distance of five miles.

TABLE F-1

1987 ANNUAL LAND USE CENSUS (NEAREST RESIDENCE)

DIRECTION	DISTANCE (miles)	NAME, ADDRESS, PHONE NUMBER
N	0.9	*
N	0.9	*
NNE	0.9	*
NE	1.2	*
ENE	2.5	*
ENE	2.5	*
E	1.1	*
ESE	2.3	*
ESE	3.2	*
SE	2.9	*
SSE	1.7	*
S	3.0	*
SSW	3.0	*
SW	0.8	*
WSW	1.5	*
W	2.0	*
WNW	1.6	*
NW	1.6	*
NNW	1.6	*

* Obtained upon request from the Clinton Power Station Radiological Environmental Group

TABLE F-2

1987 ANNUAL LAND USE CENSUS
(DAIRY AND/OR LIVESTOCK)

DISTANCE (MILES) AND DIRECTION	NAME, ADDRESS AND PHONE NUMBER	BREED	NO. COWS	NO. COWS MILKED	NO. GOATS	NO. GOATS MILKED	LIVESTOCK	DAIRY USED	GRAZING PERIOD
0.9/N	*	NA	0	0	0	0	31	NA	April - October
2.8/N	*	NA	0	0	1	0	0	NA	April - October
3.0/N	*	NA	0	0	0	0	10	NA	April - October
1.3/NNE	*	NA	0	0	0	0	20	NA	April - October
2.0/NNE	*	NA	4	0	0	0	6	NA	April - October
2.5/NNE	*	NA	5	0	0	0	14	NA	April - October
3.2/NNE	*	NA	0	0	0	0	40-50	NA	April - October
2.3/NE	*	NA	0	0	0	0	15	NA	April - October
3.2/NE	*	NA	39	1	0	0	102	NA	April - October
NA/ENE	*	NA	NA	NA	NA	NA	NA	NA	NA
3.1/E	*	NA	7	0	0	0	6	NA	April - October
5.7/ESE	*	NA	0	0	0	0	10	NA	April - October
2.9/SE	*	NA	25	0	0	0	25	NA	April - October
2.7/SSE	*	NA	9	0	0	0	12	NA	April - October
2.8/SSE	*	NA	3	0	0	0	8	NA	April - October
2.8/SSE	*	NA	0	0	1	0	0	NA	April - October
3.0/S	*	NA	0	0	0	0	20	NA	Year Round
3.3/SSW	*	NA	0	0	0	0	15	NA	April - October
3.4/SSW	*	NA	0	0	0	0	5	NA	April - October
3.7/SW	*	NA	12	0	0	0	12	NA	April - October
2.9/WSW	*	NA	0	0	0	0	17	NA	April - October
NA/W	NA	NA	NA	NA	NA	NA	NA	NA	NA
NA/WNW	NA	NA	NA	NA	NA	NA	NA	NA	NA
NA/NW	NA	NA	NA	NA	NA	NA	NA	NA	NA
1.0/NNW	*	NA	0	0	0	0	31	NA	April - October
TOTALS		NA	104	2	1	0	368-378	NA	Mainly April to October

* Obtained upon request from the Clinton Power Station Radiological Environmental Group

TABLE F-3

1987 ANNUAL LAND USE CENSUS
(GARDEN)

Direction	Distance (miles)	Name, Address, and Phone Number	Type of Vegetation	How Used
N	0.9	*	Cabbage, Lettuce	Own Use
N	0.9	*	Cabbage	Own Use
N	1.4	*	Lettuce	Own Use
N	2.7	*	Cabbage	Own Use
N	2.8	*	Cabbage, Lettuce	Own Use
N	2.8	*	Lettuce	Own Use
N	3.0	*	Cabbage, Lettuce	Own Use
NNE	0.9	*	No Broad Leaf	Own Use
NNE	2.0	*	Cabbage, Lettuce	Own Use
NNE	2.5	*	Lettuce	Own Use
NNE	2.5	*	Cabbage, Lettuce	Own Use
NNE	2.5	*	Cabbage	Own Use
NNE	2.7	*	Cabbage, Lettuce	Own Use
NNE	3.0	*	Cabbage, Lettuce	Own Use
NNE	3.2	*	Cabbage, Lettuce	Own Use
NNE	3.4	*	No Broad Leaf	Own Use
NE	1.2	*	Lettuce	Own Use
NE	1.9	*	No Broad Leaf	Own Use
NE	3.4	*	Cabbage, Lettuce	Own Use
ENE	2.5	*	Cabbage, Lettuce	Own Use
ENE	2.6	*	Cabbage, Lettuce	Own Use
ENE	2.6	*	Cabbage, Lettuce	Own Use
ENE	2.6	*	Cabbage, Lettuce	Own Use
ENE	2.7	*	Cabbage, Lettuce	Own Use
ENE	2.7	*	Cabbage, Lettuce	Own Use
ENE	2.7	*	Cabbage, Lettuce	Own Use
ENE	2.7	*	Cabbage, Lettuce	Own Use
ENE	2.7	*	Cabbage, Lettuce	Own Use
ENE	2.8	*	Lettuce, Spinach	Own Use
ENE	2.8	*	Cabbage, Lettuce	Own Use
ENE	2.8	*	Cabbage, Lettuce	Own Use
ENE	2.8	*	Cabbage, Lettuce	Own Use
ENE	2.9	*	Cabbage, Lettuce	Own Use
ENE	2.9	*	Cabbage, Lettuce	Own Use
E	1.1	*	Cabbage, Lettuce	Own Use
E	1.5	*	Cabbage, Chard, Lettuce	Own Use
E	2.4	*	Cabbage	Own Use
E	2.4	*	Cabbage, Lettuce	Own Use
E	2.4	*	Cabbage	Own Use
E	3.1	*	Lettuce	Own Use
ESE	3.2	*	Cabbage, Lettuce	Own Use
SE	2.9	*	Lettuce	Own Use
SSE	2.7	*	Cabbage, Lettuce	Own Use

TABLE F-3 (continued)

1987 ANNUAL LAND USE CENSUS
(Garden)

Direction	Distance (miles)	Name, Address, and Phone Number	Type of Vegetation	How Used
S	3.0	*	No Broad Leaf	Own Use
S	3.0	*	Cabbage, Lettuce	Own Use
SSW	3.0	*	Cabbage, Lettuce	Own Use
SSW	3.2	*	Cabbage, Lettuce	Own Use
SSW	3.2	*	Cabbage, Lettuce	Own Use
SSW	3.3	*	Cabbage, Lettuce	Own Use
SSW	3.4	*	Cabbage, Lettuce	Own Use
SW	0.8	*	No Broad Leaf	Own Use
SW	3.5	*	No Broad Leaf	Own Use
SW	3.6	*	Lettuce	Own Use
SW	3.7	*	Cabbage, Lettuce	Own Use
WSW	1.5	*	No Broad Leaf	Own Use
WSW	2.3	*	Lettuce	Own Use
WSW	2.3	*	No Broad Leaf	Own Use
WSW	2.3	*	Cabbage, Lettuce	Own Use
WSW	3.1	*	Cabbage	Own Use
WSW	3.3	*	Cabbage, Lettuce	Own Use
WSW	3.7	*	Cabbage, Lettuce	Own Use
WSW	3.7	*	Cabbage, Lettuce	Own Use
W	1.4	*	No Broad Leaf	Own Use
W	1.7	*	Cabbage, Lettuce	Own Use
W	2.0	*	Cabbage, Lettuce	Own Use
W	2.0	*	Cabbage, Lettuce	Own Use
W	2.3	*	Cabbage, Lettuce	Own Use
W	2.9	*	Cabbage, Lettuce	Own Use
W	3.3	*	Cabbage	Own Use
WNW	1.0	*	Cabbage, Lettuce	Own Use
WNW	1.6	*	Cabbage, Lettuce	Own Use
WNW	2.0	*	Cabbage, Lettuce	Own Use
WNW	2.8	*	Cabbage, Lettuce	Own Use
WNW	3.3	*	Cabbage, Lettuce	Own Use
WNW	1.4	*	Cabbage, Lettuce	Own Use
NW	1.6	*	Cabbage, Lettuce	Own Use
NW	1.7	*	Cabbage, Lettuce	Own Use
NW	2.3	*	Cabbage, Lettuce	Own Use
NW	2.4	*	Cabbage, Lettuce	Own Use
NNW	1.6	*	No Broad Leaf	Own Use
NNW	2.3	*	Cabbage, Lettuce	Own Use
NNW	2.5	*	Lettuce	Own Use

* Obtained upon request from Clinton Power Station Radiological Environmental Group

APPENDIX G

1987 Meteorological Summary

Cumulative joint frequency distribution of wind speed, wind direction and atmospheric stability for the period January 1, 1987 through December 31, 1987 is presented in Appendix G. There are seven stability classes from A to G; stability Class A is the least severe and Class G most severe. This data was derived from the data collected by the on-site meteorological tower.

TABLE G-1
ANNUAL JOINT FREQUENCY DISTRIBUTION OF METEOROLOGICAL PARAMETERS - 1987

STABILITY CLASS A

WIND SPEED (MPH) AT 10 METER LEVEL

Direction	1-3	4-7	8-12	13-18	19-24	24	TOTAL
N	8.00E00	2.60E01	4.00E01	6.00E00	0.00E-01	0.00E-01	8.00E01
NNE	6.00E00	2.10E01	1.80E01	4.00E00	0.00E-01	0.00E-01	4.90E01
NE	2.60E01	6.50E01	1.50E01	6.00E00	0.00E-01	0.00E-01	1.13E02
ENE	1.40E01	3.80E01	3.60E01	8.00E00	1.00E00	2.00E00	9.90E01
E	2.10E01	3.70E01	2.40E01	3.00E00	0.00E-01	0.00E-01	8.50E01
ESE	3.00E01	4.10E01	2.10E01	0.00E-01	1.00E00	0.00E-01	9.30E01
SE	1.80E01	5.20E01	1.20E01	0.00E-01	0.00E-01	0.00E-01	8.20E01
SSE	2.40E01	9.40E01	1.30E01	6.00E00	0.00E-01	0.00E-01	1.37E02
S	2.70E01	1.41E02	8.30E01	2.10E01	0.00E-01	0.00E-01	2.72E02
SSW	1.70E01	7.20E01	8.60E01	1.70E01	0.00E-01	0.00E-01	1.92E02
SW	9.00E00	5.30E01	4.80E01	1.80E01	3.00E00	0.00E-01	1.31E02
WSW	7.00E00	4.10E01	3.50E01	3.60E01	1.30E01	5.00E00	1.37E02
W	9.00E00	1.50E01	3.10E01	4.70E01	5.00E00	1.40E01	1.21E02
WNW	1.30E01	2.50E01	4.60E01	3.30E01	6.00E00	3.00E00	1.26E02
NW	1.30E01	6.60E01	3.90E01	4.20E01	1.20E01	0.00E-01	1.72E02
NNW	5.00E00	4.50E01	3.50E01	2.30E01	2.00E00	0.00E-01	1.10E02
Total	2.47E02	8.32E02	5.83E02	2.70E02	4.30E01	2.40E01	2.00E03

STABILITY CLASS B

WIND SPEED (MPH) AT 10 METER LEVEL

Direction	1-3	4-7	8-12	13-18	19-24	24	TOTAL
N	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
NNE	0.00E-01	2.00E00	1.00E00	2.00E00	0.00E-01	0.00E-01	5.00E00
NE	0.00E-01	0.00E-01	4.00E00	4.00E00	0.00E-01	0.00E-01	8.00E00
ENE	0.00E-01	0.00E-01	4.00E00	0.00E-01	0.00E-01	0.00E-01	4.00E00
E	0.00E-01	4.00E00	0.00E-01	0.00E-01	0.00E-01	0.00E-01	4.00E00
ESE	0.00E-01	5.00E00	2.00E00	0.00E-01	0.00E-01	0.00E-01	7.00E00
SE	0.00E-01	7.00E00	3.00E00	0.00E-01	0.00E-01	0.00E-01	1.00E01
SSE	0.00E-01	2.00E00	2.00E00	0.00E-01	0.00E-01	0.00E-01	4.00E00
S	0.00E-01	4.00E00	7.00E00	4.00E00	0.00E-01	0.00E-01	1.50E01
SSW	0.00E-01	1.00E00	1.70E01	0.00E-01	4.00E00	0.00E-01	2.20E01
SW	0.00E-01	2.00E00	1.00E01	1.00E00	0.00E-01	0.00E-01	1.30E01
WSW	0.00E-01	1.00E00	1.10E01	1.20E01	0.00E-01	0.00E-01	2.40E01
W	0.00E-01	2.00E00	9.00E00	4.00E00	2.00E00	0.00E-01	1.70E01
WNW	0.00E-01	2.00E00	7.00E00	6.00E00	1.00E00	0.00E-01	1.60E01
NW	0.00E-01	3.00E00	1.10E01	1.00E01	1.00E00	0.00E-01	2.50E01
NNW	0.00E-01	1.00E00	6.00E00	2.00E00	0.00E-01	0.00E-01	9.00E00
Total	0.00E-01	3.60E01	9.40E01	4.50E01	8.00E00	0.00E-01	1.83E02

TABLE G-1
ANNUAL JOINT FREQUENCY DISTRIBUTION OF METEOROLOGICAL PARAMETERS - 1987

STABILITY CLASS C

WIND SPEED (MPH) AT 10 METER LEVEL

Direction	1-3	4-7	8-12	13-18	19-24	24	TOTAL
N	0.00E-01	2.00E00	3.00E00	0.00E-01	1.00E00	0.00E-01	6.00E00
NNE	0.00E-01	1.00E00	3.00E00	1.00E00	0.00E-01	1.00E00	6.00E00
NE	0.00E-01	3.00E00	1.10E01	0.00E-01	1.00E00	0.00E-01	1.50E01
ENE	0.00E-01	4.00E00	6.00E00	0.00E-01	0.00E-01	0.00E-01	1.00E01
E	0.00E-01	4.00E00	1.00E00	0.00E-01	0.00E-01	0.00E-01	5.00E00
ESE	0.00E-01	8.00E00	3.00E00	0.00E-01	0.00E-01	0.00E-01	1.10E01
SE	1.00E00	1.20E01	2.00E00	0.00E-01	0.00E-01	0.00E-01	1.50E01
SSE	0.00E-01	1.00E00	2.00E00	2.00E00	0.00E-01	0.00E-01	5.00E00
S	0.00E-01	4.00E00	7.00E00	3.00E00	1.00E00	0.00E-01	1.50E01
SSW	1.00E00	1.00E00	1.30E01	2.00E00	0.00E-01	0.00E-01	1.70E01
SW	0.00E-01	3.00E00	9.00E00	5.00E00	0.00E-01	0.00E-01	1.70E01
WSW	0.00E-01	7.00E00	8.00E00	5.00E00	0.00E-01	0.00E-01	2.00E01
W	1.00E00	2.00E00	1.30E01	6.00E00	0.00E-01	0.00E-01	2.20E01
WNW	1.00E00	1.00E00	2.00E00	1.20E01	0.00E-01	0.00E-01	1.60E01
NW	1.00E00	3.00E00	1.20E01	4.00E00	0.00E-01	0.00E-01	2.00E01
NNW	0.00E-01	0.00E00	8.00E00	2.00E00	0.00E-01	0.00E-01	1.00E01
Total	5.00E00	5.60E01	1.03E02	4.20E01	3.00E00	1.00E00	2.10E02

STABILITY CLASS D

WIND SPEED (MPH) AT 10 METER LEVEL

Direction	1-3	4-7	8-12	13-18	19-24	24	TOTAL
N	8.00E00	2.70E01	9.50E01	2.30E01	6.00E00	1.00E00	1.60E02
NNE	8.00E00	2.70E01	3.70E01	3.60E01	1.90E01	7.00E00	1.34E02
NE	9.00E00	2.20E01	5.00E01	6.30E01	8.00E00	0.00E-01	1.52E02
ENE	5.00E00	1.40E01	1.00E01	0.00E-01	0.00E-01	0.00E-01	2.90E01
E	6.00E00	1.80E01	4.00E00	0.00E-01	0.00E-01	0.00E-01	2.80E01
ESE	7.00E00	2.70E01	2.00E01	1.50E01	1.00E00	0.00E-01	7.00E01
SE	1.00E01	5.10E01	3.80E01	1.30E01	1.00E00	0.00E-01	1.13E02
SSE	5.00E00	3.50E01	3.50E01	1.60E01	0.00E-01	0.00E-01	9.10E01
S	5.00E00	2.10E01	7.30E01	2.00E01	1.00E00	0.00E-01	1.20E02
SSW	4.00E00	4.70E01	7.70E01	2.00E01	6.00E00	0.00E-01	1.54E02
SW	8.00E00	2.00E01	4.80E01	1.50E01	0.00E-01	0.00E-01	9.10E01
WSW	2.00E00	2.90E01	2.70E01	6.00E00	0.00E-01	0.00E-01	6.40E01
W	5.00E00	2.40E01	6.80E01	3.60E01	1.50E01	0.00E-01	1.48E02
WNW	3.00E00	1.70E01	8.40E01	3.90E01	8.00E00	0.00E-01	1.51E02
NW	3.00E00	2.20E01	6.80E01	2.10E01	3.00E00	0.00E-01	1.17E02
NNW	4.00E00	2.20E01	3.00E01	1.00E00	0.00E-01	0.00E-01	5.70E01
Total	9.20E01	4.23E02	7.64E02	3.24E02	6.80E01	8.00E00	1.68E03

TABLE G-1
ANNUAL JOINT FREQUENCY DISTRIBUTION OF METEOROLOGICAL PARAMETERS - 1987

STABILITY CLASS E

Win:j SPEED (MPH) AT 10 METER LEVEL

Direction	1-3	4-7	8-12	13-18	19-24	24	TOTAL
N	7.00E00	2.70E01	5.20E01	1.30E01	5.00E00	0.00E-01	1.04E02
NNE	7.00E00	2.50E01	3.90E01	1.50E01	4.00E00	0.00E-01	9.00E01
NE	9.00E00	5.30E01	7.40E01	2.90E01	6.00E00	0.00E-01	1.71E02
ENE	8.00E00	3.60E01	2.60E01	1.00E01	7.00E00	0.00E-01	8.70E01
E	1.10E01	2.20E01	4.00E00	0.00E-01	0.00E-01	0.00E-01	3.70E01
ESE	1.80E01	7.40E01	3.60E01	5.00E00	0.00E-01	0.00E-01	1.33E02
SE	1.70E01	7.20E01	2.60E01	4.00E00	0.00E-01	0.00E-01	1.19E02
SSE	1.50E01	7.60E01	6.50E01	4.00E00	0.00E-01	0.00E-01	1.60E02
S	1.30E01	1.09E02	1.23E02	1.70E01	2.00E00	0.00E-01	2.64E02
SSW	9.00E00	8.10E01	1.61E02	4.40E01	2.00E00	0.00E-01	2.97E02
SW	1.40E01	2.80E01	5.80E01	2.30E01	0.00E-01	0.00E-01	1.23E02
WSW	5.00E00	3.90E01	3.40E01	4.00E00	0.00E-01	0.00E-01	8.20E01
W	1.40E01	3.10E01	7.10E01	3.40E01	3.00E00	0.00E-01	1.53E02
WNW	1.30E01	3.80E01	4.20E01	1.90E01	3.00E00	0.00E-01	1.15E02
NW	7.00E00	3.90E01	3.90E01	2.80E01	3.00E00	1.00E00	1.17E02
NNW	3.00E00	2.30E01	3.00E01	2.80E01	7.00E00	2.00E00	9.30E01
Total	1.70E02	7.73E02	8.80E02	2.77E02	4.20E01	3.00E00	2.15E03

STABILITY CLASS F

WIND SPEED (MPH) AT 10 METER LEVEL

Direction	1-3	4-7	8-12	13-18	19-24	24	TOTAL
N	1.90E01	1.70E01	7.00E00	0.00E-01	0.00E-01	0.00E-01	4.30E01
NNE	1.00E01	2.00E01	5.00E00	1.00E00	0.00E-01	0.00E-01	3.60E01
NE	6.00E00	4.70E01	7.00E00	0.00E-01	0.00E-01	0.00E-01	6.00E01
ENF	1.00E01	3.90E01	3.30E01	4.70E01	6.00E00	0.00E-01	1.35E02
E	2.10E01	3.90E01	3.10E01	1.60E01	0.00E-01	0.00E-01	1.07E02
ESE	1.70E01	3.50E01	3.00E00	1.00E00	0.00E-01	0.00E-01	5.60E01
SE	1.10E01	3.90E01	2.00E00	0.00E-01	0.00E-01	0.00E-01	5.20E01
SSE	1.50E01	6.60E01	6.00E00	0.00E-01	0.00E-01	0.00E-01	8.70E01
S	1.10E01	8.10E01	2.70E01	2.00E00	0.00E-01	0.00E-01	1.21E02
SSW	1.40E01	4.80E01	5.40E01	2.00E00	0.00E-01	0.00E-01	1.18E02
SW	1.60E01	5.80E01	5.60E01	3.00E01	0.00E-01	0.00E-01	1.60E02
WSW	1.00R01	2.50E01	2.50E01	1.70E01	4.00E00	0.00E-01	8.10E01
W	1.20E01	2.20E01	1.60E01	3.00E00	1.00E00	0.00E-01	5.40E01
WNW	1.40E01	2.70E01	6.00E00	0.00E-01	0.00E-01	0.00E-01	4.70E01
NW	1.00E01	2.90E01	7.00E00	1.00E00	1.00E00	0.00E-01	4.80E01
NNW	5.00E00	7.00E00	8.00E00	6.00E00	8.00E00	5.00E00	3.90E01
Total	2.01E02	5.99E02	2.93E02	1.26E02	2.00E01	5.00E00	1.24E03

TABLE G-1

Annual Joint Frequency Distribution of Meteorological Parameters - 1987

STABILITY CLASS C

WIND SPEED (MPH) AT 10 METER LEVEL

Direction	1-3	4-7	8-12	13-18	19-24	24	TOTAL
N	7.00E00	5.00E00	2.00E00	0.00E-01	0.00E-01	0.00E-01	1.40E01
NNE	1.00E01	1.00E01	2.00E00	0.00E-01	0.00E-01	0.00E-01	2.20E01
NE	2.50E01	7.10E01	3.00E00	0.00E-01	0.00E-01	0.00E-01	9.90E01
ENE	1.80E01	3.10E01	9.00E00	2.00E01	2.00E00	0.00E-01	8.00E01
E	1.00E01	1.30E01	1.50E01	4.10E01	3.00E00	0.00E-01	8.20E01
ESE	1.50E01	4.00E00	0.00E-01	0.00E-01	0.00E-01	0.00E-01	1.90E01
SE	8.00E00	2.70E01	1.00E00	0.00E-01	0.00E-01	0.00E-01	3.60E01
SSE	2.10E01	2.70E01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	4.80E01
S	1.90E01	2.90E01	4.00E00	4.00E00	0.00E-01	0.00E-01	5.60E01
SSW	9.00E00	1.70E01	5.00E00	0.00E-01	0.00E-01	0.00E-01	3.10E01
SW	9.00E00	3.80E01	3.00E00	6.00E00	2.00E00	0.00E-01	5.80E01
WSW	1.10E01	1.90E01	1.10E01	1.40E01	0.00E-01	0.00E-01	5.50E01
W	9.00E00	7.00E00	1.00E00	0.00E-01	0.00E-01	0.00E-01	1.70E01
WNW	2.10E01	1.10E01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	3.20E01
NW	1.20E01	1.00E01	1.00E00	0.00E-01	0.00E-01	0.00E-01	2.30E01
NNW	1.00E01	0.00E-01	0.00E-01	1.00E00	0.00E-01	0.00E-01	1.10E01
Total	2.14E02	3.19E02	5.70E01	8.60E01	7.00E00	0.00E-01	6.83E02

PERIODS OF CALM(HOURS): 3.000E00
HOURS OF INVALID DATA : 0.000E-01
HOURS OF GOOD DATA : 8.196E3 = 93.6% OF TOTAL HOURS

TABLE G-2

CLASSIFICATION OF ATMOSPHERIC STABILITY

Stability Classification	Pasquill Categories	1 std. Dev. (degrees)	Temperature change with height ($^{o}C/100m$)
Extremely unstable	A	25.0	-1.9
Moderately unstable	B	20.0	-1.9 to -1.7
Slightly unstable	C	15.0	-1.7 to -1.5
Neutral	D	10.0	-1.5 to -0.5
Slightly stable	E	5.0	-0.5 to 1.5
Moderately stable	F	2.5	1.5 to 4.0
Extremely stable	G	1.7	4.0

1 Standard deviation of horizontal wind direction over a period of 15 minutes to 1 hour. The values shown are averages for each stability classification.

APPENDIX H

1987 REMP Sample Collection and Analysis Methods

Analysis methods used to determine sample media activities are listed in Table H-1. The procedures listed are those issued by the analysis laboratory that are reviewed and approved by the Radiological Environmental Group of the Clinton Power Station Radiation Protection Department. Any revisions to these procedures are routed through the radiological environmental group prior to implementation by the analysis laboratory.

TABLE H-1

CLINTON POWER STATION

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

SUMMARY OF SAMPLE COLLECTION AND ANALYSIS METHODS

1987

Analysis	Sample Medium	Sampling Method	Approximate Sample Size Collected	Teledyne Procedure Number	Procedure Abstract
Gross Beta	AP	Continuous air sampling through filter media	$280m^3$	TIML-AP-02	Sample counted on a low level gas flow proportional counter.
	WW	Grab	3.8L	TIML-W(DS)-01	Sample evaporated on a stainless steel planchet for low-level gas flow proportional counting
	SW	Grab	3.8L	TIML-W(DS)-01	Sample evaporated on a stainless steel planchet for low-level gas flow proportional counting
	SW	Composite	3.8L	TIML-W(DS)-01	Sample evaporated on a stainless steel planchet for low-level gas flow proportional counting
	VE	Grab	2.5kg	TIML-AB-01	Sample asked for low-level gas flow proportional counting
	BS	Grab	1.5-2.0kg	TIML-AB-01	Sample ground for low-level gas flow proportional counting
	SS	Grab	1.5-2.0kg	TIML-AB-01	Sample ground for low-level gas flow proportional counting

TABLE H-1

CLINTON POWER STATION

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

SUMMARY OF SAMPLE COLLECTION AND ANALYSIS METHODS

1987

Analysis	Sample Medium	Sampling Method	Approximate Sample Size Collected	Teledyne Procedure Number	Procedure Abstract
Gamma Spectroscopy	AP	Composite	3640m^3	TIML-GS-01	Germanium gamma isotopic analysis
	G	Grab	2.2kg	TIML-GS-01	Germanium gamma isotopic analysis
	WW	Grab	3.8L	TIML-GS-01	Germanium gamma isotopic analysis
	WW	Composite	15.2L	TIML-GS-01	Germanium gamma isotopic analysis
	SW	Composite	3.8L	TIML-GS-01	Germanium gamma isotopic analysis
	VE	Grab	2.5kg	TIML-GS-01	Germanium gamma isotopic analysis
	BS	Grab	1.5-2.0kg	TIML-GS-01	Germanium gamma isotopic analysis
	SS	Grab	1.5-2.0kg	TIML-GS-01	Germanium gamma isotopic analysis
	SL	Grab	0.5kg	TIML-GS-01	Germanium gamma isotopic analysis
	F	Grab	2.5kg	TIML-GS-01	Germanium gamma isotopic analysis

TABLE H-1

CLINTON POWER STATION

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

SUMMARY OF SAMPLE COLLECTION AND ANALYSIS METHODS

1987

Analysis	Sample Medium	Sampling Method	Approximate Sample Size Collected	Teledyne Procedure Number	Procedure Abstract
	M	Grab	3.8L	TIML-GS-01	Germanium gamma isotopic analysis
TLD	ID	Continuous Exposure	TLD	TIML-TLD-01	Integration of thermally stimulated visible photons
Gross Alpha	SW	Composite	3.8L	TIML-W(DS)-01	Sample evaporated on a stainless steel planchet for low-level gas flow proportional counting
	WW	Grab	3.8L	TIML-W(DS)-01	Sample evaporated on a stainless steel planchet for low-level gas flow proportional counting
	WW	Composite	15.2L	TIML-W(DS)-01	Sample evaporated on a stainless steel planchet for low-level gas flow proportional counting
	BS	Grab	1.5-2.0kg	TIML-AB-01	TIML-AB-01 Sample pulverized for low-level gas flow proportional counting

TABLE H-1

CLINTON POWER STATION

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

SUMMARY OF SAMPLE COLLECTION AND ANALYSIS METHODS

1987

Analysis	Sample Medium	Sampling Method	Approximate Sample Size Collected	Teledyne Procedure Number	Procedure Abstract
Gross Alpha	SS	Grab	1.5-2.0kg	TIML-AB-01	Sample pulverized for low-level gas flow proportional counting
Sr-90	BS	Grab	1.5-2.0kg	TIML-SR-06	Hydrochloric acid leach and low-level gas flow proportional counting
	SS	Grab	1.5-2.0kg	TIML-SR-06	Hydrochloric acid leach and low-level gas flow proportional counting
Tritium	WW	Composite	3.8L	TIML-T-02	Distillation followed by counting in a liquid scintillation counter
	SW	Composite	3.8L	TIML-T-02	Distillation followed by counting in a liquid scintillation counter
	DW	Composite	3.8L	TIML-T-02	Distillation followed by counting in a liquid scintillation counter

APPENDIX I

1987 Data Tables (Raw Data)

The data tables presented in Appendix I represent the raw data used to derive the results stated in this report. The data was obtained from the final monthly progress report submitted to the Clinton Power Station by Teledyne Isotopes Midwest Laboratory.

TABLE I-1

GROSS BETA AND IODINE - 131 ACTIVITY IN AIR PARTICULATES FOR 1987 (a)

(pCi/m^3 ± 1 s.d.)

Collection Period	CL-1	CL-2	CL-3	CL-4	CL-6
2/25/87-3/4/87	0.019±0.004	0.014±0.003	0.022±0.004	0.015±0.004	0.018±0.004
3/4/87-3/11/87	0.032±0.004	0.027±0.004	0.031±0.004	0.028±0.004	0.031±0.004
3/11/87-3/18/87	0.029±0.004	0.022±0.004	0.023±0.004	0.030±0.004	0.022±0.004
3/18/87-3/25/87	0.021±0.004	0.018±0.004	0.016±0.004	0.015±0.003	0.020±0.004
3/25/87-4/2/87	0.018±0.004	0.015±0.004	0.019±0.004	0.015±0.004	0.018±0.004
4/2/87-4/8/87	0.049±0.005	0.036±0.004	0.041±0.005	0.027±0.004	0.032±0.004
4/8/87-4/15/87	0.016±0.004	0.012±0.005	0.014±0.004	0.012±0.004	0.019±0.004
4/15/87-4/22/87	0.014±0.004	0.012±0.003	0.016±0.004	0.018±0.004	0.017±0.004
4/22/87-4/29/87	0.027±0.004	0.020±0.004	0.019±0.004	0.019±0.004	0.025±0.004
4/29/87-5/6/87	0.029±0.004	0.026±0.004	0.030±0.004	0.029±0.004	0.027±0.004
5/6/87-5/13/87	0.022±0.004	0.021±0.004	0.027±0.004	0.026±0.004	0.024±0.004
5/13/87-5/20/87	0.022±0.004	0.015±0.004	0.021±0.004	0.026±0.004	0.027±0.004
5/20/87-5/27/87	0.015±0.004	0.014±0.004	0.013±0.004	0.008±0.003	0.016±0.004
5/27/87-6/3/87	0.018±0.005	0.015±0.004	0.022±0.004	0.015±0.004	0.015±0.004
6/3/87-6/10/87	0.021±0.005	0.020±0.005	0.019±0.004	0.026±0.005	0.026±0.005
6/10/87-6/17/87	0.016±0.004	0.078±0.011*	0.030±0.004	0.071±0.011*	0.030±0.004
6/17/87-6/24/87	0.024±0.004	0.024±0.004	0.028±0.004	0.024±0.004	0.028±0.004
6/24/87-7/1/87	0.025±0.004	0.023±0.004	0.027±0.004	0.036±0.004	0.030±0.004
7/1/87-7/8/87	0.020±0.004	0.028±0.010	0.024±0.004	0.022±0.004	0.024±0.004
7/8/87-7/15/87	0.014±0.004	0.014±0.004	0.019±0.004	0.018±0.006	0.016±0.004
7/15/87-7/22/87	0.042±0.005	0.038±0.005	0.032±0.004	0.018±0.010	0.036±0.005
7/22/87-7/29/87	0.033±0.004	0.035±0.004	0.031±0.004	0.033±0.004	0.032±0.004
7/29/87-8/5/87	0.033±0.004	0.028±0.004	0.030±0.004	0.033±0.004	0.033±0.004
8/5/87-8/12/87	0.022±0.004	0.024±0.004	0.023±0.004	0.030±0.004	0.027±0.004
8/12/87-8/19/87	0.033±0.004	0.030±0.004	0.030±0.004	0.032±0.004	0.026±0.004
8/19/87-8/26/87	0.031±0.004	0.024±0.004	0.023±0.004	0.023±0.004	0.027±0.004
8/26/87-9/2/87	0.029±0.004	0.025±0.004	0.026±0.004	0.025±0.004	0.027±0.004
9/2/87-9/9/87	0.044±0.005	0.040±0.005	0.050±0.005	0.045±0.005	0.044±0.005
9/9/87-9/16/87	0.042±0.005	0.038±0.004	0.040±0.004	0.041±0.005	0.045±0.005
9/16/87-9/23/87	0.023±0.004	0.022±0.003	0.018±0.003	0.020±0.003	0.019±0.003
9/23/87-9/30/87	0.040±0.004	0.034±0.004	0.040±0.004	0.031±0.004	0.040±0.005
9/30/87-10/7/87	0.016±0.004	0.017±0.004	0.014±0.004	0.016±0.004	0.017±0.004
10/7/87-10/14/87	0.016±0.004	0.024±0.004	0.022±0.004	0.022±0.004	0.025±0.004
10/14/87-10/21/87	0.029±0.004	0.033±0.004	0.035±0.004	0.033±0.004	0.039±0.004
10/21/87-10/28/87	0.023±0.004	0.023±0.004	0.025±0.004	0.021±0.004	0.024±0.004
10/28/87-11/4/87	0.045±0.005	0.048±0.005	0.054±0.005	0.044±0.005	0.049±0.005
11/4/87-11/11/87	0.034±0.004	0.027±0.004	0.026±0.004	0.027±0.004	0.028±0.004
11/11/87-11/18/87	0.035±0.004	0.034±0.004	0.032±0.004	0.030±0.004	0.032±0.004
11/18/87-11/25/87	0.040±0.004	0.038±0.004	0.038±0.004	0.038±0.004	0.040±0.004
11/25/87-12/2/87	0.012±0.003	0.017±0.004	0.014±0.003	0.014±0.004	0.012±0.003
12/2/87-12/9/87	0.026±0.004	0.028±0.004	0.031±0.004	0.032±0.004	0.031±0.004
12/9/87-12/16/87	0.020±0.004	0.018±0.004	0.021±0.004	0.022±0.004	0.018±0.004
12/16/87-12/23/87	0.032±0.004	0.032±0.004	0.036±0.004	0.030±0.004	0.032±0.004
12/23/87-12/30/87	0.026±0.004	0.027±0.004	0.029±0.004	0.024±0.004	0.024±0.004

TABLE I-1 (continued)

Collection Period	CL-7	CL-8	CL-11(c)	CL-94
2/25/87-3/4/87	0.018±0.004	0.017±0.004	0.019±0.004	0.013±0.003
3/4/87-3/11/87	0.035±0.004	0.028±0.004	0.030±0.004	0.031±0.004
3/11/87-3/18/87	0.031±0.006	0.026±0.004	0.030±0.004	0.027±0.004
3/18/87-3/25/87	0.021±0.004	0.018±0.004	0.014±0.003	0.019±0.004
3/25/87-4/2/87	0.018±0.004	0.016±0.004	0.016±0.004	0.015±0.004
4/2/87-4/8/87	0.032±0.004	0.054±0.005	0.058±0.004	0.041±0.005
4/8/87-4/15/87	0.018±0.004	0.015±0.004	0.018±0.004	0.014±0.004
4/15/87-4/22/87	0.012±0.004	0.012±0.004	0.017±0.004	0.010±0.004
4/22/87-4/29/87	0.021±0.004	0.023±0.004	0.025±0.004	0.016±0.004
4/29/87-5/6/87	0.025±0.004	0.024±0.004	0.028±0.004	0.028±0.004
5/6/87-5/13/87	0.026±0.004	0.021±0.004	0.022±0.004	0.026±0.004
5/13/87-5/20/87	0.024±0.004	0.023±0.004	0.024±0.004	0.016±0.004
5/20/87-5/27/87	0.010±0.003	0.012±0.003	0.014±0.004	0.012±0.003
5/27/87-6/3/87	0.009±0.005	0.013±0.004	0.020±0.004	0.005±0.004*
6/3/87-6/10/87	0.023±0.005	0.017±0.004	0.022±0.005	0.023±0.005
6/10/87-6/17/87	0.027±0.004	0.043±0.005	0.030±0.004	0.011±0.003
6/17/87-6/24/87	0.026±0.004	0.028±0.004	0.029±0.005	0.026±0.004
6/24/87-7/1/87	0.033±0.004	0.023±0.004	0.028±0.004	0.015±0.004
7/1/87-7/8/87	0.020±0.004	0.021±0.005	0.025±0.004	0.024±0.004
7/8/87-7/15/87	0.021±0.004	0.015±0.004	0.022±0.004	0.016±0.004
7/15/87-7/22/87	0.037±0.005	0.034±0.004	0.034±0.005	0.036±0.005
7/22/87-7/29/87	0.035±0.004	0.033±0.004	0.032±0.004	0.031±0.004
7/29/87-8/5/87	0.032±0.004	0.034±0.004	0.034±0.004	0.028±0.004
8/5/87-8/12/87	0.025±0.004	0.018±0.004	0.027±0.004	0.024±0.004
8/12/87-8/19/87	0.033±0.004	0.020±0.005	0.031±0.004	0.026±0.004
8/19/87-8/26/87	0.027±0.004	0.038±0.020	0.031±0.004	0.029±0.004
8/26/87-9/2/87	0.028±0.004	0.026±0.004	0.025±0.004	0.031±0.004
9/2/87-9/9/87	0.042±0.005	0.040±0.005	0.044±0.005	0.039±0.005
9/9/87-9/16/87	0.037±0.004	0.042±0.004	0.039±0.005	0.039±0.004
9/16/87-9/23/87	0.021±0.003	<0.080*	0.018±0.003	0.022±0.004
9/23/87-9/30/87	0.037±0.004	0.036±0.004	0.040±0.005	0.042±0.004
9/30/87-10/7/87	0.014±0.004	0.017±0.004	0.019±0.004	0.018±0.004
10/7/87-10/14/87	0.023±0.004	0.023±0.004	0.024±0.004	0.022±0.004
10/14/87-10/21/87	0.033±0.004	0.036±0.004	0.034±0.004	0.035±0.004
10/21/87-10/28/87	0.022±0.004	0.023±0.004	0.025±0.004	0.023±0.004
10/28/87-11/4/87	0.048±0.005	0.043±0.004	0.049±0.005	0.051±0.005
11/4/87-11/11/87	0.029±0.004	0.031±0.004	0.030±0.004	0.028±0.004
11/11/87-11/18/87	0.032±0.004	0.036±0.004	0.031±0.004	0.034±0.004
11/18/87-11/25/87	0.042±0.004	0.041±0.005	0.043±0.004	0.033±0.004
11/25/87-12/2/87	0.014±0.004	0.012±0.003	0.015±0.004	0.015±0.004
12/2/87-12/9/87	0.029±0.004	0.034±0.004	0.030±0.004	0.028±0.004
12/9/87-12/16/87	0.020±0.004	0.019±0.004	0.018±0.004	0.015±0.004
12/16/87-12/23/87	0.032±0.004	0.033±0.004	0.028±0.004	0.030±0.004
12/23/87-12/30/87	0.025±0.004	0.027±0.004	0.023±0.004	0.027±0.004

(a) - all I-131 activity is < 0.07 pCi/m^3 unless otherwise noted in Table B-1

* - unreliable results, excluded from the mean

(c) - control location, all other locations indicators

TABLE I-2

GAMMA ISOTOPIC ACTIVITY IN AIR PARTICULATES FOR 1987

($pCi/m^3 \pm 1$ s.d.)

Site	Isotope	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
CL-1	Be-7	0.06±0.01	0.14±0.04	0.08±0.01	0.05±0.01
	K-40	< 0.02	< 0.04	< 0.01	< 0.01
	Co-60	< 0.002	< 0.003	< 0.001	< 0.001
	Nb-95	< 0.002	< 0.002	< 0.001	< 0.001
	Zr-95	< 0.002	< 0.005	< 0.002	< 0.002
	Ru-103	< 0.002	< 0.004	< 0.001	< 0.001
	Ru-106	< 0.010	< 0.019	< 0.007	< 0.007
	Cs-134	< 0.0009	< 0.002	< 0.0008	< 0.001
	Cs-137	< 0.001	< 0.002	< 0.0008	< 0.007
	Ce-141	< 0.002	< 0.003	< 0.001	< 0.001
	Ce-144	< 0.004	< 0.008	< 0.003	< 0.003
CL-2	Be-7	0.06±0.01	0.13±0.03	0.11±0.03	0.05±0.01
	K-40	< 0.01	< 0.05	0.05±0.01	< 0.01
	Co-60	< 0.001	< 0.002	< 0.002	< 0.002
	Nb-95	< 0.001	< 0.003	< 0.002	< 0.002
	Zr-95	< 0.002	< 0.004	< 0.004	< 0.003
	Ru-103	< 0.001	< 0.003	< 0.002	< 0.001
	Ru-106	< 0.007	< 0.020	< 0.013	< 0.012
	Cs-134	< 0.0009	< 0.002	< 0.001	< 0.001
	Cs-137	< 0.0010	< 0.002	< 0.002	< 0.001
	Ce-141	< 0.001	< 0.003	< 0.002	< 0.002
	Ce-144	< 0.003	< 0.007	< 0.007	< 0.007
CL-3	Be-7	0.08±0.02	0.09±0.02	0.07±0.01	0.06±0.02
	K-40	< 0.01	< 0.02	< 0.007	< 0.03
	Co-60	< 0.002	< 0.002	< 0.0008	< 0.002
	Nb-95	< 0.002	< 0.002	< 0.001	< 0.002
	Zr-95	< 0.003	< 0.003	< 0.002	< 0.004
	Ru-103	< 0.002	< 0.002	< 0.001	< 0.002
	Ru-106	< 0.01	< 0.010	< 0.007	< 0.012
	Cs-134	< 0.002	< 0.001	< 0.0007	< 0.001
	Cs-137	< 0.002	< 0.001	< 0.0007	< 0.002
	Ce-141	< 0.004	< 0.002	< 0.001	< 0.002
	Ce-144	< 0.008	< 0.004	< 0.003	< 0.005

TABLE I-2 (Continued)

Site	Isotope	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
CL-4	Be-7	0.08±0.02	0.11±0.02	0.10±0.02	0.05±0.01
	K-40	< 0.02	< 0.01	< 0.02	< 0.01
	Co-60	< 0.002	< 0.001	< 0.002	< 0.001
	Nb-95	< 0.001	< 0.002	< 0.003	< 0.002
	Zr-95	< 0.002	< 0.003	< 0.003	< 0.002
	Ru-103	< 0.001	< 0.001	< 0.002	< 0.001
	Ru-106	< 0.008	< 0.009	< 0.012	< 0.010
	Cs-134	< 0.0008	< 0.001	< 0.001	< 0.001
	Cs-137	< 0.0007	< 0.001	< 0.001	< 0.001
	Ce-141	< 0.002	< 0.001	< 0.003	< 0.002
	Ce-144	< 0.004	< 0.006	< 0.008	< 0.006
CL-6	Be-7	0.09±0.02	0.12±0.02	0.10±0.03	0.05±0.01
	K-40	< 0.02	< 0.02	< 0.03	< 0.02
	Co-60	< 0.002	< 0.002	< 0.002	< 0.001
	Nb-95	< 0.001	< 0.002	< 0.002	< 0.001
	Zr-95	< 0.003	< 0.003	< 0.002	< 0.002
	Ru-103	< 0.002	< 0.002	< 0.003	< 0.001
	Ru-106	< 0.01	< 0.02	< 0.012	< 0.009
	Cs-134	< 0.001	< 0.001	< 0.001	< 0.001
	Cs-137	< 0.001	< 0.002	< 0.002	< 0.001
	Ce-141	< 0.002	< 0.003	< 0.004	< 0.001
	Ce-144	< 0.006	< 0.009	< 0.007	< 0.003
CL-7	Be-7	0.07±0.01	0.10±0.01	0.10±0.03	0.06±0.02
	K-40	< 0.01	< 0.01	< 0.02	0.03±0.01
	Co-60	< 0.002	< 0.001	< 0.002	< 0.001
	Nb-95	< 0.002	< 0.002	< 0.002	< 0.001
	Zr-95	< 0.003	< 0.002	< 0.004	< 0.002
	Ru-103	< 0.002	< 0.001	< 0.003	< 0.001
	Ru-106	< 0.01	< 0.008	< 0.015	< 0.006
	Cs-134	< 0.001	< 0.001	< 0.001	< 0.001
	Cs-137	< 0.001	< 0.0007	< 0.001	< 0.001
	Ce-141	< 0.003	< 0.001	< 0.004	< 0.002
	Ce-144	< 0.007	< 0.003	< 0.008	< 0.005

TABLE I-2 (Continued)

Site	Isotope	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
CL-8	Be-7	0.06±0.01	0.12±0.03	0.09±0.02	0.05±0.01
	K-40	< 0.03	< 0.04	< 0.03	< 0.01
	Co-60	< 0.002	< 0.003	< 0.001	< 0.001
	Nb-95	< 0.0009	< 0.002	< 0.002	< 0.001
	Zr-95	< 0.001	< 0.005	< 0.002	< 0.001
	Ru-103	< 0.001	< 0.003	< 0.002	< 0.001
	Ru-106	< 0.01	< 0.02	< 0.01	< 0.005
	Cs-134	< 0.001	< 0.002	< 0.001	< 0.001
	Cs-137	< 0.002	< 0.002	< 0.002	< 0.001
	Ce-141	< 0.001	< 0.003	< 0.003	< 0.001
	Ce-144	< 0.004	< 0.007	< 0.005	< 0.002
CL-11	Be-7	0.07±0.01	0.09±0.02	0.08±0.02	0.07±0.02
	K-40	< 0.01	< 0.02	< 0.02	< 0.04
	Co-60	< 0.001	< 0.002	< 0.002	< 0.001
	Nb-95	< 0.001	< 0.003	< 0.003	< 0.002
	Zr-95	< 0.002	< 0.003	< 0.004	< 0.003
	Ru-103	< 0.001	< 0.002	< 0.002	< 0.002
	Ru-106	< 0.006	< 0.01	< 0.01	< 0.01
	Cs-134	< 0.0007	< 0.0009	< 0.001	< 0.001
	Cs-137	< 0.0008	< 0.001	< 0.001	< 0.001
	Ce-141	< 0.001	< 0.002	< 0.002	< 0.002
	Ce-144	< 0.003	< 0.005	< 0.004	< 0.005
CL-94	Be-7	0.10±0.03	0.11±0.03	0.07±0.01	0.05±0.01
	K-40	< 0.03	< 0.04	< 0.01	< 0.01
	Co-60	< 0.002	< 0.001	< 0.001	< 0.001
	Nb-95	< 0.002	< 0.002	< 0.002	< 0.001
	Zr-95	< 0.003	< 0.003	< 0.003	< 0.002
	Ru-103	< 0.002	< 0.003	< 0.002	< 0.001
	Ru-106	< 0.02	< 0.01	< 0.008	< 0.007
	Cs-134	< 0.001	< 0.002	< 0.0008	< 0.001
	Cs-137	< 0.002	< 0.002	< 0.0009	< 0.001
	Ce-141	< 0.004	< 0.005	< 0.002	< 0.002
	Ce-144	< 0.009	< 0.010	< 0.003	< 0.005

TABLE I-3

1987 CPS REMP QUARTERLY TLD RESULTS

(Dose in mRem/Quarter ± 1 s.d.)

Station Code	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
CL-1	17.4±1.3	19.6±0.6	19.0±1.4	20.9±0.6
CL-2	18.2±1.1	20.0±0.4	21.2±1.4	21.5±1.0
CL-3	17.7±0.7	22.2±0.8	19.1±1.1	23.0±0.8
CL-4	17.5±1.1	18.6±0.8	20.1±0.8	19.5±1.0
CL-5	18.4±1.4	17.2±0.6	20.4±0.7	17.6±0.5
CL-6	15.6±0.9	17.4±0.5	20.6±1.1	18.1±0.8
CL-7	20.0 *	21.2±1.8	18.1±0.5	20.6±0.6
CL-8	18.2±0.6	19.6±0.9	20.6±1.0	19.7±1.2
CL-11(c)	19.3 *	19.6±0.5	18.6±0.8	19.6±0.7
CL-20	16.6±0.8	20.5±0.5	18.6±0.9	19.9±0.6
CL-21	18.7±1.0	21.7±1.4	20.4±0.6	21.6±1.3
CL-22	16.9±0.8	19.5±0.8	18.3±1.6	21.2±1.4
CL-23	18.4±1.3	17.0 *	17.0 *	15.5±0.5
CL-24	15.4±0.7	16.4±0.7	16.9±0.4	19.1±1.0

TABLE I-3 (Continued)

1987 CPS REMP QUARTERLY TLD RESULTS
(Dose in mRem/Quarter ± 1 s.d.)

Station Code	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
CL-25	1[illegible].6±1.2	16.2±0.5	16.4±0.5	16.5±1.2
CL-26	14.0±0.4	18.7±0.9	16.9±0.5	18.2±0.9
CL-27	15.5±0.7	21.2±1.5	17.4±1.0	20.2±1.3
CL-28	17.7±0.7	22.4±0.6	20.0±0.9	21.8±0.7
CL-29	16.6±0.9	23.2±0.8	18.4±0.5	23.2±1.8
CL-30	16.0±0.6	25.6±2.2	18.6±0.8	23.6±0.6
CL-31	14.4±0.4	19.8±0.9	16.6±0.7	20.6±1.0
CL-32	15.5±0.6	22.1±1.3	16.9±0.4	22.6±0.7
CL-33(c)	16.2±1.2	23.1±1.0	17.9±0.6	24.0±0.7
CL-34	18.1±0.4	26.3±0.8	20.7±0.6	27.6±0.9
CL-35	15.6±0.9	18.6 *	17.8±0.4	22.3±1.5
CL-36	15.3±0.5	20.7±0.8	17.5±1.5	21.7±1.4
CL-37	16.1±0.6	21.7±1.0	19.4±1.1	23.6±1.7
CL-38	15.3±0.6	21.7±0.4	19.2±1.8	21.9±0.8

TABLE I-3 (Continued)

1987 CPS REMP QUARTERLY TLD RESULTS
(Dose in mRem/Quarter ± 1 s.d.)

Station Code	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
CL-39	14.2±1.0	20.0±0.6	16.6±1.1	19.6±0.7
CL-40	15.7±0.9	21.1±0.7	17.7±1.0	21.9±1.2
CL-41	17.4±1.7	17.4 *	17.4 *	17.4 *
CL-42	14.6±1.1	20.6±1.2	19.2±1.7	21.0±1.4
CL-43	16.4±1.1	22.6±1.9	20.2±0.9	23.0±1.3
CL-44	15.2±0.9	21.6±1.0	17.4±1.6	20.7±1.0
CL-45	18.2±0.8	25.7±0.9	22.4 *	23.3±0.7
CL-46	15.8±1.2	21.6±0.9	17.2±1.0	20.4±1.0
CL-47	16.7±0.6	24.9±0.9	19.0±0.4	23.3±0.8
CL-48	18.5±1.0	23.7±1.2	22.1±1.6	23.6±1.3
CL-49	15.8±0.6	23.8±1.1	18.9±1.6	23.0±0.9
CL-50	14.9±1.0	23.7±0.9	16.6±1.0	23.0±0.7
CL-51	16.0±0.8	23.4±0.8	18.8±0.7	22.8±1.1
CL-52	15.8±0.6	23.2±1.0	17.5±0.4	21.9±0.8

TABLE I-3 (Continued)

1987 CPS REMP QUARTERLY TLD RESULTS
(Dose in mRem/Quarter ± 1 s.d.)

Station Code	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
CL-53	14.5±0.8	22.2±0.8	16.1±1.0	20.4±0.8
CL-54	14.1±0.4	23.4±1.4	16.7±0.8	21.5±0.8
CL-55	15.6±1.0	21.8±1.1	17.5±1.0	21.1±1.6
CL-56	17.3±1.2	24.0±0.9	19.0±1.2	21.4±0.8
CL-57	16.9±1.1	23.0±1.0	19.5±0.8	22.0±1.6
CL-58	15.7±1.0	19.2 *	19.2 *	22.6±0.9
CL-59	20.8 *	20.8 *	18.9±0.7	22.7±1.2
CL-60	17.0±1.4	24.2±1.4	22.3±1.6	22.5±1.1
CL-61	16.0±1.4	22.9±1.1	17.7±1.2	23.2±1.2
CL-62	11.6±0.8	23.7±0.8	20.3 *	25.7±1.9
CL-63	16.2±1.1	25.9±0.7	19.8±1.0	25.2±1.0
CL-64	15.8±0.9	23.8±1.4	17.7±0.8	22.0±1.1
CL-65	16.3±0.9	23.8±0.9	18.2±0.5	23.4±1.1
CL-66	15.5±0.9	21.1±1.2	15.6±1.2	20.3±0.9

TABLE I-3 (Continued)

1987 CPS REMP QUARTERLY TLD RESULTS
(Dose in mRem/Quarter ± 1 s.d.)

Station Code	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
CL-67	16.6±0.8	22.6±1.5	20.7±1.4	21.2±0.7
CL-68	13.6±0.9	20.4±0.8	16.2±0.7	20.2±0.7
CL-69	18.5±1.4	25.3±1.0	20.2±0.4	24.8±1.3
CL-70	15.3±1.6	23.9±0.9	18.5±0.6	22.2±1.5
CL-71	18.3±1.2	23.6±0.9	19.0±0.5	23.6±0.9
CL-72	17.2±0.8	18.9 *	18.9 *	20.6±1.1
CL-73	18.0±1.2	23.3±0.8	19.0±0.9	24.5±1.6
CL-74	17.8±0.8	19.6 *	19.6 *	21.5±0.8
CL-75	18.1±1.0	21.3±1.1	19.8±1.6	21.0±0.3
CL-76	17.3±1.1	23.6±0.7	19.3±0.9	20.1 *
CL-77	16.1±0.6	17.5 *	17.5 *	18.9±1.1
CL-78	16.2±0.8	21.6±0.6	18.1±0.6	21.2±1.1
CL-79	15.5±1.0	22.6±1.3	17.9±0.8	20.6±1.0
CL-80	16.3±1.3	24.9±0.9	18.6±1.5	19.9 *

TABLE I-3 (Continued)

1987 CPS REMP QUARTERLY TLD RESULTS
(Dose in mRem/Quarter ± 1 s.d.)

Station Code	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
CL-81	16.2±0.4	22.1±1.0	18.0±0.6	22.5±1.3
CL-82	16.8±0.7	17.2 *	17.2 *	17.6±1.2
CL-83	17.7±1.2	22.8±1.3	19.9±1.4	22.4±1.2
CL-84	17.2±1.2	23.9±0.8	18.6±0.6	21.6±1.0
CL-85	17.6±1.1	22.8±0.7	19.5±1.4	21.6±1.1
CL-86	19.0±0.4	23.9±1.2	21.4±1.3	23.6±1.9
CL-87	18.3±0.4	24.5±1.3	21.3±1.6	22.8±1.0
CL-109	15.5±0.5	22.4±1.6	20.4±0.4	21.5±1.6
CL-110	17.8±0.8	20.5±0.9	19.4±0.6	19.4±0.8
CL-111	17.8±0.9	11.3±0.6	13.4 *	11.2±1.0
CL-112	15.3±0.6	18.0±0.8	16.5±0.5	17.8±0.6
CL-113	17.9±0.6	22.1±1.2	20.3±1.0	20.8±0.9

(c) - control Station all others indicators
* - TLD results missing, replace by taking average of all other quarters at same location for year
(a) - for station location description refer to Table A-1

TABLE I-4

GROSS BETA ACTIVITY IN SURFACE WATER FOR 1987

($pCi/m^3 \pm 1$ s.d.)

Station Location

Date	CL-9	CL-10(c)	CL-13	CL-90(a)	CL-91(b)	CL-92	CL-93
03/25/87	1.5±0.6	< 1.0	1.3±0.6	4.8±1.0	1.1±0.6	1.4±0.5	(d)
04/29/87	1.4±0.6	1.3±0.6	1.3±0.7	1.8±0.6	1.4±0.6	1.4±0.6	(d)
05/27/87	1.8±0.6	2.0±0.9	2.3±1.0	3.6±0.7	< 1.6	2.3±1.0	(d)
06/24/87	2.6±0.7	1.9±0.7	3.0±0.8	4.0±0.8	2.9±0.7	2.4±0.7	(d)
07/29/87	< 1.1	< 1.1	2.4±0.7	2.1±0.7	1.8±0.7	1.7±0.7	(d)
08/26/87	2.3±0.7	1.6±0.6	2.8±0.7	1.8±0.5	1.8±0.7	2.3±0.7	(d)
09/30/87	2.5±0.6	2.6±0.6	2.5±0.7	5.0±0.9	2.1±0.6	2.1±0.6	(d)
10/28/87	3.0±0.7	2.5±0.7	2.0±0.7	2.5±0.7	2.3±0.7	2.0±0.5	(d)
11/25/87	2.4±0.8	2.6±0.8	1.7±0.8	1.5±0.8	2.7±0.7	2.3±0.8	3.2±0.9
12/30/87	3.0±0.8	3.4±0.8	2.2±0.7	2.2±0.7	2.3±0.8	1.2±0.7	2.6±0.7

a - Downstream Sample Location of Discharge Point

b - Upstream Sample Location

c - Control Location, all other locations indicators

d - New Sample Location Started November, 1987

TABLE I-5

GROSS ALPHA ACTIVITY IN SURFACE WATER FOR 1987
(pCi/1±1 s.d.)

Date	CL-90(a)	CL-91(b)
03/25/87	< 2.0	< 1.2
04/29/87	1.0±0.7	< 0.9
05/27/87	1.3±0.8	< 1.7
06/24/87	< 1.3	2.6±1.1
07/29/87	< 0.8	< 0.8
08/26/87	< 0.8	< 0.9
09/30/87	1.2±0.8	< 0.8
10/28/87	1.0±0.6	< 0.8
11/25/87	< 0.9	< 0.9
12/30/87	< 1.1	<1.4

a - Downstream Sample Location

b - Upstream Sample Location

TABLE I-6

GAMMA ISOTOPIC ACTIVITY IN SURFACE WATER FOR 1987
(pCi/l)

Site	Isotope	3/25/87	4/29/87	5/27/87	6/24/87	7/29/87	8/26/87	9/30/87	10/28/87	11/25/87	12/30/87
CL-9	Be-7	< 12.0	< 12.5	< 23.0	< 26.2	< 11.3	< 22.9	< 19.3	< 16.4	< 13.2	< 15.1
	K-40	< 17.0	< 23.2	< 33.4	< 41.1	< 30.5	< 34.5	< 37.5	< 38.2	< 23.8	< 38.5
	Mn-54	< 5.0	< 1.5	< 2.3	< 2.6	< 1.3	< 2.3	< 2.2	< 1.7	< 1.4	< 1.8
	Fe-59	< 12.0	< 3.5	< 5.7	< 6.9	< 2.5	< 5.4	< 5.1	< 3.5	< 3.8	< 3.6
	Co-58	< 5.0	< 1.5	< 2.4	< 2.6	< 1.3	< 2.6	< 2.0	< 1.8	< 1.5	< 1.8
	Co-60	< 5.0	< 1.5	< 2.4	< 2.6	< 1.3	< 2.7	< 2.3	< 1.8	< 1.5	< 1.7
	Zn-65	< 6.0	< 2.8	< 4.8	< 5.2	< 3.1	< 5.3	< 4.8	< 3.8	< 2.8	< 4.2
	Nb-95	< 10.0	< 1.6	< 2.5	< 2.7	< 1.4	< 2.5	< 2.2	< 2.0	< 1.4	< 1.9
	Zr-95	< 10.0	< 2.6	< 4.3	< 5.0	< 2.3	< 4.3	< 4.0	< 3.4	< [illegible]	< 3.2
	Cs-134	< 5.0	< 1.3	< 2.2	< 2.3	< 1.4	< 2.2	< 2.1	< 1.8	< 1.2	< 1.9
	Cs-137	< 5.0	< 1.7	< 2.7	< 3.0	< 1.4	< 2.6	< 2.5	< 2.0	< 1.3	< 1.9
	Ba-140	< 60.0	< 5.8	< 13.6	< 19.1	< 6.2	< 11.2	< 8.4	< 6.9	< 9.2	< 9.3
	La-140	< 15.0	< 1.6	< 3.5	< 5.0	< 1.7	< 3.0	< 1.9	< 2.0	< 2.9	< 2.8
	Ce-144	< 11.0	< 12.4	< 22.6	< 25.9	< 12.0	< 23.3	< 22.4	< 18.3	< 11.2	< 13.7
CL-10(c)	Be-7	< 18.0	< 16.3	< 15.3	< 18.5	< 12.3	< 16.2	< 14.9	< 15.8	< 15.8	< 15.5
	K-40	< 12.0	< 37.3	< 37.8	< 40.1	< 20.7	< 39.1	< 18.9	< 38.6	< 41.2	< 39.6
	Mn-54	< 5.0	< 1.9	< 2.0	< 2.2	< 1.3	< 1.9	< 1.8	< 1.8	< 1.9	< 1.8
	Fe-59	< 12.0	< 5.0	< 4.5	< 5.6	< 3.7	< 4.0	< 3.8	< 3.6	< 3.8	< 4.1
	Co-58	< 5.0	< 2.1	< 2.1	< 2.4	< 1.4	< 1.8	< 1.9	< 1.8	< 1.8	< 1.9
	Co-60	< 5.0	< 2.3	< 2.4	< 2.6	< 1.4	< 2.0	< 2.1	< 1.8	< 1.9	< 1.8
	Zn-65	< 6.0	< 4.7	< 4.8	< 5.6	< 2.6	< 4.1	< 4.0	< 3.9	< 3.6	< 4.0
	Nb-95	< 10.0	< 2.3	< 2.2	< 2.6	< 1.4	< 2.0	< 1.8	< 1.8	< 1.8	< 2.0
	Zr-95	< 10.0	< 3.5	< 3.5	< 4.1	< 2.2	< 3.7	< 3.2	< 3.2	< 3.2	< 3.5
	Cs-134	< 5.0	< 1.8	< 1.9	< 2.2	< 1.2	< 2.1	< 1.9	< 2.0	< 1.9	< 2.1
	Cs-137	< 5.0	< 2.0	< 2.1	< 2.2	< 1.5	< 2.0	< 1.9	< 1.9	< 1.3	< 1.9
	Ba-140	< 60.0	< 7.0	< 8.8	< 14.0	< 6.5	< 8.7	< 6.6	< 6.4	< 10.5	< 10.4
	La-140	< 15.0	< 2.6	< 3.8	< 6.4	< 1.9	< 2.7	< 2.5	< 1.8	< 3.2	< 3.3
	Ce-144	< 19.0	< 13.0	< 13.2	< 14.6	< 15.3	< 13.4	< 12.6	< 13.5	< 13.7	< 14.2

TABLE I-6 (continued)

Site	Isotope	3/25/87	4/29/87	5/27/87	6/24/87	7/29/87	8/26/87	9/30/87	10/28/87	11/25/87	12/30/87
CL-13	Be-7	< 11.0	< 23.0	< 12.9	< 22.7	< 10.3	< 17.3	< 25.1	< 16.0	< 13.5	< 16.0
	K-40	< 12.0	< 38.6	< 32.2	< 42.0	< 18.3	< 19.1	< 42.8	< 37.4	< 35.0	< 33.8
	Mn-54	< 5.0	< 2.4	< 1.5	< 2.4	< 1.2	< 2.1	< 2.7	< 1.9	< 1.8	< 2.0
	Fe-59	< 12.0	< 6.2	< 2.9	< 5.5	< 3.2	< 4.2	< 7.4	< 3.9	< 4.3	< 4.0
	Co-58	< 5.0	< 2.5	< 1.5	< 2.7	< 1.2	< 2.1	< 3.0	< 2.0	< 1.7	< 1.8
	Co-60	< 5.0	< 2.3	< 1.4	< 2.6	< 1.3	< 2.2	< 3.1	< 2.2	< 2.0	< 2.0
	Zn-65	< 6.0	< 4.9	< 3.3	< 5.1	< 2.3	< 4.6	< 7.2	< 4.6	< 4.0	< 4.4
	Nb-95	< 10.0	< 2.6	< 1.5	< 3.0	< 1.2	< 2.1	< 3.5	< 2.2	< 2.0	< 2.0
	Zr-95	< 10.0	< 4.3	< 2.6	< 4.8	< 2.0	< 3.9	< 5.9	< 3.6	< 3.3	< 3.4
	Cs-134	< 5.0	< 2.2	< 1.6	< 2.4	< 1.1	< 2.2	< 2.4	< 2.0	< 1.7	< 1.8
	Cs-137	< 5.0	< 2.6	< 1.5	< 2.5	< 1.4	< 2.3	< 2.6	< 1.9	< 1.8	< 1.9
	Ba-140	< 60.0	< 8.6	< 7.5	< 6.8	< 4.9	< 8.7	< 9.1	< 6.1	< 7.6	< 9.1
	La-140	< 15.0	< 1.8	< 2.0	< 2.6	< 1.5	< 2.5	< 3.3	< 2.6	< 2.8	< 3.5
	Ce-144	< 10.0	< 22.0	< 13.0	< 22.4	< 13.1	< 19.2	< 16.7	< 12.9	< 10.5	< 11.3
CL-90(a)	Be-7	< 14.0	< 13.5	< 18.6	< 20.8	< 13.8	< 14.6	< 16.7	< 21.9	< 13.6	< 24.5
	K-40	< 23.0	< 36.5	< 39.5	< 48.6	< 34.9	< 36.1	< 38.7	< 39.0	< 38.3	< 39.7
	Mn-54	< 5.0	< 1.6	< 2.1	< 2.3	< 1.7	< 1.8	< 1.6	< 2.5	< 1.5	< 2.4
	Fe-59	< 12.0	< 3.8	< 4.5	< 5.0	< 3.2	< 3.3	< 3.9	< 4.9	< 3.2	< 5.1
	Co-58	< 5.0	< 1.9	< 2.2	< 2.4	< 1.6	< 1.7	< 1.8	< 2.3	< 1.6	< 2.2
	Co-60	< 5.0	< 1.9	< 2.0	< 2.0	< 1.7	< 1.8	< 1.7	< 2.5	< 1.6	< 2.4
	Zn-65	< 6.0	< 4.1	< 4.7	< 5.2	< 3.5	< 3.9	< 3.8	< 4.4	< 3.2	< 4.7
	Nb-95	< 10.0	< 2.0	< 2.5	< 2.5	< 1.6	< 1.8	< 2.0	< 2.5	< 1.7	< 2.4
	Zr-95	< 10.0	< 3.1	< 4.2	< 4.1	< 2.9	< 3.2	< 3.5	< 3.9	< 2.7	< 4.6
	Cs-134	< 5.0	< 1.6	< 2.2	< 2.4	< 1.7	< 1.9	< 1.8	< 2.2	< 1.6	< 2.3
	Cs-137	< 5.0	< 1.7	< 2.2	< 2.4	< 1.6	< 1.8	< 1.8	< 2.6	< 1.6	< 2.6
	Ba-140	< 60.0	< 5.7	< 12.7	< 16.4	< 6.6	< 6.9	< 10.6	< 12.2	< 9.6	< 9.2
	La-140	< 15.0	< 2.3	< 3.6	< 4.5	< 2.0	< 2.0	< 3.0	< 2.9	< 2.7	< 1.9
	Ce-144	< 13.0	< 11.1	< 19.3	< 18.6	< 11.4	< 12.1	< 13.7	< 22.6	< 12.0	< 22.7

TABLE I-6 (continued)

Site	Isotope	3/25/87	4/29/87	5/27/87	6/24/87	7/29/87	8/26/87	9/30/87	10/28/87	11/25/87	12/30/87
CL-91(b)	Be-7	< 10.0	< 17.4	< 15.1	< 19.3	< 11.2	< 12.2	< 19.5	< 23.1	< 11.5	< 16.9
	K-40	< 21.0	< 37.1	< 27.3	< 40.4	< 32.7	< 32.1	< 40.8	< 40.6	< 30.1	< 38.3
	Mn-54	< 5.0	< 1.9	< 1.9	< 2.4	< 1.4	< 1.3	< 2.0	< 2.3	< 1.2	< 1.9
	Fe-59	< 12.0	< 4.2	< 5.0	< 5.4	< 2.8	< 2.7	< 4.8	< 5.7	< 2.6	< 3.8
	Co-58	< 5.0	< 2.0	< 1.6	< 2.7	< 1.4	< 1.4	< 2.2	< 2.6	< 1.4	< 1.8
	Co-60	< 5.0	< 1.9	< 1.9	< 2.4	< 1.4	< 1.3	< 2.0	< 2.1	< 1.2	< 1.9
	Zn-65	< 6.0	< 3.9	< 3.3	< 5.1	< 2.8	< 3.4	< 4.4	< 4.6	< 2.8	< 4.0
	Nb-95	< 10.0	< 2.2	< 2.1	< 2.6	< 1.4	< 1.4	< 2.5	< 2.3	< 1.4	< 2.1
	Zr-95	< 10.0	< 3.6	< 3.2	< 4.1	< 2.5	< 2.4	< 4.0	< 4.3	< 2.3	< 3.6
	Cs-134	< 5.0	< 1.9	< 1.5	< 2.0	< 1.4	< 1.6	< 2.2	< 2.2	< 1.4	< 1.9
	Cs-137	< 5.0	< 2.0	< 2.0	< 2.3	< 1.4	< 1.6	< 1.9	< 2.6	< 1.3	< 2.1
	Ba-140	< 60.0	< 6.7	< 9.4	< 16.1	< 5.9	< 7.1	< 16.8	< 12.6	< 7.6	< 9.8
	La-140	< 15.0	< 1.9	< 2.8	< 6.2	< 1.9	< 1.9	< 4.7	< 3.7	< 2.2	< 2.9
	Ce-144	< 11.0	< 17.4	< 15.4	< 14.6	< 9.7	< 12.7	< 14.7	< 22.4	< 10.7	< 19.0
CL-92	Be-7	< 17.0	< 11.0	< 22.6	< 19.8	< 14.2	< 13.0	< 14.7	< 18.3	< 14.4	< 26.2
	K-40	< 18.0	< 28.4	< 37.2	< 38.8	< 34.5	< 32.9	< 31.[illegible]	< 39.3	< 38.7	< 37.6
	Mn-54	< 5.0	< 1.1	< 2.3	< 1.9	< 1.7	< 1.4	< 1.5	< 2.0	< 1.6	< 2.4
	Fe-59	< 12.0	< 2.5	< 6.2	< 4.6	< 4.0	< 2.8	< 3.3	< 4.3	< 3.5	< 6.3
	Co-58	< 5.0	< 1.3	< 2.3	< 2.3	< 1.9	< 1.6	< 1.7	< 2.1	< 1.6	< 2.5
	Co-60	< 5.0	< 1.0	< 2.4	< 2.3	< 2.1	< 1.5	< 1.4	< 2.0	< 1.7	< 2.4
	Zn-65	< 6.0	< 2.6	< 4.9	< 4.2	< 4.6	< 3.4	< 3.4	< 4.2	< 3.7	< 5.2
	Nb-95	< 10.0	< 1.4	< 2.2	< 2.7	< 1.9	< 1.5	< 1.8	< 2.3	< 1.8	< 2.7
	Zr-95	< 10.0	< 2.1	< 4.2	< 4.2	< 3.1	< 2.6	< 2.9	< 4.0	< 3.0	< 4.8
	Cs-134	< 5.0	< 1.2	< 2.1	< 2.2	< 1.7	< 1.6	< 1.6	< 2.1	< 1.6	< 2.4
	Cs-137	< 5.0	< 1.2	< 2.7	< 2.0	< 1.9	< 1.6	< 1.5	< 2.1	< 1.7	< 2.7
	Ba-140	< 60.0	< 4.5	< 12.8	< 16.1	< 7.8	< 7.2	< 11.7	< 7.6	< 10.0	< 9.3
	La-140	< 15.0	< 1.2	< 3.0	< 5.0	< 2.9	< 1.7	< 2.9	< 2.3	< 3.4	< 1.9
	Ce-144	< 19.0	< 10.4	< 21.8	< 14.5	< 11.9	< 13.4	< 13.4	< 19.1	< 12.3	< 24.4

TABLE I-6 (continued)

Site	Isotope	11/25/87	12/30/87
CL-93(d)	Be-7	< 17.4	< 17.0
	K-40	< 38.7	< 41.6
	Mn-54	< 1.8	< 1.9
	Fe-59	< 3.9	< 4.0
	Co-58	< 1.9	< 1.8
	Co-60	< 1.9	< 2.1
	Zn-65	< 4.0	< 4.1
	Nb-95	< 2.2	< 2.0
	Zr-95	< 3.6	< 3.5
	Cs-134	< 1.9	< 2.1
	Cs-137	< 2.0	< 2.0
	Ba-140	< 6.8	< 7.3
	La-140	< 2.1	< 2.3
	Ce-144	< 18.6	< 14.8

(a) - downstream sample location

(b) - upstream sample location

(c) - control location, all other location indicators

(d) - new sample location added in November, 1987

TABLE I-7

IODINE-131 and TRITIUM ACTIVITY IN SURFACE WATER 1987
(pCi/l ± 1 s.d.)

Tritium

Site	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
*CL-9	< 174	#	#	< 174	#	#	< 190	#	#	< 166
*CL-10(c)	< 174	#	#	< 174	#	#	< 190	#	#	< 120
*CL-13	< 174	#	#	< 174	#	#	< 190	#	#	< 112
*CL-90(a)	< 174	#	#	< 174	#	#	< 190	#	#	< 130
CL-91(b)	< 174	< 174	<148	< 152	< 166	< 166	< 189	< 164	< 171	< 183
CL-92	< 174	< 174	<148	< 152	< 166	< 166	< 189	< 164	< 171	< 122
CL-93(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	< 170	152±84

Iodine-131

CL-90(a)	< 0.5	< 0.5	< 0.5	<0.5	< 0.2	< 0.3	<0.2	< 0.4	< 0.4	<0.2

- sample analyzed only once per quarter

* - samples are quarterly composites of monthly samples

(a) - downstream sample location, only surface water location for I-131

(b) - upstream sample location

(c) - control location, all other locations indicators

(d) - new sample location added November, 1987

TABLE I-8

Gamma Isotopic, Gross Beta, Gross Alpha and Tritium Activity in Drinking Water for 1987
CL-14 (pCi/l ± 1 s.d.)

Isotope	3/25/87	4/29/87	5/27/87	6/24/87	7/29/87	8/26/87	9/30/87	10/28/87	11/25/87	12/30/87
Gross alpha	< 0.7	1.8±0.3	< 0.5	< 0.4	< 0.5	< 0.5	< 0.4	< 0.2	< 0.5	< 0.6
Gross beta	1.3±0.3	1.8±0.3	1.7±0.3	1.8±0.3	1.4±0.3	< 0.4	1.9±0.3	0.6±0.2	1.9±0.3	1.6±0.3
Be-7	<13.0	< 15.9	< 14.6	< 18.7	< 22.1	< 20.3	< 19.5	< 14.4	< 20.5	< 17.3
K-40	<16.0	< 36.7	< 23.6	< 38.1	< 36.3	< 34.4	< 38.9	< 26.0	< 42.0	< 39.4
Mn-54	< 5.0	< 1.7	< 1.6	< 2.0	< 2.3	< 2.1	< 2.0	< 1.7	< 2.3	< 2.0
Fe-59	<12.0	< 4.1	< 4.4	< 4.5	< 6.2	< 5.3	< 5.0	< 4.2	< 4.7	< 4.1
Co-58	< 5.0	< 1.9	< 1.7	< 2.2	< 2.6	< 2.3	< 2.4	< 1.7	< 2.2	< 1.8
Co-60	< 5.0	< 1.8	< 1.6	< 2.0	< 2.3	< 2.5	< 2.4	< 1.8	< 2.2	< 2.0
Zn-65	< 6.0	< 3.8	< 3.3	< 4.5	< 5.0	< 4.9	< 4.9	< 3.3	< 4.6	< 4.3
Nb-95	<10.0	< 2.2	< 1.7	< 2.3	< 2.6	< 2.2	< 2.8	< 1.6	< 2.8	< 2.3
Zr-95	<10.0	< 3.3	< 2.7	< 3.9	< 4.3	< 3.8	< 4.3	< 2.5	< 4.3	< 3.8
Cs-134	< 5.0	< 1.9	< 1.4	< 2.1	< 2.0	< 2.0	< 2.0	< 1.3	< 2.3	< 2.0
Cs-137	< 5.0	< 1.8	< 1.8	< 1.9	< 2.3	< 2.6	< 2.1	< 1.8	< 2.2	< 2.2
Ba-140	<60.0	< 6.4	< 9.2	< 14.1	< 15.8	< 9.2	< 15.5	< 8.3	< 8.0	< 10.9
La-140	<15.0	< 2.0	< 2.6	< 4.2	< 3.7	< 2.1	< 6.0	< 2.7	< 2.5	< 3.2
Ce-144	<12.0	< 12.4	< 14.0	< 14.0	< 22.1	< 21.6	< 14.2	< 1.3	< 21.9	< 19.7

	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
Tritium	< 174	< 174	< 190	< 190

TABLE I-S

TRITIUM AND IODINE - 131 ACTIVITY IN WELL WATER FOR 1987

Iodine-131 (pCi/l)

Site	3/11/87	3/25/87	3/31/87	4/15/87	4/29/87	5/13/87	5/27/87	6/10/87	6/24/87	7/8/87	7/22/87	7/29/87
CL-7(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
CL-12(t)	< 0.5	< 0.5	< 0.2	< 0.2	< 0.3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.3	< 0.2	< 0.1
CL-12(u)	< 0.5	< 0.5	< 0.3	< 0.3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.1

	8/5/87	8/19/87	9/2/87	9/16/87	9/30/87	10/14/87	10/28/87	11/11/87	11/25/87	12/9/87	12/23/87
CL-7(a)	(a)	(a)	(a)	< 0.3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.3	< 0.2	< 0.2
CL-12 (t)	< 0.2	< 0.2	< 0.5	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
CL-12(u)	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.4	< 0.2	< 0.2	< 0.2

TRITIUM(b)

Site	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
CL-7	<174	<174	<190	<177
CL-12(t)	<174	<174	<189	<177
CL-12(u)	<174	<174	<189	<177

(a) - Analysis added to program in September, 1987

(b) - quarterly composites of semi-monthly samples

(t) - Treated well water

(u) - Untreated well water

TABLE I-10

GROSS ALPHA, GROSS BETA, AND GAMMA ISOTOPIC ACTIVITY IN WELL WATER AT CL-7 FOR 1987 (a) (pCi/l ± 1 s.d.)

Isotope	3/25/87	3/31/87	4/29/87	5/27/87	6/24/87	6/30/87	7/29/87
Gross alpha(b)	-	-	< 1.7	< 2.2	< 1.0	< 1.4	< 1.5
Gross beta	< 1.3	3.0±0.9	1.0±0.8	3.1±0.8	3.0±0.9	1.6±0.9	2.2±1.0
Be-7	< 21.0	< 15.3	<20.1	<14.7	< 18.0	<18.8	<14.2
K-40	< 13.0	< 22.8	<31.5	<33.8	< 25.4	<36.1	<35.8
Mn-54	< 5.0	< 1.6	< 2.2	< 1.6	< 4.9	< 2.1	< 1.6
Fe-59	< 12.0	< 4.2	< 5.1	< 3.2	< 1.5	< 4.6	< 3.4
Co-58	< 5.0	< 1.6	< 1.9	< 1.6	< 1.5	< 2.1	< 1.7
Co-60	< 5.0	< 1.9	< 2.0	< 1.5	< 1.7	< 1.5	< 1.7
Zn-65	< 6.0	< 3.5	< 4.4	< 3.7	< 3.3	< 5.2	< 3.8
Nb-95	< 10.0	< 1.6	< 1.9	< 1.7	< 1.7	< 2.2	< 1.7
Zr-95	< 10.0	< 3.2	< 3.8	< 2.8	< 2.9	< 3.8	< 3.0
Cs-134	< 5.0	< 1.3	< 1.9	< 1.8	< 1.6	< 2.5	< 2.0
Cs-137	< 5.0	< 1.7	< 2.5	< 1.6	< 2.2	< 2.2	< 1.7
Ba-140	< 60.0	< 5.9	< 7.4	< 9.3	< 10.6	<12.2	< 7.6
La-140	< 15.0	< 1.6	< 1.9	< 2.3	< 3.8	< 3.6	< 2.1
Ce-144	< 22.0	< 12.7	<19.6	<14.1	< 5.0	<17.6	<11.8

Isotope	8/26/87	9/2/87	9/16/87	9/30/87	October	November	December
Gross alpha(b)	< 1.5	< 1.3	< 1.4	< 1.2	< 1.5	<1.8	< 1.1
Gross beta	1.7±0.9	2.5±0.8	2.6±0.8	3.2±0.6	2.9±1.0	2.8±1.1	2.6±0.8
Be-7	< 13.5	< 16.4	<12.8	<13.2	< 19.8	<17.9	<15.4
K-40	< 45.6	< 37.6	<31.6	<25.7	< 45.0	<28.1	<34.0
Mn-54	< 1.5	< 1.8	< 1.4	< 1.5	< 2.1	< 1.7	< 2.1
Fe-59	< 4.0	< 3.8	< 2.9	< 3.9	< 4.9	< 4.3	< 4.4
Co-58	< 1.5	< 1.9	< 1.5	< 1.4	< 2.3	< 2.0	< 1.9
Co-60	< 1.5	< 1.6	< 1.3	< 1.6	< 1.9	< 2.1	< 2.3
Zn-65	< 3.3	< 3.6	< 3.2	< 2.8	< 5.0	< 4.0	< 4.5
Nb-95	< 1.8	< 2.1	< 1.5	< 1.5	< 2.5	< 2.1	< 2.6
Zr-95	< 2.5	< 3.5	< 2.5	< 2.9	< 4.0	< 3.6	< 3.6
Cs-134	< 1.3	< 1.8	< 1.6	< 1.2	< 2.2	< 1.7	< 2.0
Cs-137	< 1.6	< 1.8	< 1.5	< 1.8	< 2.1	< 2.1	< 1.9
Ba-140	< 6.1	< 11.9	< 7.9	< 7.6	< 7.4	< 6.1	< 6.4
La-140	< 1.8	< 3.5	< 2.2	< 2.1	< 2.0	< 1.8	< 2.6
Ce-144	< 15.2	< 16.4	<12.9	<13.0	< 16.5	<14.5	<11.9

(a) - samples changed from monthly to semi-monthly with analysis performed on monthly composites of semi-monthly samples in September 1987

(b) - analysis for gross alpha changed from second month of quarter to all monthly composite samples

TABLE I-11

GROSS ALPHA, GROSS BETA, AND GAMMA ISOTOPIC ACTIVITY IN WELL WATER AT CL-12 for 1987
(pCi/l ± 1 s.d.)

Location	Isotope	March	April	May	June	July	August	September	October	November	December
CL-12(t)	Gross alpha	< 3.0	< 2.9	< 2.9	< 3.1	< 2.0	< 2.9	< 2.9	< 1.4	< 2.8	< 3.2
	Gross beta	< 2.6	2.3±1.4	< 2.9	2.4±1.7	< 2.2	3.2±1.7	3.0±1.6	2.7±2.1	3.1±2.1	2.5±1.9
	Be-7	<14.0	<16.8	<13.8	<21.9	< 25.0	<16.7	< 22.6	< 21.8	<27.9	<29.0
	K-40	<15.0	<36.8	<32.6	<41.4	< 51.6	<27.9	< 41.0	< 40.3	<38.4	<39.2
	Mn-54	< 5.0	< 2.1	< 1.4	< 2.4	< 2.3	< 2.3	< 2.2	< 2.2	< 2.5	< 2.5
	Fe-59	<12.0	< 4.8	< 3.3	< 5.6	< 6.0	< 5.0	< 5.4	< 5.0	< 6.0	< 6.1
	Co-58	< 5.0	< 2.3	< 1.6	< 2.6	< 2.4	< 2.4	< 2.5	< 2.5	< 2.6	< 2.6
	Co-60	< 5.0	< 2.4	< 1.3	< 2.3	< 2.3	< 2.6	< 2.4	< 2.2	< 2.6	< 2.4
	Zn-65	< 6.0	< 4.9	< 3.4	< 4.8	< 5.1	< 5.4	< 4.8	< 4.6	< 4.9	< 5.6
	Nb-95	<10.0	< 2.4	< 1.8	< 2.9	< 2.6	< 2.4	< 2.9	< 2.2	< 4.9	< 2.8
	Zr-95	<10.0	< 3.4	< 2.8	< 4.7	< 4.9	< 3.8	< 4.6	< 4.6	< 5.0	< 5.2
	Cs-134	< 5.0	< 1.9	< 1.5	< 2.3	< 2.1	< 2.0	< 2.4	< 2.2	< 2.3	< 2.5
	Cs-137	< 5.0	< 2.0	< 1.5	< 2.4	< 2.6	< 2.3	< 2.3	< 2.4	< 2.7	< 3.0
	Ba-140	<60.0	< 6.5	<10.8	<17.0	< 17.6	<11.0	< 19.2	< 8.2	< 8.9	< 7.7
	La-140	<15.0	< 2.5	< 2.8	< 4.2	< 4.5	< 4.2	< 5.5	< 2.4	< 2.0	< 1.8
	Ce-144	<12.0	<12.9	<13.3	<21.8	< 23.1	<14.6	< 21.1	< 20.7	<24.6	<25.4
CL-12(u)	Gross alpha	< 3.2	< 2.9	< 1.9	< 3.0	< 2.1	< 2.9	< 1.4	< 2.6	< 2.7	< 3.0
	Gross beta	< 2.9	2.0±1.4	< 2.4	< 3.3	< 2.2	< 3.1	< 2.8	< 3.8	< 3.2	< 3.2
	Be-7	<16.0	<13.4	<22.2	<17.8	< 15.2	<18.2	< 15.9	<17.9	<18.1	<20.0
	K-40	<24.0	<32.8	<40.4	<35.9	< 28.0	<39.1	< 19.2	<37.4	<41.3	<41.1
	Mn-54	< 5.0	< 1.4	< 2.3	< 1.7	< 1.6	< 2.0	< 1.8	< 2.0	< 1.8	< 2.2
	Fe-59	<12.0	< 3.1	< 5.8	< 4.2	< 4.3	< 4.1	< 4.1	< 4.8	< 4.4	< 4.6
	Co-58	< 5.0	< 1.3	< 2.4	< 2.1	< 1.6	< 2.1	< 1.9	< 2.0	< 1.9	< 2.1
	Co-60	< 5.0	< 1.7	< 2.2	< 1.8	< 1.7	< 1.9	< 1.9	< 2.0	< 2.0	< 2.2
	Zn-65	< 6.0	< 3.3	< 4.9	< 4.2	< 3.3	< 4.4	< 4.3	< 4.7	< 4.2	< 4.8
	Nb-95	<10.0	< 1.7	< 2.3	< 2.1	< 1.5	< 2.2	< 2.0	< 2.5	< 2.2	< 2.6
	Zr-95	<10.0	< 2.6	< 4.1	< 3.5	< 3.5	< 3.8	< 3.6	< 4.0	< 3.5	< 4.2
	Cs-134	< 5.0	< 1.5	< 2.3	< 2.9	< 1.4	< 2.4	< 1.7	< 2.0	< 1.9	< 2.3
	Cs-137	< 5.0	< 1.5	< 2.6	< 1.8	< 1.6	< 2.0	< 1.8	< 2.0	< 2.0	< 2.3
	Ba-140	< 60.0	< 5.2	< 1.2	< 13.2	< 11.9	< 10.3	< 9.9	< 6.3	< 6.8	< 8.0
	La-140	< 15.0	< 1.3	< 3.3	< 3.8	< 3.6	< 3.2	< 3.6	< 2.5	< 2.3	< 2.2
	Ce-144	< 14.0	< 12.8	< 22.3	< 12.7	< 16.7	< 13.9	< 11.9	<13.5	< 4.7	<21.9

(t) - Treated well water samples

(u) - Untreated well water samples

TABLE I-12

IODINE - 131 AND GAMMA ISOTOPIC ACTIVITY IN MILK FOR 1987 (a)
CL-116 (pCi/l ± 1s.d.)

Isotope	3/25/87	4/29/87	5/6/87	5/20/87	6/3/87
I-131	< 0.5	< 0.5	< 0.4	< 0.3	< 0.3
Be-7	<13.0	<18.0	<21.0	<16.0	<17.0
K-40	1290±50	1110±50	1190±60	1210±60	1120±60
Mn-54	< 5.0	< 2.1	< 2.4	< 2.4	< 2.4
Fe-59	<12.0	< 4.8	< 6.5	< 6.0	< 6.1
Co-58	< 5.0	< 2.2	< 2.4	< 2.5	< 2.5
Co-60	< 5.0	< 2.2	< 2.6	< 2.7	< 2.9
Zn-65	< 6.0	< 5.5	< 5.6	< 6.5	< 7.0
Nb-95	<10.0	< 2.3	< 2.5	< 2.3	< 2.3
Zr-95	<10.0	< 3.9	< 4.4	< 3.8	< 4.1
Cs-134	< 5.0	< 2.1	< 2.3	< 1.9	< 2.2
Cs-137	< 5.0	< 2.1	< 2.9	< 2.1	< 2.3
Ba-140	<60.0	< 7.7	< 9.1	< 7.8	< 8.5
La-140	<15.0	< 1.8	< 2.0	< 2.9	< 3.0
Ce-144	<14.0	<16.4	<21.9	<13.4	<14.4

	6/17/87	7/1/87	7/15/87	7/29/87	8/12/87
I-131	< 0.3	< 0.4	< 0.3	< 0.2	< 0.2
Be-7	<17.0	<18.0	<15.0	<15.0	<13.0
K-40	1250±60	1220±70	1200±50	1220±60	1140±40
Mn-54	< 2.5	< 2.6	< 1.8	< 2.3	< 1.6
Fe-59	< 5.9	< 6.5	< 5.4	< 5.5	< 3.8
Co-58	< 2.6	< 2.8	< 1.7	< 2.3	< 1.7
Co-60	< 3.2	< 3.0	< 2.0	< 2.6	< 1.6
Zn-65	< 3.2	< 3.0	< 2.0	< 2.6	< 1.6
Nb-95	< 7.0	< 7.1	< 4.6	< 6.4	< 4.4
Zr-95	< 2.6	< 2.7	< 1.8	< 2.2	< 1.7
Cs-134	< 2.2	< 2.1	< 1.6	< 2.0	< 1.6
Cs-137	< 2.4	< 2.3	< 2.2	< 2.2	< 1.7
Ba-140	< 8.6	<10.6	< 8.1	< 8.1	< 8.0
La-140	< 3.2	< 3.7	< 1.9	< 2.9	< 1.8
Ce-144	<14.2	<14.7	<16.7	<13.2	<13.9

TABLE I-12 (continued)

Isotope	8/26/87	9/9/87	9/23/87	10/07/87
Sr-90(b)	---	---	---	2.3±0.3
I-131	< 0.2	< 0.5	< 0.2	< 0.4
Be-7	<17.0	< 17.0	<17.0	<21.0
K-40	1240±60	1240±60	1250±60	1200±-.70
Mn-54	< 2.6	< 2.5	< 2.6	< 2.5
Fe-59	< 5.8	< 6.5	< 6.2	< 6.9
Co-58	< 2.6	< 2.6	< 2.6	< 2.7
Co-60	< 3.0	< 3.0	< 3.0	< 2.7
Zn-65	< 6.5	< 7.0	< 7.2	< 9.7
Nb-95	< 2.3	< 2.6	< 2.5	< 2.8
Zr-95	< 4.0	< 4.2	< 4.1	< 4.8
Cs-134	< 2.1	< 2.0	< 2.2	< 2.4
Cs-137	< 2.4	< 2.4	< 2.4	< 3.0
Ba-140	< 8.5	< 10.3	<10.3	< 9.4
La-140	< 2.9	< 3.3	< 4.0	< 1.8
Ce-144	<14.3	< 14.2	<14.4	<23.0

	10/21/87	11/04/87	11/26/87	12/29/87
Sr-90(b)	2.4±0.7	2.5±0.6	2.3±0.6	2.4±0.6
I-131	< 0.4	< 0.2	< 0.3	< 0.4
Be-7	<19.0	< 17.0	<28.0	<17.0
K-40	1210±70	1220±60	1270±70	1250±70
Mn-54	< 2.5	< 2.2	< 2.9	< 2.2
Fe-59	< 6.5	< 5.3	< 8.0	< 5.4
Co-58	< 2.7	< 2.2	< 3.2	< 2.2
Co-60	< 3.2	< 2.2	< 3.7	< 2.2
Zn-65	< 7.2	< 5.4	< 7.1	< 5.6
Nb-95	< 2.7	< 2.2	< 3.0	< 2.2
Zr-95	< 4.8	< 3.7	< 5.4	< 3.8
Cs-134	< 2.4	< 2.1	< 2.6	< 2.1
Cs-137	< 2.5	< 2.0	< 3.4	< 2.3
Ba-140	< 7.7	< 7.2	< 9.6	<10.5
La-140	< 2.6	< 1.9	< 1.8	< 2.8
Ce-144	<15.6	< 15.0	<18.1	<15.5

(a) - Milk collection semi-monthly during grazing season (May - October); monthly during non-grazing season (November - April)

(b) - Analysis for Sr-90 added to program in October, 1987

TABLE I-13

GAMMA ISOTOPIC ACTIVITY IN FISH FOR 1987
(pCi/g, wet ± 1 s.d.)

CL-19

Isotope	04/15/87 Carp	04/15/87 Bluegill	04/15/87 Largemouth Bass	04/15/87 White Crappie
Be-7	< 0.041	< 0.049	< 0.072	< 0.059
K-40	2.62±0.014	2.48±0.13	2.82±0.22	2.47±0.19
Mn-54	< 0.005	< 0.006	< 0.012	< 0.008
Fe-59	< 0.013	< 0.015	< 0.027	< 0.023
Co-58	< 0.005	< 0.006	< 0.010	< 0.008
Co-60	< 0.006	< 0.006	< 0.012	< 0.008
Zn-65	< 0.014	< 0.016	< 0.026	< 0.020
Nb-95	< 0.006	< 0.007	< 0.010	< 0.007
Zr-95	< 0.010	< 0.011	< 0.018	< 0.015
Ru-103	< 0.005	< 0.006	< 0.008	< 0.007
Ru-106	< 0.044	< 0.050	< 0.082	< 0.061
Cs-134	< 0.005	< 0.006	< 0.009	< 0.007
Cs-137	< 0.005	< 0.006	< 0.010	< 0.008
Ba-140	< 0.017	< 0.020	< 0.031	< 0.025
La-140	< 0.004	< 0.009	< 0.008	< 0.007
Ce-141	< 0.006	< 0.008	< 0.009	< 0.009
Ce-144	< 0.026	< 0.030	< 0.040	< 0.038

Isotope	10/19/87 Carp	10/19/87 Largemouth Bass	10/19/87 White Crappie	10/19/87 Bluegill
Be-7	< 0.058	< 0.064	< 0.092	< 0.006
K-40	2.57±0.14	2.68±0.12	2.88±0.19	2.24±0.16
Mn-54	< 0.005	< 0.005	< 0.007	< 0.006
Fe-59	< 0.022	< 0.022	< 0.030	< 0.020
Co-58	< 0.006	< 0.008	< 0.010	< 0.008
Co-60	< 0.006	< 0.007	< 0.007	< 0.007
Zn-65	< 0.014	< 0.016	< 0.020	< 0.014
Nb-95	< 0.007	< 0.010	< 0.010	< 0.007
Zr-95	< 0.012	< 0.015	< 0.018	< 0.011
Ru-103	< 0.008	< 0.009	< 0.013	< 0.008
Ru-106	< 0.043	< 0.055	< 0.068	< 0.049
Cs-134	< 0.004	< 0.006	< 0.007	< 0.005
Cs-137	< 0.005	< 0.006	< 0.008	< 0.006
Ba-140	< 0.017	< 0.021	< 0.028	< 0.016
Ba-140	< 0.005	< 0.005	< 0.005	< 0.004
Ce-141	< 0.012	< 0.017	< 0.023	< 0.012
Ce-144	< 0.030	< 0.043	< 0.056	< 0.037

TABLE I-13 (Continued)

CL-105(c)

Isotope	04/14/87 Bluegill	04/14/87 White Crappie	04/14/87 Largemouth Bass	04/14/87 Carp
Be-7	< 0.036	< 0.071	< 0.057	< 0.074
K-40	1.38±0.13	3.25±0.22	3.15±0.20	2.42±0.13
Mn-54	< 0.006	< 0.011	< 0.009	< 0.008
Fe-59	< 0.013	< 0.027	< 0.024	< 0.022
Co-58	< 0.005	< 0.011	< 0.008	< 0.009
Co-60	< 0.006	< 0.011	< 0.010	< 0.010
Zn-65	< 0.013	< 0.026	< 0.023	< 0.019
Nb-95	< 0.006	< 0.010	< 0.008	< 0.009
Zr-95	< 0.010	< 0.018	< 0.017	< 0.015
Ru-103	< 0.005	< 0.009	< 0.008	< 0.008
Ru-106	< 0.049	< 0.088	< 0.068	< 0.076
Cs-134	< 0.005	< 0.009	< 0.008	< 0.007
Cs-137	< 0.006	< 0.010	< 0.009	< 0.009
Ba-140	< 0.020	< 0.035	< 0.027	< 0.030
La-140	< 0.006	< 0.009	< 0.007	< 0.008
Ce-141	< 0.006	< 0.010	< 0.010	< 0.015
Ce-144	< 0.026	< 0.042	< 0.041	< 0.059

Isotope	10/20/87 Carp	10/20/87 Largemouth Bass	10/20/87 White Crappie	10/20/87 Bluegill
Be-7	< 0.063	< 0.070	< 0.080	< 0.014
K-40	2.35±0.08	2.48±0.18	2.69±0.21	2.26±0.26
Mn-54	< 0.006	< 0.008	< 0.009	< 0.017
Fe-59	< 0.020	< 0.029	< 0.034	< 0.048
Co-58	< 0.007	< 0.010	< 0.010	< 0.018
Co-60	< 0.006	< 0.008	< 0.010	< 0.017
Zn-65	< 0.016	< 0.020	< 0.023	< 0.040
Nb-95	< 0.010	< 0.009	< 0.009	< 0.018
Zr-95	< 0.015	< 0.017	< 0.018	< 0.031
Ru-103	< 0.009	< 0.011	< 0.012	< 0.017
Ru-106	< 0.054	< 0.005	< 0.072	< 0.013
Cs-134	< 0.006	< 0.006	< 0.007	< 0.013
Cs-137	< 0.006	< 0.009	< 0.009	< 0.015
Ba-140	< 0.021	< 0.024	< 0.027	< 0.032
La-140	< 0.005	< 0.006	< 0.006	< 0.012
Ce-141	< 0.018	< 0.015	< 0.015	< 0.021
Ce-144	< 0.045	< 0.040	< 0.040	< 0.63

(c) - Control Location

TABLE I-14

GROSS ALPHA, GROSS BETA, STRONTIUM-90 AND GAMMA ISOTOPIC ACTIVITY IN BOTTOM SEDIMENT FOR 1987 (pCi/g, dry ± 1 s.d.)

Isotope	CL-7c	CL-10	CL-13	CL-19	CL-89	CL-105*
	04/15/87	04/15/87	04/15/87	04/15/87	04/15/87	04/14/87
Gross Alpha	7.90±3.0	9.0±3.2	4.1±2.4	6.4±2.8	5.2±1.9	13.5±4.0
Gross Beta	22.0±2.3	22.7±2.3	9.7±1.8	19.8±2.1	15.8±1.4	26.1±3.3
Sr-90	< 0.008	0.050±0.009	< 0.013	< 0.008	< 0.014	0.044±0.019
Be-7	< 0.13	< 0.27	< 0.12	< 0.22	< 0.13	< 0.24
K-40	14.70±0.47	15.27±0.58	8.17±0.38	16.14±0.58	12.45±0.31	19.08±0.57
Mn-54	< 0.017	< 0.034	< 0.018	< 0.029	< 0.016	< 0.032
Fe-59	< 0.041	< 0.080	< 0.044	< 0.070	< 0.039	< 0.066
Co-58	< 0.017	< 0.035	< 0.018	< 0.029	< 0.015	< 0.031
Co-60	< 0.023	< 0.039	< 0.024	< 0.039	< 0.021	< 0.038
Zn-65	< 0.052	< 0.083	< 0.051	< 0.078	< 0.040	< 0.075
Nb-95	< 0.021	< 0.038	< 0.020	< 0.031	< 0.018	< 0.032
Zr-95	< 0.032	< 0.062	< 0.030	< 0.052	< 0.031	< 0.055
Cs-134	< 0.024	< 0.037	< 0.021	< 0.031	< 0.012	< 0.031
Cs-137	0.32±0.02	0.58±0.05	< 0.017	0.12±0.03	0.077±0.014	0.59±0.05
Ba-140	< 0.060	< 0.12	< 0.063	< 0.10	< 0.057	< 0.12
La-140	< 0.025	< 0.028	< 0.024	< 0.020	< 0.010	< 0.027
Ce-144	< 0.084	< 0.26	< 0.082	< 0.23	< 0.10	< 0.29
Ac-228	1.07±0.06	1.22±0.14	< 0.061	0.88±0.13	0.55±0.06	1.45±0.13
Bi-212	< 0.20	< 0.54	< 0.22	< 0.44	< 0.28	< 0.50
Bi-214	0.80±0.04	0.73±0.08	< 0.031	0.61±0.06	< 0.056	0.82±0.07
Pb-212	1.09±0.03	1.71±0.07	0.34±0.02	1.15±0.06	0.59±0.02	1.97±0.08
Pb-214	0.81±0.04	0.88±0.07	0.25±0.02	0.72±0.07	0.44±0.02	0.96±0.07
Ra-226	2.09±0.20	2.29±0.46	0.64±0.20	2.06±0.46	[illegible].20±0.24	2.66±0.45
Tl-208	1.01±0.05	1.32±0.12	0.31±0.04	0.12±0.03	0.54±0.04	1.50±0.10

TABLE I-14 (Continued)

Isotope	CL-7 10/19/87	CL-10 10/19/87	CL-13 10/19/87	CL-19 10/19/87	CL-89 10/19/87	CL-105* 10/20/87
Gross Alpha	5.5±1.4	8.4±2.9	2.6±1.2	4.9±2.2	8.3±2.9	8.8±2.0
Gross Beta	10.8±1.0	25.3±2.5	9.6±1.3	20.2±2.4	27.9±3.4	27.9±1.8
Sr-90	0.05±0.01	0.06±0.0091	0.05±0.01	0.01±0.01	0.06±0.01	0.04±0.01
Be-7	0.31±0.17	< 0.27	< 0.10	< 0.10	< 0.62	< 0.27
K-40	14.90±0.39	17.26±0.43	8.34±0.20	14.73±0.27	14.49±0.61	15.8±0.27
Mn-54	< 0.017	< 0.027	< 0.012	< 0.010	< 0.030	< 0.09
Fe-59	< 0.046	< 0.074	< 0.033	< 0.036	< 0.021	< 0.022
Co-58	< 0.018	< 0.030	< 0.012	< 0.012	< 0.054	< 0.009
Co-60	< 0.020	< 0.031	< 0.015	< 0.012	< 0.032	< 0.0012
Zn-65	< 0.038	< 0.062	< 0.029	< 0.025	< 0.074	< 0.029
Nb-95	< 0.022	< 0.034	< 0.014	< 0.012	< 0.069	< 0.011
Zr-95	< 0.035	< 0.057	< 0.025	< 0.024	< 0.12	< 0.016
Cs-134	< 0.014	< 0.025	< 0.009	< 0.007	< 0.022	< 0.014
Cs-137	0.30±0.02	0.58±0.04	< 0.011	0.07±0.01	0.50±0.04	0.40±0.01
Ba-140	< 0.062	< 0.094	< 0.034	< 0.033	< 0.10	< 0.033
La-140	< 0.011	< 0.023	< 0.007	< 0.006	< 0.019	< 0.014
Ce-144	< 0.10	< 0.13	< 0.058	< 0.053	< 0.16	< 0.055
Ac-228	1.13±0.09	1.44±0.09	0.38±0.03	0.60±0.05	1.30±0.14	1.05±0.05
Bi-212	< 0.30	< 0.40	< 0.19	< 0.17	< 0.48	< 0.12
Bi-214	0.80±0.05	0.9[illegible]±0.05	0.23±0.02	0.40±0.02	0.73±0.07	0.66±0.02
Pb-212	1.20±0.03	1.85±0.04	0.37±0.01	0.67±0.02	1.42±0.06	1.31±0.02
Pb-214	0.94±0.05	1.09±0.05	0.28±0.02	0.49±0.02	0.84±0.08	0.73±0.02
Ra-226	2.34±0.37	2.48±0.31	0.61±0.11	0.96±0.16	1.72±0.56	1.80±0.14
Tl-208	1.11±0.07	1.65±0.02	0.37±0.02	0.56±0.01	1.11±0.08	0.98±0.04

* - Control location, all other locations indicators

TABLE I-15

GROSS ALPHA, GROSS BETA, STRONTIUM-90 AND GAMMA ISOTOPIC ACTIVITY IN SHORELINE SEDIMENT FOR 1987 (pCi/g, dry ± 1 s.d.)

	CL-7b	CL-7d	CL-10	CL-19	CL-88	CL-89	CL-105*
Isotope	04/15/87	04/15/87	04/15/87	04/15/87	04/15/87	04/15/87	04/15/87
Gross Alpha	2.7±2.2	4.6±2.6	< 3.3	< 3.1	2.6±2.2	3.2±2.3	3.4±2.1
Gross Beta	11.2±1.9	11.7±1.9	3.9±1.5	6.9±1.7	10.8±1.9	13.2±1.9	9.0±1.7
Sr-90	< 0.005	< 0.004	< 0.005	< 0.007	< 0.009	< 0.006	< 0.017
Be-7	< 0.083	< 0.067	< 0.096	< 0.076	< 0.13	< 0.13	< 0.083
K-40	7.16±0.26	5.97±0.27	6.10±0.37	5.89±0.29	7.94±0.41	11.50±0.55	10.15±0.25
Mn-54	< 0.011	< 0.009	< 0.014	< 0.011	< 0.016	< 0.021	< 0.012
Fe-59	< 0.029	< 0.023	< 0.034	< 0.028	< 0.034	< 0.057	< 0.026
Co-58	< 0.012	< 0.010	< 0.014	< 0.012	< 0.015	< 0.022	< 0.011
Co-60	< 0.015	< 0.014	< 0.019	< 0.015	< 0.021	< 0.032	< 0.017
Zn-65	< 0.034	< 0.029	< 0.041	< 0.033	< 0.037	< 0.066	< 0.031
Nb-95	< 0.013	< 0.011	< 0.015	< 0.012	< 0.015	< 0.023	< 0.011
Zr-95	< 0.021	< 0.018	< 0.024	< 0.019	< 0.030	< 0.035	< 0.020
Cs-134	< 0.015	< 0.011	< 0.015	< 0.012	< 0.011	< 0.023	< 0.010
Cs-137	< 0.011	< 0.008	< 0.013	< 0.010	< 0.016	< 0.021	< 0.012
Ba-140	< 0.042	< 0.033	< 0.047	< 0.039	< 0.058	< 0.066	< 0.041
La-140	< 0.017	< 0.013	< 0.019	< 0.014	< 0.011	< 0.026	< 0.008
Ce-144	< 0.070	< 0.045	< 0.062	< 0.065	< 0.10	< 0.096	< 0.053
Ac-228	0.31±0.04	< 0.031	< 0.048	< 0.038	< 0.098	0.36±0.06	0.26±0.04
Bi-212	< 0.014	< 0.12	< 0.16	< 0.15	< 0.26	< 0.27	< 0.16
Bi-214	< 0.020	< 0.016	< 0.022	< 0.019	< 0.051	< 0.032	0.17±0.02
Pb-212	0.27±0.02	0.18±0.02	0.15±0.02	0.13±0.02	0.25±0.04	0.42±0.03	0.32±0.02
Pb-214	0.25±0.02	0.12±0.01	0.45±0.08	0.12±0.02	0.23±0.04	0.26±0.03	0.19±0.02
Ra-226	0.69±0.13	< 0.15	< 0.20	< 0.19	< 0.32	0.84±0.19	0.44±0.14
Tl-208	0.27±0.02	0.14±0.02	0.11±0.03	0.13±0.02	0.23±0.06	0.38±0.05	0.24±0.04

TABLE I-15 (Continued)

Isotope	CL-7b 10/19/87	CL-7d 10/19/87	CL-10 10/19/87	CL-19 10/19/87	CL-88 10/19/87	CL-89 10/19/87	CL-105* 10/20/87
Gross Alpha	< 2.1	< 3.0	< 2.4	3.4±1.9	< 2.1	4.2±2.1	< 2.0
Gross Beta	11.2±2.0	8.4±2.2	13.0±1.9	10.7±2.0	6.4±1.0	13.0±2.1	10.6±1.8
Sr-90	0.00[illegible]±0.001	0.002±0.001	0.015±0.007	0.016±0.010	0.002±0.001	0.018±0.010	< 0.012
Be-7	< 0.13	< 0.08	< 0.13	< 0.07	< 0.10	0.31±0.06	< 0.07
K-40	7.71±0.24	8.05±0.27	10.51±0.30	8.25±0.24	7.05±0.21	9.19±0.27	7.23±0.20
Mn-54	< 0.013	< 0.010	< 0.016	< 0.007	< 0.008	< 0.010	< 0.008
Fe-59	< 0.047	< 0.028	< 0.043	< 0.029	< 0.031	< 0.040	< 0.029
Co-58	< 0.017	< 0.010	< 0.018	< 0.009	< 0.010	< 0.013	< 0.009
Co-60	< 0.017	< 0.013	< 0.020	< 0.010	< 0.010	< 0.014	< 0.010
Zn-65	< 0.034	< 0.026	< 0.040	< 0.023	< 0.021	< 0.032	< 0.023
Nb-95	< 0.018	< 0.011	< 0.018	< 0.014	< 0.012	< 0.019	< 0.014
Zr-95	< 0.031	< 0.020	< 0.032	< 0.017	< 0.020	< 0.023	< 0.018
Cs-134	< 0.011	< 0.008	< 0.014	< 0.009	< 0.006	< 0.012	< 0.008
Cs-137	< 0.011	< 0.009	< 0.013	< 0.007	< 0.008	0.025±0.006	< 0.006
Ba-140	< 0.039	< 0.034	< 0.064	< 0.024	< 0.029	< 0.030	< 0.025
La-140	< 0.009	< 0.007	< 0.013	< 0.009	< 0.005	< 0.012	< 0.010
Ce-144	< 0.060	< 0.048	< 0.065	< 0.040	< 0.055	< 0.042	< 0.047
Ac-228	0.21±0.04	0.20±0.04	0.28±0.05	0.22±0.02	0.19±0.03	0.34±0.03	< 0.02
Bi-212	< 0.17	< 0.14	< 0.20	< 0.09	< 0.13	< 0.12	< 0.08
Bi-214	0.16±0.02	0.15±0.02	0.18±0.02	0.19±0.01	0.14±0.02	0.28±0.02	< 0.01
Pb-212	0.27±0.02	0.18±0.01	0.38±0.03	0.25±0.01	0.22±0.01	0.45±0.02	0.15±0.01
Pb-214	0.21±0.02	0.16±0.02	0.22±0.03	0.19±0.01	0.16±0.02	0.28±0.01	0.13±0.01
Ra-226	0.50±0.15	0.40±0.15	0.52±0.19	0.39±0.08	0.39±0.14	0.62±0.09	0.20±0.01
Tl-208	0.23±0.10	0.20±0.03	0.27±0.04	0.23±0.02	0.16±0.03	0.34±0.02	0.13±0.01

* - Control location, all other locations indicators

TABLE I-16

GAMMA ISOTOPIC ACTIVITY IN AQUATIC VEGETATION FOR 1987
(pCi/g, wet ± 1 s.d.)

Isotope	CL-7C 04/14/87	CL-10 04/14/87	CL-19 04/14/87	CL-105* 04/14/87
Be-7	0.80±0.21	0.44±0.07	< 0.38	0.38±0.03
K-40	0.79±0.45	0.58±0.15	2.21±0.65	1.67±0.10
Mn-54	< 0.029	< 0.014	< 0.047	< 0.006
Fe-59	< 0.067	< 0.028	< 0.090	< 0.012
Co-58	< 0.028	< 0.014	< 0.046	< 0.005
Co-60	< 0.031	< 0.014	< 0.042	< 0.006
Zn-65	< 0.058	< 0.033	< 0.11	< 0.016
Nb-95	< 0.030	< 0.016	< 0.050	< 0.005
Zr-95	< 0.054	< 0.026	< 0.079	< 0.009
Cs-134	< 0.025	< 0.015	< 0.048	< 0.006
Cs-137	< 0.032	< 0.013	< 0.047	0.034±0.004
Ba-140	< 0.089	< 0.044	< 0.16	< 0.017
La-140	< 0.026	< 0.013	< 0.040	< 0.007
Ce-144	< 0.13	< 0.061	< 0.27	< 0.028

Isotope	CL-7C 10/19/87	CL-10 10/19/87	CL-19 10/19/87	CL-105* 10/19/87
Be-7	< 0.22	< 0.26	< 0.24	< 0.40
K-40	1.15±0.48	1.06±0.50	1.34±0.47	2.62±0.64
Mn-54	< 0.028	< 0.028	< 0.036	< 0.043
Fe-59	< 0.052	< 0.060	< 0.077	< 0.12
Co-58	< 0.025	< 0.028	< 0.035	< 0.048
Co-60	< 0.035	< 0.028	< 0.031	< 0.042
Zn-65	< 0.061	< 0.055	< 0.070	< 0.11
Nb-95	< 0.028	< 0.023	< 0.033	< 0.060
Zr-95	< 0.046	< 0.050	< 0.056	< 0.094
Cs-134	< 0.026	< 0.025	< 0.029	< 0.051
Cs-137	< 0.058	< 0.033	< 0.030	< 0.043
Ba-140	< 0.093	< 0.092	< 0.094	< 0.14
La-140	< 0.026	< 0.022	< 0.026	< 0.044
Ce-144	< 0.13	< 0.18	< 0.11	< 0.22

* Control location, all other locations indicators

TABLE I-17

GROSS BETA AND GAMMA ISOTOPIC ACTIVITY IN VEGETABLES FOR 1987 (a) (pCi/g, wet)

Isotope	CL-18 Lettuce 06/24/87	CL-18 Cabbage 06/24/87	CL-13 Chard 06/24/87	CL-18 Chard 07/29/87	CL-18 Cabbage 07/29/87	CL-18 Soybean Leaves 07/29/87
Gross Beta	6.64±0.14	4.79±0.11	4.40±9.17	4.57±0.24	3.08±0.15	3.13±012
Be-7	0.15±0.04	< 0.072	< 0.074	0.44±0.10	0.50±0.05	0.96±0.06
K-40	5.03±0.19	3.75±0.18	6.78±0.28	3.74±0.24	2.58±0.17	2.39±0.14
Mn-54	< 0.007	< 0.007	< 0.009	< 0.007	< 0.007	< 0.006
Fe-59	< 0.017	< 0.022	< 0.024	< 0.018	< 0.016	< 0.015
Co-58	< 0.007	< 0.008	< 0.010	< 0.006	< 0.007	< 0.006
Co-60	< 0.007	< 0.008	< 0.010	< 0.007	< 0.008	< 0.007
Zn-65	< 0.020	< 0.018	< 0.024	< 0.016	< 0.018	< 0.017
Nb-95	< 0.007	< 0.008	< 0.010	< 0.007	< 0.007	< 0.006
Zr-95	< 0.012	< 0.014	< 0.017	< 0.012	< 0.013	< 0.010
I-131	< 0.009	< 0.017	< 0.018	< 0.008	< 0.010	< 0.008
Cs-134	< 0.007	< 0.006	< 0.008	< 0.006	< 0.008	< 0.005
Cs-137	< 0.007	< 0.008	< 0.010	< 0.007	< 0.008	< 0.006
Ba-140	< 0.031	< 0.046	< 0.050	< 0.026	< 0.033	< 0.025
La-140	< 0.006	< 0.009	< 0.012	< 0.005	< 0.009	< 0.008
Ce-144	< 0.042	< 0.058	< 0.069	< 0.054	< 0.043	< 0.031

TABLE I-17 (continued)

Isotope	CL-18 Chard 08/26/87	CL-18 Cabbage 08/26/87	CL-18 Soybean Leaves 08/26/87	CL-18 Cabbage 09/30/87	CL-18 Swiss Chard 09/30/87	Soybean Leaves 10/14/87
Gross Beta	3.48±0.13	3.24±0.16	3.76±0.19	3.04±0.16	4.06±0.16	3.14±0.20
Be-7	0.56±0.04	0.54±0.05	3.76±0.18	< 0.068	0.28±0.04	< 0.061
K-40	4.30±0.16	2.54±0.16	2.80±0.27	2.44±0.17	3.81±0.20	13.10±0.32
Mn-54	< 0.008	< 0.008	< 0.014	< 0.009	< 0.007	< 0.009
Fe-59	< 0.019	< 0.018	< 0.031	< 0.020	< 0.019	< 0.0026
Co-58	< 0.008	< 0.007	< 0.014	< 0.009	< 0.007	< 0.010
Co-60	< 0.009	< 0.008	< 0.013	< 0.010	< 0.008	< 0.009
Zn-65	< 0.022	< 0.019	< 0.033	< 0.024	< 0.021	< 0.027
Nb-95	< 0.008	< 0.007	< 0.014	< 0.009	< 0.008	< 0.011
Zr-95	< 0.013	< 0.012	< 0.025	< 0.016	< 0.013	< 0.015
I-131	< 0.009	< 0.010	< 0.021	< 0.010	< 0.009	< 0.024
Cs-134	< 0.008	< 0.006	< 0.015	< 0.008	< 0.007	< 0.008
Cs-137	< 0.008	< 0.007	< 0.014	< 0.009	< 0.007	< 0.008
Ba-140	< 0.032	< 0.032	< 0.068	< 0.030	< 0.027	< 0.027
La-140	< 0.010	< 0.010	< 0.019	< 0.010	< 0.008	< 0.005
Ce-144	< 0.043	< 0.038	< 0.076	< 0.055	< 0.039	< 0.048

TABLE I-17 (continued)

Isotope	CL-114 Lettuce 06/24/87	CL-114 Cabbage 06/24/87	CL-114 Chard 06/24/87	CL-114 Chard 07/29/87	CL-114 Cabbage 07/29/87	CL-114 Soybean Leaves 07/29/87
Gross Beta	7.17±0.38	3.45±0.22	2.74±0.12	1.98±0.10	3.57±0.15	3.12±0.12
Be-7	0.30±0.07	< 0.058	< 0.090	0.21±0.05	0.67±0.05	1.32±0.16
K-40	5.20±0.25	3.26±0.25	3.68±0.23	2.95±0.14	2.51±0.17	2.92±0.34
Mn-54	< 0.010	< 0.008	< 0.010	< 0.006	< 0.008	< 0.015
Fe-59	< 0.025	< 0.020	< 0.024	< 0.015	< 0.020	< 0.037
Co-58	< 0.008	< 0.006	< 0.009	< 0.006	< 0.007	< 0.013
Co-60	< 0.010	< 0.009	< 0.008	< 0.006	< 0.008	< 0.016
Zn-65	< 0.020	< 0.022	< 0.020	< 0.014	< 0.017	< 0.034
Nb-95	< 0.009	< 0.008	< 0.008	< 0.006	< 0.007	< 0.015
Zr-95	< 0.016	< 0.013	< 0.015	< 0.010	< 0.014	< 0.027
I-131	< 0.010	< 0.015	< 0.013	< 0.010	< 0.011	< 0.020
Cs-134	< 0.007	< 0.006	< 0.008	< 0.005	< 0.006	< 0.014
Cs-137	0.026±0.008	< 0.007	< 0.009	< 0.006	< 0.008	< 0.015
Ba-140	< 0.037	< 0.039	< 0.040	< 0.028	< 0.035	< 0.062
La-140	< 0.088	< 0.011	< 0.008	< 0.005	< 0.007	< 0.021
Ce-144	< 0.058	< 0.054	< 0.070	< 0.047	< 0.061	< 0.074

TABLE I-17 (continued)

Isotope	CL-114 Corn Leaves 07/29/87	CL-114 Chard 08/26/87	CL-114 Cabbage 08/26/87	CL-114 Soybean Leaves 08/26/87	CL-114 Corn Leaves 08/26/87	CL-114 Cabbage 09/30/87	CL-114 Swiss Chard 09/30/87
Gross Beta	2.49±0.14	4.51±0.16	3.10±0.13	5.10±0.26	3.76±0.22	3.27±0.15	6.35±0.21
Be-7	1.55±0.08	0.38±0.04	0.70±0.05	4.35±0.20	2.69±0.14	0.25±0.04	0.38±0.05
K-40	2.15±0.15	4.35±0.19	2.42±0.15	3.77±0.27	4.19±0.26	2.68±0.16	5.71±0.25
Mn-54	< 0.008	< 0.007	< 0.006	< 0.012	< 0.010	< 0.00[illegible]	< 0.010
Fe-59	< 0.016	< 0.017	< 0.014	< 0.028	< 0.026	< 0.014	< 0.023
Co-58	< 0.008	< 0.007	< 0.006	< 0.011	< 0.010	< 0.006	< 0.010
Co-60	< 0.007	< 0.008	< 0.006	< 0.012	< 0.010	< 0.006	< 0.010
Zn-65	< 0.018	< 0.018	< 0.015	< 0.029	< 0.022	< 0.015	< 0.024
Nb-95	< 0.008	< 0.008	< 0.006	< 0.011	< 0.010	< 0.006	< 0.009
Zr-95	< 0.013	< 0.013	< 0.011	< 0.022	< 0.018	< 0.011	< 0.017
I-131	< 0.012	< 0.010	< 0.008	< 0.018	< 0.011	< 0.007	< 0.011
Cs-134	< 0.008	< 0.006	< 0.006	< 0.010	< 0.008	< 0.006	< 0.009
Cs-137	< 0.008	< 0.007	< 0.006	< 0.013	0.016±0.010	< 0.006	< 0.010
Ba-140	< 0.037	< 0.030	< 0.026	< 0.054	< 0.041	< 0.024	< 0.037
La-140	< 0.009	< 0.008	< 0.006	< 0.012	< 0.010	< 0.027	< 0.009
Ce-144	< 0.058	< 0.055	< 0.036	< 0.076	< 0.084	< 0.037	< 0.072

TABLE I-17 (continued)

Isotope	CL-115 Corn Leaves 06/24/87	CL-115 Soybean Leaves 06/24/87	CL-115 Chard 07/29/87	CL-115 Cabbage 07/29/87	CL-115 Soybean Leaves 07/29/87	CL-115 Chard 08/26/87
Gross Beta	1.58±0.07	2.72±0.13	3.25±0.13	2.85±0.13	6.05±0.17	3.44±0.15
Be-7	0.41±0.06	0.32±0.09	0.24±0.04	0.26±0.05	1.37±0.07	0.38±0.08
K-40	1.81±0.16	2.85±0.24	2.18±0.13	1.44±0.14	1.41±0.12	2.73±0.18
Mn-54	< 0.011	< 0.010	< 0.007	< 0.006	< 0.006	< 0.008
Fe-59	< 0.021	< 0.026	< 0.016	< 0.014	< 0.016	< 0.021
Co-58	< 0.010	< 0.010	< 0.006	< 0.006	< 0.006	< 0.008
Co-60	< 0.011	< 0.010	< 0.007	< 0.006	< 0.007	< 0.008
Zn-65	< 0.023	< 0.021	< 0.015	< 0.013	< 0.017	< 0.019
Nb-95	< 0.011	< 0.010	< 0.007	< 0.006	< 0.006	< 0.008
Zr-95	< 0.019	< 0.019	< 0.012	< 0.010	< 0.011	< 0.015
I-131	< 0.017	< 0.025	< 0.010	< 0.009	< 0.009	< 0.011
Cs-134	< 0.010	< 0.009	< 0.006	< 0.005	< 0.006	< 0.007
Cs-137	< 0.01[illegible]	< 0.011	< 0.007	< 0.006	< 0.006	< 0.009
Ba-140	< 0.050	< 0.061	< 0.031	< 0.027	< 0.026	< 0.034
La-140	< 0.012	< 0.013	< 0.008	< 0.007	< 0.010	< 0.007
Ce-144	< 0.085	< 0.081	< 0.052	< 0.058	< 0.036	< 0.065

TABLE I-17 (continued)

Isotope	CL-115 Cabbage 08/26/87	CL-115 Soybean Leaves 08/26/87	CL-115 Cabbage 09/30/87	CL-117 Soybean Leaves 08/26/87	CL-117 Corn Leaves 08/26/87
Gross Beta	2.24±0.12	2.90±0.18	2.43±0.12	6.32±0.26	3.90±0.27
Be-7	0.55±0.05	5.12±0.17	0.18±0.03	3.66±0.22	4.05±0.13
K-40	1.77±0.13	2.06±0.20	1.85±0.11	4.58±0.32	2.53±0.19
Mn-54	< 0.007	< 0.010	< 0.005	< 0.014	< 0.009
Fe-59	< 0.015	< 0.022	< 0.010	< 0.036	< 0.020
Co-58	< 0.007	< 0.011	< 0.005	< 0.014	< 0.010
Co-60	< 0.007	< 0.010	< 0.004	< 0.014	< 0.009
Zn-65	< 0.017	< 0.027	< 0.013	< 0.031	< 0.023
Nb-95	< 0.007	< 0.011	< 0.005	< 0.014	< 0.009
Zr-95	< 0.013	< 0.019	< 0.008	< 0.025	< 0.016
I-131	< 0.010	< 0.019	< 0.006	< 0.025	< 0.013
Cs-134	< 0.007	< 0.012	< 0.005	< 0.012	< 0.010
Cs-137	< 0.008	< 0.011	< 0.005	< 0.015	< 0.010
Ba-140	< 0.031	< 0.056	< 0.021	< 0.069	< 0.041
La-140	< 0.008	< 0.013	< 0.005	< 0.014	< 0.010
Ce-144	< 0.061	< 0.088	< 0.038	< 0.011	< 0.075

(a) - collection performed monthly when available during growing season and at time of harvest, normal sample green leafy or tuberous vegetables.

TABLE I-18

GAMMA ISOTOPIC ACTIVITY IN GRASS FOR 1987 (pCi/g, wet) (a)

CL-1

Isotope	04/15/87	04/29/87	05/13/87	05/27/87	06/10/87	06/24/87	07/08/87	07/22/87	08-05-87
Be-7	2.57±0.13	0.99±0.09	0.77±0.08	0.81±0.14	1.76±0.16	1.80±0.39	3.17±0.27	1.42±0.22	1.15±0.08
K-40	4.80±0.28	5.39±0.29	7.25±0.36	6.84±0.37	6.94±0.48	5.51±0.72	6.12±0.51	8.59±0.47	7.30±0.27
Mn-54	< 0.013	< 0.010	< 0.011	< 0.015	< 0.023	< 0.026	< 0.012	< 0.016	< 0.009
Fe-59	< 0.032	< 0.026	< 0.026	< 0.042	< 0.052	< 0.072	< 0.034	< 0.040	< 0.022
Co-58	< 0.014	< 0.011	< 0.011	< 0.014	< 0.022	< 0.025	< 0.013	< 0.016	< 0.010
Co-60	< 0.014	< 0.011	< 0.012	< 0.017	< 0.023	< 0.030	< 0.013	< 0.016	< 0.009
Zn-65	< 0.031	< 0.026	< 0.030	< 0.034	< 0.061	< 0.059	< 0.027	< 0.041	< 0.025
Nb-95	< 0.015	< 0.011	< 0.012	< 0.015	< 0.023	< 0.028	< 0.012	< 0.016	< 0.010
Zr-95	< 0.025	< 0.019	< 0.019	< 0.026	< 0.035	< 0.060	< 0.024	< 0.030	< 0.016
I-131	< 0.023	< 0.020	< 0.012	< 0.025	< 0.027	< 0.038	< 0.019	< 0.025	< 0.014
Cs-134	< 0.013	< 0.010	< 0.012	< 0.014	< 0.020	< 0.024	< 0.011	< 0.014	< 0.010
Cs-137	< 0.014	< 0.010	< 0.011	< 0.016	< 0.022	< 0.030	< 0.014	< 0.020	< 0.009
Ba-140	< 0.049	< 0.034	< 0.038	< 0.069	< 0.084	< 0.016	< 0.060	< 0.080	< 0.046
La-140	< 0.011	< 0.008	< 0.010	< 0.016	< 0.032	< 0.039	< 0.015	< 0.017	< 0.011
Ce-144	< 0.011	< 0.056	< 0.063	< 0.012	< 0.114	< 0.219	< 0.010	< 0.14	< 0.066

TABLE I-18 (continued)

Isotope	08/19/87	09/02/87	09/16/87	09/30/87	10/14/87	10/28/87	11/25/87	12/30/87
Be-7	1.34±0.13	1.83±0.12	1.22±0.10	1.49±0.14	2.31±0.26	3.89±0.17	3.05±0.14	5.99±0.26
K-40	8.03±0.36	8.69±0.42	6.19±0.34	6.30±0.34	7.59±0.63	5.56±0.30	3.68±0.22	3.12±0.32
Mn-54	< 0.010	< 0.013	< 0.014	< 0.014	< 0.015	< 0.011	< 0.008	< 0.014
Fe-59	< 0.037	< 0.033	< 0.034	< 0.034	< 0.040	< 0.030	< 0.022	< 0.034
Co-58	< 0.011	< 0.014	< 0.014	< 0.013	< 0.015	< 0.011	< 0.008	< 0.015
Co-60	< 0.010	< 0.014	< 0.017	< 0.015	< 0.018	< 0.011	< 0.008	< 0.016
Zn-65	< 0.031	< 0.036	< 0.039	< 0.032	< 0.043	< 0.024	< 0.020	< 0.031
Nb-95	< 0.013	< 0.015	< 0.015	< 0.014	< 0.016	< 0.012	< 0.010	< 0.015
Zr-95	< 0.021	< 0.025	< 0.025	< 0.024	< 0.028	< 0.019	< 0.016	< 0.027
I-131	< 0.017	< 0.025	< 0.018	< 0.016	< 0.022	< 0.017	< 0.019	< 0.024
Cs-134	< 0.010	< 0.014	< 0.012	< 0.013	< 0.015	< 0.010	< 0.007	< 0.014
Cs-137	< 0.012	< 0.012	< 0.014	< 0.014	< 0.015	< 0.012	< 0.009	< 0.016
Ba-140	< 0.053	< 0.070	< 0.058	< 0.052	< 0.046	< 0.050	< 0.048	< 0.054
La-140	< 0.010	< 0.018	< 0.0[illegible]	< 0.011	< 0.019	< 0.015	< 0.011	< 0.012
Ce-144	< 0.087	< 0.070	< 0.072	< 0.11	< 0.079	< 0.079	< 0.059	< 0.103

TABLE I-18 (continued)

CL-2

Isotope	04/15/87	04/29/87	05/13/87	05/27/87	06/10/87	06/24/87	07/08/87	07/22/87	08/05/87
Be-7	4.12±0.16	1.20±0.06	0.53±0.06	0.89±0.18	1.34±0.19	2.42±0.34	1.84±0.11	3.77±0.34	1.51±0.23
K-40	3.88±0.25	6.15±0.21	5.01±0.24	10.6±0.71	6.74±0.44	8.53±0.67	5.15±0.27	17.9±0.75	7.11±0.44
Mn-54	< 0.011	< 0.011	< 0.009	< 0.021	< 0.017	< 0.025	< 0.012	< 0.028	< 0.018
Fe-59	< 0.027	< 0.027	< 0.021	< 0.050	< 0.037	< 0.069	< 0.026	< 0.077	< 0.046
Co-58	< 0.012	< 0.012	< 0.009	< 0.021	< 0.016	< 0.022	< 0.012	< 0.030	< 0.018
Co-60	< 0.012	< 0.011	< 0.010	< 0.022	< 0.016	< 0.024	< 0.012	< 0.028	< 0.018
Zn-65	< 0.031	< 0.027	< 0.025	< 0.052	< 0.040	< 0.054	< 0.031	< 0.070	< 0.043
Nb-95	< 0.011	< 0.013	< 0.009	< 0.023	< 0.017	< 0.027	< 0.012	< 0.028	< 0.019
Zr-95	< 0.019	< 0.021	< 0.017	< 0.040	< 0.028	< 0.040	< 0.021	< 0.050	< 0.034
I-131	< 0.017	< 0.026	< 0.011	< 0.033	< 0.020	< 0.043	< 0.020	< 0.046	< 0.030
Cs-134	< 0.010	< 0.010	< 0.010	< 0.020	< 0.015	< 0.022	< 0.013	< 0.023	< 0.016
Cs-137	< 0.011	< 0.011	< 0.010	< 0.021	< 0.016	< 0.028	< 0.013	< 0.030	< 0.020
Ba-140	< 0.034	< 0.038	< 0.036	< 0.096	< 0.070	< 0.12	< 0.041	< 0.10	< 0.094
La-140	< 0.012	< 0.009	< 0.008	< 0.027	< 0.019	< 0.032	< 0.008	< 0.021	< 0.017
Ce-144	< 0.062	< 0.087	< 0.073	< 0.010	< 0.12	< 0.21	< 0.088	< 0.21	< 0.14

TABLE I-18 (continued)

	08/19/87	09/02/87	09/16/87	09/30/87	10/14/87	10/28/87	11/25/87	12/30/87
Be-7	0.78±0.10	0.82±0.09	1.33±0.09	1.26±0.11	1.49±0.12	2.56±0.14	2.98±0.26	7.58±0.46
K-40	6.87±0.40	6.22±0.33	5.87±0.30	5.17±0.27	7.22±0.40	6.98±0.39	5.04±0.34	4.32±0.54
Mn-54	< 0.015	< 0.015	< 0.010	< 0.009	< 0.014	< 0.013	< 0.016	< 0.024
Fe-59	< 0.036	< 0.036	< 0.024	< 0.025	< 0.036	< 0.031	< 0.037	< 0.058
Co-58	< 0.015	< 0.016	< 0.010	< 0.009	< 0.014	< 0.013	< 0.014	< 0.024
Co-60	< 0.016	< 0.016	< 0.011	< 0.011	< 0.015	< 0.014	< 0.015	< 0.023
Zn-65	< 0.038	< 0.035	< 0.027	< 0.021	< 0.036	< 0.034	< 0.034	< 0.055
Nb-95	< 0.016	< 0.017	< 0.011	< 0.009	< 0.015	< 0.014	< 0.014	< 0.023
Zr-95	< 0.028	< 0.028	< 0.018	< 0.017	< 0.027	< 0.023	< 0.027	< 0.045
I-131	< 0.022	< 0.029	< 0.014	< 0.010	< 0.019	< 0.021	< 0.031	< 0.041
Cs-134	< 0.015	< 0.014	< 0.012	< 0.008	< 0.014	< 0.013	< 0.013	< 0.024
Cs-137	< 0.016	< 0.016	< 0.010	< 0.010	< 0.014	< 0.014	< 0.016	< 0.027
Ba-140	< 0.069	< 0.081	< 0.046	< 0.034	< 0.047	< 0.045	< 0.059	< 0.095
La-140	< 0.020	< 0.022	< 0.011	< 0.009	< 0.012	< 0.012	< 0.013	< 0.017
Ce-144	< 0.077	< 0.12	< 0.058	< 0.058	< 0.084	< 0.081	< 0.094	< 0.21

TABLE I-18 (continued)

CL-8

Isotope	04/15/87	04/29/87	05/13/87	05/27/87	06/10/87	06/24/87	07/08/87	07/22/87	08-05-87
Be-7	0.87±0.10	0.45±0.13	0.28±0.07	0.05±0.008	0.81±0.15	0.30±0.10	1.65±0.10	0.91±0.10	0.53±0.08
K-40	6.10±0.26	6.88±0.33	7.03±0.31	6.92±0.26	6.23±0.38	7.76±0.33	5.94±0.26	7.32±0.39	7.53±0.41
Mn-54	< 0.008	< 0.013	< 0.013	<0.012	< 0.016	< 0.012	< 0.011	< 0.016	<0.016
Fe-59	< 0.024	< 0.039	< 0.030	< 0.030	< 0.035	< 0.031	< 0.026	< 0.036	< 0.039
Co-58	< 0.008	< 0.014	< 0.013	<0.012	< 0.016	< 0.012	< 0.012	< 0.015	< 0.016
Co-60	< 0.008	< 0.014	< 0.013	<0.012	< 0.017	< 0.012	< 0.011	< 0.019	< 0.017
Zn-65	< 0.021	< 0.032	< 0.030	< 0.033	< 0.039	< 0.032	< 0.026	< 0.042	< 0.042
Nb-95	< 0.008	< 0.014	< 0.013	<0.012	< 0.016	< 0.012	< 0.012	< 0.016	< 0.015
Zr-95	< 0.014	< 0.026	< 0.023	<0.021	< 0.026	< 0.020	< 0.020	< 0.026	<0.026
I-131	< 0.011	< 0.029	< 0.015	<0.017	< 0.022	< 0.012	< 0.018	< 0.020	<0.021
Cs-134	< 0.007	< 0.012	< 0.012	<0.012	< 0.014	< 0.011	< 0.010	< 0.014	<0.014
Cs-137	< 0.008	< 0.014	< 0.013	<0.012	< 0.017	< 0.016	< 0.012	< 0.014	< 0.015
Ba-140	< 0.030	< 0.049	< 0.045	< 0.054	< 0.064	< 0.043	< 0.053	< 0.064	< 0.064
La-140	< 0.007	< 0.010	< 0.011	< 0.014	< 0.017	< 0.009	< 0.014	< 0.022	< 0.023
Ce-144	< 0.050	< 0.011	< 0.097	< 0.066	< 0.121	< 0.096	< 0.065	< 0.073	< 0.075

TABLE I-18 (continued)

Isotope	08/15/87	9/02/87	09/16/87	09/30/87	10/14/87	10/28/87	11/25/87	12/30/87
Be-7	0.63±0.10	1.47±0.23	1.00±0.18	1.17±0.10	3.15±0.13	4.18±0.29	2.09±0.10	4.98±0.20
K-40	7.87±0.32	6.58±0.43	4.84±0.33	5.43±0.33	8.85±0.32	5.92±0.50	3.63±0.21	3.93±0.27
Mn-54	< 0.022	< 0.020	< 0.015	< 0.012	< 0.012	< 0.010	< 0.009	< 0.014
Fe-59	< 0.052	< 0.050	< 0.036	< 0.029	< 0.026	< 0.025	< 0.024	< 0.030
Co-58	< 0.021	< 0.020	< 0.015	< 0.013	< 0.013	< 0.010	< 0.009	< 0.014
Co-60	< 0.026	< 0.018	< 0.016	< 0.014	< 0.011	< 0.010	< 0.010	< 0.015
Zn-65	< 0.059	< 0.045	< 0.033	< 0.031	< 0.031	< 0.027	< 0.024	< 0.034
Nb-95	< 0.020	< 0.020	< 0.015	< 0.013	< 0.012	< 0.011	< 0.010	< 0.015
Zr-95	< 0.034	< 0.034	< 0.026	< 0.022	< 0.020	< 0.018	< 0.016	< 0.026
I-131	< 0.028	< 0.043	< 0.023	< 0.014	< 0.018	< 0.022	< 0.017	< 0.024
Cs-134	< 0.017	< 0.018	< 0.014	< 0.013	< 0.012	< 0.011	< 0.086	< 0.014
Cs-137	< 0.020	< 0.022	< 0.015	< 0.013	< 0.013	< 0.010	< 0.087	< 0.015
Ba-140	< 0.085	< 0.11	< 0.067	< 0.049	< 0.043	< 0.035	< 0.045	< 0.051
La-140	< 0.032	< 0.025	< 0.014	< 0.013	< 0.009	< 0.008	< 0.014	< 0.014
Ce-144	< 0.093	< 0.16	< 0.12	< 0.078	< 0.086	< 0.074	< 0.045	< 0.125

TABLE I-18 (continued)

CL-11(c)

Isotope	04/15/87	04/29/87	05/13/87	05/27/87	06/10/87	06/24/87	07/08/87	07/22/87	08/05/87
Be-7	2.36±0.36	0.76±0.10	0.83±0.13	0.65±0.12	0.81±0.008	0.49±0.15	1.98±0.15	0.67±0.08	0.58±0.07
K-40	4.75±0.21	7.60±0.27	14.40±0.73	8.74±0.36	6.84±0.32	5.54±0.34	5.84±0.28	6.03±0.31	7.73±0.36
Mn-54	< 0.008	< 0.009	< 0.025	< 0.012	< 0.013	< 0.016	< 0.011	< 0.010	< 0.012
Fe-59	< 0.012	< 0.025	< 0.059	< 0.031	< 0.031	< 0.040	< 0.028	< 0.026	< 0.027
Co-58	< 0.022	< 0.009	< 0.025	< 0.011	< 0.012	< 0.015	< 0.011	< 0.011	< 0.012
Co-60	< 0.007	< 0.008	< 0.028	< 0.013	< 0.014	< 0.016	< 0.011	< 0.011	< 0.013
Zn-65	< 0.024	< 0.022	< 0.071	< 0.028	< 0.035	< 0.036	< 0.027	< 0.029	< 0.031
Nb-95	< 0.024	< 0.008	< 0.024	< 0.011	< 0.013	< 0.016	< 0.011	< 0.012	< 0.011
Zr-95	< 0.046	< 0.015	< 0.041	< 0.020	< 0.024	< 0.026	< 0.021	< 0.020	< 0.020
I-131	< 0.010	< 0.015	< 0.024	< 0.015	< 0.018	< 0.029	< 0.019	< 0.016	< 0.012
Cs-134	< 0.007	< 0.007	< 0.022	< 0.010	< 0.014	< 0.014	< 0.010	< 0.011	< 0.011
Cs-137	0.009±0.007	< 0.009	< 0.023	0.033±0.016	0.067±0.010	0.069±0.018	< 0.012	< 0.011	< 0.011
Ba-140	< 0.025	< 0.032	< 0.074	< 0.052	< 0.053	< 0.056	< 0.054	< 0.049	< 0.043
La-140	< 0.006	< 0.007	< 0.023	< 0.013	< 0.014	< 0.012	< 0.011	< 0.014	< 0.011
Ce-144	< 0.073	< 0.050	< 0.12	< 0.090	< 0.098	< 0.12	< 0.088	< 0.059	< 0.062

TABLE I-18 (continued)

Isotope	08/19/87	09/02/87	09/16/87	09/30/87	10/14/87	10/28/87	11/25/87	12/30/87
Be-7	1.07±0.15	1.64±0.13	1.65±0.15	2.53±0.22	1.27±0.12	2.01±1.06	2.23±0.11	4.17±0.14
K-40	7.00±0.37	6.24±0.34	4.86±0.33	6.46±0.45	7.78±0.34	6.89±0.31	6.03±0.29	6.42±0.28
Mn-54	< 0.012	< 0.015	< 0.012	< 0.018	< 0.012	< 0.011	< 0.010	< 0.010
Fe-59	< 0.038	< 0.039	< 0.031	< 0.046	< 0.032	< 0.030	< 0.025	< 0.021
Co-58	< 0.012	< 0.016	< 0.011	< 0.018	< 0.011	< 0.011	< 0.010	< 0.010
Co-60	< 0.013	< 0.015	< 0.013	< 0.019	< 0.013	< 0.013	< 0.011	< 0.010
Zn-65	< 0.030	< 0.038	< 0.026	< 0.039	< 0.031	< 0.031	< 0.026	< 0.024
Nb-95	< 0.014	< 0.018	< 0.012	< 0.018	< 0.011	< 0.011	< 0.012	< 0.010
Zr-95	< 0.025	< 0.029	< 0.020	< 0.029	< 0.018	< 0.020	< 0.019	< 0.017
I-131	< 0.017	< 0.034	< 0.016	< 0.026	< 0.016	< 0.017	< 0.023	< 0.016
Cs-134	< 0.011	< 0.015	< 0.010	< 0.014	< 0.009	< 0.010	< 0.010	< 0.010
Cs-137	< 0.014	< 0.016	< 0.014	< 0.020	< 0.012	< 0.011	< 0.011	< 0.010
Ba-140	< 0.062	< 0.089	< 0.055	< 0.076	< 0.052	< 0.033	< 0.060	< 0.033
La-140	< 0.015	< 0.022	< 0.013	< 0.018	< 0.013	< 0.010	< 0.014	< 0.008
Ce-144	< 0.094	< 0.12	< 0.093	< 0.12	< 0.071	< 0.051	< 0.088	< 0.066

(a) grass collected in lieu of milk, Gamma Isotopic analysis includes I-131, collection is semi-monthly (May - October) and monthly (November - April)

(c) control location, all other locations indicators

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ILLINOIS POWER COMPANY

IP

CLINTON POWER STATION, P.O. BOX 678, CLINTON, ILLINOIS 61727

April 29, 1988

Docket No. 50-461

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Clinton Power Station
Annual Radiological Environmental
Monitoring Report

Dear Sir:

Attached is the Annual Radiological Environmental Monitoring Report for Clinton Power Station for the period from initial criticality to December 31, 1987. This submittal is provided in accordance with the requirements of section 6.9.1.6 of the Clinton Power Station Technical Specifications.

If you have any questions, please contact me.

Sincerely yours,

F. A. Spangenberg, III
Manager - Licensing and Safety

DWW/krm

Attachment

cc: NRC Clinton Licensing Project Manager
NRC Resident Office
Regional Administrator, Region III, USNRC
Illinois Department of Nuclear Safety

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