VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

April 27, 1995

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D. C. 20555

Serial No. 95-201
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Docket Nos. 50-280
50-281
License Nos. DPR-32
DPR-37

Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION UNITS 1 AND 2
ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

Attached is the 1994 Annual Radiological Environmental Operating Report for Surry Power Station which fulfills the reporting requirements of Surry Technical Specification 6.6.B.2.

Very truly yours,

M. L. Bowling, Manager
Nuclear Licensing and Programs

Attachment

cc: U. S. Nuclear Regulatory Commission
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A025

50-280
4/27/95

Surry Power Station

1994 Annual Radiological Environmental Operating Report

VIRGINIA POWER

Virginia Electric and Power Company

Surry Power Station

Radiological Environmental Monitoring Program

January 1, 1994 to December 31, 1994

Prepared by

VIRGINIA ELECTRIC AND POWER COMPANY

and

TELEDYNE BROWN ENGINEERING

Annual Radiological Environmental Operating Report

Surry Power Station

January 1, 1994 to December 31, 1994

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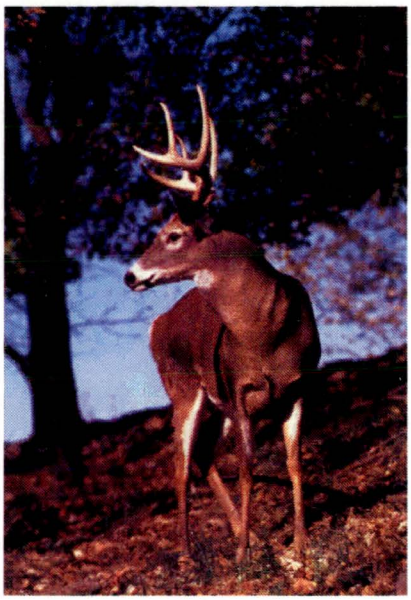
Preface

This report is submitted as required by Technical Specification 6.6.B.2, Annual Radiological Environmental Operating Report for Surry, Units 1 and 2, Virginia Electric and Power Company Docket Nos. 50-280 and 50-281.

Executive Summary

This document is a detailed report of the 1994 Surry Nuclear Power Station Radiological Environmental Monitoring Program (REMP). Radioactivity levels from January 1 through December 31, 1994 in air, water, silt, shoreline sediment, milk, aquatic biota, food products, vegetation, and direct exposure pathways have been analyzed, evaluated, and summarized. The REMP is designed to confirm that radiological effluent releases are As Low As is Reasonably Achievable (ALARA), no undue environmental effects occur, and the health and safety of the public is protected. The program also detects any unexpected environmental processes which could allow radioactive accumulations in the environment or food pathway chains.

Radiation and radioactivity in the environment is constantly monitored within a 25 mile radius of the station. Virginia Power also collects samples within this area. A number of sampling locations for each medium were selected using available meteorological, land use, and water use data. Two types of samples are taken. The first type, control samples, are collected from areas that are beyond measurable influence of Surry Nuclear Power Station or any other nuclear facility. These samples are used as reference data. Normal background radiation levels, or radiation present due to causes other than Surry Power Station, can thus be compared to the environment surrounding the nuclear power station. Indicator samples are the second sample type obtained. These samples show how much radiation is contributed to the environment by the plant. Indicator samples are taken from areas close to the station where any plant contribution will be at the highest concentration.



Prior to station operation, samples were collected and analysed to determine the amount of radioactivity present in the area. The resulting values are used as a "pre-operational baseline." Analysis results from the indicator samples are compared to both current control sample values and the pre-operational baseline to determine if changes in radioactivity levels are attributable to station operations, other causes such as the Chernobyl accident, or natural variation.

Teledyne Brown Engineering provides sample analyses for various radioisotopes as appropriate for each sample media. Participation in the Environmental Protection Agency's (EPA) Interlaboratory Comparison Program provides an independent check of sample measurement precision and accuracy. Typically, radioactivity levels in the environment are so low that analysis values frequently fall below the minimum detection limits of state-of-the-art measurement methods. Because of this, the Nuclear Regulatory Commission (NRC) requires that equipment used for radiological environmental monitoring must be able to detect specified minimum Lower Limits of Detection (LLD). This ensures that analyses are as accurate as possible. Samples with extremely low levels of radiation which cannot be detected are therefore reported as being below the LLD. The NRC also mandates a "reporting level." Licensed nuclear facilities must report any releases equal to or greater than this reporting level. Environmental radiation levels are sometimes referred to as a percent of the reporting level.

Analytical results are divided into five categories based on exposure pathways: Airborne, waterborne, aquatic, ingestion, and direct radiation. Each of these pathways is described below:

- The airborne exposure pathway includes airborne iodine and airborne particulates. The 1993 airborne results were very similar to previous years and to preoperational levels. No increase was noted and there were no detections of fission products or other man-made isotopes in the airborne particulate media during 1994.

- The waterborne exposure pathway includes well water and river water. No river water samples indicated the presence of radioisotopes except tritium and naturally occurring potassium. The average tritium activity in 1994 was 2.0% of the NRC reporting level. No man-made isotopes were detected in well water. This trend is consistent throughout the operational monitoring program.

- The aquatic exposure pathway includes silt and shoreline sediment samples. Silt contained some cesium-137 and cobalt-60. During the preoperational period, there were no man-made isotopes detected for this pathway. Man-made isotopes have accumulated. Gamma-emitting isotope concentrations in 1994, however, indicate a decreasing trend compared to the previous five year period. Shoreline sediment, which may provide a direct exposure pathway, contained no man-made isotopes.

- The ingestion exposure pathway includes milk, aquatic biota, and food product samples. Iodine-131 was not detected in any 1994 milk samples and has not been detected in milk prior to or since the 1986 Chernobyl accident. Strontium-90, attributable to past atmospheric nuclear weapons testing, was detected at levels equivalent to the previous year. Naturally occurring potassium-40 was detected at average environmental levels.

  The aquatic biota exposure pathway includes samples taken from localized populations of crabs, fish, clams, and oysters. Naturally occurring potassium-40 was detected in each of the aquatic biota samples at average environmental levels. Vegetation samples revealed naturally occurring potassium-40 and beryllium-7 at levels which are average for the previous five years.

- The direct exposure pathway measures environmental radiation doses by use of thermoluminescent dosimeters (TLDs). TLD results have indicated a steady trend and compares well with the last five years of data.

During 1994, as in previous years, operation of the Surry Nuclear Power Station created no adverse environmental affects or health hazards. The maximum dose calculated for the hypothetical individual at the Surry Power Station site boundary due to liquid and gaseous effluents released from the site during 1994 was 0.45 millirem. For reference this dose may be compared to the 360 millirem average annual exposure to every person in the United States from natural and man-made sources. Natural sources in the environment provide approximately 82% of radiation exposure to man while Nuclear Power contributes less than 0.1%. These results demonstrate not only compliance with federal and state regulations, but also demonstrate the adequacy of radioactive effluent control at the Surry Nuclear Power Station.

I. Introduction

The operational Radiological Environmental Monitoring Program (REMP) conducted for the year 1994 for the Surry Power Station is provided in this report. The results of measurements and analyses of data obtained from samples collected from January 1, 1994 through December 31, 1994 are summarized.

A. The Surry Power Station of Virginia Electric and Power Company is located on the Gravel Neck peninsula adjacent to the James River, approximately 25 miles upstream of the Chesapeake Bay. The site consists of two units, each with pressurized water reactor (PWR) nuclear steam supply system and turbine generator furnished by Westinghouse Electric Corporation. Each unit is designed with a gross electrical output of 822.6 megawatts electric (MWe). Unit 1 achieved commercial operation on December 22, 1972, and Unit 2 on May 1, 1973.

B. The United States Nuclear Regulatory Commission (USNRC) regulations (10CFR50.34a) require that nuclear power plants be designed, constructed, and operated to keep levels of radioactive material in effluents to unrestricted areas as low as reasonably achievable (ALARA). To ensure these criteria are met, the operating license for Surry Power Station includes Technical Specifications which address the release of radioactive effluents. Inplant monitoring is used to ensure that these release limits are not exceeded. As a precaution against unexpected or undefined environmental processes which might allow undue accumulation of radioactivity in the environment, a program for monitoring the plant environs is also included in Surry Power Station Technical Specifications.

C. Virginia Electric and Power Company is responsible for collecting the various indicator and control environmental samples. Teledyne Brown Engineering is responsible for sample analysis and submitting reports of radioanalyses. The results are used to determine if changes in radioactivity levels could be attributable to station operations. Measured values are compared with control levels, which vary with time due to such external events as cosmic ray bombardment, weapons test fallout, and seasonal variations of naturally occurring isotopes. Data collected prior to the plant operation is used to indicate the degree of natural variation to be expected. This preoperational data is compared with data collected during the operational phase to assist in evaluating any radiological impact of the plant operation.

D. Occasional samples of environmental media show the presence of man-made isotopes. As a method of referencing the measured radionuclide concentrations in the sample media to a dose consequence to man, the data is compared to the reporting level concentrations listed in the USNRC Regulatory Guide 4.8 and VPAP-2103, Offsite Dose Calculation Manual. These concentrations are based upon the annual dose commitment recommended by 10CFR50, Appendix I, to meet the criterion of "As Low As Is Reasonably Achievable".

E. This report documents the results of the Radiological Environmental Monitoring Program for 1994 and satisfies the following objectives of the program:

1. To provide measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides that lead to the highest potential

radiation exposure of the maximum exposed members of the public resulting from the station operation.

2. To supplement the radiological effluent monitoring program by verifying that radioactive effluents are within allowable limits.

3. To identify changes of radioactivity in the environment.

4. To verify that the plant operations have no detrimental effect on the health and safety of the public.

II. Nuclear Power And The Environment: In Perspective

Coal, oil, natural gas, nuclear power, and hydropower have all been used to run the nation's electric generating stations. Each method, however, has its drawbacks. Coal-fired power can damage the environment during the mining process, or by airborne discharges such as fly-ash and chemicals which contribute to acid rain. Oil and natural gas are costly because of their limited supply. Few suitable sites for hydropower exist, and building the large dams necessary to produce Hydropower has a significant impact on the environment.

Nuclear energy provides an alternate source of energy which is readily available. The operation of nuclear power stations has a very small impact on the environment. In fact, hundreds of acres adjoining Surry Power Station are a state waterfowl refuge, and Lake Anna, next to North Anna Power Station, is a well-known fishing site with a state park on its shore.

In order to more fully understand this unique energy source, background information about basic radiation characteristics, risk assessment, reactor operation, effluent control, environmental monitoring, and radioactive waste is provided in this section.

Fundamentals

The Atom

Everything we encounter is made of atoms. Atoms are the smallest parts of an element that still have all the chemical properties of that element. At the center of an atom is a nucleus. The nucleus consists of neutrons and protons. Electrons move in an orbit around the nucleus and are negatively charged. Protons and neutrons are nearly identical in size and weight, and each is about 2000 times heavier than an electron. The proton, however, has a positive charge, while the neutron has no charge, it is electrically neutral. Figure 1 presents a simple diagram of an atom.

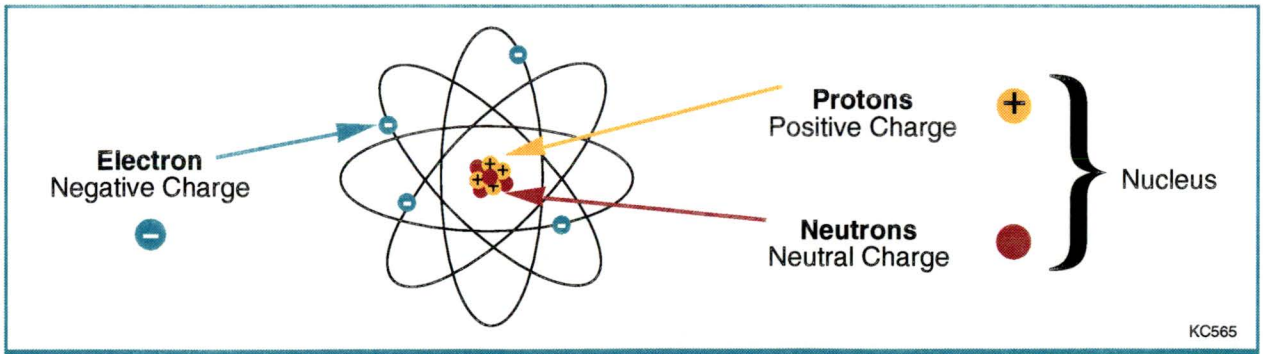


Figure 1. Atomic Structure

Isotopes

The number of protons in the atom of any specific element is always the same. For example, all hydrogen atoms have one proton whereas all oxygen atoms have eight protons. Unlike protons,

the number of neutrons in the nucleus of an element may vary. Atoms with the same number of protons, but a different number of neutrons, are called isotopes. Table 1 lists the isotopes of uranium.

Isotopes	Symbols	Number of Protons	Number of Neutrons
Uranium-235	^{235}U	92	143
Uranium-236	^{236}U	92	144
Uranium-237	^{237}U	92	145
Uranium-238	^{238}U	92	146
Uranium-239	^{239}U	92	147
Uranium-240	^{240}U	92	148

Table 1. Uranium Isotopes

Radiation and Radioactivity

Radionuclides

Normally, the parts of an atom are in a balanced or stable state. A small percentage of atoms naturally contain excess energy and therefore are not stable atoms. If the nucleus of an atom contains excess energy, it may be called a radioactive atom, a radioisotope, or radionuclide. The excess energy is usually due to an imbalance in the number of electrons, protons, and/or neutrons which make up the atom.

Radionuclides can be naturally occurring, such as uranium-238, thorium-232 and potassium-40, or man-made, such as iodine-131, cesium-137, and cobalt-60.

Radioactive Decay

Radioactive atoms attempt to reach a stable (non-radioactive) state through a process known as radioactive decay. Radioactive decay is the release of energy from the atom through the emission of particulate and/or electromagnetic radiation. Particulate radiation may be in the form of electrically charged particles such as alpha (2 protons plus 2 neutrons) or beta particles (1 electron), or may be electrically neutral, such as neutrons. Part of the electromagnetic spectrum consists of gamma rays and X-rays which are similar to light and microwaves, but have a much higher energy.

Half-Life

A radioactive half-life is the amount of time required for a radioactive substance to lose half of its activity through the process of radioactive decay. Cobalt-60 has a half-life of about 5 years.

After 5 years, 50% of its radioactivity is gone, and after 10 years, 75% has decayed away. Radioactive half-lives vary from millionths of a second to millions of years.

Radioactive atoms may decay directly to a stable state or may undergo a series of decay stages. During the decay process, several daughter products may be formed which eventually transform into stable atoms. Naturally occurring radium-226, for example, has 10 successive daughter products (including radon) resulting finally with lead-206 as a stable form.

Types Of Radiation

Two types of radiation are considered in the nuclear industry, particulate and electromagnetic. Particulate radiation may come from the nucleus of an atom in the form of an ejected alpha particle. Alpha particles consists of two protons together with two neutrons.

Alpha particles have a very limited ability to penetrate matter. A piece of paper will stop all alpha radiation from sources outside the body are not considered to be a radiation hazard.

A beta particle is like an electron that has been ejected from the nucleus of an atom. Skin or a thin piece of aluminum will stop beta radiation. Exposure to beta radiation can be a hazard to the skin or lens of the eye. Because of their limited ability to penetrate the body, beta and alpha radiation are a health concern primarily if swallowed or inhaled where they might cause internal radiation exposure. Gamma rays are like X-rays, except that they come from the nucleus of an atom while X-rays come from the electron rings.

Gamma rays can penetrate deep into the body and thus give a "whole-body" radiation dose. Several inches of concrete or lead will stop both gamma and X-rays. Figure 5 shows the approximate penetrating ability of various types of radiation.

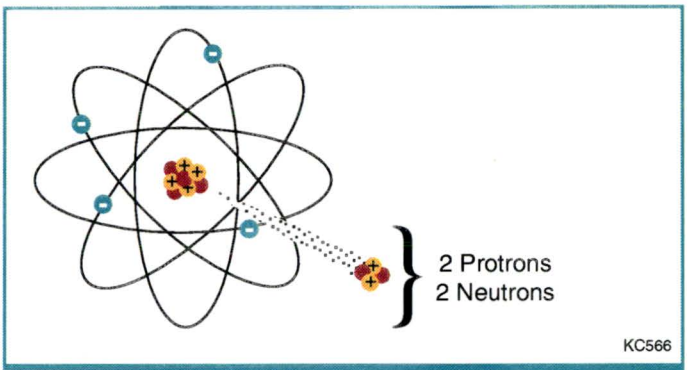


Figure 2. Alpha Particle

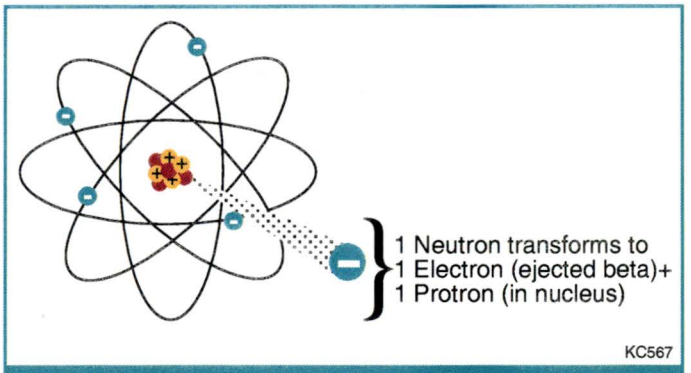


Figure 3. Beta Particle

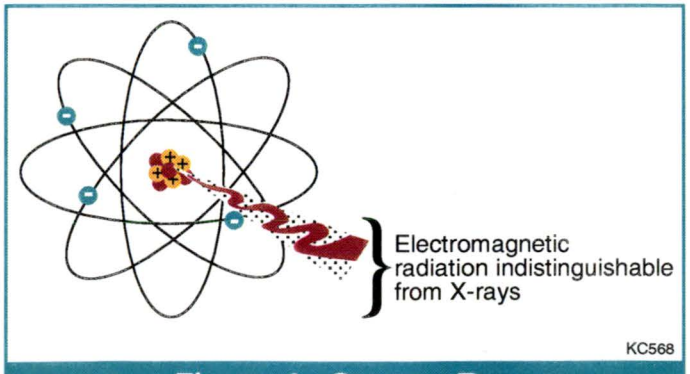
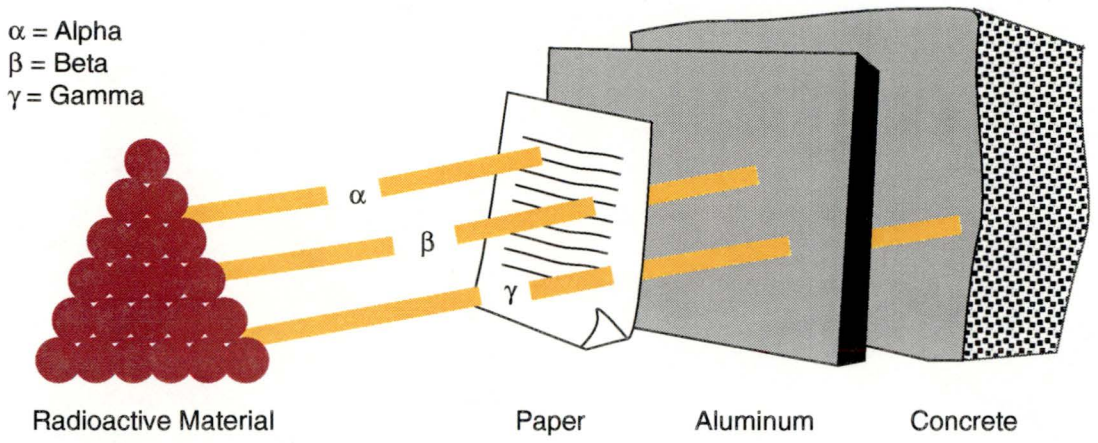


Figure 4. Gamma Ray



As radiation travels, it collides with other atoms and loses energy. Alpha particles can be stopped by a sheet of paper, beta particles by a thin sheet of aluminum, and gamma radiation by several inches of concrete or lead.

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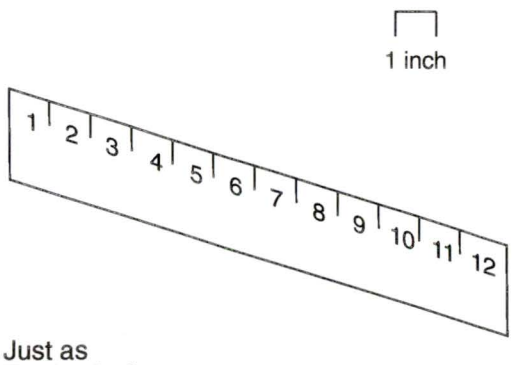
Figure 5. The Penetrating Ability of Various Types of Radiation

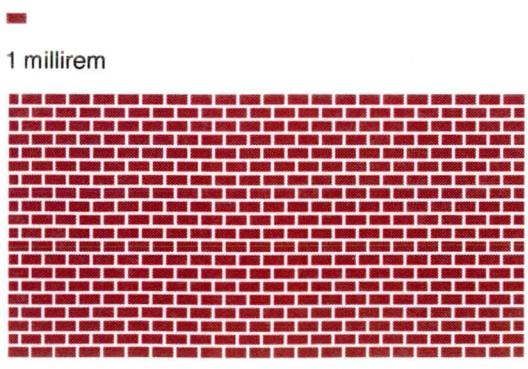
Quantities And Units Of Radioactive Measurement

Several quantities and units are used to describe radioactivity and its effects. In the following sections two terms, rem and activity, will be used to describe amounts of radiation.

Rem measures the potential effect of radiation exposure on human cells. Small doses are counted in millirem. Each millirem is equal to one thousandth of a rem. Federal standards limit exposure for an individual member of the public to 500 millirem annually. This annual limit does not include the average 300 millirem received from natural sources and approximately 60 millirem from medical applications.



Just as
Twelve inches
equals one foot



1000 millirem equals 1 rem

KC561

Figure 6. Unit Comparison

Activity is the number of nuclei in a sample that disintegrate (decay) every second. Each time a nucleus disintegrates, radiation is emitted. The unit of activity is the Curie. A Curie (Ci) is the amount of radioactive material which decays at a rate of 37 billion atoms per second. Smaller units of the Curie are often used. Two common units are the microCurie (uCi), one millionth of a Curie, and the picoCurie (pCi), one trillionth of a Curie. A Curie is a measurement of radioactivity, not a quantity of material. The amount of material necessary to make one Curie varies. For example, one gram of radium-226 is one Curie of radioactivity, but it would take 9,170,000 grams (about 10 tons) of thorium-232 to obtain one Curie.

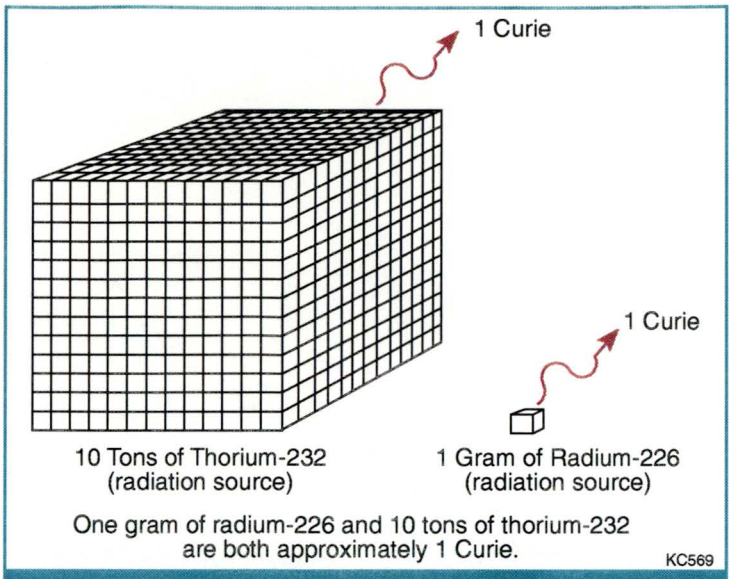


Figure 7. The Curie, a Measurement of Activity

Sources Of Radiation

Background Radiation

Radiation is not a new creation of the nuclear power industry; it is a natural occurrence on the earth. Mankind has always lived with radiation and always will. Every second of our lives, over 7,000 atoms undergo radioactive decay in the body of the average adult. Radioactivity exists naturally in the soil, water, air and space. All of these common sources of radiation contribute to the natural background radiation that we are exposed to each day.

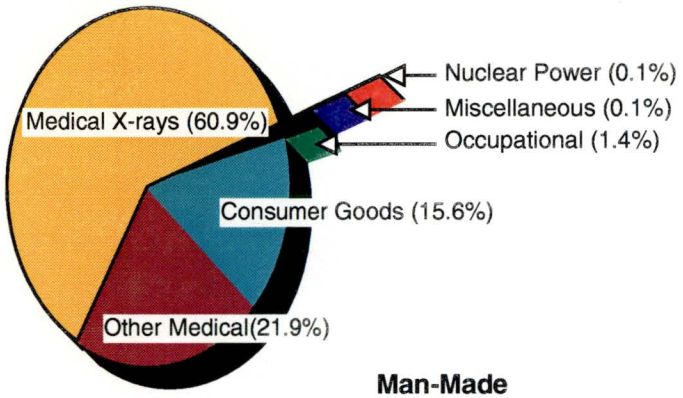
The earth is constantly showered by a steady stream of high energy gamma rays. These rays come from space and are known as cosmic radiation. Our atmosphere shields out most of this radiation, but everyone still receives about 20 to 50 millirem each year from this source. At high altitudes, the air is thinner and provides less protection from cosmic radiation. Because of this, people living at higher altitudes or even flying in an airplane are exposed to more radiation. Radioactive atoms commonly found in the atmosphere as a result of cosmic ray interactions include beryllium-7, carbon-14, tritium, and sodium-22.

Other natural sources of radiation include radionuclides naturally found in soil, water, food, building materials and even people. People have always been radioactive, in part because the carbon found in our bodies is a mixture of all carbon isotopes, both non-radioactive and radioactive. Approximately two-thirds of the whole body dose from natural sources is contributed by radon gas. About one-third of the naturally occuring external terrestrial and internal whole body radiation dose is attributable to a naturally radioactive isotope of potassium, potassium-40.

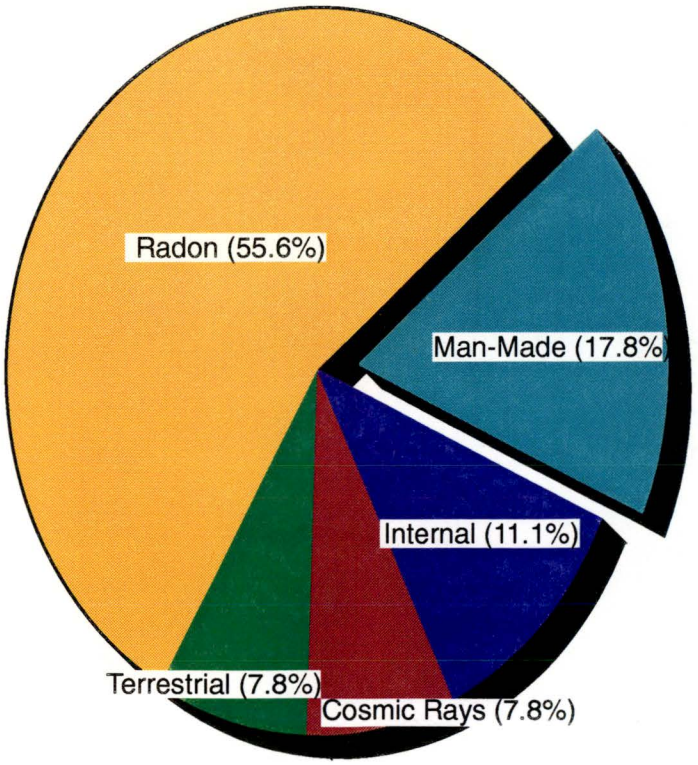
Man-Made

In addition to naturally occurring radiation, people are also exposed to man-made radiation. The largest sources of these exposures are from medical X-rays, fluoroscopic examinations, radioactive drugs, and tobacco. Small doses are received from consumer products such as television, smoke alarms, and fertilizers. Very small doses result from the production of nuclear power. Fallout from nuclear weapons tests is another source of man-made exposure. Fallout radionuclides include strontium-90, cesium-137, carbon-14, and tritium.

Man-Made Sources



Natural And Man-Made Sources



Man-Made

Medical	
Diagnostic X-Rays	39.00
Other Medical	14.00
Consumer Products	5.00 to 13.00
Occupational	0.90
Miscellaneous	
Environmental	0.06
Nuclear Power	0.05

Natural Background

Radon and Radon Daughters	200.00
Cosmic Rays	27.00
Cosmogenic Radiation	1.00
Terrestrial Radiation	28.00
Internal Radiation	40.00

Total 360.00 MREM Per Year

NCRP Report No. 93, "Ionizing Radiation Exposure of the Population of the United States," 30 Dec 1987, Bethesda, MD 20814

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Figure 8. Average Annual Dose Equivalent To Persons In The U.S. From Various Radiation Sources

Effects Of Radiation

Studies

The effects of ionizing radiation on human health have been under study for more than eighty years. Scientists have obtained valuable knowledge through the study of laboratory animals that were exposed to radiation under controlled conditions. It has proven difficult, however, to relate the biological effects of irradiated laboratory animals to the potential health effects on humans. Because of this, human populations irradiated under various circumstances have been studied in great depth. These groups include:

- Survivors of the atomic bomb.
- Persons undergoing medical radiation treatment.
- Radium dial painters during World War I who ingested large amounts of radioactivity by "tipping" the paint brushes with their lips.
- Uranium miners, who inhaled large amounts of radioactive dust while mining pitchblende (uranium ore).
- Early radiologists, who accumulated large doses of radiation from early X-ray equipment while being unaware of the potential hazards.

Analysis of these groups has increased our knowledge of health effects resulting from large radiation doses. Less is known about the effects of low doses of radiation. To be on the conservative side, we assume that health effects occur proportionally to those observed following a large dose of radiation. That is, if one dose of radiation causes an effect, then half the dose will cause half the effect. Radiation scientists agree that this assumption overestimates the risks associated with low level radiation exposure. The effects predicted in this manner have not been actually observed in individuals exposed to low level radiation.

Health Risks

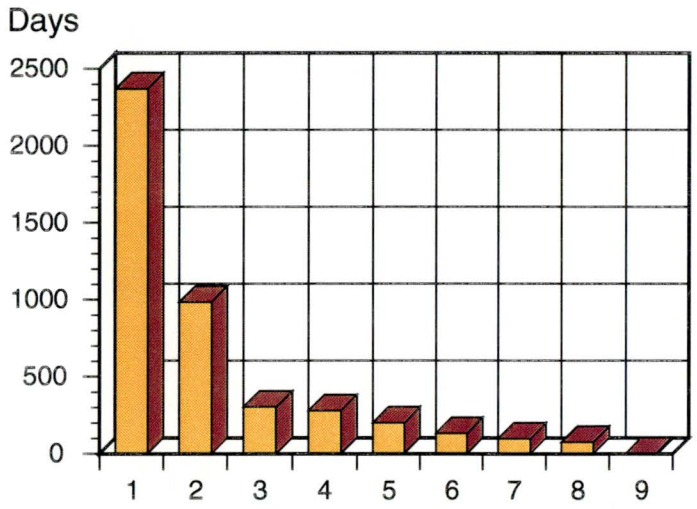
Since the actual effects of exposure to low level radiation are difficult to measure, scientists often refer to the possible risk involved. The problem is one of evaluating alternatives, of comparing risks and weighing them against benefits. People make decisions involving risks every day, such as deciding whether to wear seat belts or smoke cigarettes. Risks are a part of everyday life. The question is to determine how great the risks are.

We accept the inevitability of automobile accidents. Building safer cars or wearing seat belts will reduce the risk of injury. You could choose to not drive to be even safer, but pedestrians and bicyclists are also injured by cars. Reducing the risk of injury from automobiles to zero requires moving to a place where there are no automobiles.

While accepting the many daily risks of living, some people feel that their demands for energy should be met on an essentially risk-free basis. Attention is focused on safeguarding the public, developing a realistic assessment of the risks, and placing them in perspective.

Because you cannot see, feel, taste, hear, or smell radiation, it is often a source of concern. We have the same lack of sensory perception for things such as radio waves, carbon monoxide, and small concentrations of numerous cancer causing substances. Although these risks are just as real as the risks associated with radiation, they have not generated the same degree of concern as radiation.

Most risks are with us throughout our lives, and their effects can be added up over a lifetime to obtain a total effect on our life span. The typical life span for an American woman is now 76 years, whereas men average 71 years of age. Figure 9 shows a number of different factors that decreased our average life expectancy.



Activity

1. Smoking 1 Pack of Cigarettes a Day
2. Being 20% Overweight
3. Construction
4. Agriculture
5. Auto Accidents
6. Avg Alcohol Consumption per Person
7. Home Accidents
8. All Industry Hazards
9. Radiation Dose of 6.5 Millirem per Year for 30 Years

NCRP Report No. 95, "Radiation Exposure of the U.S. Population from Consumer Products and Miscellaneous Sources," National Council on Radiation Protection and Measurements, 30 Dec 1987, Bethesda, MD 20814

KC562

Figure 9. Estimated Average Days Of Life Expectancy Lost Due To Various Health Risks

The American Cancer Society estimates that about 30 percent of all Americans will develop cancer at some time in their lives from all possible causes. So, in a group of 10,000 people it is expected that 3,000 of them will develop cancer. If each person were to receive a radiation exposure of one rem in addition to natural background radiation, then it is expected that three more may develop cancer during their lifetime. This increases the risk from 30 percent to 30.03 percent. Hence, the risks of radiation exposure are small when compared to the risks of everyday life.

These comparisons should give you some idea of the risk involved in activities that you are familiar with. They give a basis for judging what smoking, eating, or driving a car could mean to your health and safety. Everyone knows that life is full of risks. If you have the basis for judgment, you can decide what to do or what not to do.

Nuclear Reactor Operation

Electricity in the United States is being produced using fossil fuel, uranium, or falling water. A fossil-fueled power station burns coal, oil or natural gas in a boiler to produce energy. Nuclear power stations use uranium fuel and the heat produced from the fission process to make energy. In both cases, they heat and boil water to produce steam. The steam is used to drive a turbine which turns a generator and produces electricity.

Nuclear Fuel

Uranium (U) is the basic ingredient in nuclear fuel, consisting of U-235 and U-238 atoms. Natural uranium contains less than one percent U-235 when it is mined. Commercial nuclear power plants use fuel with a U-235 content of approximately three percent. The process used to increase the U-235 concentration is known as enrichment.

Reactor Operation

After enrichment, the uranium fuel is chemically changed to uranium dioxide, a dry black powder. This powder is compressed into small ceramic pellets. Each fuel pellet is about 3/4 inches long and 3/8 inches in diameter. The pellets are placed into 12 foot long metal tubes made of zirconium alloy to make a fuel rod. About five pounds of pellets are used to fill each rod. A total of 204 fuel rods make a single fuel assembly. Virginia Power nuclear reactors contains 157 fuel assemblies (Figure 10).

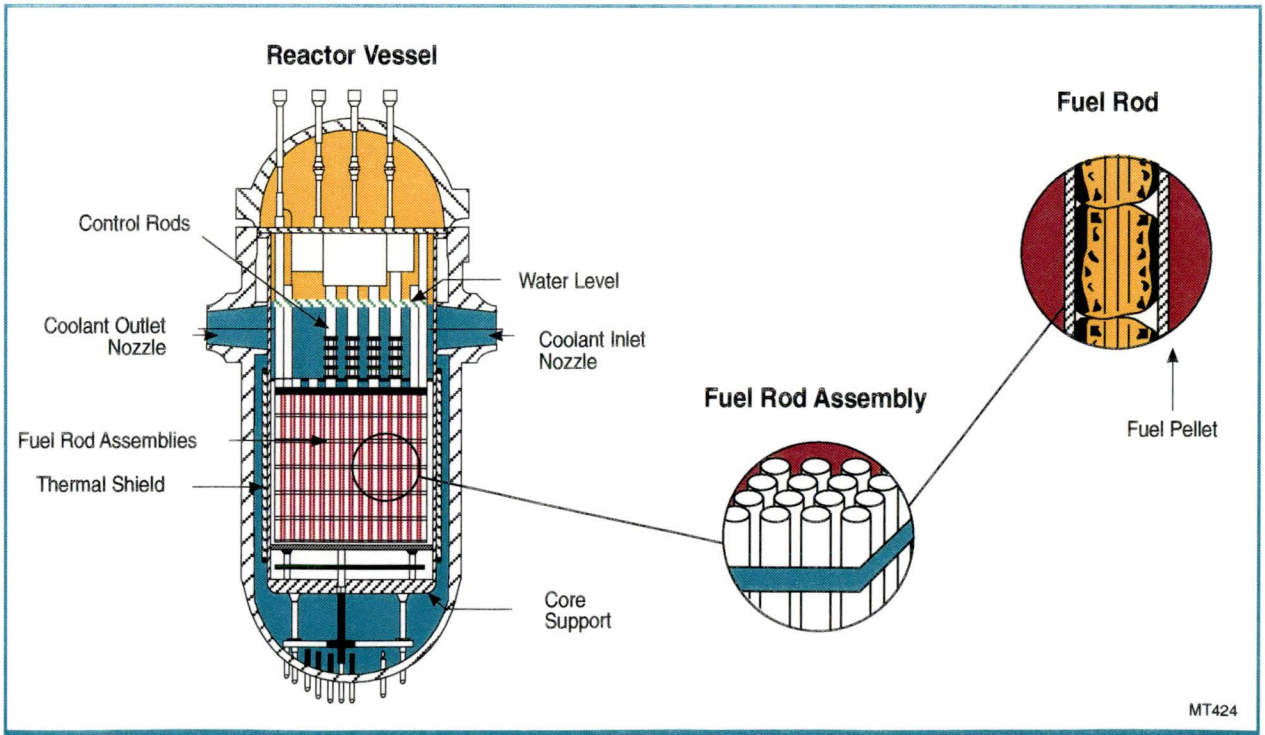


Figure 10. Reactor Vessel With Fuel Assemblies, Rods, and Fuel Pellets

Fission

Nuclear energy is produced by a process called fission. Fission occurs in a reactor when uranium is split into fragments producing heat and releasing neutrons. These neutrons strike other uranium atoms, causing them to split (fission) and release more heat and neutrons. This is called a chain reaction (Figure 11) and is controlled by the use of reactor control rods.

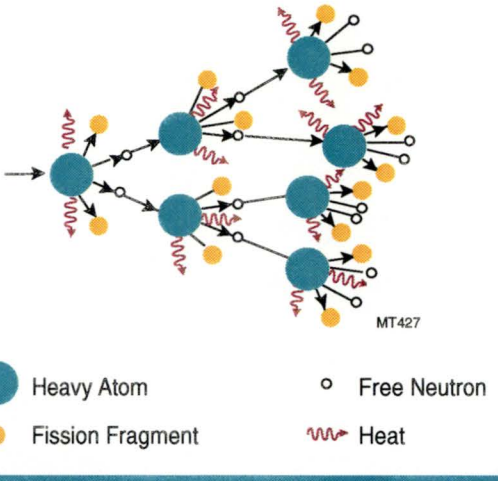


Figure 11. Fission: A Chain Reaction

Control rods are an essential part of the nuclear reactor. Control rods contain cadmium, indium, and silver metals which absorb and control the amount of neutrons produced in the reactor. The control rods act to slow down or stop the chain reaction. A chain reaction cannot occur when the control rods are inserted completely into the core. When the control rods are withdrawn, the chain reaction begins and heat is generated.

Design & Operation

Surry Power Station and North Anna Power Station use a Pressurized Water Reactor (PWR) system to generate electricity. There are two complete and independent PWR systems on-site at both Surry and North Anna Power Stations. These are referred to as Unit-1 and Unit-2.

The reactor core is inside a large steel container called the Reactor Pressure Vessel. The reactor core is always surrounded by water. The fissioning of the uranium fuel makes the fuel rods get hot. The hot fuel rods heat the water, which serves as a coolant that carries away heat.

In a pressurized water reactor, heat is moved from place to place by moving water, the reactor's coolant. The water flows in closed loops. As (primary) water moves through the core it gets very hot (605°F), but because it is under such high pressure, 2235 pounds per square inch (psi), it doesn't boil. The hot water then flows to the steam generator. The steam generator is a heat exchanger. Reactor coolant passes through it but doesn't mix with the steam generator (secondary) water. Instead, heat from the primary water is transferred through thousands of tubes to the cooler secondary water. The water in the steam generator is under much less pressure, and the heat boils the secondary water to steam. At Virginia Electric and Power stations, each unit has 3 steam generators.

The steam is piped to a steam turbine that turns an electric generator. The exhausted steam from the turbine is cooled and converted back to water in a condenser. The condenser is also a heat exchanger; in it heat passes from the steam to a third loop of water. In Surry's case the James River provides the third loop water. At North Anna Power Station third loop water is from Lake Anna. The steam turns back to liquid and is pumped back to the steam generator. Figure 12 is a diagram of typical nuclear reactor systems.

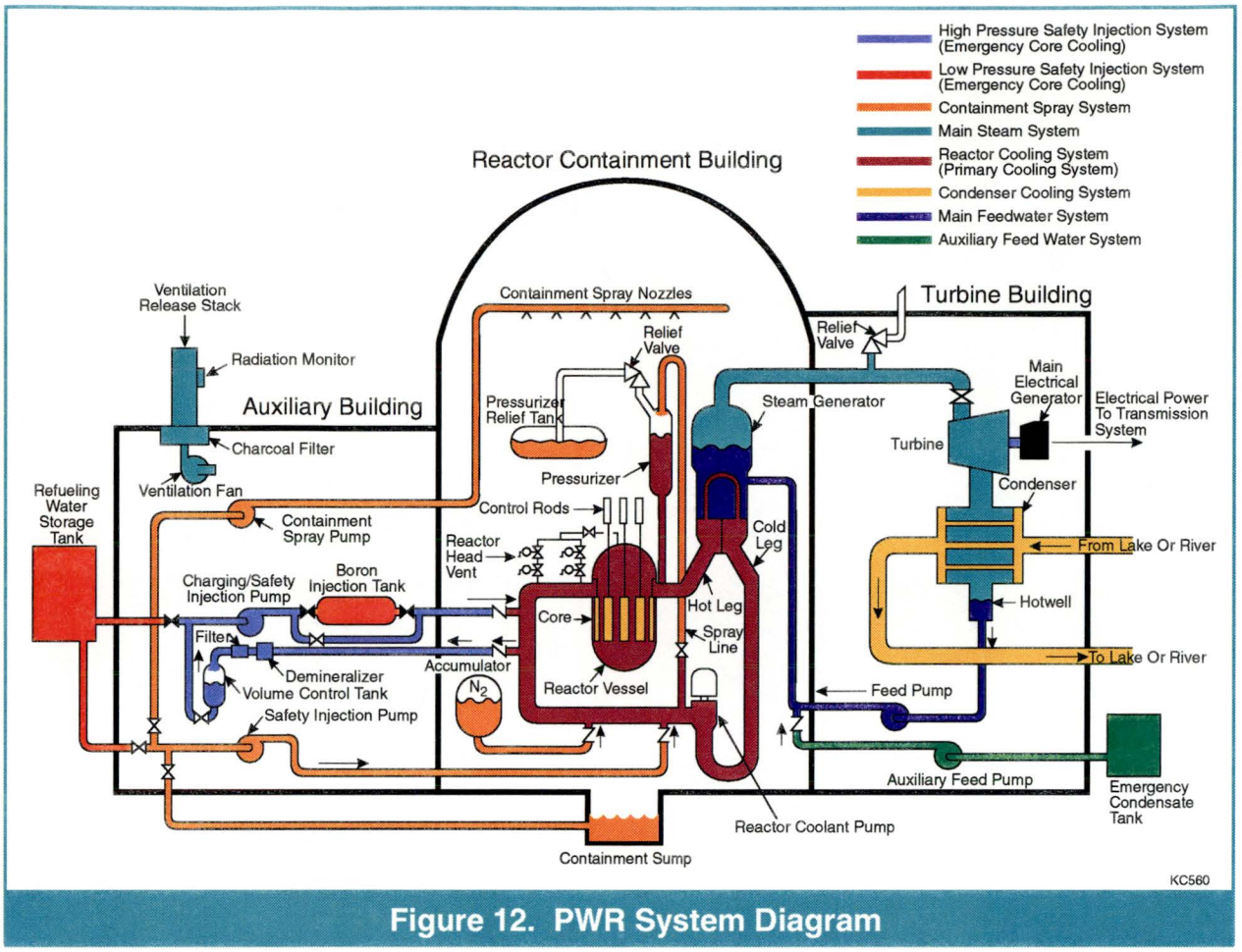


Figure 12. PWR System Diagram

Containment

Nuclear power plants are designed to prevent the escape of large quantities of radiation and radioactive substances. Two principles are used. First, thick, heavy walls are used as shielding to absorb radiation and prevent its escape. Second, strong, airtight walls called containment, are used to prevent the escape of radioactive materials.

The reactor pressure vessel and the containment building that houses it are enormously strong (Figure 13). Strong enough, in fact, to withstand a direct hit from a jet airliner. The reactor core lies within a sealed pressure vessel. Like all boilers its walls must be very strong because the water inside must be kept under high pressure. The reactor pressure vessel in a nuclear power plant is even heavier than an ordinary steam boiler because of the need to minimize the chance of rupture and release of any radioactive materials. The reactor pressure vessel is made from a stainless steel alloy 6 to 8 inches thick.

Around the reactor pressure vessel is a thick concrete wall. This wall acts as shielding, protecting workers by absorbing radiation resulting from the nuclear chain reaction. Next an airtight 1/2 inch steel liner surrounds the entire interior of the containment. If the reactor pressure vessel or any of the primary piping should break, the escaping steam would be trapped inside the liner.

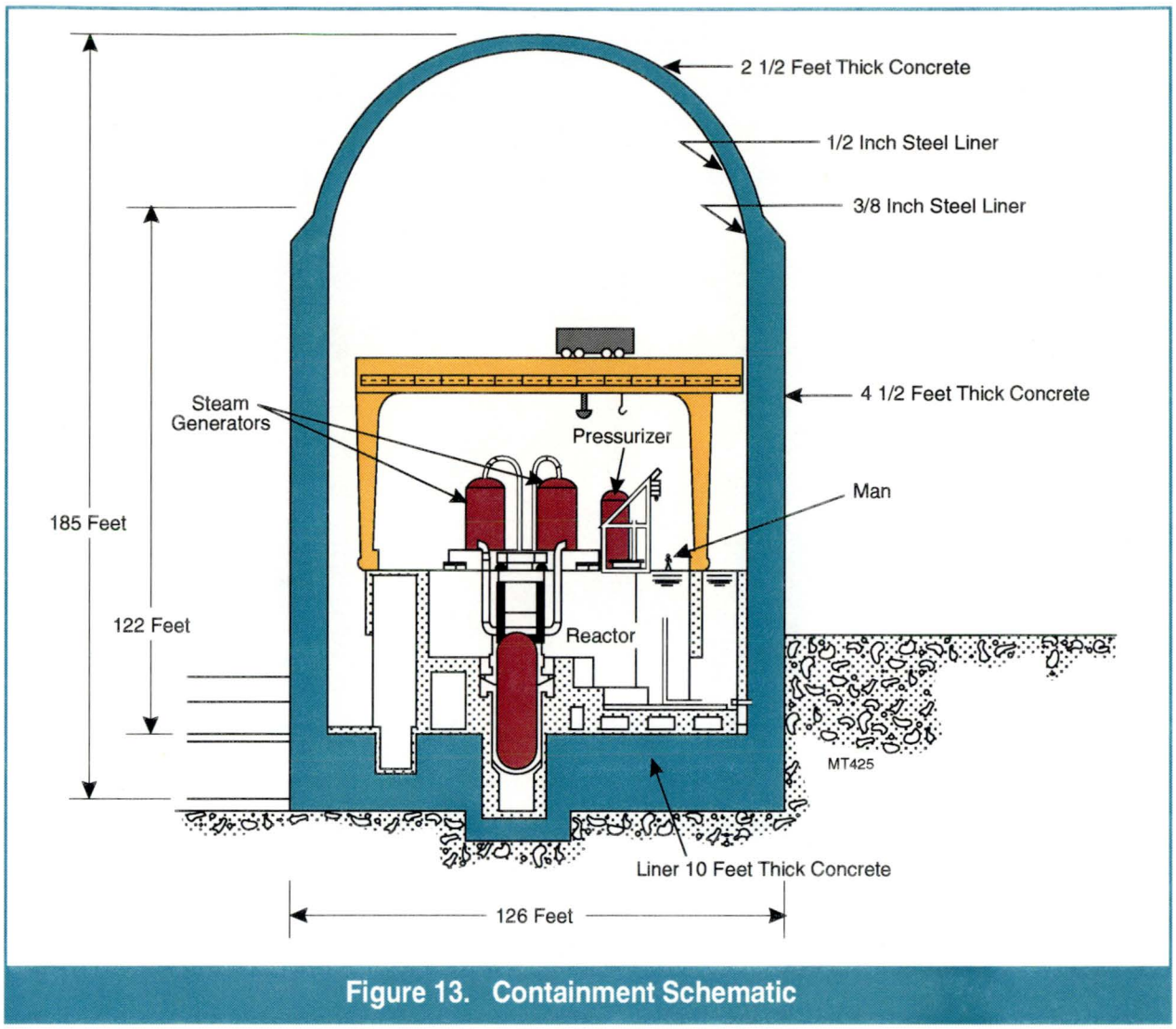


Figure 13. Containment Schematic

Finally, the building's reinforced concrete outer wall is 4 1/2 feet thick tapering to 2 1/2 feet at the top of the dome. It is designed to act as shielding and is also intended to withstand natural and man-made events like earthquakes and even the direct impact from a large commercial jet aircraft.

Operating the Reactor Safely

Accidents

The most serious accident that could happen in a nuclear power plant involves overheating in the nuclear reactor core. Such an accident would result from a loss-of-coolant accident or LOCA. During a LOCA, primary coolant would no longer circulate through the reactor core to remove heat. Circulation could be lost if a combination of pipes burst, for example. Conceivably, a dry, overheated reactor core could melt through the pressure vessel.

The reactor itself is designed to respond automatically to such an emergency. Operators are also trained to make corrections for any system failure. The automatic and operator responses have two goals: to prevent damage to the reactor, and prevent the release of radiation. Shutting the reactor down is relatively easy. Control rods drop in and chemical to stop the nuclear reaction are injected into the coolant. Losing the coolant itself tends to stop the chain reaction because the coolant is needed to keep the nuclear chain reaction going. Within 10 seconds of shutdown, the amount of heat is less than 5 percent of the amount produced at full power and within 15 minutes, less than 1 percent.

To carry heat away during an accident, all reactors have Emergency Core Cooling Systems (ECCS). The ECCS consists of primary and back-up pumps and reservoirs of coolant that operate separately from those that normally circulate through the system. A nuclear reactor has many different back-up safety systems designed so that if one fails another is always available.

Workers

There are many different jobs at a nuclear power plant and they are filled by people with diverse backgrounds. All employees are initially trained and then retrained annually by the company. Virginia Power's Training centers are fully accredited by the National Academy for Nuclear Training and the Institute for Nuclear Power Operations. The operators are tested and certified by the United States Nuclear Regulatory Commission (NRC).

Safety Statistics

Job safety is another measure of assurance that the station is being properly operated. Surry Power Station attained 5,000 man hours without a lost time accident and is continuing that record into 1995. North Anna has attained over 3,000,000 man hours without a lost time accident.

Summary

- Nuclear energy provides an alternate source of energy which is readily available. The operation of a nuclear power station has a very small impact on the environment.
- Radiation is not a new creation of the nuclear power industry; it is a natural occurrence on the earth. Mankind has always lived with radiation and always will. Radioactivity exists naturally in the soil, water, air and space. All these common sources of radiation contribute to the natural background radiation to which we are exposed.
- In addition to naturally occurring radiation and radioactivity, people are also exposed to man-made radiation. Very small doses result from the production of nuclear power.
- Nuclear power plants are designed to prevent the escape of radiation and radioactive substances.
- A nuclear reactor has many different back-up safety systems designed so that if one fails another is available.

III. SAMPLING AND ANALYSIS PROGRAM

A. Sampling Program

1. Table 2 summarizes the sampling program for Surry Power Station during 1994. The Radiological Monitoring Locations, Figure 14, denote the air sample and TLD stations for VEPCO and the State of Virginia. Sample locations are color coded to designate sample types shown in the Surry Emergency Plan maps.

2. For routine TLD measurements, two dosimeters made of $CaSO_4$:Dy in a teflon card are deployed at each sampling location. Several TLDs are co-located with NRC and Commonwealth of Virginia direct radiation recording devices. These are indicted as "co-location" samples.

3. In addition to the Radiological Environmental Monitoring Program required by Surry Technical Specifications, Virginia Electric and Power Company splits samples with the Commonwealth of Virginia. All samples listed in Table 2 are collected by Vepco personnel except for those labeled state split. All samples are shipped to Teledyne Brown Engineering located in Westwood, New Jersey.

4. All samples listed in Table 1 are taken at indicator locations except those labeled "control".

B. Analysis Program

1. Table 3 summarizes the analysis program conducted by Teledyne Brown Engineering for Surry Power Station during 1994.

TABLE 2

(Page 1 of 4)

SURRY - 1994

RADIOLOGICAL SAMPLING STATION

DISTANCE AND DIRECTION FROM UNIT NO. 1

Sample Media	Location	Station	Distance Miles	Direction	Degrees	Collection Frequency	Remarks	
Environmental	Control	(00)	-	-	-	Quarterly	Onsite*	
(TLD's)	West North West	(02)	0.17	WNW	292°	Quarterly	Site Boundary	
	Surry Station Discharge	(03)	0.6	NW	309°	Quarterly	Site Boundary	
	North North West	(04)	0.4	NNW	330°	Quarterly	Site Boundary	
	North	(05)	0.33	N	357°	Quarterly	Site Boundary	
	North North East	(06)	0.28	NNE	22°	Quarterly	Site Boundary	
	North East	(07)	0.31	NE	45°	Quarterly	Site Boundary	
	East North East	(08)	0.43	ENE	68°	Quarterly	Site Boundary	
	East (Exclusion)	(09)	0.31	E	90°	Quarterly	Onsite	
	West	(10)	0.40	W	270°	Quarterly	Site Boundary	
	West South West	(11)	0.45	WSW	250°	Quarterly	Site Boundary	
	South West	(12)	0.30	SW	225°	Quarterly	Site Boundary	
	South South West	(13)	0.43	SSW	203°	Quarterly	Site Boundary	
	South	(14)	0.48	S	180°	Quarterly	Site Boundary	
	South South East	(15)	0.74	SSE	157°	Quarterly	Site Boundary	
	South East	(16)	1.00	SE	135°	Quarterly	Site Boundary	
	East	(17)	0.57	E	90°	Quarterly	Site Boundary	
	Station Intake	(18)	1.23	ESE	113°	Quarterly	Site Boundary	
	Hog Island Reserve	(19)	1.94	NNE	26°	Quarterly	Near Resident,	co-location
	Bacons Castle	(20)	4.45	SSW	202°	Quarterly	Apx. 5 mile	co-location
	Route 633	(21)	3.5	SW	224°	Quarterly	Apx. 5 mile	
	Alliance	(22)	5.1	WSW	248°	Quarterly	Apx. 5 mile	co-location
	Surry	(23)	8.0	WSW	250°	Quarterly	Population Center	
	Route 636 and 637	(24)	4.0	W	270°	Quarterly	Apx. 5 mile	
	Scotland Wharf	(25)	5.0	WNW	285°	Quarterly	Apx. 5 mile	co-location
	Jamestown	(26)	6.3	NW	310°	Quarterly	Apx. 5 mile	co-location
	Colonial Parkway	(27)	3.7	NNW	330°	Quarterly	Apx. 5 mile	
	Route 617 and 618	(28)	5.2	NNW	340°	Quarterly	Apx. 5 mile	
	Kingsmill	(29)	4.8	N	2°	Quarterly	Apx. 5 mile	
	Williamsburg	(30)	7.8	N	0°	Quarterly	Population Center	co-location
	Kingsmill North	(31)	5.6	NNE	14°	Quarterly	Apx. 5 mile	
	Budweiser	(32)	5.7	NNE	27°	Quarterly	Population Center	

* TLD stored in a lead shield in environmental building

TABLE 2

(Page 2 of 4)

SURRY - 1994

RADIOLOGICAL SAMPLING STATION

DISTANCE AND DIRECTION FROM UNIT NO. 1

Sample Media	Location	Station	Distance Miles	Direction	Degrees	Collection Frequency	Remarks	
Environmental TLD's(Cont.)	Water Plant	(33)	4.8	NE	41°	Quarterly	Apx. 5 mile	
	Dow	(34)	5.1	ENE	70°	Quarterly	Apx. 5 mile	
	Lee Hall	(35)	7.1	ENE	73°	Quarterly	Population Center	co-location
	Goose Island	(36)	5.0	E	88°	Quarterly	Apx. 5 mile	
	Fort Eustis	(37)	4.8	ESE	107°	Quarterly	Apx. 5 mile	co-location
	Newport News	(38)	16.5	ESE	102°	Quarterly	Population Center	
	James River Bridge	(39)	14.8	SSE	147°	Quarterly	Control Location	
	Benn's Church	(40)	14.5	S	175°	Quarterly	Control Location	
	Smithfield	(41)	11.5	S	176°	Quarterly	Population Center	
	Rushmere	(42)	5.2	SSE	156°	Quarterly	Apx. 5 mile	
	Rt. 628	(43)	5.0	S	177°	Quarterly	Apx. 5 mile	co-location
Air Charcoal and Particulate	Surry Station	(SS)	.37	NNE	15°	Weekly	Site boundary location with Highest D/Q	
	Hog Island Reserve	(HIR)	2.0	NNE	26°	Weekly	Co-location	
	Bacons Castle	(BC)	4.5	SSW	202°	Weekly		
	Alliance	(ALL)	5.1	WSW	248°	Weekly	Co-location	
	Colonial Parkway	(CP)	3.7	NNW	330°	Weekly		
	Dow Chemical	(DOW)	5.1	ENE	70°	Weekly		
	Fort Eustis	(FE)	4.8	ESE	107°	Weekly		
	Newport News	(NN)	16.5	ESE	122°	Weekly	Control Location	
River Water	Surry Discharge		0.17	NW	325°	Monthly	State Split	
	Scotland Wharf		5.0	WNW	285°	Monthly	Control Location/State Split	
	Surry Station Intake		1.9	ESE	77°	Bi-monthly		
	Hog Island Point		2.4	NE	52°	Bi-monthly		
	Newport News		12.0	SE	140°	Bi-monthly		
	Chickahominy River		11.2	WNW	300°	Bi-monthly	Control Location	
	Surry Station Discharge		0.17	NW	325°	Monthly		
	Scotland Wharf		5.0	WNW	285°	Monthly		

TABLE 2

(Page 3 of 4)

SURRY - 1994

RADIOLOGICAL SAMPLING STATION

DISTANCE AND DIRECTION FROM UNIT NO. 1

Sample Media	Location	Distance Miles	Direction	Degrees	Collection Frequency	Remarks
Well Water	Surry Station	-	-	-	Quarterly	Onsite*
	Hog Island Reserve	2.0	NNE	27°	Quarterly	
	Bacons Castle	4.5	SSW	203°	Quarterly	
	Jamestown	6.3	NW	309°	Quarterly	
Shoreline Sediment	Hog Island Reserve	0.8	N	5°	Semi-Annually	
	Burwell's Bay	7.76	SSE	167°	Semi-Annually	
Silt	Chickahominy River	11.2	WNW	300°	Semi-Annually	Control Location
	Surry Station Intake	1.9	ESE	77°	Semi-Annually	
	Hog Island Point	2.4	NE	52°	Semi-Annually	
	Point of Shoals	6.4	SSE	157°	Semi-Annually	
	Newport News	12.0	SE	140°	Semi-Annually	
	Surry Station Discharge	0.5	NNW	341°	Semi-Annually	
Milk	Lee Hall (a)	7.1	ENE	64°	Monthly	State Split
	Epps	4.8	SSW	201°	Monthly	State Split
	Colonial Parkway	3.7	NNW	337°	Monthly	
	Judkins	6.2	SSW	211°	Monthly	
	Williams	22.5	S	182°	Monthly	Control Location
Oysters	Deep Water Shoals	3.9	ESE	105°	Bi-Monthly	
	Point of Shoals	6.4	SSE	157°	Bi-Monthly	
	Rock Landing Shoals	7.8	SE	140°	Bi-Monthly	State Split
	Newport News	12.0	SE	140°	Bi-Monthly	
Clams	Chickahominy River	11.2	WNW	300°	Bi-Monthly	Control Location
	Surry Station Discharge	1.3	NNW	341°	Bi-Monthly	State Split
	Hog Island Point	2.4	NE	52°	Bi-Monthly	
	Jamestown	5.1	WNW	300°	Bi-Monthly	
	Lawnes Creek	2.4	SE	131°	Bi-Monthly	

* Well water sample taken onsite at Surry Environmental Building

(a) Lee Hall dairy station became unavailable 09/92. Replacement sample is not required.

TABLE 2

(Page 4 of 4)

SURRY - 1994

RADIOLOGICAL SAMPLING STATION

DISTANCE AND DIRECTION FROM UNIT NO. 1

Sample Media	Location	Distance Miles	Direction	Degrees	Collection Frequency	Remarks
Crabs	Surry Station Discharge	0.6	NW	312°	Annually	
Fish	Surry Station Discharge	0.6	NW	312°	Semi-Annually	
Crops	Brock's Farm	3.8	S	188°	Annually	State Split
(Corn,Peanuts)	Slade's Farm	2.4	S	177°	Annually	State Split
Soybeans)	Spratley's Garden	3.2	S	185°	Annually	State Split
(Cabbage,Kale)	Pool's Garden	2.3	S	182°	Annually	State Split
	Carter's Grove Garden	4.8	NE	56°	Annually	State Split
	Stone's Garden	-	-	-	Annually	State Split
	Luca's Garden	-	-	-	Annually	State Split/Control Loc. (Chester, Va.)
	Spratley's Garden (a)	3.2	S	185°	Annually	State Split

(a) Spratley's Garden replaced Poole's Garden on 6/23/92.

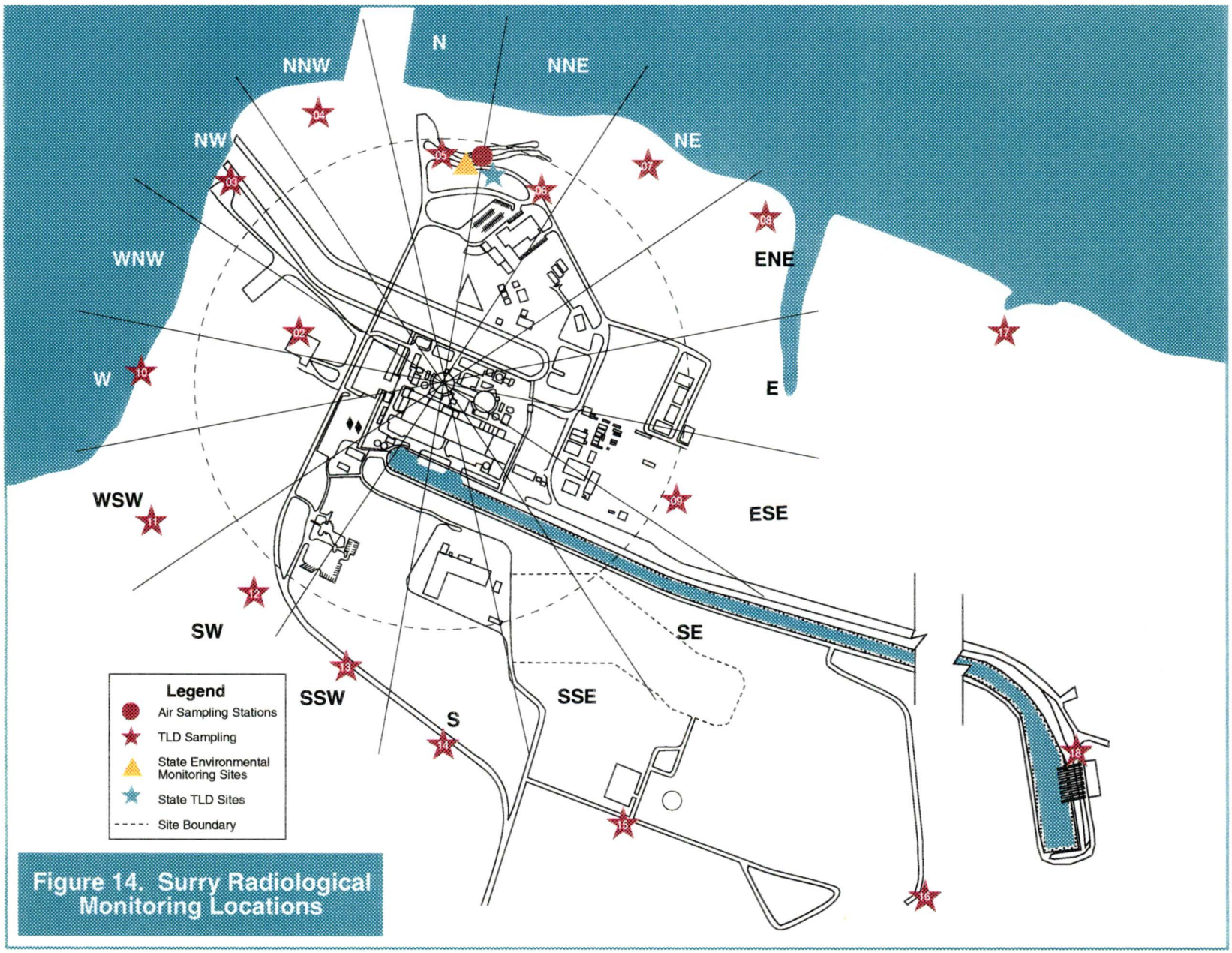
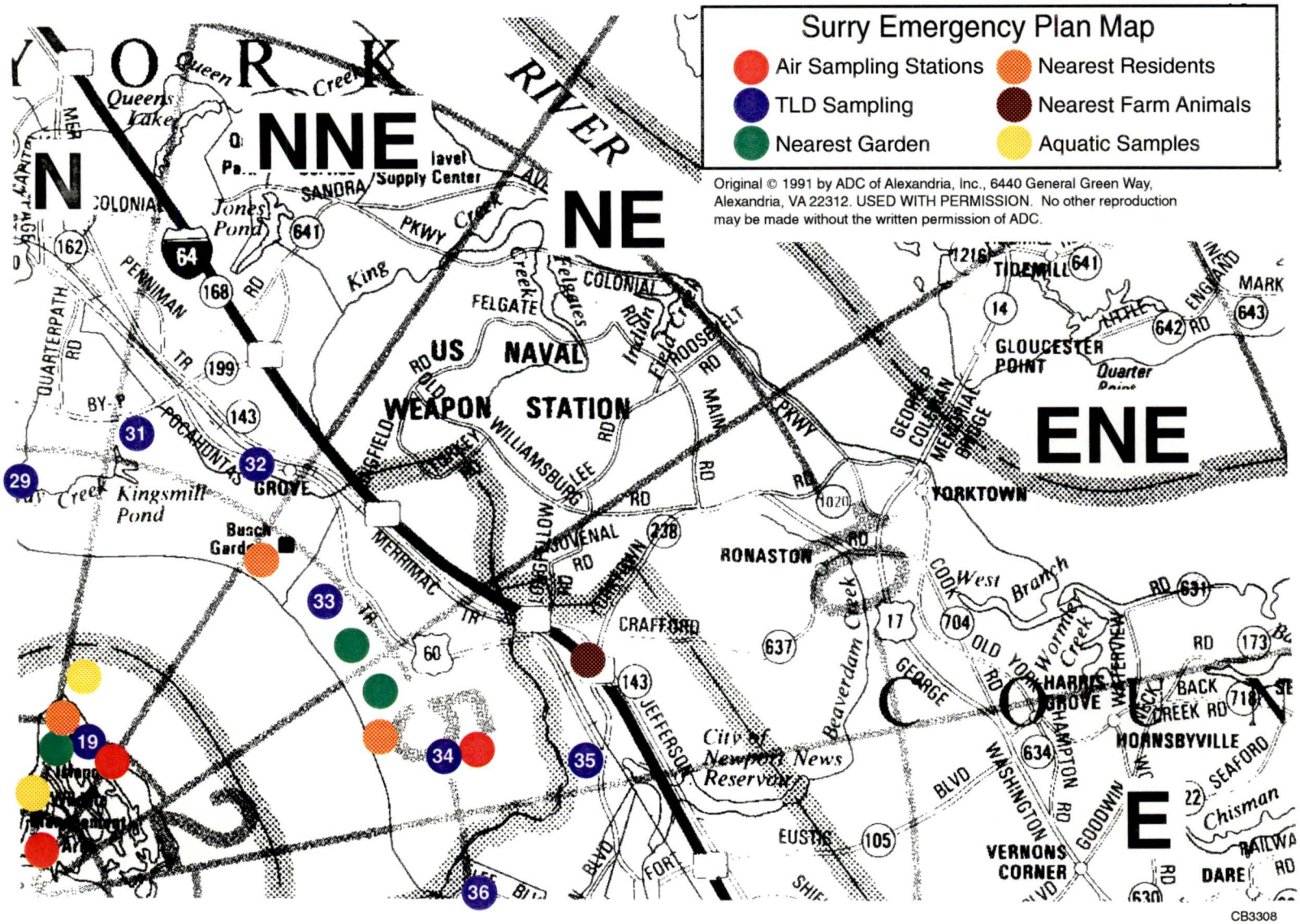


Figure 14. Surry Radiological Monitoring Locations

SV645A


Surry Emergency Plan Map
Air Sampling Stations
Nearest Residents
TLD Sampling
Nearest Farm Animals
Nearest Garden
Aquatic Samples
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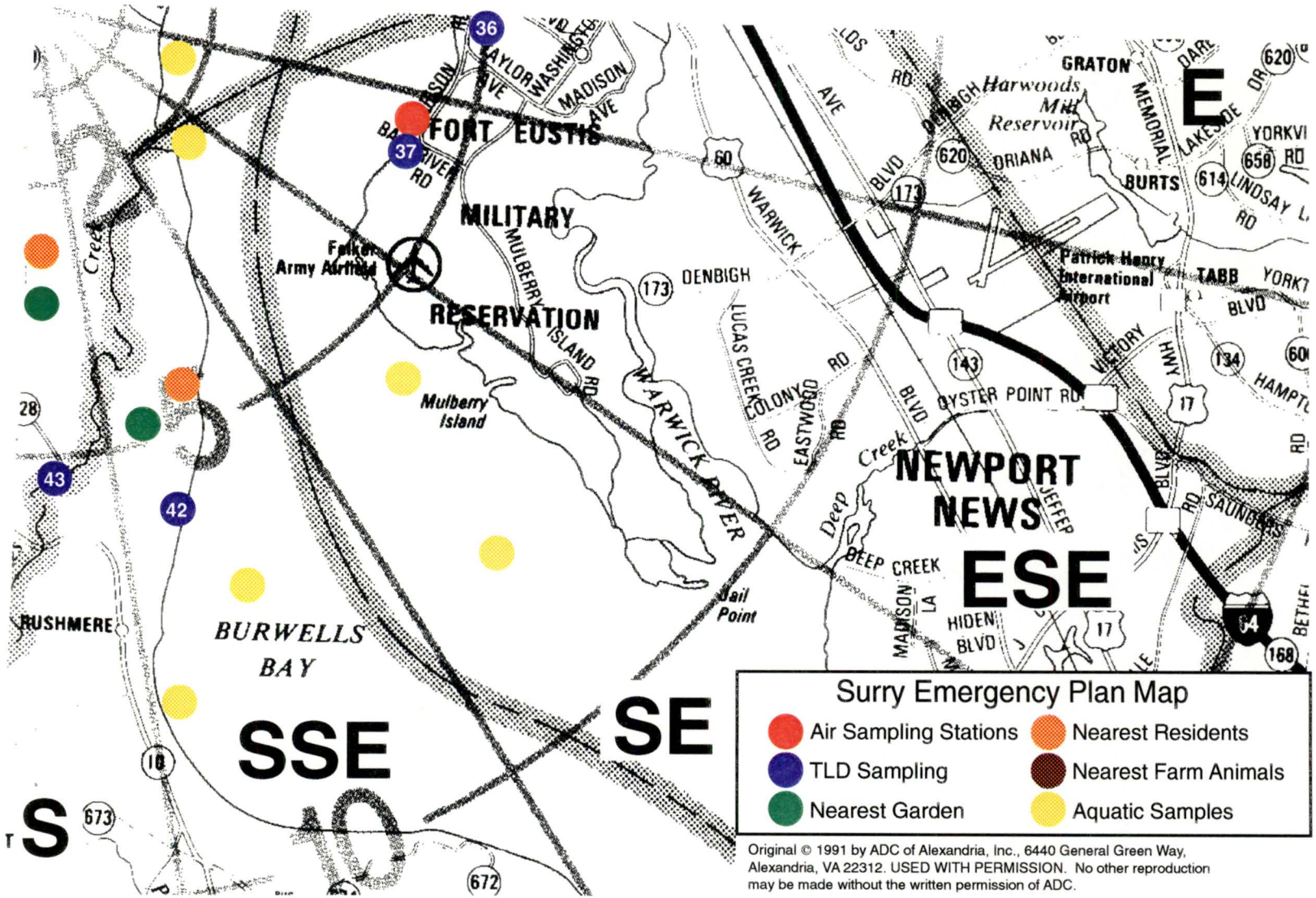
NNE
NE
ENE
E
US NAVAL WEAPON STATION
YORKTOWN
GLOUCESTER POINT
RONASTON
CRAFFORD
HOAKSBYVILLE
VERNONS CORNER
Queens Lake
Kingsmill Pond
Jones Pond
City of Newport News Reservoir
Beaverdam Creek
West Branch Cook
Wormley Creek
COLONIAL PKWY
JEFFERSON
WILLIAMSBURG
MERRIMAC TR
QUARTERPATH RD
POCAHONTAS TR
FELGATE
SANDRA
CB3308



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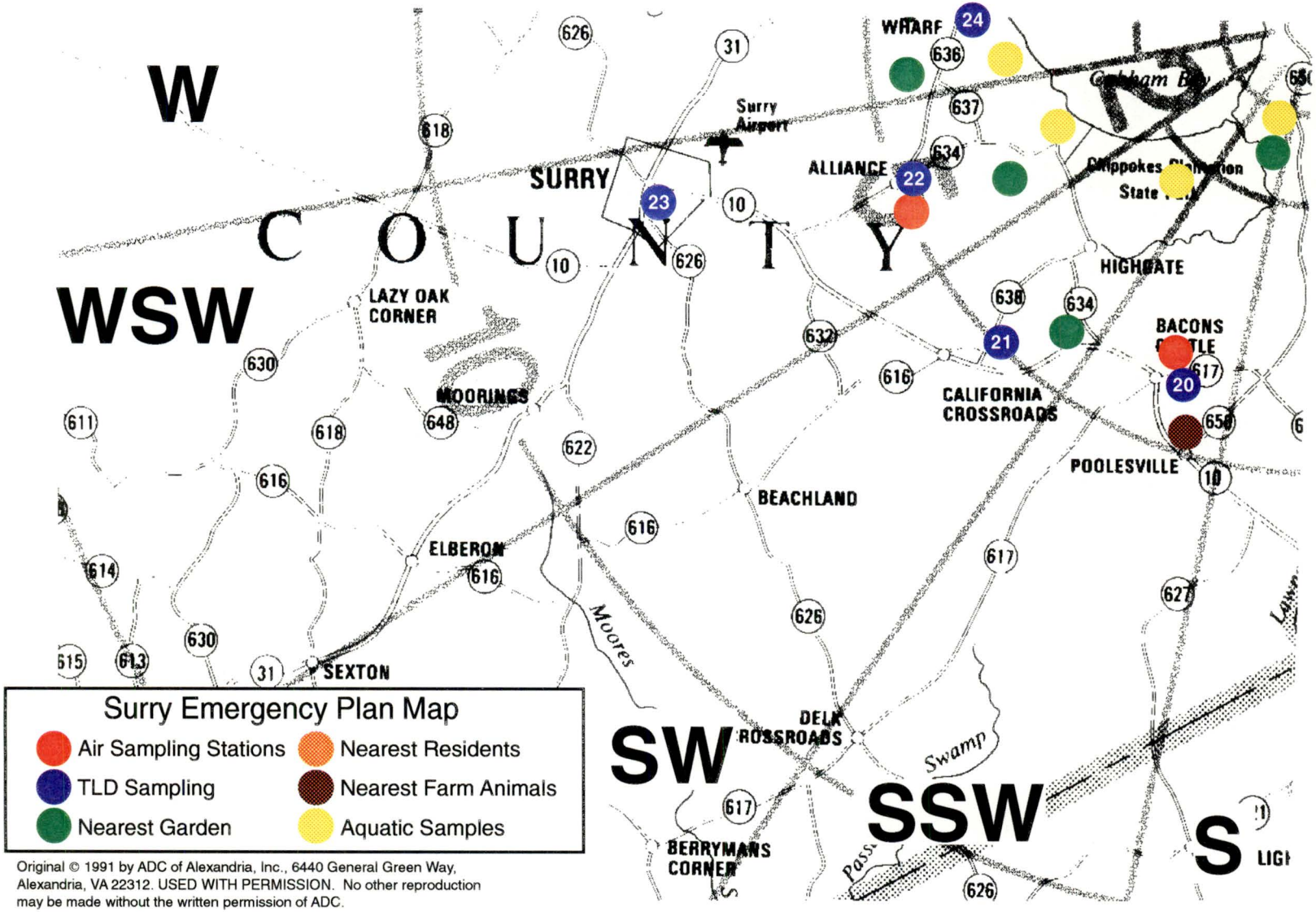

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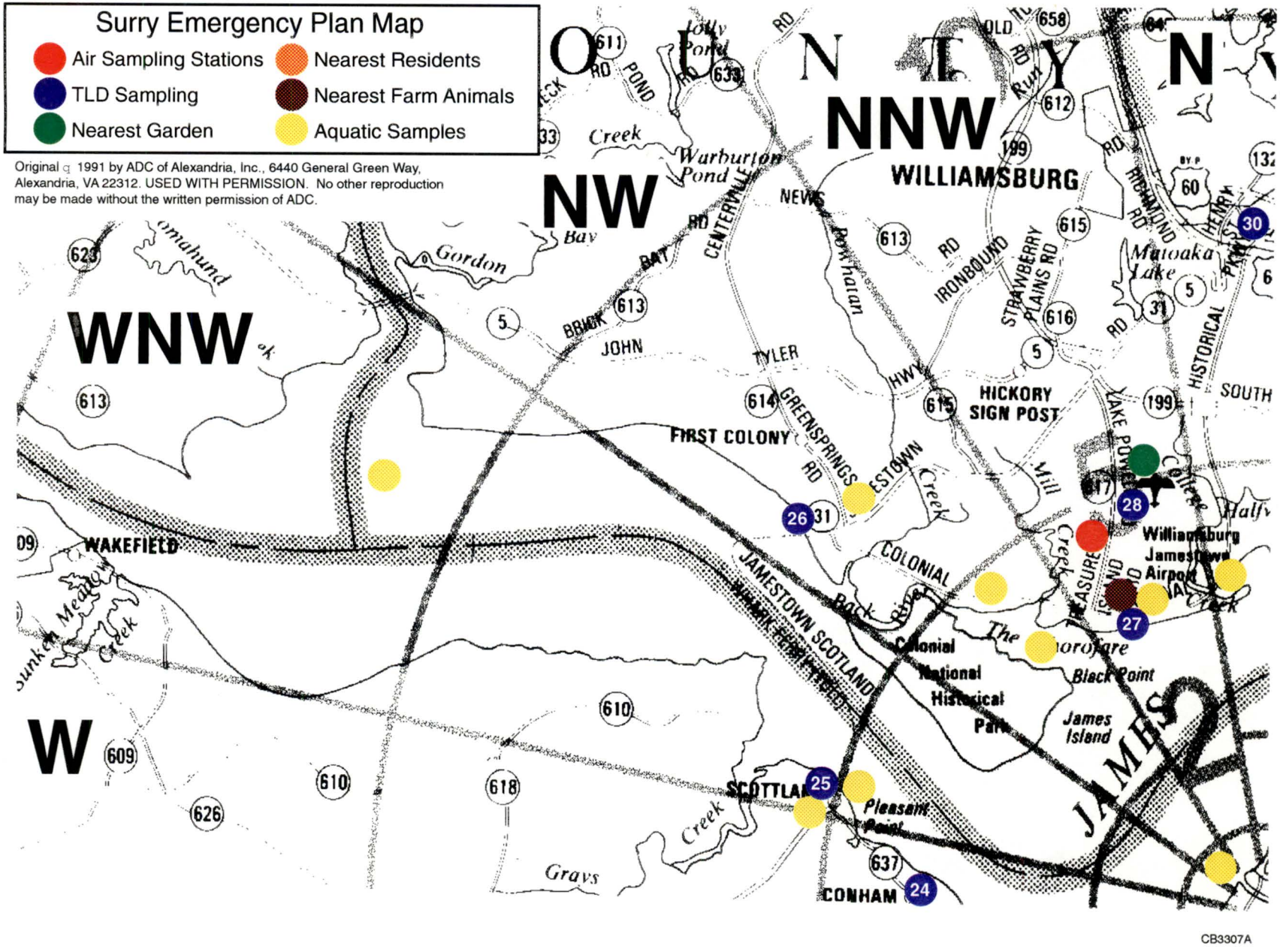
Surry Emergency Plan Map
Air Sampling Stations
Nearest Residents
TLD Sampling
Nearest Farm Animals
Nearest Garden
Aquatic Samples
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NNW
NW
WNW
W
WILLIAMSBURG
WAKEFIELD
SCOTTLAND
CONHAM
HICKORY SIGN POST
FIRST COLONY
JAMESTOWN SCOTLAND FERRY
Colonial National Historical Park
James Island
Williamsburg Jamestown Airport
Mataoka Lake
Warburton Pond
Gordon Creek
Gravs Creek
Sunken Meadow Creek
Mill Creek
Black Point
Pleasant Point
JAMES
CB3307A

TABLE 3

SURRY POWER STATION

SAMPLE ANALYSIS PROGRAM

SAMPLE MEDIA	FREQUENCY	ANALYSIS	LLD*	REPORT UNITS
Thermoluminescent Dosimetry (TLD)	Quarterly	Gamma Dose	2.0	mR/std.month
Air Iodine	Weekly	I-131	0.07	pCi/m^3
Air Particulate	Weekly	Gross Beta	0.01	pCi/m^3
	Quarterly (a)	Gamma Isotopic		pCi/m^3
		Cs-134	0.05	
		Cs-137	0.06	
River Water	Quarterly composite of monthly sample	Tritium (H-3)	2000	pCi/l
	Monthly and Bi-monthly	I-131	10	pCi/l
		Gamma Isotopic		
		Mn-54	15	
		Fe-59	30	
		Co-58	15	
		Co-60	15	
		Zn-65	30	
		Zr-95	30	
		Nb-95	15	
		Cs-134	15	
		Cs-137	18	
		Ba-140	60	
		La-140	15	
Well Water	Quarterly	Tritium (H-3)	2000	pCi/l
		I-131	1	
		Gamma Isotopic		
		Mn-54	15	
		Fe-59	30	
		Co-58	15	
		Co-60	15	
		Zn-65	30	
		Zr-95	30	
		Nb-95	15	
		Cs-134	15	
		Cs-137	18	
		Ba-140	60	
		La-140	15	

Footnotes located at end of table.

TABLE 3 (Cont.)

SURRY POWER STATION

SAMPLE ANALYSIS PROGRAM

SAMPLE MEDIA	FREQUENCY	ANALYSIS	LLD*	REPORT UNITS
Shoreline Sediment	Semi-Annual	Gamma Isotopic		pCi/kg-dry
		Cs-134	150	
		Cs-137	180	
Silt	Semi-Annual	Gamma Isotopic		pCi/kg-dry
		Cs-134	150	
		Cs-137	180	
Milk	Monthly	I-131	1	pCi/l
		Gamma Isotopic		
		Cs-134	15	
		Cs-137	18	
		Ba-140	60	
		La-140	15	
Oyster	Bi-Monthly	Gamma Isotopic		pCi/kg-wet
		Mn-54	130	
		Fe-59	260	
		Co-58	130	
		Co-60	130	
		Zn-65	260	
		Cs-134	130	
		Cs-137	150	
Clams	Bi-Monthly	Gamma Isotopic		pCi/kg-wet
		Mn-54	130	
		Fe-59	260	
		Co-58	130	
		Co-60	130	
		Zn-65	260	
		Cs-134	130	
		Cs-137	150	
Crabs	Annually	Gamma Isotopic		pCi/kg-wet
		Mn-54	130	
		Fe-59	260	
		Co-58	130	
		Co-60	130	
		Zn-65	260	
		Cs-134	130	
		Cs-137	150	

Footnotes located at end of table.

TABLE 3 (Cont.)

SURRY POWER STATION

SAMPLE ANALYSIS PROGRAM

SAMPLE MEDIA	FREQUENCY	ANALYSIS	LLD*	REPORT UNITS
Fish	Semi-Annual	Gamma Isotopic		pCi/kg-wet
		Mn-54	130	
		Fe-59	260	
		Co-58	130	
		Co-60	130	
		Zn-65	260	
		Cs-134	130	
		Cs-137	150	
Crops	Annually	Gamma Isotopic		pCi/kg-wet
		I-131	60	
		Cs-134	60	
		Cs-137	80	

Note:

This table is not a complete listing of nuclides which can be detected and reported. Other peaks that are measurable and identifiable, together with the above nuclides, shall also be identified and reported.

* LLDs indicate those levels that the environmental samples should be analyzed to, in accordance with the Surry Radiological Environmental Program. Actual analysis of the samples by Teledyne Brown Engineering may be lower than those listed.

(a) Quarterly composites of each location's weekly air particulate samples are analyzed for gamma emitters.

Appendix B
REMP Exceptions For Scheduled
Sampling And Analysis During 1994 - Surry

Location	Description	Date of Sampling	Reasons(s) for Loss/Exception
CP	Air Particulate/ Air Iodine	02/04/94-02/15/94	No electricity to station. New location chosen. No sample available.
05	Direct Radiation/TLD	Second Quarter	TLDs missing; cause unknown. One replacement TLD placed in field from 6/15 to 7/7/94 but results were not representative of quarter and not reported.

V. Summary and Discussion - 1994 Analytical Results

Data from the radiological analyses of environmental media collected during 1994 are tabulated and discussed below. The procedures and specifications followed in the laboratory for these analyses are as required in the Teledyne Brown Engineering Quality Assurance Manual and are explained in the Teledyne Brown Engineering Analytical Procedures. A synopsis of analytical procedures used for the environmental samples is provided in Appendix D. In addition to internal quality control measures performed by Teledyne, the laboratory also participates in the Environmental Protection Agency's Interlaboratory Comparison Program. Participation in this program ensures that independent checks on the precision and accuracy of the measurements of radioactive material in environmental samples are performed. The results of the EPA Interlaboratory Comparison are provided in Appendix E.

Radiological analyses of environmental media characteristically approach and frequently fall below the detection limits of state-of-the-art measurement methods. The "less than" values in the data tables were calculated for each specific analysis and are dependent on sample size, detector efficiency, length of counting time, chemical yield, when appropriate, and the radioactive decay factor from time of counting to time of collection. Teledyne Brown Engineering's analytical methods meet the Lower Limit of Detection (LLD) requirements given in Table 2 of the USNRC Branch Technical Position of Radiological Monitoring (November 1979, Revision 1) and the ODCM.

The following is a discussion and summary of the results of the environmental measurements taken during the 1994 reporting period.

Airborne Exposure Pathway

Airborne Radioiodine

Charcoal cartridges are used to collect airborne radioiodine. Once a week, the samples are collected and analyzed. The results are presented in Table B-1. All results are below the lower limit of detection with no positive activity detected. These results are similar to preoperational data and the results of samples taken prior to and after the 1986 accident in the Soviet Union at Chernobyl.

Airborne Gross Beta

Results of the weekly gross beta analysis are presented in Table B-2. A review of Table B-2 indicates that results from the station indicator compare favorably to the control location in Newport News.

Quarterly averages are consistent with background radioactivity levels. The gross beta concentrations observed indicate a steady trend compared to levels found during the previous seven years. Gross beta activity found during the preoperational and early operating period of Surry were higher because of nuclear weapons testing. During the past two decades nearly 740 nuclear weapons have been tested worldwide. In 1985 weapons testing ceased, and with the exception of the Chernobyl accident in 1986, airborne gross beta results have trended at stable levels.

Airborne Gamma Isotopic

Air particulate filters are analyzed for isotopes that are gamma emitters. The results of the composite analysis are listed in Table B-3. No gamma emitting radioactivity attributable to the power station was detected. However, natural background radioactivity was detected in many of the samples. The two isotopes that were identified are beryllium-7 and potassium-40. Beryllium-7 is continuously produced in the upper atmosphere by cosmic radiation. Potassium-40 is naturally present in foods, building materials and soil.

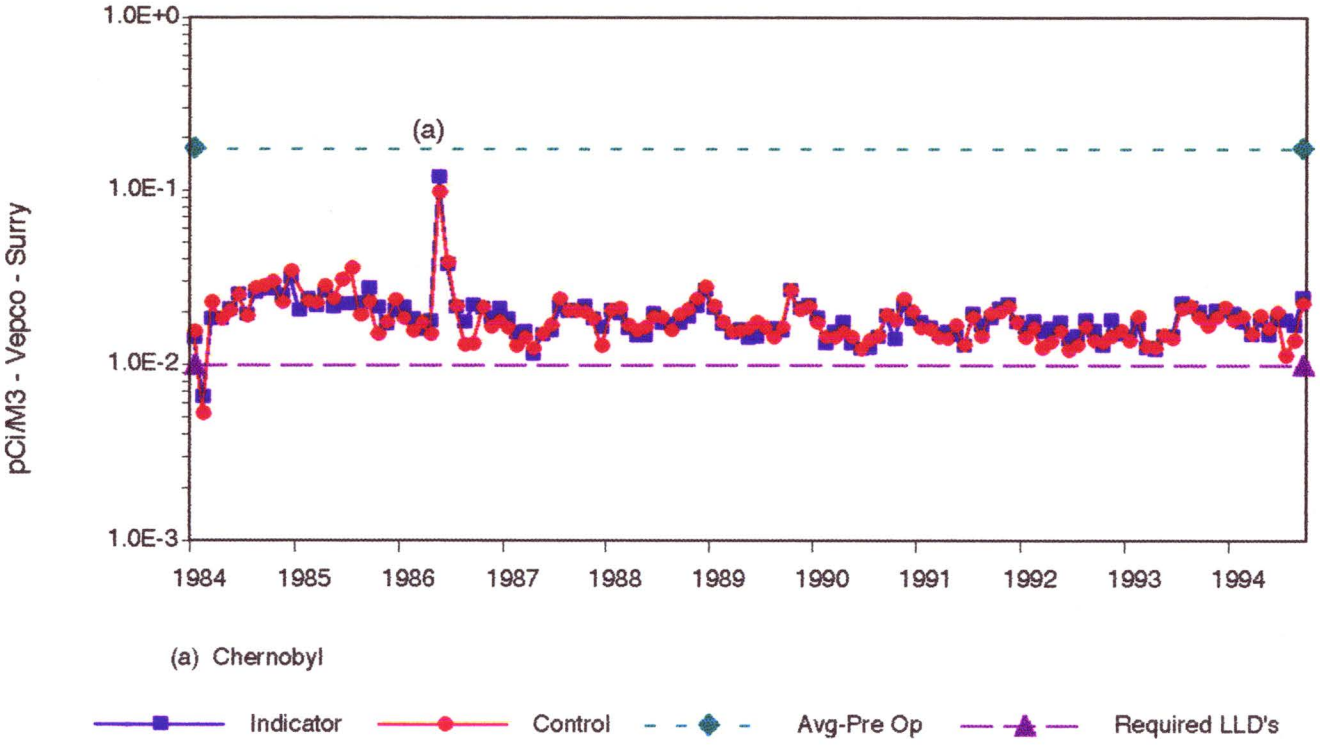
WATERBORNE EXPOSURE PATHWAY

River Water

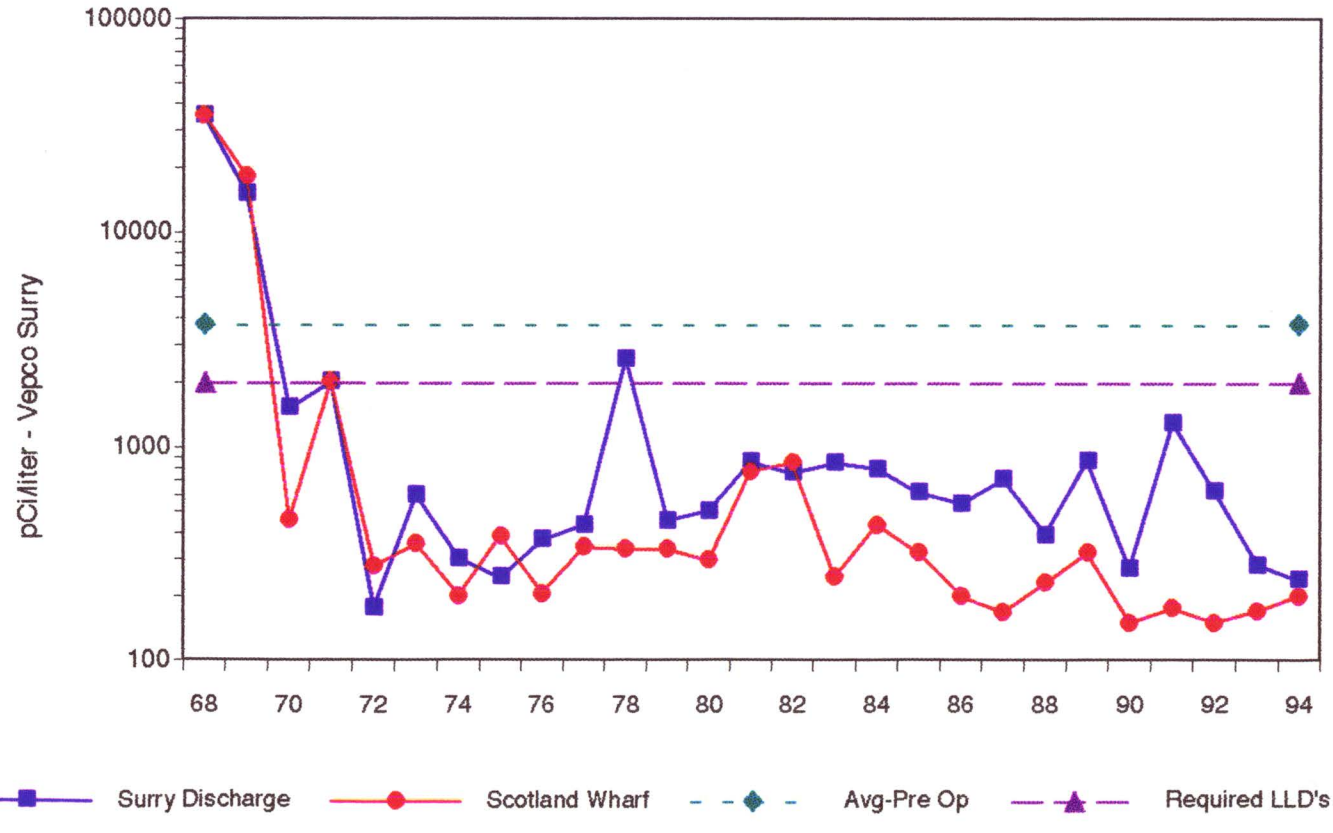
The analysis results for the James River water sampling program are presented in Table B-4. Samples of James River water are collected as monthly grab samples at both Surry Discharge and Scotland Wharf and bi-monthly grab samples at Hog Island Point, Newport News, Chickahominy River and Surry Intake. All samples are analyzed by gamma spectroscopy and for iodine-131 by a radiochemical procedure. These samples are also composited and analyzed for tritium on a quarterly basis.

Naturally occurring potassium-40 was measured in 18 samples with an average concentration of 98.6 pCi/liter.

TRENDING GRAPH - 1: GROSS BETA IN AIR PARTICULATES



TRENDING GRAPH - 2: TRITIUM IN RIVER WATER



All samples were analyzed for gamma emitting radioisotopes. With the exception of naturally occurring potassium-40 no other gamma emitters were detected. In particular, no iodine-131 was detected. This trend is consistent with previous years.

Tritium was measured in 11 of 24 quarterly composite samples. The average tritium concentration was 275 pCi/liter. Preoperational data for tritium indicated levels of activity considerably higher than current levels due, in part, to atmospheric weapons testing. The State of Virginia collects water samples from the station discharge and a control site located upstream of the station Scotland Wharf. These samples are taken as part of the State Split Sample Program and analyzed independently. The results are presented in Table B-5. River water from the station discharge measured a tritium concentration of 548 pCi/liter. The control location had one measurement of tritium at a concentration of 200 pCi/liter. Scotland Wharf is taken as a weekly grab sample. Station discharge is sampled by a composite sampler and collected weekly. Monthly composite samples are prepared for gamma and iodine-131 analysis and quarterly composites are prepared for tritium analysis.

The trend graphs provide a comparison of tritium concentration measured in the downstream sample (Surry Station Discharge) and in the upstream control location (Scotland Wharf). As expected, the Surry discharge samples indicated higher levels of tritium than the control location. The water in the discharge canal is further diluted by the river water beyond the discharge structure. The average tritium concentration in grab samples taken downstream of the station indicate good comparison to the State Split control concentration.

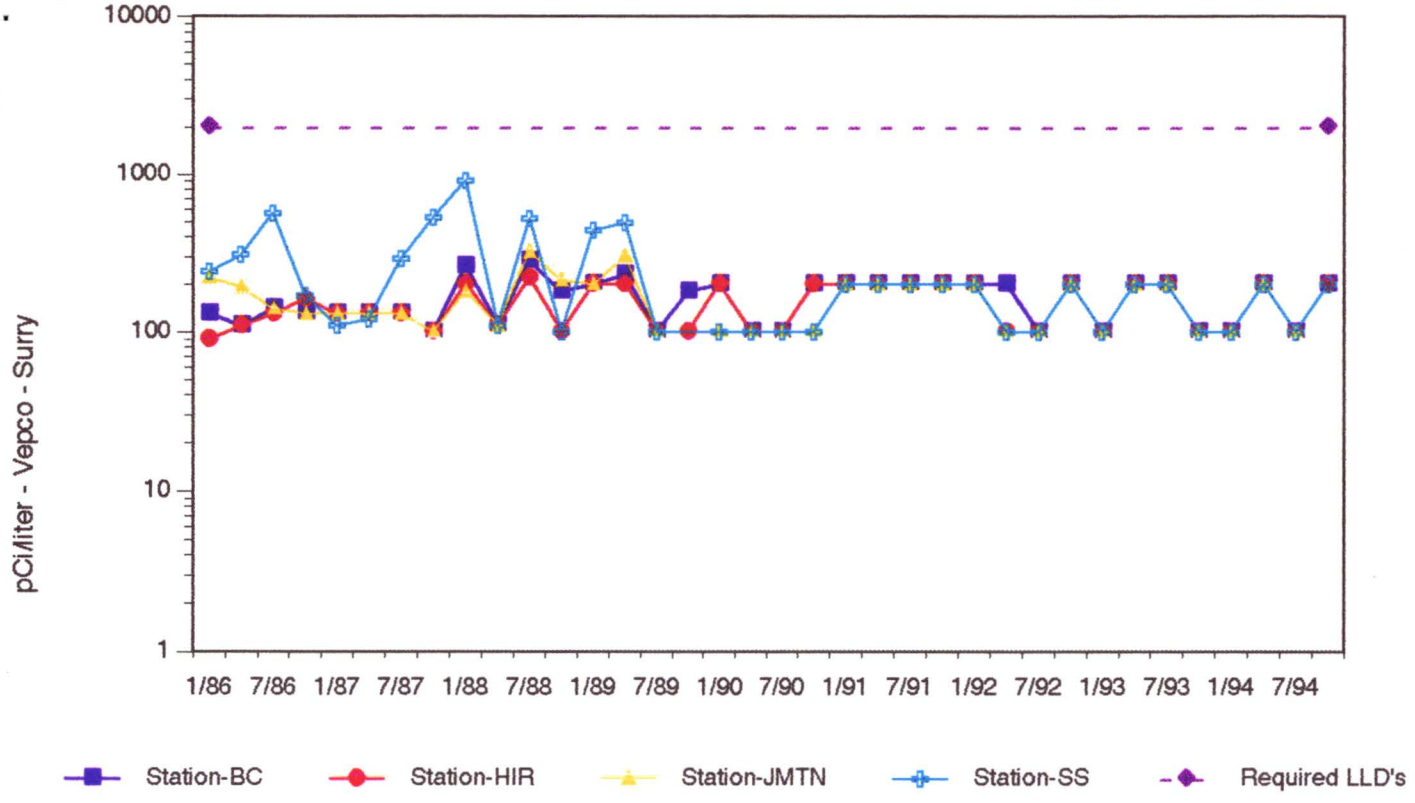
Well Water

Well water is not considered to be affected by station operations because there are no discharges made to this pathway. However, Surry does monitor well water and analyzes water samples from four indicator locations. The results of these sample analysis are presented in Table B-6.

These samples were analyzed by gamma spectroscopy and indicated that there were no man made radioisotopes present or naturally occurring isotopes. Preoperational samples were only analyzed for gross alpha and gross beta. Gamma emitting isotopes have not been detected within the recent past and this trend is consistent throughout the operational monitoring program.

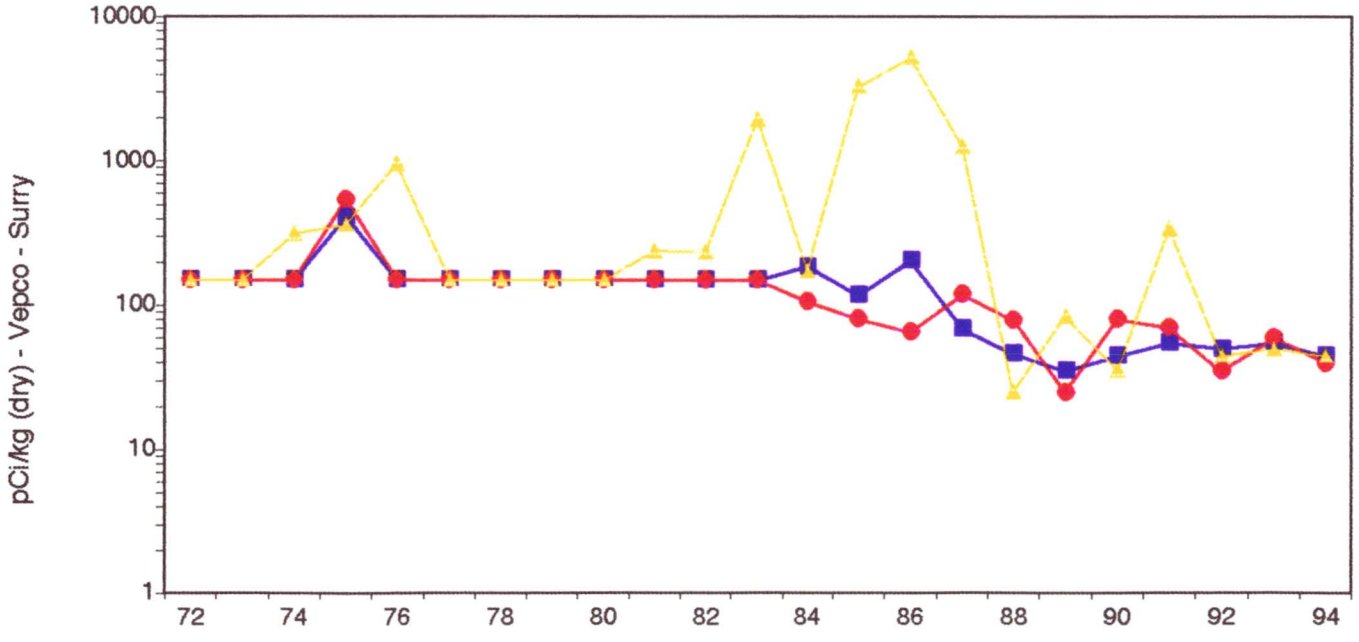
All well water samples were analyzed for tritium. No tritium was detected in any of the control or indicator samples. Preoperational samples were not analyzed for tritium.

TRENDING GRAPH - 3: TRITIUM IN WELL WATER



Station JMTN has been eliminated due to program change 12/1/94.

TRENDING GRAPH - 4: COBALT-58 IN SEDIMENT SILT



During the preoperational period, cobalt-58 was not detected in the samples analyzed.

AQUATIC EXPOSURE PATHWAY

Silt

Silt samples were taken to evaluate any buildup of radionuclides in the environment due to the operation of the power station. The radioactivity in silt is a result of precipitation of radionuclides in the waste discharges and the subsequent dispersion of the material by the river current. Sampling this pathway provides a good indication of the dispersion effects of effluents to the river. Buildup of radionuclides in silt could indirectly lead to increasing radioactivity levels in clams, oysters and fish.

Silt samples are collected from six locations both upstream and downstream of the power station. These samples are analyzed for gamma emitting radioisotopes. The results of these analyses are presented in Table B-7.

The NRC does not assign reporting levels to radioisotopes measured in this pathway. However, Surry's operating license requires that the concentrations of man made and naturally occurring gamma emitters be tracked and trended. Preoperational analyses indicates that there were no man made radioisotopes present in this pathway.

Cobalt-60 and cesium-137 average levels indicate a decrease in concentration when compared to last year and the previous 8 year trend.

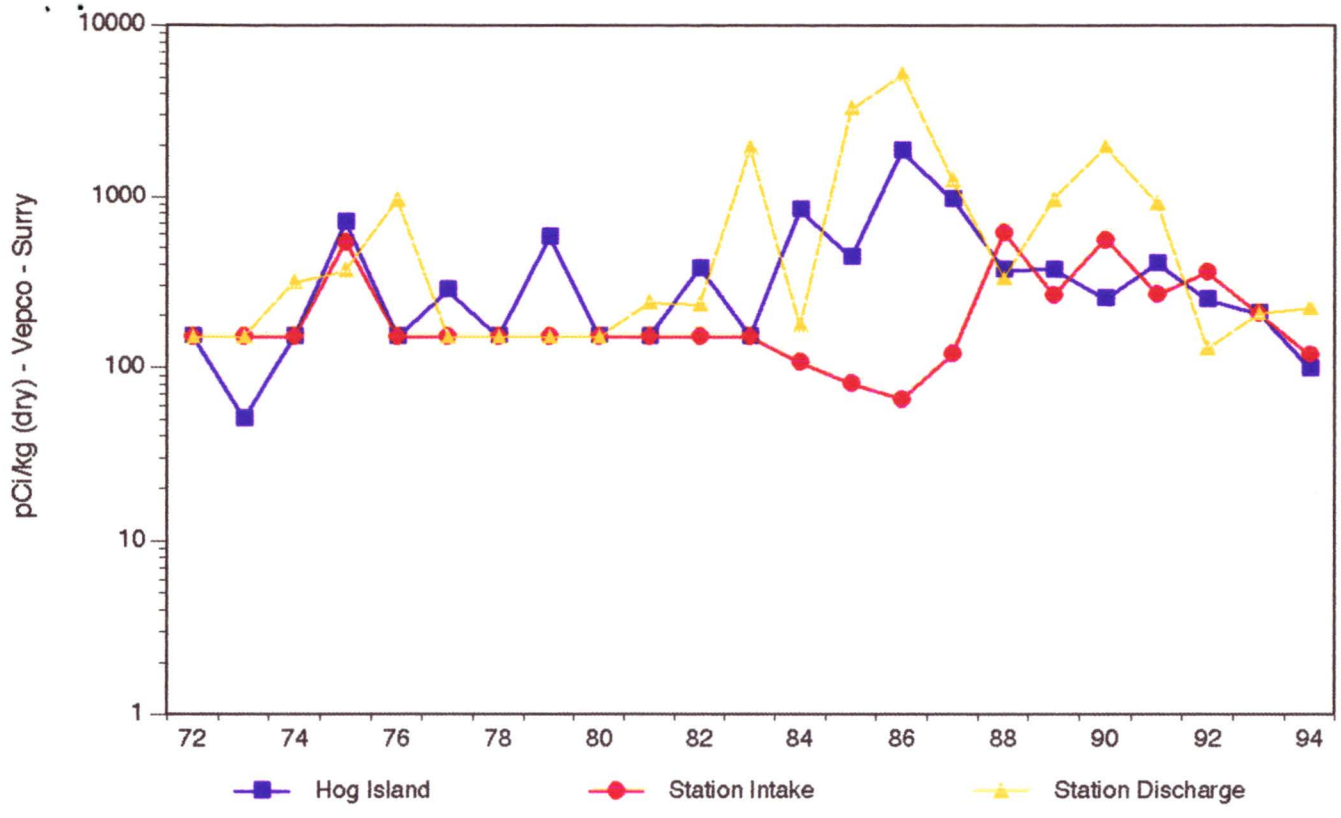
The concentration of man made radioisotopes in silt is projected to decrease. Surry Power Station currently has in service a Radioactive Waste Treatment Facility which employs state of the art technologies to reduce the volume and activity of liquid effluents and reduce the impact on the environment. This facility went into operation in September of 1991.

Shoreline Sediment

Unlike river bottom silt, shoreline sediment may provide a direct dose to humans. Buildup of radioisotopes along the shoreline may provide a source of direct exposure for those using the area for commercial and recreational uses. Samples were taken in February and August at Hog Island Point and at Burwell's Bay. The samples were analyzed by gamma spectroscopy and the results are presented in Table B-8.

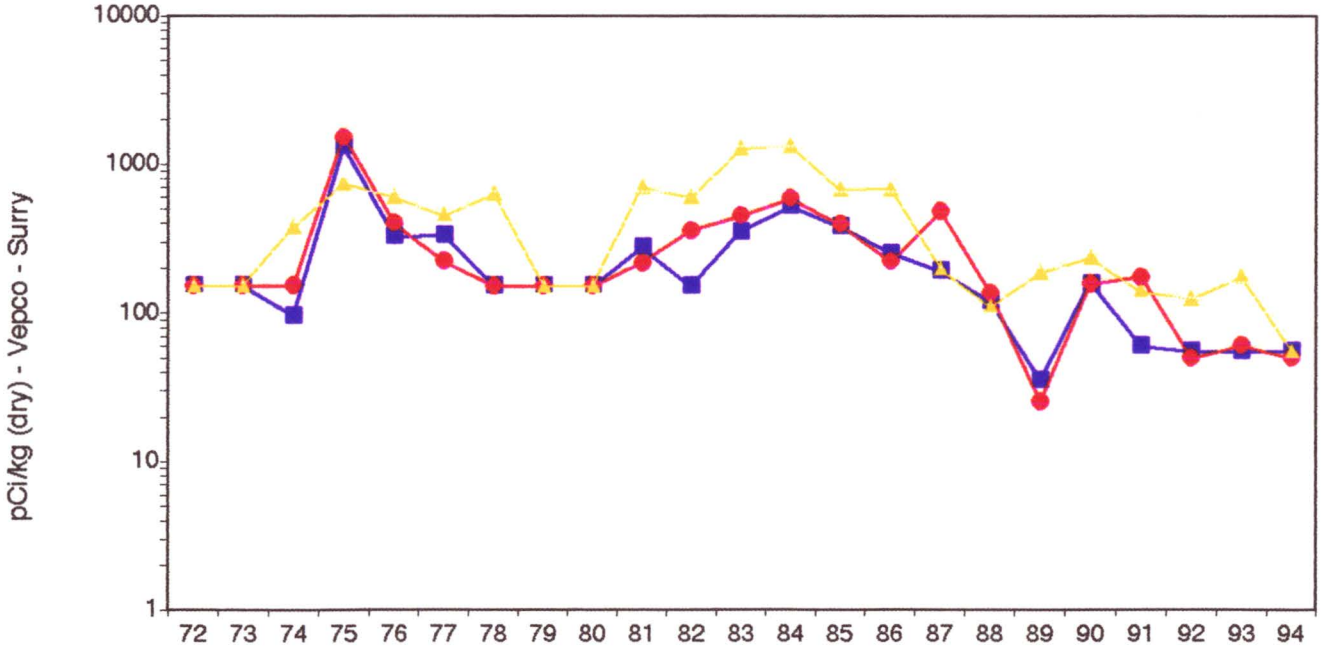
This exposure pathway was not selected for analysis during the preoperational years. Nevertheless, samples analyzed over the past 7 years from this pathway indicate a steady trend in

TRENDING GRAPH - 5: COBALT-60 IN SILT



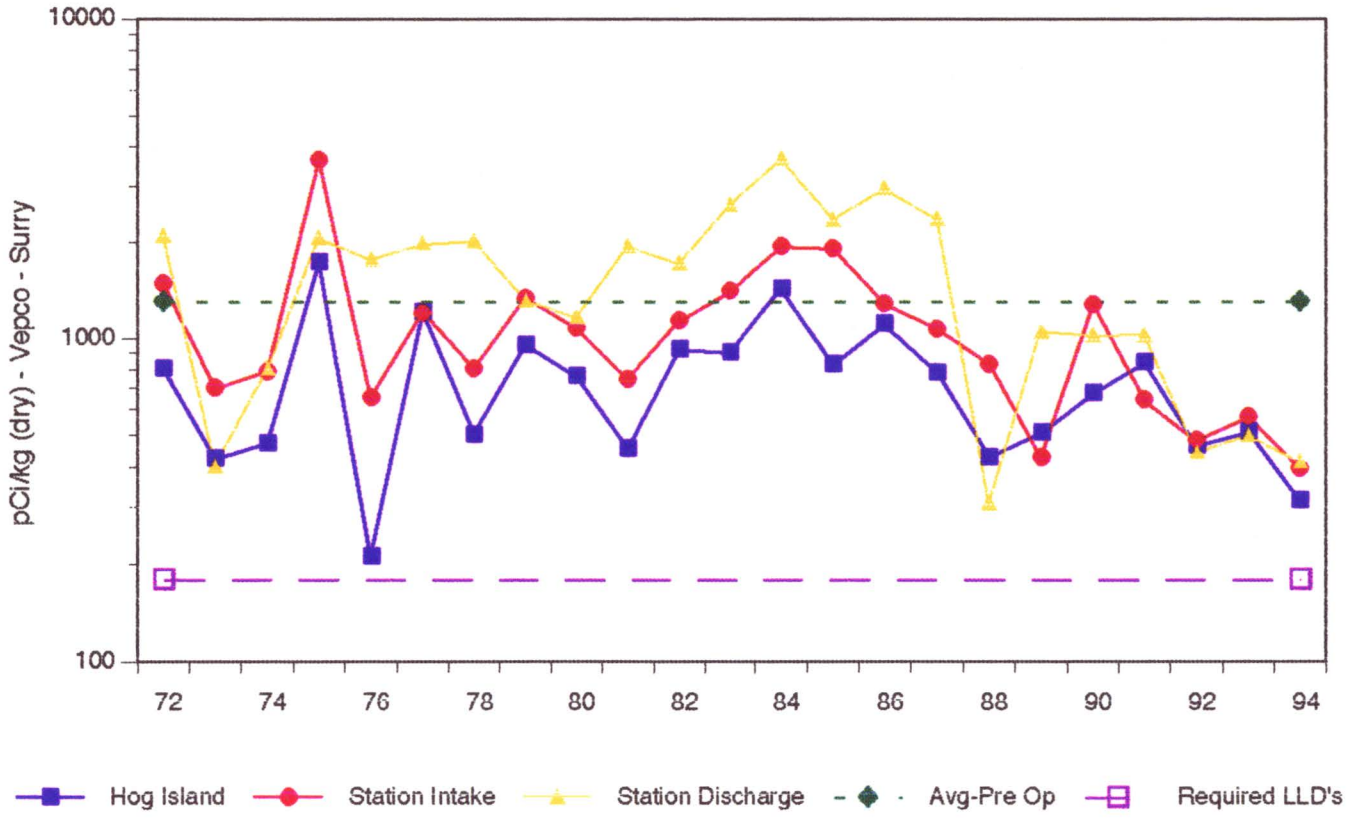
During the preoperational period, cobalt-60 was not detected in the smples analyzed.

TRENDING GRAPH - 6: CESIUM-134 IN SILT

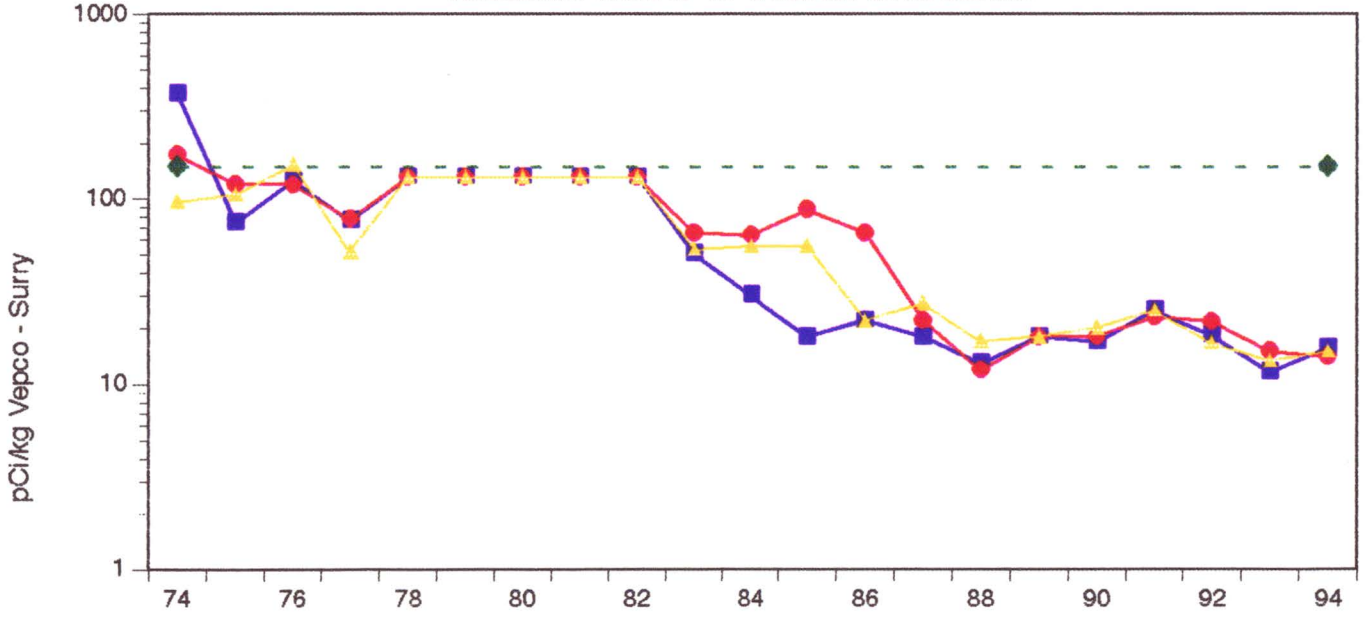


During the preoperational period, cesium-134 was not detected in the samples analyzed.

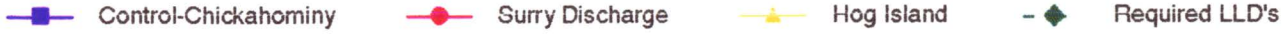
TRENDING GRAPH - 7: CESIUM-137 IN SILT



TRENDING GRAPH - 8: COBALT-58 IN CLAMS



During the preoperational period, cobalt-58 was not detected in the samples analyzed.



the detection of gamma emitting radioisotopes. This years analysis along with last years results indicates that no radioisotopes attributable to the operation of the power station have been detected.

Naturally occurring radioisotopes were measured in several of the samples. Potassium-40, thorium-228 and radium-226 show a steady trend over the recent past with the execption of one sample obtained at Burwell's which indicated elevated levels of thorium-228 and radium-226.

INGESTION EXPOSURE PATHWAY

Milk

Milk samples are an important indicator for measuring the affect of radioactive iodine, and other radioisotopes in airborne releases. The dose consequence to man is from both a direct and indirect exposure pathway. The direct exposure pathway is from the inhalation of radioactive material. The indirect exposure pathway is from the grass-cow-milk pathway. In this pathway radioactive material is deposited on the plants which is then consumed by the dairy animals. The radioactive material is in turn passed on to man via the milk. The results of iodine-131 and other gamma analysis of milk are presented in Table B-9.

Iodine-131 has not been detected in milk prior to and since the 1986 accident at Chernobyl in the Soviet Union.

Preoperational data shows that cesium-137 was detected in this pathway. The average activity over the past six years is consistent with the preoperational data. Cesium-137 was not detected during 1994.

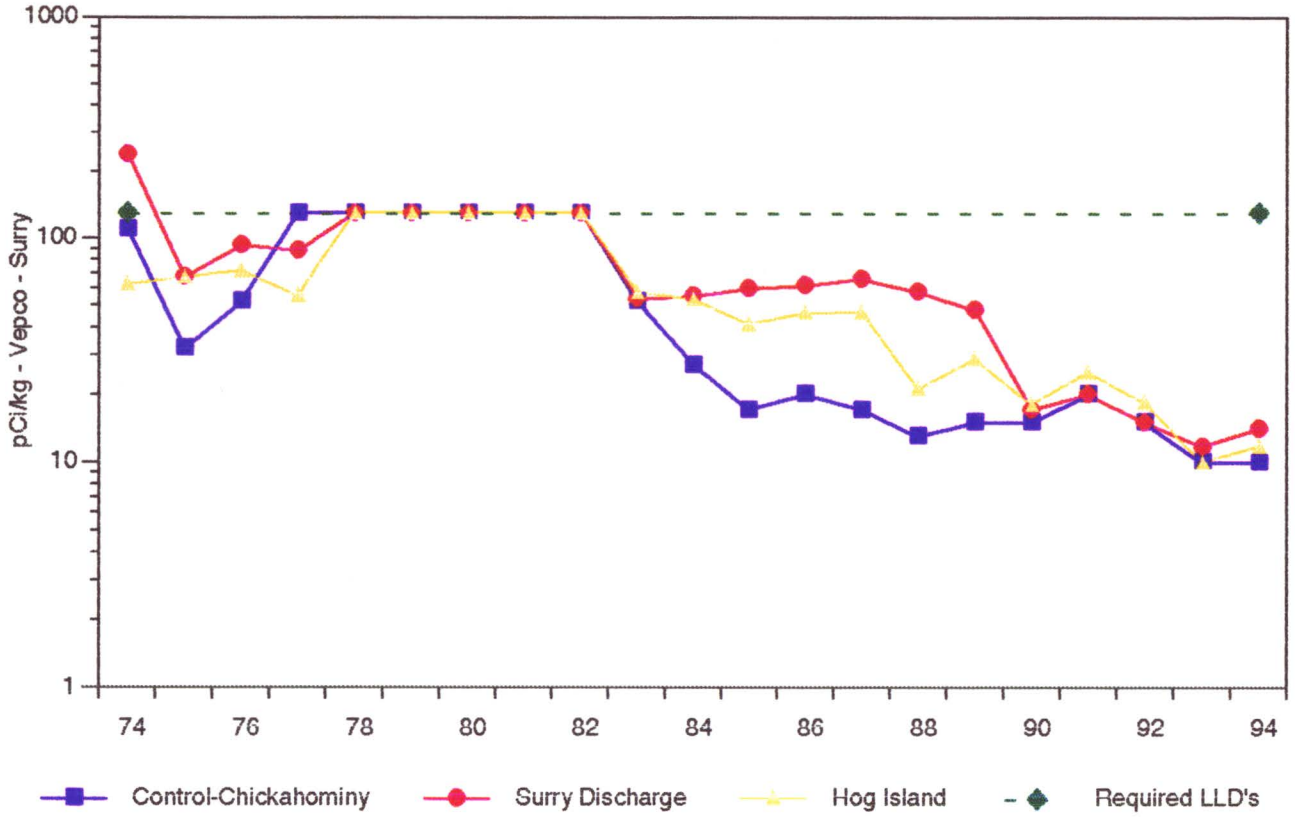
Naturally occurring potassium-40 was detected in all samples analyzed. The preoperational monitoring program did not analyze for this radioisotope.

Strontium-90 was detected in all of the 8 samples collected in participation with the State Split Program. Preoperational data shows levels 5 times higher than present values. This years analysis is equivalent to the previous year. It should be noted that strontium-90 is not a part of station effluents but rather a product of weapons fallout.

Aquatic Biota

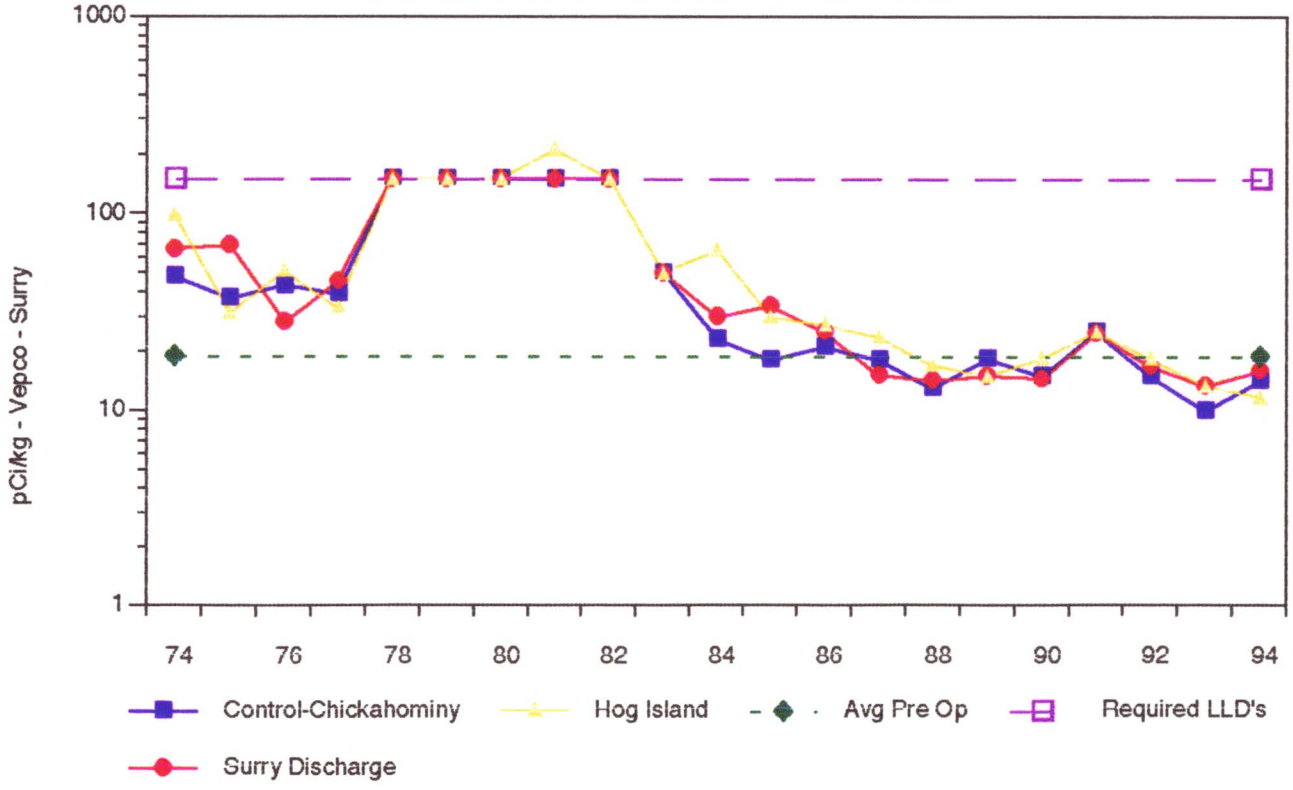
All plants and animals have the ability to concentrate certain chemicals. Radioisotopes display the same chemical properties as their non-radioactive counter part. VEPCO samples

TRENDING GRAPH - 9: COBALT-60 IN CLAMS



During the preoperational period, cobalt-60 was not detected in the samples analyzed.

TRENDING GRAPH - 10: CESIUM-137 IN CLAMS



various aquatic biota to determine the accumulation of radioisotopes in the environment. The results of the sampling program for this pathway are detailed below.

Clams were analyzed from 5 different locations. The results of the analyses are presented in Table B-10. As expected, naturally occurring potassium-40 was detected in 26 of the 30 samples. Potassium-40 is a naturally occurring radioisotope and is not a component of station effluent.

No other gamma emitting radioisotopes were detected. The trend of gamma emitting radioisotopes in clams over the recent past continues to decrease and is well below the lower limits of detection. This marked decrease coincides with the extensive steam generator replacement project completed in 1982.

Oysters were analyzed from 3 different locations. The results of the analyses are presented in Table B-11. As expected, naturally occurring potassium-40 was detected in 21 of the 23 samples. The current average level of potassium-40 is comparable to the preoperational average. There were no gamma emitting radioisotopes detected in any samples. This is consistent with preoperational data and data collected since the 1986 accident at Chernobyl in the Soviet Union.

A crab sample was collected in June from the discharge canal of the station and analyzed by gamma spectroscopy. The results of the analyses are presented in Table B-12. As expected naturally occurring potassium-40 was detected. Potassium-40 is a naturally occurring radioisotope and is not a component of station effluent. No other gamma emitting radioisotopes were detected in this sample. This is consistent with preoperational data and data collected during the past eight years.

Two fish samples were collected in April and two in October from the station discharge canal and analyzed by gamma spectroscopy. The results of the analyses are presented in Table B-13. As expected naturally occurring potassium-40 was detected in all samples. Cesium-137 was not observed in any of the fish samples. The trend in cesium-137 in fish shows a decrease when compared to the previous seven years.

Food Products and Vegetation

Food products and vegetation samples were collected from four different locations and analyzed by gamma spectroscopy. The results of the analyses are presented in Table B-14. As expected naturally occurring potassium-40 was detected in all samples. The average concentration

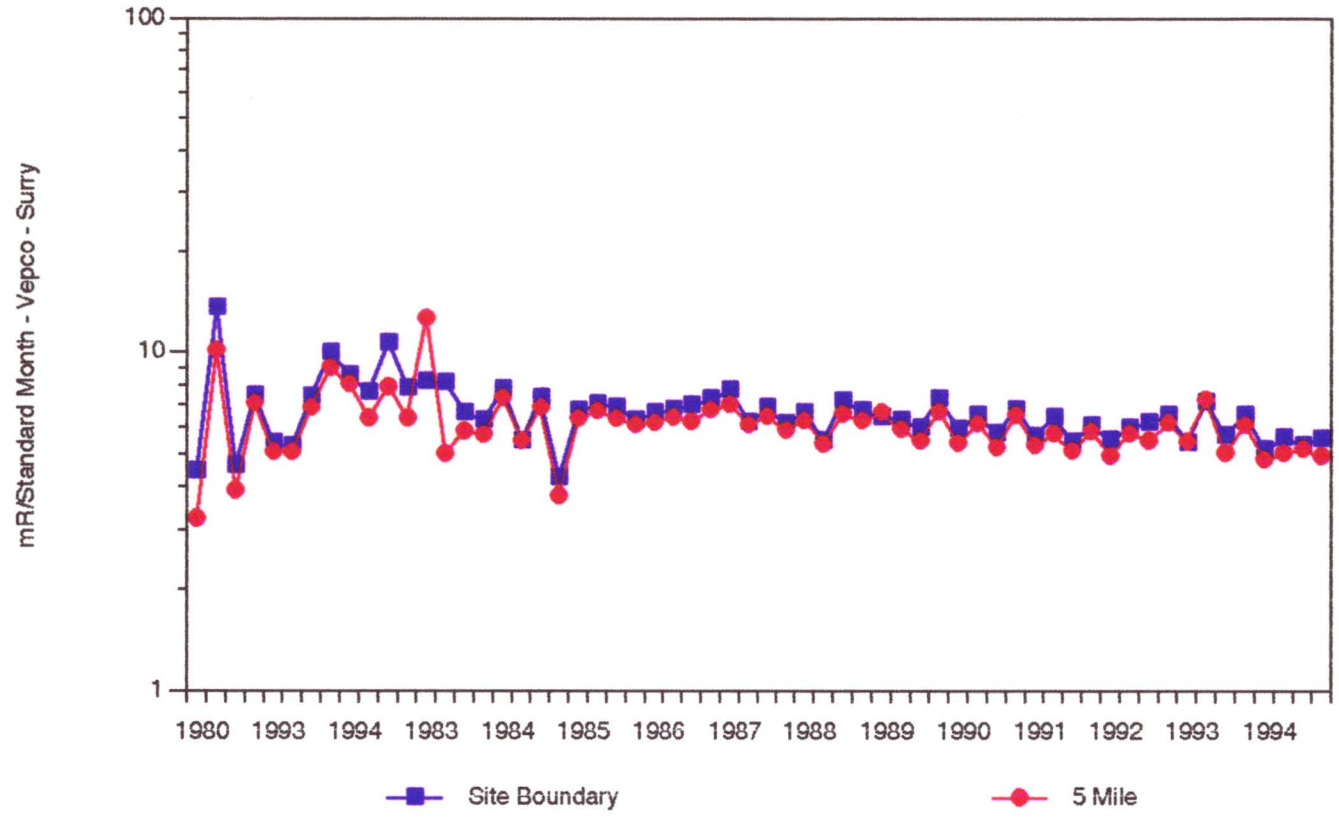
was lower than the previous five year average. Potassium-40 is a naturally occurring radioisotope and is not a component of station effluent. Naturally occurring beryllium-7 was detected in one of the nine samples. The concentration of radioactivity found in the samples this year is comparable to last year and may be attributable to world wide fallout.

DIRECT RADIATION EXPOSURE PATHWAY

A thermoluminescent dosimeter (TLD) is an inorganic crystal used to detect ambient radiation. TLDs are placed in two concentric rings around the station; one at the site boundary and the other at approximately 5 miles from the station. TLDs are also placed in special interest areas such as population areas and nearby residences. Several additional TLDs serve as controls and these TLDs measure ambient radiation. Ambient radiation comes from naturally occurring radioisotopes in the air and soil, radiation from cosmic origin, fallout from nuclear weapons testing, station effluents and direct radiation from the station.

The results of the analyses are presented in Table B-15 and B-16. Control and indicator averages indicate a steady trend in ambient radiation levels and compares well with the last five years of data.

TRENDING GRAPH - 11: DIRECT RADIATION MEASREMENTS TLD RESULTS



VI. CONCLUSIONS

The results of the 1994 Radiological Environmental Monitoring Program for Surry Nuclear Power Station have been presented. The following sections present conclusions for each pathway individually followed by a program summary.

Airborne Exposure Pathway

Air particulate gross beta concentrations of all the indicator locations for 1994 trend well with the control location. The gross beta concentrations indicate a steady trend when compared to the levels found during the previous 7 years. Gamma isotopic analysis of the particulate samples identified natural background radioactivity. No radioactivity attributable to the operation of the power station were identified.

Waterborne Exposure Pathway

All river water samples were analyzed for gamma emitting radioisotopes. With the exception of naturally occurring potassium-40 no other gamma emitters were detected. In particular, no iodine-131 was detected.

Tritium activity was measured in eleven samples with an average concentration of 275 pCi/liter. This value is less than the average for the past five years. This concentration is less than 1.0% of the Reporting Level Concentration of 30,000 pCi/liter. Because there is no supply of drinking water or water used for crop irrigation, there is an insignificant dose consequence to the public from this pathway. Research of the preoperational data for tritium indicates levels of activity considerably higher than current levels due to atmospheric weapons testing.

Well Water

Well water samples were analyzed and indicated that there were no man made radioisotopes present.

Silt

The NRC does not assign reporting levels to radioisotopes measured in this pathway. The average levels of man made radioisotopes in silt indicate a decrease in concentration when compared to the previous 8 year trend. In September 1991 Surry Power Station put into service a

Radioactive Waste Treatment facility which reduces the activity of liquid effluents released to the environment.

Shoreline Sediment

Only naturally occurring radioisotopes were detected at concentrations equivalent to normal background activities. There were no radioisotopes attributable to the operation of the power station found in any sample.

Milk

Milk samples are an important indicator for measuring the affect of radioactive iodine and radioisotopes in airborne releases.

Iodine-131 was not measured in any of the 48 milk samples. Naturally occurring potassium-40 was detected at a slight increase in average concentration when compared to the average of the previous year.

Cesium-137 was not detected in any samples. The concentration of strontium-90 in this years analysis, 2.15 pCi/liter, measured the same as the previous year. Strontium-90 is not a part of station effluent, but rather a product of weapons fallout.

Aquatic Biota

Clams, Oysters and Crabs

As expected, naturally occurring potassium-40 was detected in all 26 of the 30 clam samples, 21 of the 23 oyster samples and in the crab sample. A review of the pervious 6 years indicates the potassium in clams and oysters is at average environmental levels. There were no other gamma emitting radioisotopes detected in any of the samples. This trend is consistent with preoperational data.

Fish

As expected, naturally occurring potassium-40 was detected in all four samples.

Cesium-137 was not observed in any fish samples during 1994, nor were any other gamma emitting radioisotopes detected in any of the samples.

Food Products and Vegetation

As expected, naturally occurring potassium-40 was measured in all nine samples. Beryllium-7 was detected in one of the nine samples collected and analyzed.

Cesium-137 was not observed in food samples during 1994. The concentration of radioactivity found in samples this year is comparable to last year. This radioisotope may be attributable to world wide fallout.

Direct Radiation Exposure Pathway

Control and indicator averages indicate a decreasing trend in ambient radiation levels. This years levels are slightly less than the previous five years.

The direct radiation exposure that may be attributed to the station operation is 0.6 mR/standard month (0.019 mR/day). This exposure is not significant when compared to the United States average background radiation levels of 360 mRem/year (0.98 mRem/day).

VII. REFERENCES

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11. United States Nuclear Regulatory Commission Regulatory Guide 1.109, Rev. 1, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR50, Appendix I", October, 1977.

12. United States Nuclear Regulatory Commission, Regulatory Guide 4.8 "Environmental Technical Specifications for Nuclear Power Plants", December, 1975.

13. USNRC Branch Technical Position, "Acceptable Radiological Environmental Monitoring Program", Rev. 1, November 1979.

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RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Surry Nuclear Power Station, Surry County, Virginia - 1994

Docket No. 5-280-281

Medium or Pathway Sampled (Unit)	Analysis Type	Analysis Total No.	LLD*	All Indicator Locations Mean Range	Location with Highest Mean Name	Location with Highest Mean Distance Direction	Location with Highest Mean Mean Range	Control Location Mean Range	Non-routine Reported Measurements
Air Iodine pCi/m3)	I-131	415	0 07	-0/363) -	N/A			-(0/52)	0
Air Iodine Particulate (1e-03 pCi/m3)	Gross	415	10	19.5(363/363) (7.3-91) -	CP NW	3.7 mi	19.5(51/51) (11-91)	17.2(52/52) (7.0-28)	0
	Gamma	32							
	Be-7	32	-	128(28/28) (67.8-198)	FE ESE	4.8 mi	133(4/4) (71.9-198)	125(4/4) (84.1-193)	0
	K-40	32	130	10.2(7/28) (2.94-34.5)	FE ESE	4.8 mi	34.5(1/4) -	-(0/0) -	0
River Water (a) (pCi/liter)	Gamma	48							
	K-40	48	-	103(16/42) (52.2-177)	NN SE	12.0 mi	143(3/6) (77.6-177)	66.9(2/6) (52.7-81.1)	0
	H-3	24		282(10/20) (200-420)	HIP NE	2.4 mi	313(3/4) (220-420)	200(1/4) -	0
River Water (b) (pCi/liter) **State Split**	Gamma	24							
	K-40	24	-	107(4/12) (80.0-136)	SD NW	0.17 mi	107(4/12) (80.0-136)	46.2(5/12) (40.4-51.2)	0
	H-3	8	-	548(4/4) (320-830)	SD NW	0.17 mi	548(4/4) (320-830)	200(1/4) -	0
Well Water (pCi/liter)	Gamma	15							
	K-40	15		-(0/15) -	N/A			-(0/0) -	0
	H-3	15		-(0/15) -	N/A			-(0/0) -	0

* LLD is the Lower Limit of Detection as defined and required in USNRC Branch Technical Position on an Acceptable Radiological Environmental Monitoring Program, Revision 1, November 1979.

(a) Analyses for monthly and bi-monthly samples are listed in Table B-4.

(b) Monthly State Split analyses presented in Table B-5.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Surry Nuclear Power Station, Surry County, Virginia - 1994

Docket No. 5-280-281

Medium or Pathway Sampled (Unit)	Analysis Type	Analysis Total No.	LLD*	All Indicator Locations Mean Range	Location with Highest Mean Name	Location with Highest Mean Distance Direction	Location with Highest Mean Mean Range	Control Location Mean Range	Non-routine Reported Measurements
Silt (pCi/kg dry)	Gamma	12							
	Be-7	12		1248(8/10) (493-2540)	POS	6.4 mi SSE	2005(2/2) (1470-2540)	-(0/2) -	0
	K-40	12		12790(10/10) (12600-16400)	CHIC WNW	11.2 mi	16150(2/2) (15700-16600)	16150(2/2) (15700-16600)	0
	Co-60	12		126(9/10) (61.8-232)	SD	0.17 mi NW	221(2/2) (209-232)	93.9(2/2) (78.8-109)	0
	Cs-134	12		-(0/10) -				-(0/2) -	0
	Cs-137	12		342(10/10) (182-493)	CHIC WNW	11.2 mi	433(2/2) (5427-438)	433(2/2) (427-438)	0
	Ra-226	12		1787(9/9) (1370-2510)	CHIC WNW	11.2 mi	2280(2/2) (2200-2360)	2280(2/2) (2200-2360)	0
	Th-228	12		978(10/10) (730-1180)	CHIC WNW	11.2 mi	1180(2/2) (1130-1230)	11800(2/2) (1130-1230)	0
Shoreline Sediment (pCi/kg dry)	Gamma	4							
	Be-7	4		402(1/4) -	BB	7.76 mi SSE	402(1/2) -	-(0/0) -	0
	K-40	4		4168(4/4) (1330-6240)	HIR	0.8 mi N	6215(2/2) (6190-6240)	-(0/0) -	0
	Ra-226	4		1869(2/4) (467-3270)	BB	7.76 mi SSE	1869(2/2) (467-3270)	-(0/0) -	0
	Th-228	4		818(3/4) (93.5-2220)	BB	7.76 mi SSE	1180(2/2) (140-2220)	-(0/0) -	0

* LLD is the Lower Limit of Detection as defined and required in USNRC Branch Technical Position on an Acceptable Radiological Environmental Monitoring Program, Revision 1, November 1979.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Surry Nuclear Power Station, Surry County, Virginia - 1994

Docket No. 5-280-281

Medium or Pathway Sampled (Unit)	Analysis Type	Analysis Total No.	LLD*	All Indicator Locations Mean Range	Location with Highest Mean Name	Location with Highest Mean Distance Direction	Location with Highest Mean Mean Range	Control Location Mean Range	Non-routine Reported Measurements
Milk (pCi/liter)	Gamma	48							
	K-40	48	-	1381(36/36) (1150-1770)	CP	3.7 mi NNW	1424(12/12) (1300-1770)	1349(12/12) (1220-1470)	0
	I-131	48	1	-(0/36) -	N/A			(0/12) -	0
	Sr-89	8	-	-(0/8) -	N/A			-(0/0) -	0
	Sr-90	8	-	2.15(8/8) (0.9-3.4)	CP	3.7 mi NNW	2.35(4/4) (1.4-3.4)	-(0/0) -	0
Clams (pCi/kg wet)	**Gamma Spec**	**30**							
	K-40	-		418(20/23) (199-745)	HIP	2.4 mi NE	473(4/6) (269-615)	297(6/7) (157-487)	0
Oysters (pCi/kg wet)	**Gamma Spec**	**23**							
	K-40	-		500(21/23) (123-1080)	POS	6.4 mi SSE	592(10/11) (256-1080)	-(0/0) -	0
Crabs (pCi/kg wet)	Gamma Spec	1							
	K-40	1		1590(1/1) -	SD	0.6 mi NW	1590(1/1) -	-(0/0) -	0
Fish (pCi/kg wet)	Gamma Spec	4							
	K-40	4		1535(4/4) (1180-1860)	SD	0.6 mi NW	1535(4/4) (1180-1860)	-(0/0) -	0

* LLD is the Lower Limit of Detection as defined and required in USNRC Branch Technical Position on an Acceptable Radiological Environmental Monitoring Program, Revision 1, November 1979.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Surry Nuclear Power Station, Surry County, Virginia - 1994

Docket No. 5-280-281

Medium or Pathway Sampled (Unit)	Analysis Type	Analysis Total No.	LLD*	All Indicator Locations Mean Range	Location with Highest Mean Name	Location with Highest Mean Distance Direction	Location with Highest Mean Mean Range	Control Location Mean Range	Non-routine Reported Measurements
Direct Radiation TLDs (mR/ std. month)	Gamma	334	2	5.20(318/318) (2.9-7.2)	STA-38	16.5 mi ESE	6.69(8/8) (6.1-7.2)	4.63(16/16) (3.9-5.5)	0
Vegetation (pCi/kg wet)	Gamma Spec	9							
	Be-7	9		233(1/8) -	Spratley's Garden		233(1/1) -	-(0/1) -	0
	K-40	9		6540(8/8) (2290-14600)	Slade's Garden		7337(3/3) (2580-14200)	4200(1/1) -	0

* LLD is the Lower Limit of Detection as defined and required in USNRC Branch Technical Position on an Acceptable Radiological Environmental Monitoring Program, Revision 1, November 1979.

TABLE B-1: IODINE-131 CONCENTRATION IN FILTERED AIR

Surry Nuclear Power Station, Surry County, Virginia - 1994

pCi/m^3 ± 2 Sigma

COLLECTION DATE	STATIONS SS	HIR	BC	ALL	CP	DOW	FE	NN
JANUARY								
12/28/93-01/05/94	< .02	< .02	< .02	< .02	< .01	< .01	< .01	< .01
01/05/94-01/11/94	< .02	< .02	< .02	< .02	< .02	< .02	< .02	< .02
01/11/94-01/18/94	< .02	< .02	< .02	< .02	< .01	< .01	< .01	< .01
01/18/94-01/25/94	< .02	< .02	< .02	< .02	< .01	< .01	< .01	< .01
FEBRUARY								
01/25/94-02/01/94	< .007	< .007	< .007	< .007	< .007	< .007	< .007	< .007
02/01/94-02/08/94	< .02	< .02	< .02	< .02	< .01	< .01	< .01	< .01
02/08/94-02/15/94	< .02	< .02	< .02	< .02	(a)	< .02	< .02	< .02
02/15/94-02/22/94	< .01	< .01	< .01	< .01	< .01	< .007	< .007	< .007
02/22/94-03/01/94	< .02	< .02	< .02	< .02	< .01	< .01	< .01	< .01
MARCH								
03/01/94-03/08/94	< .02	< .02	< .02	< .02	< .009	< .009	< .009	< .009
03/08/94-03/15/94	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01
03/15/94-03/22/94	< .009	< .009	< .009	< .009	< .01	< .01	< .01	< .01
03/22/94-03/29/94	< .02	< .02	< .02	< .02	< .01	< .01	< .01	< .01
APRIL								
03/29/94-04/05/95	< .02	< .02	< .01	< .01	< .01	< .01	< .01	< .01
04/05/94-04/12/94	< .02	< .02	< .02	< .02 (b)	< .01	< .01	< .01	< .01
04/12/94-04/19/94	< .02	< .02	< .02	< .02	< .01	< .01	< .01	< .01
04/19/94-04/26/94	< .009	< .009	< .008	< .009	< .02	< .02	< .02	< .01
04/26/94-05/03/94	< .007	< .007	< .007	< .007	< .01	< .01	< .01	< .01
MAY								
05/03/94-05/10/94	< .007	< .007	< .007	< .007	< .01	< .01	< .01	< .01
05/10/94-05/17/94	< .01	< .01	< .01	< .01	< .02	< .02	< .02	< .02
05/17/94-05/24/94	< .009	< .009	< .009	< .009	< .02	< .02	< .02	< .02
05/24/94-05/31/94	< .02	< .02	< .02	< .02	< .01	< .01	< .01	< .01
JUNE								
05/31/94-06/07/94	< .01	< .01	< .009	< .01	< .01	< .01	< .01	< .01
06/07/94-06/14/94	< .01	< .01	< .01	< .01	< .02	< .02	< .02	< .02
06/14/94-06/21/94	< .01	< .01	< .01	< .01	< .02	< .02	< .02	< .02
06/21/94-06/28/94	< .02	< .02	< .02	< .02	< .01	< .01	< .01	< .01

(a) No electricty; new location. No sample collected.
(b) Blown fuse; low sample volume.

TABLE B-1: IODINE-131 CONCENTRATION IN FILTERED AIR

Surry Nuclear Power Station, Surry County, Virginia - 1994

pCi/m^3 ± 2 Sigma

COLLECTION DATE	STATIONS SS	HIR	BC	ALL	CP	DOW	FE	NN
JULY								
06/28/94-07/05/94	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01
07/05/94-07/12/94	< .02	< .01	< .01	< .01	< .01	< .01	< .01	< .01
07/12/94-07/19/94	< .02	< .02	< .02	< .05 (a)	< .01	< .01	< .01	< .01
07/19/94-07/26/94	< .01	< .01	< .01	< .01	< .02	< .02	< .03	< .02
07/26/94-08/02/94	< .02	< .02	< .05 (b)	< .02	< .01	< .01	< .02 (c)	< .01
AUGUST								
08/02/94-08/09/94	< .02	< .02	< .04	< .02	< .007	< .007	< .009	< .009
08/09/94-08/16/94	< .02	< .02	< .02	< .02	< .01	< .01	< .01	< .01
08/16/94-08/23/94	< .02	< .02	< .02	< .02	< .02	< .02	< .02	< .02
08/23/94-08/30/94	< .01	< .01	< .02	< .01	< .007	< .007	< .007	< .007
SEPTEMBER								
08/30/94-09/06/94	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01
09/06/94-09/13/94	< .02	< .02	< .02	< .02	< .01	< .01	< .01	< .01
09/13/94-09/20/94	< .01	< .01	< .01	< .01	< .02 (d)	< .009	< .01	< .02
09/20/94-09/27/94	< .02	< .02	< .02	< .02	< .02	< .02	< .02	< .02
OCTOBER								
09/27/94-10/04/94	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01
10/04/94-10/11/94	< .02	< .02	< .02	< .02	< .01	< .01	< .01	< .01
10/11/94-10/18/94	< .009	< .008	< .008	< .009	< .01	< .01	< .01	< .01
10/18/94-10/25/94	< .01	< .01	< .01	< .01	< .009	< .009	< .009	< .009
10/25/94-11/01/94	< .01	< .01	< .01	< .01	< .02	< .02	< .02	< .02
NOVEMBER								
11/01/94-11/08/94	< .007	< .007	< .007	< .007	< .008	< .008	< .008	< .008
11/08/94-11/15/94	< .01	< .01	< .01	< .01	< .02	< .02	< .02	< .02
11/15/94-11/21/94	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01
11/21/94-11/29/94	< .02	< .02	< .02	< .02	< .01	< .01	< .01	< .01
DECEMBER								
11/29/94-12/06/94	< .02	< .02	< .02	< .02	< .01	< .01	< .01	< .02
12/06/94-12/13/94	< .01	< .01	< .01	< .01	< .009	< .009	< .009	< .009
12/13/94-12/20/94	< .02	< .02	< .02	< .02	< .01	< .01	< .01	< .01
12/20/94-12/28/94	< .02	< .02	< .02	< .02	< .02	< .02	< .02	< .02

(a) Low sample volume.
(b) Sampler failure; low sample volume.
(c) Power outage; low sample volume.
(d) Low sample volume: cause unknown.

TABLE B-2: GROSS BETA CONCENTRATION IN AIR PARTICULATES

Surry Nuclear Power Station, Surry County, Virginia - 1994

1.0 e-03 pCi/m^3 ± 2 Sigma

COLLECTION DATE	STATIONS SS	HIR	BC	ALL	CP	DOW	FE	NN	Average ± 2 Sigma
JANUARY - 1994									
12/28-01/05	20 ± 2	20 ± 2	19 ± 2	19 ± 2	19 ± 2	18 ± 2	19 ± 2	19 ± 2	19 ± 1
01/05-01/11	20 ± 2	17 ± 2	19 ± 2	18 ± 2	20 ± 2	17 ± 2	18 ± 2	17 ± 2	18 ± 3
01/11-01/18	16 ± 2	15 ± 2	13 ± 2	14 ± 2	15 ± 2	15 ± 2	16 ± 2	14 ± 2	15 ± 2
01/18-01/25	29 ± 2	24 ± 2	28 ± 2	28 ± 2	26 ± 2	27 ± 2	29 ± 2	25 ± 2	27 ± 4
01/25-02/01	16 ± 2	15 ± 2	17 ± 2	14 ± 2	17 ± 2	15 ± 2	17 ± 2	13 ± 2	16 ± 3
FEBRUARY									
02/01-02/08	26 ± 2	25 ± 2	25 ± 2	25 ± 2	21 ± 2	25 ± 2	29 ± 2	26 ± 2	25 ± 4
02/08-02/15	14 ± 2	14 ± 2	12 ± 2	15 ± 2	(a)	14 ± 2	9.0 ± 1.5	14 ± 2	13 ± 4
02/15-02/22	17 ± 2	15 ± 2	14 ± 2	13 ± 2	16 ± 3	15 ± 2	16 ± 2	19 ± 2	16 ± 4
02/22-03/01	15 ± 2	17 ± 2	14 ± 2	15 ± 2	15 ± 2	13 ± 2	16 ± 2	14 ± 2	15 ± 3
MARCH									
03/01-03/08	13 ± 2	12 ± 2	13 ± 2	14 ± 2	13 ± 2	13 ± 2	11 ± 2	12 ± 2	13 ± 2
03/08-03/15	17 ± 2	17 ± 2	15 ± 2	16 ± 2	19 ± 2	16 ± 2	17 ± 2	17 ± 2	17 ± 2
03/15-03/22	15 ± 2	12 ± 2	14 ± 2	14 ± 2	15 ± 2	14 ± 2	15 ± 2	15 ± 2	14 ± 2
03/22-03/29	14 ± 2	15 ± 2	13 ± 2	14 ± 2	14 ± 2	13 ± 2	18 ± 2	15 ± 2	15 ± 3
Qtr. Avg. ± 2 s.d.	**18 ±10**	**17 ± 8**	**17 ±10**	**17 ± 9**	**18 ± 7**	**17 ± 9**	**18 ±11**	**17 ± 9**	**17 ± 9**
APRIL									
03/29-04/05	13 ± 2	16 ± 2	12 ± 2	16 ± 2	17 ± 2	16 ± 2	18 ± 2	17 ± 2	16 ± 4
04/05-04/12	18 ± 2	18 ± 2	15 ± 2	26 ± 6 (b)	19 ± 2	14 ± 2	19 ± 2	18 ± 2	18 ± 7
04/12-04/19	15 ± 2	16 ± 2	14 ± 2	15 ± 2	15 ± 2	12 ± 2	16 ± 2	16 ± 2	15 ± 3
04/19-04/26	18 ± 2	21 ± 2	18 ± 2	24 ± 2	25 ± 2	17 ± 2	25 ± 2	23 ± 2	21 ± 7
04/26-05/03	14 ± 2	18 ± 2	18 ± 2	19 ± 2	21 ± 2	19 ± 2	20 ± 2	19 ± 2	19 ± 4
MAY									
05/03-05/10	12 ± 2	16 ± 2	13 ± 2	17 ± 2	14 ± 2	15 ± 2	14 ± 2	16 ± 2	15 ± 3
05/10-05/17	13 ± 2	15 ± 2	14 ± 2	16 ± 2	19 ± 2	14 ± 2	16 ± 2	17 ± 2	16 ± 4
05/17-05/24	9.1 ± 1.5	7.3 ± 1.4	9.7 ± 1.5	9.5 ± 1.5	11 ± 2	9.4 ± 1.5	11 ± 2	11 ± 2	10 ± 3
05/24-05/31	16 ± 2	18 ± 2	18 ± 2	21 ± 2	19 ± 2	18 ± 2	20 ± 2	19 ± 2	19 ± 3
JUNE									
05/31-06/07	15 ± 2	15 ± 2	14 ± 2	15 ± 2	14 ± 2	14 ± 2	16 ± 2	14 ± 2	15 ± 1
06/07-06/14	15 ± 2	10 ± 2	14 ± 2	19 ± 2	16 ± 2	16 ± 2	19 ± 2	15 ± 2	16 ± 6
06/14-06/21	19 ± 2	19 ± 2	18 ± 2	20 ± 2	21 ± 2	19 ± 2	21 ± 2	22 ± 2	20 ± 3
06/21-06/28	23 ± 2	18 ± 2	19 ± 2	27 ± 2	23 ± 2	16 ± 2	18 ± 2	27 ± 2	21 ± 8
Qtr. Avg. ± 2 s.d.	**15 ± 7**	**16 ± 7**	**15 ± 6**	**19 ±10**	**18 ± 8**	**15 ± 6**	**18 ± 7**	**18 ± 8**	**17 ± 3**

(a) No electricity due to power loss. New location selected.
(b) Blown fuse; low sample volume.

TABLE B-2: GROSS BETA CONCENTRATION IN AIR PARTICULATES

Surry Nuclear Power Station, Surry County, Virginia - 1994

1.0 e-03 pCi/m^3 ± 2 Sigma

COLLECTION DATE	STATIONS SS	HIR	BC	ALL	CP	DOW	FE	NN	Average ± 2 Sigma
JULY									
06/28-07/05	15 ± 2	18 ± 2	17 ± 2	17 ± 2	17 ± 2	16 ± 2	18 ± 2	18 ± 2	17 ± 2
07/05-07/12	24 ± 3	20 ± 3	20 ± 2	25 ± 3	25 ± 3	19 ± 2	28 ± 3	10 ± 2	21 ±11
07/12-07/19	15 ± 2	14 ± 2	15 ± 2	60 ± 7(a)	16 ± 2	16 ± 2	17 ± 2	8.1 ± 1.3	20 ±33
07/19-07/26	10 ± 2	11 ± 2	11 ± 2	13 ± 2	11 ± 2	9.8 ± 1.5	15 ± 2	12 ± 1	12 ± 3
07/26-08/02	14 ± 2	14 ± 2	17 ± 4 (b)	17 ± 2	14 ± 2	13 ± 2	12 ± 3	7.0 ± 1.3(c)	14 ± 6
AUGUST									
08/02-08/09	11 ± 1	12 ± 2	29 ± 3	13 ± 2	16 ± 2	14 ± 2	16 ± 2	11 ± 2	15 ±12
08/09-08/16	13 ± 2	15 ± 2	14 ± 2	17 ± 2	16 ± 2	16 ± 2	15 ± 2	9.1 ± 1.5	14 ± 5
08/16-08/23	13 ± 2	11 ± 2	16 ± 2	13 ± 2	13 ± 2	13 ± 2	12 ± 2	8.8 ± 1.5	12 ± 4
08/23-08/30	22 ± 2	20 ± 2	27 ± 2	21 ± 2	22 ± 2	22 ± 2	20 ± 2	25 ± 2	22 ± 5
SEPTEMBER									
08/30-09/06	18 ± 2	19 ± 2	21 ± 2	16 ± 2	20 ± 2	16 ± 2	15 ± 2	22 ± 2	18 ± 5
09/06-09/13	24 ± 2	20 ± 2	27 ± 2	23 ± 2	23 ± 2	21 ± 2	22 ± 2	27 ± 2	23 ± 5
09/13-09/20	31 ± 2	32 ± 2	34 ± 2	32 ± 2	91 ± 7(d)	31 ± 2	35 ± 2	28 ± 2	39 ±42
09/20-09/27	14 ± 2	12 ± 2	13 ± 2	12 ± 2	11 ± 2	14 ± 2	12 ± 2	11 ± 2	12 ± 2
Qtr. Avg. ± 2 s.d.	**17 ±12**	**17 ±12**	**20 ±14**	**21 ±26**	**23 ±42**	**17 ±11**	**18 ±14**	**15 ±16**	**18 ±15**
OCTOBER									
09/27-10/04	20 ± 2	18 ± 2	24 ± 2	22 ± 2	23 ± 2	18 ± 2	22 ± 2	21 ± 2	21 ± 4
10/04-10/11	15 ± 2	14 ± 2	18 ± 2	16 ± 2	15 ± 2	13 ± 2	15 ± 2	16 ± 2	15 ± 3
10/11-10/18	18 ± 2	17 ± 2	22 ± 2	19 ± 2	19 ± 2	15 ± 2	21 ± 2	17 ± 2	19 ± 5
10/18-10/25	24 ± 2	20 ± 2	27 ± 2	24 ± 2	24 ± 2	20 ± 2	28 ± 2	26 ± 2	24 ± 6
10/25-11/01	13 ± 2	14 ± 2	17 ± 2	13 ± 2	13 ± 2	13 ± 2	14 ± 2	14 ± 2	14 ± 3
NOVEMBER									
11/01-11/08	17 ± 2	16 ± 2	19 ± 2	17 ± 2	19 ± 2	17 ± 2	18 ± 2	19 ± 2	18 ± 2
11/08-11/15	27 ± 2	23 ± 2	25 ± 2	21 ± 2	24 ± 2	21 ± 2	24 ± 2	23 ± 2	24 ± 4
11/15-11/21	17 ± 2	18 ± 2	20 ± 2	18 ± 2	18 ± 2	16 ± 2	17 ± 2	18 ± 2	18 ± 2
11/21-11/29	18 ± 2	18 ± 2	21 ± 2	17 ± 2	19 ± 2	15 ± 2	17 ± 2	17 ± 2	18 ± 4
DECEMBER									
11/29-12/06	20 ± 2	20 ± 2	25 ± 2	22 ± 2	23 ± 2	22 ± 2	21 ± 2	22 ± 2	22 ± 3
12/06-12/13	14 ± 2	14 ± 2	18 ± 2	15 ± 2	17 ± 2	17 ± 2	17 ± 2	17 ± 2	16 ± 3
12/13-12/20	16 ± 2	16 ± 2	20 ± 2	18 ± 2	19 ± 2	17 ± 2	19 ± 2	16 ± 2	18 ± 3
12/20-12/28	16 ± 2	20 ± 2	19 ± 2	16 ± 2	20 ± 2	19 ± 2	20 ± 2	18 ± 2	19 ± 3
Quarter Avg. ± 2 s.d.	**18 ± 8**	**18 ± 6**	**21 ± 6**	**18 ± 6**	**19 ± 7**	**17 ± 6**	**19 ± 8**	**19 ± 7**	**19 ± 6**
Annual Avg. ± 2 s.d.	**17 ± 9**	**17 ± 8**	**18 ±11**	**19 ±15**	**19 ±22**	**17 ± 8**	**18 ±10**	**17 ±10**	**18 ±12**

(a) Low sample volume.
(b) Sampler failure; low sample volume.
(c) Power outage; low sample volume.
(d) Low sample volume: cause unknown.

TABLE B-3: GAMMA EMITTER CONCENTRATION IN QUARTERLY AIR PARTICULATES*

Surry Nuclear Power Station, Surry County, Virginia - 1994

1.0 e-03 pCi/m^3 ± 2 Sigma

Station	Nuclide	First Quarter 12/28-03/29	Second Quarter 03/29-06/28	Third Quarter 06/28-09/27	Fourth Quarter 09/27-12/28	Average ± 2 s.d.
STA-SS	Be-7	117 ± 12	142 ± 14	124 ± 12	125 ± 13	127 ± 21
	K-40	< 9	< 5	< 5	2.94 ± 1.67	2.94 ± 1.67
	Co-60	< 0.3	< 0.3	< 0.3	< 0.2	-
	Cs-134	< 0.3	< 0.3	< 0.3	< 0.2	-
	Cs-137	< 0.3	< 0.3	< 0.3	< 0.3	-
	Th-228	< 0.5	< 0.5	< 0.4	< 0.4	-
STA-HIR	Be-7	118 ± 12	145 ± 15	119 ± 12	137 ± 14	130 ± 27
	K-40	< 9	< 3	5.50 ± 2.89	< 6	5.50 ± 2.89
	Co-60	< 0.3	< 0.3	< 0.4	< 0.3	-
	Cs-134	< 0.3	< 0.2	< 0.4	< 0.3	-
	Cs-137	< 0.3	< 0.2	< 0.4	< 0.3	-
	Th-228	< 0.4	< 0.3	< 0.5	< 0.7	-
STA-BC	Be-7	67.8 ± 6.8	152 ± 15	154 ± 15	142 ± 14	130 ± 82
	K-40	< 5	< 4	< 6	< 9	-
	Co-60	< 0.3	< 0.2	< 0.3	< 0.3	-
	Cs-134	< 0.3	< 0.2	< 0.3	< 0.3	-
	Cs-137	< 0.3	< 0.2	< 0.3	< 0.3	-
	Th-228	< 0.5	< 0.3	< 0.5	< 0.4	-
STA-ALL	Be-7	69.5 ± 7.0	172 ± 17	130 ± 13	138 ± 14	127 ± 85
	K-40	5.37 ± 2.30	< 9	10.7 ± 2.8	< 5	8.04 ± 7.54
	Co-60	< 0.3	< 0.3	< 0.3	< 0.2	-
	Cs-134	< 0.3	< 0.3	< 0.3	< 0.3	-
	Cs-137	< 0.3	< 0.4	< 0.3	< 0.4	-
	Th-228	< 0.3	< 0.5	< 0.4	< 0.6	-
STA-CP	Be-7	75.4 ± 7.5	172 ± 17	143 ± 14	123 ± 12	128 ± 81
	K-40	5.85 ± 2.95	6.18 ± 2.65	< 5	< 7	6.02 ± 0.47
	Co-60	< 0.3	< 0.3	< 0.3	< 0.3	-
	Cs-134	< 0.4	< 0.3	< 0.3	< 0.3	-
	Cs-137	< 0.4	< 0.3	< 0.2	< 0.3	-
	Th-228	< 0.5	< 0.4	< 0.5	< 0.5	-

* All gamma emitters other than those listed were <LLD.

TABLE B-3: GAMMA EMITTER CONCENTRATION IN QUARTERLY AIR PARTICULATES*

Surry Nuclear Power Station, Surry County, Virginia - 1994

1.0 e-03 pCi/m^3 ± 2 Sigma

Station	Nuclide	First Quarter 12/28-03/29	Second Quarter 12/28-03/29	Third Quarter 06/28-09/27	Fourth Quarter 09/27-12/28	Average ± 2 s.d.
STA-DOW	Be-7	81.0 ± 8.1	178 ± 18	112 ± 11	116 ± 12	122 ± 81
	K-40	< 4	< 5	< 5	< 3	-
	Co-60	< 0.3	< 0.2	< 0.3	< 0.2	-
	Cs-134	< 0.2	< 0.2	< 0.3	< 0.2	-
	Cs-137	< 0.2	< 0.2	< 0.3	< 0.2	-
	Th-228	< 0.4	< 0.4	< 0.5	< 0.3	-
STA-FE	Be-7	71.9 ± 7.2	198 ± 20	127 ± 13	136 ± 14	133 ± 103
	K-40	34.5 ± 3.7	< 6	< 4	< 4	34.5 ± 3.7
	Co-60	< 0.3	< 0.3	< 0.2	< 0.2	-
	Cs-134	< 0.3	< 0.3	< 0.3	< 0.2	-
	Cs-137	< 0.2	< 0.3	< 0.2	< 0.2	-
	Th-228	< 0.4	< 0.5	< 0.3	< 0.3	-
STA-NN	Be-7	84.1 ± 8.4	193 ± 19	92.0 ± 9.2	131 ± 13	125 ± 99
	K-40	< 6	< 5	< 4	< 8	-
	Co-60	< 0.4	< 0.2	< 0.2	< 0.3	-
	Cs-134	< 0.3	< 0.3	< 0.2	< 0.3	-
	Cs-137	< 0.3	< 0.3	< 0.2	< 0.3	-
	Th-228	< 0.5	< 0.5	< 0.4	< 0.4	-

* All gamma emitters other than those listed were <LLD.

*TABLE B-4: GAMMA EMITTER*AND TRITIUM CONCENTRATIONS IN RIVER WATER*

Surry Nuclear Power Station, Surry County, Virginia - 1994

pCi/l ± 2 Sigma

Station	Collection Date	Be-7	K-40	I-131	Cs-137	Ba-140	La-140	Th-228	H-3
JANUARY - 1994									
CHIC	01/25	< 20	< 50	< 0.1	< 4	< 8	< 3	< 5	< 200
HIP	01/25	< 20	< 40	< 0.1	< 3	< 7	< 3	< 4	< 200
NN	01/25	< 30	< 90	< 0.1	< 3	< 9	< 4	< 5	< 100
SD	01/25	< 30	< 50	< 0.1	< 3	< 9	< 4	< 6	< 200
SI	01/25	< 30	< 90	< 0.2	< 3	< 10	< 4	< 5	< 100
SW	01/25	< 30	< 70	< 0.1	< 3	< 10	< 5	< 6	< 200
SD	02/15	< 30	< 50	< 0.1	< 4	< 10	< 4	< 5	
SW	02/15	< 40	< 100	< 0.1	< 5	< 20	< 6	< 8	
CHIC	03/15	< 30	< 50	< 0.1	< 4	< 9	< 4	< 6	
HIP	03/15	< 20	< 60	< 0.1	< 3	< 8	< 3	< 5	
NN	03/15	< 30	< 80	< 0.1	< 3	< 10	< 4	< 5	
SD	03/15	< 30	< 60	< 0.1	< 4	< 10	< 4	< 7	
SI	03/15	< 30	< 100	< 0.2	< 4	< 10	< 5	< 6	
SW	03/15	< 30	< 70	< 0.1	< 3	< 9	< 4	< 6	
SD	04/19	< 30	< 70	< 0.1	< 4	< 10	< 4	< 8	
SW	04/19	< 30	< 100	< 0.1	< 4	< 10	< 4	< 7	
CHIC	05/17	< 30	81.1 ± 25.6	< 0.2	< 3	< 10	< 4	< 5	< 100
HIP	05/17	< 30	< 100	< 0.2	< 4	< 10	< 5	< 7	220 ± 100
NN	05/17	< 30	< 90	< 0.2	< 3	< 10	< 4	< 6	< 100
SD	05/17	< 30	< 60	< 0.2	< 4	< 10	< 4	< 6	200 ± 110
SI	05/17	< 30	< 60	< 0.2	< 3	< 10	< 5	< 7	300 ± 100
SW	05/17	< 30	< 50	< 0.2	< 3	< 10	< 5	< 6	< 100
SD	06/14	< 30	< 60	< 0.2	< 3	< 10	< 4	< 6	
SW	06/14	< 40	102 ± 31	< 0.2	< 4	< 10	< 6	< 7	

* All gamma emitters other than those listed were < LLD.

TABLE B-4: GAMMA EMITTER AND TRITIUM CONCENTRATIONS IN RIVER WATER*

Surry Nuclear Power Station, Surry County, Virginia - 1994

pCi/l ± 2 Sigma

Station	Collection Date	Be-7	K-40	I-131	Cs-137	Ba-140	La-140	Th-228	H-3
CHIC	07/26	< 30	52.7 ± 23.5	< 0.1	< 3	< 8	< 4	< 6	200 ± 130
HIP	07/26	< 20	86.4 ± 23.3	< 0.2	< 3	< 9	< 4	< 5	300 ± 130
NN	07/26	< 30	177 ± 35	< 0.2	< 4	< 10	< 4	< 7	260 ± 120
SD	07/26	< 30	92.7 ± 26.1	< 0.1	< 3	< 9	< 4	< 6	260 ± 130
SI	07/26	< 40	74.8 ± 32.3	< 0.2	< 5	< 10	< 5	< 7	320 ± 130
SW	07/26	< 30	< 90	< 0.2	< 3	< 10	< 4	< 5	< 200
SD	08/16	< 20	59.0 ± 20.4	< 0.2	< 4	< 8	< 3	< 5	
SW	08/16	< 20	< 40	< 0.1	< 3	< 7	< 3	< 5	
CHIC	09/28	< 30	< 70	< 0.3	< 3	< 20	< 6	< 6	
HIP	09/28	< 40	< 70	< 0.3	< 4	< 20	< 7	< 7	
NN	09/28	< 30	77.6 ± 25.4	< 0.4	< 3	< 20	< 6	< 6	
SD	09/28	< 40	96.0 ± 26.6	< 0.3	< 4	< 20	< 9	< 6	
SI	09/28	< 30	90.8 ± 30.8	< 0.3	< 3	< 20	< 7	< 6	
SW	09/28	< 50	124 ± 38	< 0.3	< 5	< 20	< 8	< 7	
SD	10/25	< 30	143 ± 33	< 0.2	< 4	< 10	< 5	< 7	
SW	10/25	< 20	52.2 ± 21.7	< 0.2	< 4	< 8	< 3	< 5	
CHIC	11/14	< 20	< 40	< 0.3	< 3	< 8	< 4	< 5	< 200
HIP	11/14	< 40	< 80	< 0.4	< 4	< 20	< 10	< 8	420 ± 150
NN	11/14	< 30	174 ± 32	< 0.3	< 4	< 10	< 4	< 6	< 200
SD	11/14	< 20	145 ± 29	< 0.4	< 3	< 9	< 4	< 5	260 ± 140
SI	11/14	< 30	84.0 ± 29.1	< 0.3	< 4	< 10	< 5	< 6	280 ± 140
SW	11/14	< 30	< 80	< 0.3	< 3	< 10	< 4	< 5	< 200
SD	12/13	< 20	62.4 ± 23.6	< 0.1	< 3	< 8	< 4	< 6	
SW	12/13	< 30	< 60	< 0.2	< 4	< 9	< 3	< 7	
Average ± 2 s.d.			**98.6 ± 77.5**						**275 ± 125**

* All gamma emitters other than those listed were < LLD.

TABLE B-5 GAMMA EMITTER AND TRITIUM CONCENTRATIONS IN RIVER WATER*
State-Split Samples

Surry Nuclear Power Station, Surry County, Virginia - 1994

pCi/l ± 2 Sigma

Station	Collection Date	Be-7	K-40	I-131	Cs-137	Ba-140	La-140	Th-228	H-3
SCOTLAND WH. (SW)									
Jan.	01/31	< 30	< 50	< 0.3	< 3	< 20	< 6	< 6	< 200
Feb.	02/28	< 30	< 90	< 0.5	< 3	< 10	< 5	< 5	
Mar.	03/31	< 30	< 50	< 0.5	< 4	< 20	< 10	< 5	
Apr.	04/30	< 30	40.4 ± 18.6	< 0.4	< 3	< 20	< 7	< 6	< 200
May	05/31	< 40	51.2 ± 27.8	< 0.8	< 3	< 30	< 10	< 6	
Jun.	06/30	< 30	< 50	< 0.5	< 3	< 30	< 10	< 6	
Jul.	07/31	< 30	41.8 ± 22.7	< 0.5	< 3	< 20	< 10	< 7	< 200
Aug.	08/31	< 30	47.8 ± 22.0	< 0.4	< 3	< 20	< 8	< 6	
Sep.	09/30	< 30	< 50	< 0.9	< 3	< 30	< 10	< 6	
Oct.	10/31	< 30	50.0 ± 22.9	< 0.3	< 3	< 20	< 7	< 6	200 ± 110
Nov.	11/30	< 20	< 70	< 0.2	< 3	< 10	< 6	< 4	
Dec.	12/31	< 30	< 80	< 0.5	< 3	< 20	< 7	< 5	
Average ± 2 s.d.			**46.2 ± 9.8**						**200 ± 110**
SURRY DIS. (SD)									
Jan.	01/31	< 30	< 70	< 1	< 3	< 40	< 10	< 6	470 ± 130
Feb.	02/28	< 30	< 50	< 0.5	< 3	< 10	< 6	< 5	
Mar.	03/31	< 40	< 50	< 0.7	< 5	< 30	< 10	< 6	
Apr.	04/30	< 30	< 50	< 0.4	< 4	< 20	< 9	< 6	830 ± 160
May	05/31	< 40	< 70	< 0.8	< 5	< 30	< 10	< 9	
Jun.	06/30	< 40	80.0 ± 32.7	< 0.7	< 3	< 30	< 10	< 6	
Jul.	07/31	< 30	< 60	< 0.5	< 3	< 20	< 9	< 6	320 ± 110
Aug.	08/31	< 30	108 ± 31	< 0.5	< 3	< 20	< 10	< 6	
Sep.	09/30	< 40	< 60	< 1	< 4	< 30	< 10	< 6	
Oct.	10/31	< 30	104 ± 18	< 0.4	< 3	< 10	< 6	< 5	570 ± 120
Nov.	11/30	< 30	136 ± 28	< 0.2	< 4	< 20	< 8	< 5	
Dec.	12/31	< 40	< 70	< 0.6	< 3	< 20	< 10	< 6	
Average ± 2 s.d.			**107 ± 46**						**548 ± 429**

* All gamma emitters other than those listed were <LLD.

TABLE B-6: GAMMA EMITTER AND TRITIUM CONCENTRATIONS IN WELL WATER*

Surry Nuclear Power Station, Surry County, Virginia - 1994

pCi/l ± 2 Sigma

Collection Date	Station	Be-7	K-40	I-131	Cs-137	Ba-140	La-140	Th-228	H-3
FIRST QUARTER									
03/22	BC	< 30	< 50	< 0.1	< 4	< 10	< 4	< 5	< 100
03/22	HIR	< 30	< 100	< 0.1	< 4	< 10	< 5	< 6	< 100
03/22	JMTN	< 30	< 60	< 0.1	< 4	< 10	< 6	< 9	< 100
03/22	SS	< 40	< 100	< 0.1	< 5	< 20	< 5	< 8	< 100
SECOND QUARTER									
06/28	BC	< 30	< 50	< 0.2	< 4	< 10	< 5	< 7	< 200
06/28	HIR	< 20	< 60	< 0.1	< 3	< 10	< 5	< 5	< 200
06/28	JMTN	< 40	< 100	< 0.1	< 4	< 20	< 6	< 6	< 200
06/28	SS	< 30	< 70	< 0.3	< 3	< 9	< 3	< 5	< 200
THIRD QUARTER									
09/27	BC	< 30	< 70	< 0.2	< 4	< 10	< 6	< 9	< 100
09/27	HIR	< 30	< 50	< 0.2	< 3	< 9	< 4	< 6	< 100
09/27	JMTN	< 30	< 60	< 0.2	< 3	< 9	< 4	< 7	< 100
09/27	SS	< 30	< 50	< 0.2	< 4	< 9	< 4	< 6	< 100
FOURTH QUARTER									
12/28	BC	< 30	< 60	< 0.1	< 4	< 10	< 6	< 7	< 200
12/28	HIR	< 30	< 40	< 0.2	< 3	< 10	< 5	< 5	< 200
12/28	JMTN (a)								
12/28	SS	< 30	< 60	< 0.1	< 4	< 10	< 7	< 9	< 200

* All gamma emitters other than those listed were < LLD.
(a) Station has been eliminated due to program change 12/1/94.

TABLE B-7: GAMMA EMITTER CONCENTRATIONS IN SILT*

Surry Nuclear Power Station, Surry County, Virginia - 1994

pCi/kg (dry) ± 2 Sigma

Station	CHIC	HIP	NN	POS	SD	SI
Coll. Date	03/15	03/15	03/15	03/15	03/15	03/15
Be-7	< 300	744 ± 313	493 ± 289	2540 ± 350	< 400	2030 ± 390
K-40	15700 ± 1600	12800 ± 1300	14900 ± 1500	13800 ± 1400	12600 ± 1300	13900 ± 1400
Mn-54	< 30	< 40	< 30	< 30	< 40	< 40
Co-58	< 30	< 40	< 30	< 30	< 40	< 40
Co-60	109 ± 29	100 ± 31	61.8 ± 31.6	89.0 ± 32.7	209 ± 38	136 ± 41
Cs-134	< 40	< 50	< 40	< 40	< 50	< 50
Cs-137	438 ± 44	337 ± 40	233 ± 36	366 ± 43	399 ± 44	493 ± 52
Ra-226	2200 ± 550	1520 ± 590	2080 ± 550	1440 ± 530	1890 ± 590	2430 ± 730
Th-228	1130 ± 110	995 ± 99	844 ± 84	974 ± 97	988 ± 99	987 ± 99

	CHIC	HIP	NN	POS	SD	SI	Average
Coll. Date	09/28	09/28	09/28	09/28	09/28	09/28	± 2 s. d.
Be-7	< 300	< 500	582 ± 239	1470 ± 350	1550 ± 450	576 ± 329	1248 ± 1538
K-40	16600 ± 1700	12700 ± 1300	14700 ± 1500	16400 ± 1600	15500 ± 1500	13600 ± 1400	14433 ± 2829
Mn-54	< 30	< 50	< 30	< 50	< 50	< 40	-
Co-58	< 30	< 50	< 30	< 50	< 50	< 40	-
Co-60	78.8 ± 28.0	94.2 ± 37.1	< 40	112 ± 35	232 ± 55	100 ± 39	120 ± 107
Cs-134	< 40	< 60	< 30	< 50	< 60	< 50	-
Cs-137	427 ± 44	288 ± 55	182 ± 35	401 ± 50	424 ± 63	293 ± 49	357 ± 184
Ra-226	2360 ± 550	< 1000	1370 ± 480	1470 ± 570	2510 ± 800	1370 ± 660	1876 ± 913
Th-228	1230 ± 120	1180 ± 120	730 ± 73	995 ± 100	1140 ± 110	948 ± 95	1012 ± 284

TABLE B-8: GAMMA EMITTER CONCENTRATIONS IN SHORELINE SEDIMENT*

Surry Nuclear Power Station, Surry County, Virginia - 1994

pCi/kg (dry) ± 2 Sigma

Station	HIR	Burwell's	HIR	Burwell's	Average
Collection Date	02/22	02/22	08/23	08/23	± 2 s.d.
Be-7	< 200	< 100	< 200	402 ± 108	402 ± 108
K-40	6240 ± 620	2910 ± 290	6190 ± 620	1330 ± 210	4168 ± 4901
Co-60	< 20	< 20	< 20	< 20	-
Cs-134	< 20	< 20	< 20	< 30	-
Cs-137	< 20	< 20	< 20	< 30	-
Ra-226	< 400	467 ± 255	< 400	3270 ± 480	1869 ± 3964
Th-228	93.5 ± 28.5	140 ± 19	< 40	2220 ± 220	818 ± 2429

* All gamma emitters other than those listed were < LLD.

TABLE B-9: GAMMA EMITTER STRONTIUM-89, AND STRONTIUM-90 CONCENTRATIONS IN MILK*

Surry Nuclear Power Station, Surry County, Virginia - 1994

pCi/kg (wet) ± 2 Sigma

NUCLIDE	EPPS	CP	WMS	JDKS
JANUARY				
Sr-89	< 2	< 2		
Sr-90	0.92 ± 0.21	1.9 ± 0.3		
K-40	1390 ± 40	1380 ± 140	1350 ± 140	1330 ± 130
Cs-137	< 3	< 3	< 4	< 4
I-131	< 0.2	< 0.2	< 0.1	< 0.2
FEBRUARY				
K-40	1390 ± 140	1370 ± 140	1370 ± 140	1150 ± 120
Cs-137	< 4	< 4	< 4	< 4
I-131	< 0.2	< 0.2	< 0.1	< 0.1
MARCH				
K-40	1530 ± 150	1320 ± 130	1290 ± 130	1360 ± 140
Cs-137	< 4	< 5	< 4	< 3
I-131	< 0.2	< 0.2	< 0.2	< 0.2
APRIL				
Sr-89	< 2	< 2		
Sr-90	2.3 ± 0.3	3.4 ± 0.3		
K-40	1390 ± 140	1390 ± 140	1320 ± 130	1440 ± 140
Cs-137	< 3	< 4	< 4	< 4
I-131	< 0.1	< 0.1	< 0.2	< 0.2
MAY				
K-40	1390 ± 140	1430 ± 140	1220 ± 120	1410 ± 140
Cs-137	< 4	< 4	< 4	< 4
I-131	< 0.1	< 0.2	< 0.2	< 0.2
JUNE				
K-40	1420 ± 140	1770 ± 180	1220 ± 120	1330 ± 130
Cs-137	< 3	< 4	< 4	< 5
I-131	< 0.2	< 0.2	< 0.1	< 0.2

* All gamma emitters other than those listed were < LLD.

TABLE B-9: GAMMA EMITTER STRONTIUM-89, AND STRONTIUM-90 CONCENTRATIONS IN MILK*

Surry Nuclear Power Station, Surry County, Virginia - 1994

pCi/kg (wet) ± 2 Sigma

NUCLIDE	EPPS	CP	WMS	JDKS
JULY				
Sr-89	< 1	< 1		
Sr-90	3.2 ± 0.2	1.4 ± 0.2		
K-40	1230 ± 120	1490 ± 150	1470 ± 150	1400 ± 140
Cs-137	< 4	< 4	< 4	< 4
I-131	< 0.2	< 0.2	< 0.2	< 0.2
AUGUST				
K-40	1210 ± 120	1400 ± 140	1340 ± 130	1410 ± 140
Cs-137	< 5	< 5	< 4	< 5
I-131	< 0.2	< 0.2	< 0.2	< 0.2
SEPTEMBER				
K-40	1260 ± 130	1450 ± 150	1450 ± 140	1360 ± 140
Cs-137	< 4	< 5	< 4	< 4
I-131	< 0.2	< 0.2	< 0.2	< 0.2
OCTOBER				
Sr-89	< 2	< 2		
Sr-90	1.4 ± 0.2	2.7 ± 0.2		
K-40	1280 ± 130	1300 ± 130	1400 ± 140	1390 ± 140
Cs-137	< 4	< 4	< 3	< 4
I-131	< 0.2	< 0.2	< 0.2	< 0.2
NOVEMBER				
K-40	1420 ± 140	1460 ± 150	1340 ± 130	1490 ± 150
Cs-137	< 4	< 4	< 4	< 5
I-131	< 0.2	< 0.2	< 0.2	< 0.2
DECEMBER				
K-40	1410 ± 140	1330 ± 130	1420 ± 140	1250 ± 120
Cs-137	< 4	< 5	< 5	< 4
I-131	< 0.1	< 0.2	< 0.5	< 0.2

* All gamma emitters other than those listed were < LLD.

TABLE B-10: GAMMA EMITTER CONCENTRATION IN CLAMS*

Surry Nuclear Power Station, Surry County, Virginia - 1994

pCi/kg (wet) ± 2 Sigma

Station Date	Type	Be-7	K-40	Co-58	Co-60	Cs-137	Ra-226	Th-228
CHIC								
01/25/94	Clams	< 90	235 ± 78	< 9	< 10	< 10	< 200	< 20
03/15/94	Clams	< 200	157 ± 90	< 20	< 10	< 10	< 300	< 20
05/17/94	Clams	< 200	235 ± 108	< 10	< 10	< 20	< 300	< 20
07/13/94	Clams	< 200	356 ± 116	< 20	< 20	< 20	< 300	< 30
07/26/94	Clams	< 100	< 200	< 10	< 10	< 10	< 300	< 30
09/28/94	Clams	< 200	487 ± 120	< 20	< 10	< 20	< 300	< 30
11/14/94 (a)	Clams	< 200	313 ± 110	< 20	< 10	< 10	< 200	< 20
JMTN								
01/25/94	Clams	< 100	253 ± 101	< 10	< 10	< 10	< 200	< 20
03/15/94	Clams	< 200	206 ± 92	< 20	< 10	< 20	< 200	< 20
05/17/94	Clams	< 100	209 ± 72	< 10	< 10	< 10	< 200	< 20
07/26/94	Clams	< 200	586 ± 121	< 20	< 10	< 20	< 300	< 20
09/28/94	Clams	< 200	423 ± 92	< 10	< 10	< 10	< 200	< 20
11/14/94 (b)	Clams	< 300	209 ± 105	< 20	< 10	< 10	< 200	< 20
SD								
01/25/94 (c)	Clams	< 100	199 ± 89	< 10	< 10	< 20	< 300	< 20
03/29/94 (c)	Clams	< 100	< 200	< 10	< 10	< 10	< 200	< 20
05/23/94 (c)	Clams	< 100	512 ± 97	< 10	< 10	< 10	< 300	< 20
07/13/94 (c)	Clams	< 200	356 ± 116	< 20	< 20	< 20	< 300	< 30
10/31/9 (a)(c)	Clams	< 200	745 ± 136	< 20	< 20	< 20	< 300	< 30
HIP								
01/25/94	Clams	< 100	< 300	< 10	< 10	< 10	< 300	< 30
03/15/94	Clams	< 200	< 300	< 20	< 10	< 10	< 200	< 20
05/17/94	Clams	< 100	615 ± 102	< 10	< 10	< 10	< 200	< 20
07/26/94	Clams	< 100	524 ± 117	< 10	< 10	< 10	< 200	< 20
09/28/94	Clams	< 100	269 ± 98	< 10	< 10	< 10	< 200	< 20
11/14/94 (a)	Clams	< 300	482 ± 139	< 30	< 20	< 20	< 300	< 30
LC								
01/25/94	Clams	< 100	473 ± 121	< 10	< 20	< 10	< 300	< 30
03/15/94	Clams	< 200	427 ± 116	< 20	< 10	< 10	< 400	< 30
05/17/94	Clams	< 100	472 ± 84	< 10	< 10	< 20	< 200	< 20
07/26/94	Clams	< 100	534 ± 133	< 10	< 20	< 20	< 300	< 30
09/28/94	Clams	< 200	396 ± 110	< 20	< 10	< 10	< 300	< 30
11/14/94 (a)	Clams	< 200	470 ± 97	< 20	< 10	< 10	< 200	< 20
Average ± 2 s.d.			**390 ± 307**					

* All gamma emitters other than those listed were <LLD.

(a) Sampling frequency has been changed to semiannual due to program change.

(b) Jamestown clam sampling location has been eliminated due to program change.

(c) State Split samples.

TABLE B-11: GAMMA EMITTER CONCENTRATION IN OYSTERS*

Surry Nuclear Power Station, Surry County, Virginia - 1994

pCi/kg (wet) ± 2 Sigma

Station / DATE	TYPE	Be-7	K-40	Co-58	Co-60	Cs-137	Ra-226	Th-228
RLS								
01/25/94	Oysters	< 100	498 ± 141	< 10	< 10	< 20	< 300	< 30
03/15/94	Oysters	< 200	213 ± 78	< 20	< 10	< 10	< 200	< 20
05/17/94	Oysters	< 100	423 ± 117	< 10	< 10	< 10	< 300	< 20
07/26/94	Oysters	< 100	424 ± 101	< 10	< 10	< 20	< 200	< 20
09/28/94	Oysters	< 200	490 ± 110	< 20	< 10	< 10	< 300	< 20
11/14/94 (a)	Oysters	< 300	207 ± 103	< 30	< 10	< 20	< 300	< 30
DWS								
01/25/94	Oysters	< 100	< 500	< 10	< 20	< 20	< 300	< 20
03/15/94	Oysters	< 200	369 ± 101	< 20	< 10	< 10	< 300	< 20
05/17/94	Oysters	< 200	123 ± 109	< 20	< 10	< 20	< 300	< 20
07/26/94	Oysters	< 200	693 ± 134	< 10	< 20	< 20	< 300	< 30
09/28/94	Oysters	< 200	788 ± 128	< 20	< 10	< 20	< 300	< 20
11/14/94 (b)	Oysters	< 300	359 ± 109	< 20	< 10	< 20	< 300	< 30
POS								
01/25/94 (c)	Oysters	< 100	298 ± 108	< 10	< 10	< 10	< 300	< 20
01/25/94 (c)	Oysters	< 100	538 ± 113	< 10	< 10	< 10	< 200	< 20
03/15/94	Oysters	< 200	256 ± 109	< 20	< 10	< 10	< 200	< 20
03/30/94 (c)	Oysters	< 200	416 ± 116	< 20	< 10	< 20	< 300	< 30
05/17/94	Oysters	< 200	395 ± 120	< 20	< 20	< 10	< 400	< 30
05/24/94 (c)	Oysters	< 100	1080 ± 120	< 10	< 10	< 10	< 200	< 20
07/12/94 (c)	Oysters	< 200	625 ± 114	< 20	< 10	< 20	< 300	< 30
07/26/94	Oysters	< 200	< 500	< 20	< 20	< 20	< 300	< 30
09/28/94	Oysters	< 200	609 ± 149	< 20	< 10	< 10	< 400	< 30
11/01/94 (c)	Oysters	< 100	994 ± 143	< 10	< 20	< 20	< 300	< 30
11/14/94 (a)	Oysters	< 300	708 ± 140	< 20	< 20	< 10	< 400	< 30
Average ± 2 s.d.			**500 ± 500**					

* All gamma emitters other than those listed were <LLD.
(a) Sampling frequency changed to semiannual due to program change.
(b) Station eliminated due to shellstock depletion.
(c) State split samples.

TABLE B-12: GAMMA EMITTER CONCENTRATION IN CRABS*

Surry Nuclear Power Station, Surry County, Virginia - 1994

pCi/kg (wet) ± 2 Sigma Page 1 of 1

Station / Date	Type	Be-7	K-40	Co-58	Co-60	Cs-137	Ra-226	Th-228
SD								
06/23/94	Crabs	< 200	1590 ± 180	< 20	< 10	< 20	< 300	< 30

TABLE B-13: GAMMA EMITTER CONCENTRATION IN FISH*

Surry Nuclear Power Station, Surry County, Virginia - 1994

pCi/kg (wet) ± 2 Sigma Page 1 of 1

Collection Date	Station	Sample Type	K-40	Co-58	Cs-134	Cs-137
04/21/94	SD	Catfish	1420 ± 180	< 20	< 20	< 20
04/21/94	SD	White Perch	1180 ± 150	< 20	< 20	< 20
10/18/94	SD	Catfish	1860 ± 190	< 10	< 10	< 20
10/18/94	SD	White Perch	1680 ± 220	< 30	< 20	< 20
Average ± 2 s.d.			**1535 ± 595**			

TABLE B-14: GAMMA EMITTER CONCENTRATION IN VEGETATION*

Surry Nuclear Power Station, Surry County, Virginia - 1994

pCi/kg (wet) ± 2 Sigma Page 1 of 1

Station	Sample Type	Collection Date	Be-7	K-40	I-131	Cs-134	Cs-137
Spratley (a)	Kale	05/17/94	233 ± 82	6180 ± 620	< 20	< 10	< 10
Lucas (a)	Kale	05/17/94	< 200	4200 ± 420	< 20	< 20	< 20
Brocks (a)	Peanuts	10/19/94	< 100	4660 ± 470	< 20	< 10	< 10
Brocks	Corn	10/19/94	< 40	2580 ± 260	< 6	< 5	< 6
Slades	Peanuts	10/20/94	< 100	5230 ± 520	< 20	< 10	< 10
Slades (a)	Corn	10/20/94	< 50	2580 ± 260	< 10	< 6	< 6
Brocks	Soybeans	11/12/94	< 70	14600 ± 1500	< 30	< 8	< 8
Slades (a)	Soybeans	11/17/94	< 80	14200 ± 1400	< 20	< 10	< 9
Carters (a)	Cabbage	11/22/94	< 80	2290 ± 230	< 10	< 9	< 10
Average ± 2 s.d.			**233 ± 82**	**6280 ± 9574**			

* All gamma emitters other than those listed were < LLD.
(a) State split samples.

TABLE B-15: DIRECT RADIATION MEASUREMENTS – QUARTERLY TLD RESULTS

Surry Nuclear Power Station, Surry County, Virginia - 1994

mR/month ± 2 Sigma - Set 1 - 098

Station Number	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Average ± 2 s.d.
02	6.1 ± 0.2	6.8 ± 0.5	6.2 ± 0.5	7.1 ± 1.0	6.6 ± 1.0
03	6.6 ± 1.3	7.1 ± 0.2	6.7 ± 0.4	6.6 ± 0.2	6.8 ± 0.5
04	5.1 ± 0.5	5.6 ± 1.1	4.9 ± 1.9	5.7 ± 0.3	5.3 ± 0.8
05	5.0 ± 0.6	(a)	5.2 ± 0.2	5.8 ± 0.3	5.3 ± 0.8
06	5.6 ± 0.6	6.6 ± 0.9	5.9 ± 0.2	6.1 ± 0.2	6.1 ± 0.8
07	5.2 ± 0.3	5.7 ± 0.2	5.5 ± 0.3	5.5 ± 0.3	5.5 ± 0.4
08	5.3 ± 0.7	5.9 ± 0.2	5.4 ± 0.1	5.8 ± 0.3	5.6 ± 0.6
09	5.8 ± 0.6	5.9 ± 0.8	5.7 ± 0.8	5.5 ± 0.5	5.7 ± 0.3
10	4.8 ± 0.6	5.4 ± 0.4	5.5 ± 0.2	5.6 ± 0.4	5.3 ± 0.7
11	5.3 ± 0.7	6.0 ± 0.1	5.4 ± 0.1	5.5 ± 0.4	5.6 ± 0.6
12	5.0 ± 0.9	5.9 ± 0.1	5.6 ± 0.3	5.1 ± 1.0	5.4 ± 0.8
13	5.6 ± 0.3	6.0 ± 0.4	5.7 ± 0.4	6.1 ± 0.3	5.9 ± 0.5
14	5.9 ± 0.8	6.4 ± 0.3	5.8 ± 0.2	6.0 ± 0.2	6.0 ± 0.5
15	4.9 ± 0.4	5.4 ± 0.1	5.6 ± 0.9	5.0 ± 0.3	5.2 ± 0.7
16	4.7 ± 0.7	5.6 ± 0.2	5.3 ± 0.6	4.7 ± 1.1	5.1 ± 0.9
17	4.7 ± 0.4	5.1 ± 0.2	5.3 ± 1.2	5.0 ± 0.1	5.0 ± 0.5
18	3.9 ± 0.9	4.4 ± 0.4	4.1 ± 0.8	3.7 ± 0.7	4.0 ± 0.6
19	6.1 ± 0.6	5.1 ± 0.2	5.3 ± 1.0	4.7 ± 0.7	5.3 ± 1.2
20	4.7 ± 0.5	4.7 ± 0.2	5.2 ± 0.5	4.7 ± 0.1	4.8 ± 0.5
21	4.6 ± 0.9	5.1 ± 0.2	4.9 ± 1.3	4.4 ± 0.7	4.8 ± 0.6
22	4.4 ± 1.0	5.1 ± 0.6	4.8 ± 0.1	4.4 ± 0.3	4.7 ± 0.7
23	5.5 ± 0.6	6.1 ± 1.9	5.8 ± 0.7	5.6 ± 0.3	5.8 ± 0.5
24	4.9 ± 0.6	4.9 ± 0.6	4.6 ± 1.1	4.5 ± 0.7	4.7 ± 0.4
25	5.2 ± 0.5	5.2 ± 0.4	5.9 ± 0.3	4.9 ± 0.8	5.3 ± 0.8
26	4.3 ± 0.7	5.1 ± 0.3	4.7 ± 0.3	4.6 ± 0.1	4.7 ± 0.7
27	4.6 ± 0.1	5.1 ± 0.4	5.0 ± 0.2	4.9 ± 0.1	4.9 ± 0.4
28	4.8 ± 0.9	5.2 ± 0.2	5.2 ± 0.3	4.5 ± 0.3	4.9 ± 0.7
29	4.1 ± 0.1	4.3 ± 1.3	4.7 ± 0.6	4.2 ± 0.4	4.3 ± 0.5
30	4.7 ± 0.2	4.8 ± 0.8	5.4 ± 0.8	4.3 ± 0.3	4.8 ± 0.9
31	4.2 ± 0.3	4.2 ± 0.2	4.5 ± 0.7	4.0 ± 0.3	4.2 ± 0.4
32	4.4 ± 0.4	5.1 ± 0.1	5.1 ± 0.7	4.5 ± 0.6	4.8 ± 0.8
33	5.2 ± 0.6	5.7 ± 0.2	6.5 ± 1.6	5.0 ± 1.6	5.6 ± 1.3
34	5.1 ± 0.4	6.7 ± 2.5	5.6 ± 0.5	4.9 ± 0.8	5.6 ± 1.6
35	5.1 ± 1.0	6.0 ± 0.3	5.8 ± 0.4	3.3 ± 0.3	5.1 ± 2.5
36	5.8 ± 0.6	6.0 ± 0.9	5.9 ± 0.6	5.5 ± 0.5	5.8 ± 0.4
37	5.3 ± 0.2	6.1 ± 0.7	5.3 ± 0.3	4.8 ± 0.4	5.4 ± 1.1
38	6.4 ± 1.1	6.7 ± 0.3	7.0 ± 1.0	6.4 ± 0.5	6.6 ± 0.6
39	4.9 ± 0.6	5.5 ± 0.4	5.2 ± 0.3	4.4 ± 0.8	5.0 ± 0.9
40	4.3 ± 0.2	4.4 ± 0.2	4.5 ± 0.1	4.0 ± 0.4	4.3 ± 0.4
41	5.3 ± 0.8	6.9 ± 1.1	6.1 ± 0.9	6.0 ± 0.4	6.1 ± 1.3
42	5.1 ± 0.7	4.7 ± 0.4	5.6 ± 0.3	4.8 ± 0.1	5.1 ± 0.8
43	4.9 ± 0.3	5.0 ± 0.6	5.1 ± 0.2	4.7 ± 0.5	4.9 ± 0.3
Average ± 2 s.d.	**5.1 ± 1.2**	**5.5 ± 1.5**	**5.4 ± 1.2**	**5.1 ± 1.6**	**5.3 ± 1.4**

(a) TLD missing; cause unknown. Replacement TLD placed in field from 6/15/94 to 7/7/94, however, results were not representative of quarter and not being reported.

TABLE B-16: DIRECT RADIATION MEASUREMENTS – QUARTERLY TLD RESULTS

Surry Nuclear Power Station, Surry County, Virginia - 1994

mR/month ± 2 Sigma - Set 2 - 099

Station Number	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Average ± 2 s.d.
02	5.8 ± 0.4	5.9 ± 0.2	5.4 ± 2.0	6.3 ± 0.6	5.9 ± 0.7
03	5.6 ± 1.2	5.7 ± 0.7	6.4 ± 0.2	6.7 ± 0.2	6.1 ± 1.1
04	4.9 ± 0.2	5.7 ± 0.2	4.8 ± 0.6	5.7 ± 0.5	5.3 ± 1.0
05	4.7 ± 0.4	(a)	5.2 ± 0.2	5.6 ± 0.2	5.2 ± 0.9
06	5.9 ± 0.3	5.8 ± 0.2	5.4 ± 1.4	5.8 ± 0.2	5.7 ± 0.4
07	5.2 ± 0.5	5.2 ± 0.2	5.1 ± 0.3	5.5 ± 0.6	5.3 ± 0.3
08	5.3 ± 0.4	5.7 ± 0.5	5.4 ± 0.2	5.7 ± 0.4	5.5 ± 0.4
09	5.1 ± 0.5	6.0 ± 0.3	5.5 ± 0.4	5.8 ± 0.8	5.6 ± 0.8
10	5.1 ± 0.1	5.3 ± 0.1	5.2 ± 0.4	5.6 ± 1.3	5.3 ± 0.4
11	4.9 ± 0.4	5.5 ± 0.3	5.8 ± 1.4	5.8 ± 0.1	5.5 ± 0.8
12	5.2 ± 0.3	5.5 ± 0.7	5.4 ± 0.5	5.3 ± 0.3	5.4 ± 0.3
13	5.2 ± 0.9	6.6 ± 2.9	4.9 ± 1.0	5.7 ± 0.2	5.6 ± 1.5
14	5.1 ± 0.7	5.6 ± 0.1	5.6 ± 0.5	5.5 ± 1.5	5.5 ± 0.5
15	4.9 ± 0.5	5.0 ± 0.6	4.7 ± 0.7	5.4 ± 0.2	5.0 ± 0.6
16	4.6 ± 1.0	4.8 ± 0.2	5.1 ± 0.1	5.5 ± 0.0	5.0 ± 0.8
17	4.2 ± 1.0	4.6 ± 0.1	4.6 ± 0.1	5.1 ± 0.1	4.6 ± 0.7
18	3.6 ± 0.5	3.8 ± 0.2	3.3 ± 1.0	4.4 ± 0.3	3.8 ± 0.9
19	4.5 ± 0.5	4.3 ± 0.7	4.5 ± 0.2	4.9 ± 0.4	4.6 ± 0.5
20	4.6 ± 0.1	4.3 ± 0.3	4.6 ± 0.2	4.8 ± 0.4	4.6 ± 0.4
21	4.3 ± 0.3	4.5 ± 0.3	4.8 ± 0.2	5.1 ± 0.5	4.7 ± 0.7
22	4.1 ± 0.4	4.2 ± 0.4	4.2 ± 0.1	5.0 ± 0.1	4.4 ± 0.8
23	5.1 ± 0.5	5.9 ± 0.5	5.0 ± 0.1	5.8 ± 0.1	5.5 ± 0.9
24	4.8 ± 0.5	4.5 ± 0.2	4.7 ± 0.2	5.5 ± 0.1	4.9 ± 0.9
25	4.8 ± 0.2	4.8 ± 0.2	4.9 ± 0.3	5.1 ± 0.2	4.9 ± 0.3
26	4.2 ± 0.5	4.4 ± 0.4	4.6 ± 0.1	4.8 ± 0.2	4.5 ± 0.5
27	4.4 ± 0.3	4.5 ± 0.2	4.9 ± 0.2	5.0 ± 0.1	4.7 ± 0.6
28	5.0 ± 0.2	4.2 ± 0.3	4.8 ± 0.2	4.8 ± 0.1	4.7 ± 0.7
29	3.7 ± 0.2	4.1 ± 0.2	4.3 ± 0.2	4.5 ± 0.1	4.2 ± 0.7
30	4.3 ± 0.3	4.3 ± 0.3	4.8 ± 0.1	4.9 ± 0.2	4.6 ± 0.6
31	3.9 ± 0.1	4.1 ± 0.2	4.2 ± 0.2	4.2 ± 0.1	4.1 ± 0.3
32	4.5 ± 0.2	3.9 ± 0.2	4.8 ± 0.1	4.9 ± 0.2	4.5 ± 0.9
33	4.7 ± 0.3	4.9 ± 0.3	5.4 ± 0.2	5.6 ± 0.3	5.2 ± 0.8
34	5.0 ± 0.1	5.0 ± 0.1	5.4 ± 0.0	5.2 ± 0.2	5.2 ± 0.4
35	5.4 ± 0.7	5.4 ± 0.4	5.8 ± 0.2	2.9 ± 0.3	4.9 ± 2.7
36	5.8 ± 0.5	5.1 ± 0.9	6.0 ± 0.4	5.9 ± 0.3	5.7 ± 0.8
37	5.1 ± 0.4	4.9 ± 0.3	5.2 ± 0.2	5.5 ± 0.6	5.2 ± 0.5
38	6.1 ± 0.9	6.6 ± 0.9	7.2 ± 0.8	7.1 ± 0.6	6.8 ± 1.0
39	4.6 ± 0.3	4.7 ± 0.1	5.1 ± 0.2	5.1 ± 0.1	4.9 ± 0.5
40	4.1 ± 0.4	3.9 ± 0.1	4.3 ± 0.2	4.6 ± 0.1	4.2 ± 0.6
41	5.1 ± 0.2	6.0 ± 0.5	6.5 ± 0.4	6.3 ± 0.3	6.0 ± 1.2
42	4.7 ± 0.5	4.7 ± 0.4	5.2 ± 0.3	5.2 ± 0.2	5.0 ± 0.6
43	4.7 ± 0.6	4.6 ± 0.1	4.1 ± 0.9	5.2 ± 0.2	4.7 ± 0.9
Average ± 2 s.d	**4.8 ± 1.1**	**5.0 ± 1.5**	**5.1 ± 1.4**	**5.3 ± 1.4**	**5.1 ± 1.4**

(a) TLD missing; cause unknown.

APPENDIX C
LAND USE CENSUS - 1994

LAND USE CENSUS[1]

Surry Nuclear Power Station, Surry County, Virginia

January 1 to December 31, 1994

Sector	Direction	Nearest Resident	Nearest Garden[2]	Nearest Cow	Nearest Goat
A	N	4.12 @ 8°	*	*	*
B	NNE	1.90 @ 34°	1.90 @ 34°	*	*
C	NE	4.80 @ 35°	4.91 @ 56°	*	*
D	ENE		4.91 @ 56°	*	*
E	E	*	*	*	*
F	ESE	*	*	*	*
G	SE	*	*	*	*
H	SSE	4.75 @ 152°	5.0 @ 160°	*	*
J	S	1.69 @ 182°	1.90 @ 189°	*	*
K	SSW	1.87 @ 193°	1.87 @ 193°	4.84 @ 201°	*
L	SW	2.28 @ 222°	3.65 @ 2.24°	*	*
M	WSW	2.82 @ 243°	3.57 @ 2.46°	*	*
N	W	3.15 @ 260°	4.14 @ 2.69°	*	*
P	WNW	4.79 @ 281°	*	*	*
Q	NW	4.84 @ 319°	*	*	*
R	NNW	3.73 @ 339°	4.89 @ 340°	3.65 @ 337°	*

* None

1 Locations shown by statute miles and degree heading relative to true north from radius center.

2 Area greater than 50 m^2, containing broad leaf vegetation.

APPENDIX D
SYNOPSIS OF ANALYTICAL PROCEDURES

ANALYTICAL PROCEDURES SYNOPSIS

Appendix D is a synopsis of the analytical procedures performed on samples collected for the Surry Power Station's Radiological Environmental Monitoring Program. All analyses have been mutually agreed upon by VEPCO and Teledyne Brown Engineering and include those recommended by the USNRC Branch Technical Position, Rev. 1, November 1979.

GROSS BETA ANALYSIS OF SAMPLES

Air Particulates

After a delay of five or more days, allowing for the radon-222 and radon-220 (thoron) daughter products to decay, the filters are counted in a gas-flow proportional counter. An unused air particulate filter, supplied by the customer, is counted as the blank.

Calculations of the results, the two sigma error and the lower limit of detection (LLD):

RESULT (pCi/m^3) = $((S/T) - (B/t))/(2.22\ V\ E)$

TWO SIGMA ERROR (pCi/m^3) = $2((S/T^2) + (B/t^2))^{1/2}/(2.22\ V\ E)$

LLD (pCi/m^3) = $4.66\ (B^{1/2})/(2.22\ V\ E\ t)$

where:

S	=	Gross counts of sample including blank
B	=	Counts of blank
E	=	Counting efficiency
T	=	Number of minutes sample was counted
t	=	Number of minutes blank was counted
V	=	Sample aliquot size (cubic meters)

ANALYSIS OF SAMPLES FOR TRITIUM

(Liquid Scintillation)

Water

Ten milliliters of water are mixed with 10 ml of a liquid scintillation "cocktail" and then the mixture is counted in an automatic liquid scintillator.

Calculation of the results, the two sigma error and the lower limit detection (LLD) in pCi/l:

RESULT = $(N-B)/(2.22\ V\ E)$

TWO SIGMA ERROR = $2((N + B)/\Delta t)^{1/2}/ (2.22\ V\ E)$

LLD = $4.66\ (B/\Delta t)^{1/2}/(2.22\ V\ E)$

where:

N	=	the gross cpm of the sample
B	=	the background of the detector in cpm
2.22	=	conversion factor changing dpm to pCi
V	=	volume of the sample in ml
E	=	efficiency of the detector
Δt	=	counting time for the sample

ANALYSIS OF SAMPLES FOR STRONTIUM-89 AND -90

Water

Stable strontium carrier is added to 1 liter of sample and the volume is reduced by evaporation. Strontium is precipitated as $Sr(NO_3)_2$ using nitric acid. A barium scavenge and an iron (ferric hydroxide) scavenge are performed followed by addition of stable yttrium carrier and a minimum of 5 day period for yttrium ingrowth. Yttrium is then precipitated as hydroxide, dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchette and is counted in a low level beta counter to infer Sr-90 activity. Strontium-89 activity is determined by precipitating $SrCO_3$ from the sample after yttrium separation. This precipitate is mounted on a nylon planchette and is covered with an 80 mg/cm^2 aluminum absorber for low level beta counting.

Milk

Stable strontium carrier is added to 1 liter of sample and the sample is first evaporated, then ashed in a muffle furnace. The ash is dissolved and strontium is precipitated as phosphate, then is dissolved and precipitated as $SrN0_3$ using fuming (90%) nitric acid. A barium chromate scavenge and an iron (ferric hydroxide) scavenge are then performed. Stable yttrium carrier is added and the sample is allowed to stand for a minimum of 5 days for yttrium ingrowth. Yttrium is then precipitated as hydroxide, dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchette and is counted in a low level beta counter to infer Sr-90 activity. Strontium-89 is determined by precipitating $SrC0_3$ from the sample after yttrium separation. This precipitate is mounted on a nylon planchette and is covered with an 80 mg/cm^2 aluminum absorber for low level beta counting.

Soil and Sediment

The sample is first dried under heat lamps and an aliquot is taken. Stable strontium carrier is added and the sample is leached in hydrachloric acid. The mixture is filtered and strontium is precipitated from the liquid portion as phosphate. Strontium is precipitated as $Sr(N0_3)_2$ using fuming (90& nitric acid. A barium chromate scavenge and an iron (ferric hydroxide) scavenge are then performed. Stable yttrium carrier is added and the sample is allowed to stand for a minimum of 5 days for yttrium ingrowth. Yttrium is then precipitated as hydroxide, dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchette and is counted in a low level beta counter to infer Sr-90 activity. Strontium-89 activity is determined by precipitating $SrC0_3$ from the sample after yttrium separation. This precipitate is mounted on a nylon planchette and is covered with an 80 mg/cm2 aluminum absorber for low level beta counting.

Organic Solids

A wet portion of the sample is dried and then ashed in a muffle furnace. Stable strontium carrier is added and the ash is leached in hydrochloric acid. The sample is filtered and strontium is precipitated from the liquid portion as phosphate. Strontium is precipitated as $Sr(N0_3)$ using fuming (90%) nitric acid. An iron (ferric hydroxide) scavenge is performed, followed by addition of stable yttrium carrier and a minimum of 5 days period for yttrium ingrowth. Yttrium is then precipitated as hydroxide, dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchette and is counted in a low level beta counter to infer strontium-90 activity. Strontium-89 activity is determined by precipitating $SrC0_3$ from the sample after yttrium separation. This precipitate is mounted on a nylon planchette and is covered with an 80 mg/cm^2 aluminum absorber for low level beta counting.

Air Particulates

Stable strontium carrier is added to the sample and it is leached in nitric acid to bring deposits into solution. The mixture is then filtered and the filtrate is reduced in volume by evaporation. Strontium is precipitated as $Sr(N0_3)_2$ using fuming (90%) nitric acid. A barium scavenge is used to remove some interfering species. An iron (ferric hydroxide) scavenge is performed, followed by addition of stable yttrium carrier and a 7 to 10 day period for yttrium ingrowth. Yttrium is then precipitated as hydroxide, dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchette and is counted in a low level beta counter to infer strontium-90 activity. Strontium-89 activity is determined by precipitating $SrC0_3$ from the sample after yttrium separation. This precipitate is mounted on a nylon planchette and is covered with 80 mg/cm^2 aluminum absorber for low level beta counting.

Calculations of the results, two sigma errors and lower limits of detection (LLD) are expressed in activity of pCi/volume or pCi/mass:

RESULT Sr-89 $= (N/Dt-B_C-B_A)/(2.22\ V\ Y_S\ DF_{SR-89}\ E_{SR-89})$

TWO SIGMA ERROR Sr-89 $= 2((N/Dt+B_C+B_A)/\Delta t)^{1/2}/(2.22\ V\ Y_S\ DF_{SR-89}\ E_{SR-89})$

LLD Sr-89 $= 4.66((B_C+B_A)/\Delta t)^{1/2}/(2.22\ V\ YS\ DF_{SR-89}\ E_{SR-89})$

RESULT Sr-90 $= (N/\Delta t - B)/(2.22\ V\ Y_1\ Y_2\ DF\ IF\ E)$

TWO SIGMA ERROR Sr-90 $= 2((N/\Delta t+B)/\Delta t)^{1/2}/(2.22\ V\ Y_1\ Y_2\ DF\ E\ IF))$

LLD Sr-90 $= 4.66(B/\Delta t)^{1/2}/(2.22\ V\ Y_1\ Y_2\ IF\ DF\ E)$

WHERE:

N	=	total counts from sample (counts)
Δt	=	counting time for sample (min)
B_C	=	background rate of counter (cpm) using absorber configuration
2.22	=	dpm/pCi
V	=	volume or weight of sample analyzed
B_A	=	background addition from Sr-90 and ingrowth of Y-90
B_A	=	$0.016\ (K) + (K)\ E_{Y/abs})\ (IG_{Y-90})$
Y_S	=	chemical yield of strontium
DF_{SR-89}	=	decay factor from the mid collection date to the counting date for SR-89
E_{SR-89}	=	efficiency of the counter for SR-89 with the 80 mg/cm.sq. aluminum absorber
K	=	$(N\Delta t - B_{C)Y-90}/(E_{Y-90}\ IF_{Y-90}\ DF_{Y-90}Y_1)$
$DF_{Y-90})$	=	the decay factor for Y-90 from the "milk" time to the mid count time
E_{Y-90}	=	efficiency of the counter for Y-90
IF_{Y-90}	=	ingrowth factor for Y-90 from scavenge time to milking time
IG_{Y-90}	=	the ingrowth factor for Y-90 into the strontium mount from the "milk" time to the mid count time
0.016	=	the efficiency of measuring SR-90 through a No. 6 absorber
$EY_{/abs}$	=	the efficiency of counting Y-90 through a No. 6 absorber
B	=	background rate of counter (cpm)
Y_1	=	chemical yield of yttrium
Y_2	=	chemical yield of strontium
DF	=	decay factor of yttrium from the radiochemical milking time to the mid count time
E	=	efficiency of the counter for Y-90
IF	=	ingrowth factor for Y-90 from scavenge time to the radio-chemical milking time

ANALYSIS OF SAMPLES FOR IODINE-131

Milk or Water

Two liters of sample are first equilibrated with stable iodide carrier. A batch treatment with anion exchange resin is used to remove iodine from the sample. The iodine is then stripped from the resin with sodium hypochlorite solution, is reduced with hydroxylamine hydrochloride and is extracted into carbon tetrachloride as free iodine. It is then back-extracted as iodide into sodium bisulfite solution and is precipitated as palladium iodide. The sodium bisulfite solution and is precipitated as palladium iodide. The precipitate is weighed for chemical yield and is mounted on a nylon planchette for low level beta counting. The chemical yield is corrected by measuring the stable iodide content of the milk or the water with a specific ion electrode.

Calculations of results, two sigma error and the lower limit of detection (LLD) in pCi/l:

RESULT		=	$(N/\Delta t-B)/(2.22\ E\ V\ Y\ DF)$
TWO SIGMA ERROR		=	$2((N/\Delta t+B)/\Delta t)^{1/2}/(2.22\ E\ V\ Y\ DF)$
LLD		=	$= 4.66(B/\Delta t)^{1/2}/(2.22\ E\ V\ Y\ DF)$
where:	N	=	total counts from sample (counts)
	Δt	=	counting time for sample (min)
	B	=	background rate of counter (cpm)
	2.22	=	dpm/pCi
	V	=	volume or weight of sample analyzed
	Y	=	chemical yield of the mount or sample counted
	DF	=	decay factor from the collection to the counting date
	E	=	efficiency of the counter for I-131, corrected for self absorption effects by the formula
	E	=	$E_s(\exp-0.0061M)/(\exp-0.0061M_s)$
	E_s	=	efficiency of the counter determined from an I-131 standard mount
	Ms	=	mass of $Pd1_2$ on the standard mount, mg
	M	=	mass of PDI_2 on the sample mount, mg

GAMMA SPECTROMETRY OF SAMPLES

Milk and Water

A 1.0 liter Marinelli beaker is filled with a representative aliquot of the sample. The sample is then counted for approximately 1000 minutes with a shielded Ge(Li) detector coupled to a mini-computer-based data acquisition system which performs pulse height analysis.

Dried Solids Other Than Soils and Sediments

A large quantity of the sample is dried at a low temperature, less than 100°C. As much as possible (up to the total sample) is loaded into a tared 1-liter Marinelli and weighed. The sample is then counted for approximately 1000 minutes with a shielded Ge(Li) detector coupled to a mini-computer-based data acquisition system which performs pulse height analysis.

Fish

As much as possible (up to the total sample) of the edible portion of the sample is loaded into a tared Marinelli and weighed. The sample is then counted for approximately 1000 minutes with a shielded Ge(Li) detector coupled to a mini-computer-based data acquisition system which performs pulse height analysis.

Soils and Sediments

Soils and sediments are dried at a low temperature, less than 100°C. The soil or sediment is loaded fully into a tared, standard 300 cc container and weighed. The sample is then counted for approximately six hours with a shielded Ge(Li) detector coupled to a mini-computer-based data acquisition system which performs pulse height and analysis.

Charcoal Cartridges (Air Iodine)

Charcoal cartridges are counted up to five at a time, with one positioned on the face of a Ge(Li) detector and up to four on the side of the Ge(Li) detector. Each Ge(Li) detector is calibrated for both positions. The detection limit for I-131 of each charcoal cartridge can be determined (assuming no positive I-131) uniquely from the volume of air which passed through it. In the event I-131 is observed in the initial counting of a set, each charcoal cartridge is then counted separately, positioned on the face of the detector.

Air Particulate

The thirteen airborne particulate filters for a quarterly composite for each field station are aligned one in front of another and then counted for at least six hours with a shielded Ge(Li)

detector coupled to a mini-computer-based data acquisition system which performs pulse height analysis.

A mini-computer software program defines peaks by certain changes in the slope of the spectrum. The program also compares the energy of each peak with a library of peaks for isotope identification and then performs the radioactivity calculation using the appropriate fractional gamma ray abundance, half life, detector efficiency, and net counts in the peak region. The calculation of results, two sigma error and the lower limit of detection (LLD) in pCi/volume of pCi/mass:

RESULT		=	(S-B)/(2.22 t E V F DF)
TWO SIGMA ERROR		=	$2(S+B)^{1/2}/(2.22\ t\ E\ V\ F\ DF)$
LLD		=	$4.66(B)^{1/2}/(2.22\ t\ E\ V\ F\ DF)$
where:	S	=	Area, in counts, of sample peak and background (region of spectrum of interest)
	B	=	Background area, in counts, under sample peak, determined by a linear interpolation of the representative backgrounds on either side of the peak
	t	=	length of time in minutes the sample was counted
	2.22	=	dpm/pCi
	E	=	detector efficiency for energy of interest and geometry of sample
	V	=	sample aliquot size (liters, cubic meters, kilograms, or grams)
	F	=	fractional gamma abundance (specific for each emitted gamma)
	DF	=	decay factor from the mid-collection date to the counting date

ENVIRONMENTAL DOSIMETRY

Teledyne Brown Engineering uses a $CaSO_4$:Dy thermoluminescent dosimeter (TLD) which the company manufactures. This material has a high light output, negligible thermally induced signal loss (fading), and negligible self dosing. The energy response curve (as well as all other features) satisfies NRC Reg. Guide 4.13. Transit doses are accounted for by use of separate TLDs.

Following the field exposure period the TLDs are placed in a Teledyne Brown Engineering Model 8300. One fourth of the rectangular TLD is heated at a time and the measured light emission (luminescence) is recorded. The TLD is then annealed and exposed to a known Cs-137 dose; each area is then read again. This provides a calibration of each area of each TLD after every field use. The transit controls are read in the same manner.

Calculations of results and the two sigma error in net milliRoentgen (mR):

RESULT = $D = (D_1+D_2+D_3+D_4)/4$

TWO SIGMA ERROR = $2((D_1-D)^2+(D_2-D)^2+(D_3-D)^2+(D_4-D)^2)/3)^{1/2}$

WHERE:

D_1	=	the net mR of area 1 of the TLD, and similarly for D_2, D_3, and D_4
D1	=	I_1 K/R_1 - A
I_1	=	the instrument reading of the field dose in area 1
K	=	the known exposure by the Cs-137 source
R_1	=	the instrument reading due to the Cs-137 dose on area 1
A	=	average dose in mR, calculated in similar manner as above, of the transit control TLDs
D	=	the average net mR of all 4 areas of the TLD.

APPENDIX E
EPA INTERLABORATORY COMPARISON PROGRAM

EPA Interlaboratory Comparison Program

Teledyne Brown Engineering participates in the US EPA Interlaboratory Comparison Program to the fullest extent possible. That is, Teledyne participates in the program for all radioactive isotopes prepared and at the maximum frequency of availability. In this section trending graphs (since 1981) and the 1994 data summary tables are presented for isotopes in the various sample media applicable to the Surry Power Station's Radiological Environmental Monitoring Program. The footnotes of the table discuss investigations of problems encountered in a few cases and the steps taken to prevent reoccurrence.

VEPCO - SURRY

EPA INTERLABORATORY COMPARISON PROGRAM 1994

EPA Preparation	Date TI Mailed Re sults	Date EPA Issued Results	Media	Nuclide	EPA Results(a)	TI Results(b)	Norm Dev. (Known)(c)	**Warning ***Action
01/14/94	03/04/94	05/13/94	Water	Sr-89	25.0 ± 5.0	24.00 ± 1.00	-0.35	
				Sr-90	15.0 ± 5.0	15.67 ± 1.53	0.23	
01/28/94	02/25/94	04/12/94	Water	Gr-Alpha	15.0 ± 5.0	21.67 ± 0.58	2.31	** (d)
				Gr-Beta	62.0 ± 10.0	72.33 ± 3.79	1.79	
02/04/94	03/04/94	04/26/94	Water	I-131	119.0 ± 12.0	110.33 ± 0.00	-1.30	
02/11/94	04/14/94	05/23/94	Water	Ra-226	19.9 ± 3.0	21.00 ± 1.00	0.64	
				Ra-228	14.7 ± 3.7	15.67 ± 1.53	0.45	
03/04/94	03/31/94	05/13/94	Water	H-3	4936.0 ± 494.0	4833.33 ± 152.75	-0.36	
04/19/94	06/13/94	08/02/94	Water	Gr-Beta	117.0 ± 18.0	102.67 ± 6.43	-1.38	
				Sr-89	20.0 ± 5.0	19.00 ± 1.00	-0.35	
				Sr-90	14.0 ± 5.0	13.00 ± 0.00	-0.35	
				Co-60	20.0 ± 5.0	23.67 ± 3.21	1.27	
				Cs-134	34.0 ± 5.0	34.00 ± 1.73	0.00	
				Cs-137	29.0 ± 5.0	34.00 ± 2.65	1.73	
				Gr-Alpha	86.0 ± 22.0	78.00 ± 3.00	-0.63	
				Ra-226	20.0 ± 3.0	15.67 ± 1.53	-2.50	** (e)
				Ra-228	20.1 ± 5.0	15.33 ± 0.58	-1.65	
06/10/94	07/15/94	10/31/94	Water	Co-60	50.0 ± 5.0	43.00 ± 2.00	-2.42	** (f)
				Zn-65	134.0 ± 13.0	13.33 ± 0.58	-16.08	*** (g)
				Ru-106	252.0 ± 25.0	201.33 ± 9.29	-3.51	*** (h)
				Cs-134	40.0 ± 5.0	29.33 ± 3.79	-3.70	*** (i)
				Cs-137	49.0 ± 5.0	49.67 ± 1.53	0.23	
				Ba-133	98.0 ± 10.0	85.00 ± 3.00	-2.25	** (j)
06/17/94	08/10/94	10/03/94	Water	Ra-226	15.0 ± 2.3	15.33 ± 0.58	0.25	
				Ra-228	15.4 ± 3.9	16.33 ± 1.53	0.41	
07/22/94	08/19/94	10/14/94	Water	Gr-Alpha	32.0 ± 8.0	25.33 ± 2.89	-1.44	
				Gr-Beta	10.0 ± 5.0	16.00 ± 0.00	2.08	** (k)
08/05/94	08/29/94	10/24/94	Water	H-3	9951.0 ± 995.0	9700.00 ± 100.04	-0.44	

VEPCO - SURRY

EPA INTERLABORATORY COMPARISON PROGRAM 1994

EPA Preparation	Date TI Mailed Re sults	Date EPA Issued Results	Media	Nuclide	EPA Results(a)	TI Results(b)	Norm Dev. (Known)	**Warning ***Action
08/26/94	11/14/94	12/23/94	Air Filter	Gr-Alpha	35.0 ± 9.0	31.33 ± 2.08	-0.71	
				Gr-Beta	56.0 ± 10.0	59.33 ± 3.21	0.58	
				Sr-90	20.0 ± 5.0	18.00 ± 1.00	-0.69	
				Cs-137	15.0 ± 5.0	17.00 ± 1.73	0.69	
09/16/94	11/11/94	09/16/94	Water	U	10.2 ± 2.6	9.70 ± 0.52	2.12	** (l)
				Ra-226	10.0 ± 1.5	10.67 ± 0.58	0.77	
				Ra-228	10.2 ± 2.6	9.70 ± 0.52	-0.33	
09/30/94	12/08/94	02/06/95	Milk	Sr-89	25.0 ± 5.0	24.33 ± 2.52	-0.23	
				Sr-90	15.00 ± 5.0	17.67 ± 1.53	0.92	
				I-131	75.0 ± 8.0	81.67 ± 5.86	1.44	
				Cs-137	59.0 ± 5.0	70.33 ± 4.62	3.93	*** (m)
				K	1715.0 ± 86.0	1740.00 ± 153.95	0.50	
10/07/94	11/15/94	12/23/94	Water	I-131	79.0 ± 8.0	71.00 ± 3.00	-1.73	
10/18/94	12/20/94	03/03/95	Water	Gr-Beta	142.0 ± 21.0	120.00 ± 0.00	-1.81	
				Sr-89	25.0 ± 5.0	24.67 ± 2.08	-0.12	
				Sr-90	15.0 ± 5.0	14.33 ± 1.15	-0.23	
				Co-60	40.0 ± 5.0	41.00 ± 1.00	0.35	
				Cs-134	20.0 ± 5.0	21.67 ± 1.53	0.58	
				Cs-137	39.0 ± 5.0	41.67 ± 2.31	0.92	
				Gr-Alpha	57.0 ± 14.0	51.33 ± 1.53	-0.70	
				Ra-226	9.9 ± 1.5	11.33 ± 0.58	1.66	
				Ra-228	10.1 ± 2.5	9.33 ± 0.58	-0.53	
10/28/94	12/08/94	02/15/95	Water	Gr-Alpha	57.0 ± 14.0	47.00 ± 3.00	-1.24	
				Gr-Beta	23.0 ± 5.0	25.33 ± 1.53	0.81	
11/04/94	12/30/94	02/13/95	Water	Co-60	59.0 ± 5.0	52.00 ± 0.00	-2.42	** (n)
				Zn-65	100.0 ± 10.0	81.33 ± 7.02	-3.23	*** (n)
				Cs-134	24.0 ± 5.0	19.67 ± 2.52	-1.50	
				Cs-137	49.0 ± 5.0	54.33 ± 2.31	1.85	
				Ba-133	73.0 ± 7.0	58.33 ± 2.89	-3.63	*** (n)

Footnotes:

(a) Average ± experimental sigma.

(b) Expected laboratory precision (1 sigma, 1 determination)

(c) Normalized deviation from the known.

EPA Preparation	Date TI Mailed Re sults	Date EPA Issued Results	Media	Nuclide	EPA Results(a)	TI Results(b)	Norm Dev. (Known)	**Warning ***Action

Footnotes: (Cont.)

(d) There appears to be variation in self-absorption matrix. The EPA confirms that the composition of their tap water from Lake Mead, varies seasonally which can cause variation in alpha, beta results. No corrective action required at this time since results are within ± 3 sigma control limits.

(e) No specific or apparent reason found. Data sheets verified and detector efficiencies calibrated. Will exert care in making dilutions and using correct sample type on concentration of acids. Will check future samples to see if a pattern develops.

(f) A second aliquot was analyzed, paying particular attention to volume aliquoted. The result, 52 pCi/l, was in good agreement with the EPA. The three original results, each counted on a different detector, showed good precision. The measurement of Co-60 has not been a problem. Future EPA cross-checks will be weighted and results followed to check for a possible trend "out of control".

(g) The average value of three analyses on the "Report of Analysis" was 133 pCi/liter which is in good agreement with the EPA. Apparently, incorrect results were entered into the EPA computer. Future data will be printed from the computer screen to check entries.

(h) The EPA has indicated that the Radiation Quality Assurance Program has been experiencing problems with the ruthenium-106 analysis. See attached letter from EPA.

(i) The first aliquot, prepared according to EPA dilution instructions was counted on four detectors in the 1 liter Marinelli geometry with Cs-134 results (based on the 796 KeV peak) in pCi/l of 32.0, 25.1, 31.7, and 30.8. The 31.7 result was not reported. Had that been reported instead of 25.1, the average would have been 31.5 and the normalized deviation would have been -2.94 instead of -3.70. A second aliquot was prepared and a single measurement was made with the result of 31.1 pCi/l. An undiluted aliquot was measured in a 150 ml geometry with the result of 33.5 pCi/l. That result is comparable with the Marinelli results. Thus none of: sample preparation (dilution, volume determination, maintaining correct pH, etc.), sample geometry, or detector efficiency seem to be the cause of the low results.

(j) There is no apparent reason for the low result, however the average value, 85 pCi/l is in good agreement to the grand average (86.46). No corrective action planned.

(k) EPA result for gross beta in water were corrected for 20% crosstalk into the beta channel from the Th-230 alpha spike. Recent measurements show that the crosstalk can be much higher (37% for Tennelec counter #3 and 54% for gamma products counter #1). The normalized deviation from the grand average was only 0.38. Future results will be corrected with specific crosstalk values determined by counting Th-230 standards.

(l) Possible aliquoting error. The instrument calibration, spike, and blank results all appear normal. No procedural changes are planned. Previous results were well within one normalized deviation. Future measurements will be reviewed to determine if a trend in results above the two sigma warning limit is occurring.

(m) The milk sample was counted four times. The reported Cs-137 values were based on one aliquot of 1 liter volume and an aliquot of 0.865 liter counted two times. It is suspected that the 0.865 liter volume was incorrectly determined. If 1 liter (the usual volume for counting milk samples) is used in the calculation, then the average of three results equals 63.6 pCi/l which gives a normalized deviation to the Known of 1.59. The fourth count (a 1 liter aliquot) had a Cs-137 equal to 64.2 pCi/l which is in good agreement with the average of the other three. Teledyne will set up a log for recording aliquots used for EPA samples and record how the aliquot volume was determined.

(n) The EPA requires that water samples be diluted before gamma analysis. That imposes a feature not appropriate for the handling of environmental samples. As in the 06/10/94 water sample, it appears that the first aliquot may not have been accurately prepared. A second aliquot was prepared and counted three times with results in pCi/l and normalized deviation of:

Co-60	60.6	+0.55
Zn-65	100.	0.0
Cs-134	22.9	-0.38
Cs-137	58.5	+3.29
Ba-133	69.8	-0.79

Four of the five are now in good agreement with the EPA results. The Cs-137 is high, but within the control limits when compared to the grand average deviation of all laboratories of 2.89. The grand average was 51.9 pCi/l. For future samples of this type we will have two technicians each prepare an aliquot and compare the counting results to check for preparation technique differences.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL MONITORING SYSTEMS LABORATORY-LAS VEGAS
P O BOX 93478
LAS VEGAS NEVADA 89193-3478
(702/798-2100 · FTS 545-2100)

Dear Participant:

The Radiation Quality Assurance Program has been experiencing problems with the Ruthenium-106 currently used in the Performance Evaluation (PE) Studies and in the Standards Distribution Program. If these problems can be satisfactorily resolved, this analyte will once again be placed into this PE Study. If the problems cannot be resolved, the Ruthenium-106 will be replaced.

Formal written notice will be given to all participants that are enrolled in the Gamma in Water PE Study before the Ruthenium-106 is reintroduced or replaced. At that time, new calibration standards will be available to all participants in the Gamma in Water PE Study.

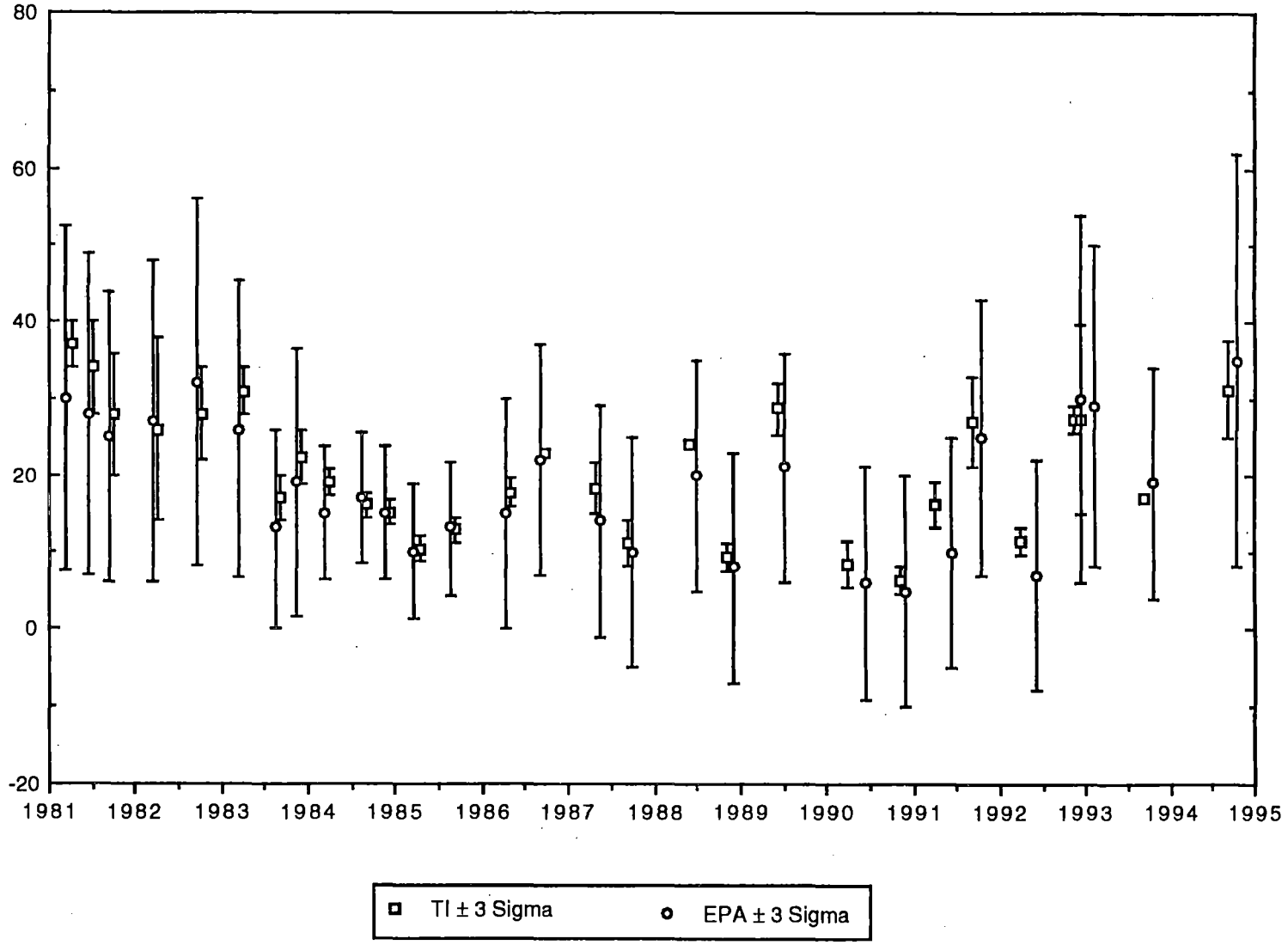
Sincerely,

George Dilbeck

George Dilbeck
Chemist
Performance Evaluation Program
Radioanalysis Branch (RSA-RADQA)

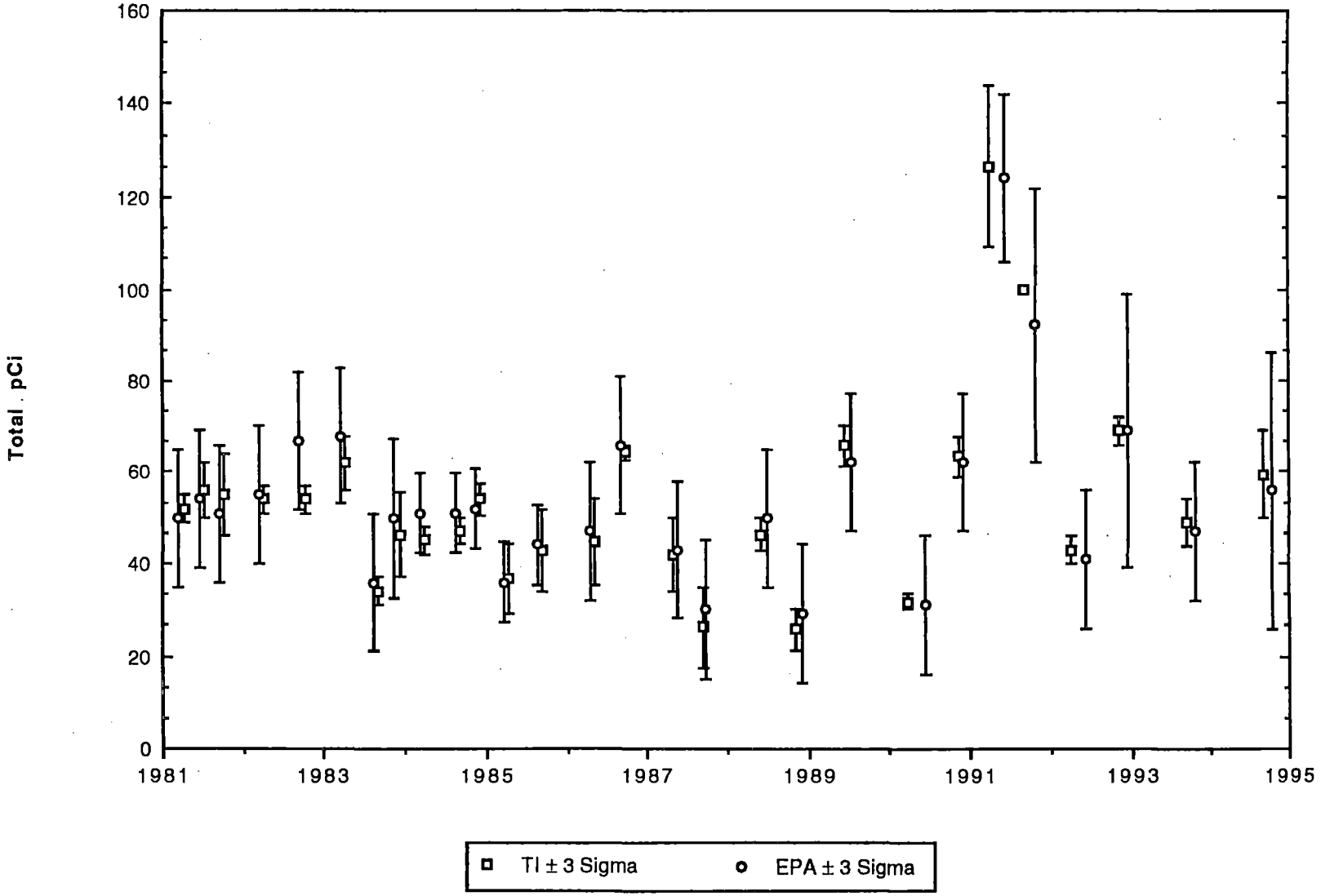
EPA CROSS CHECK PROGRAM

GROSS ALPHA IN AIR PARTICULATES (pg. 1 of 1)



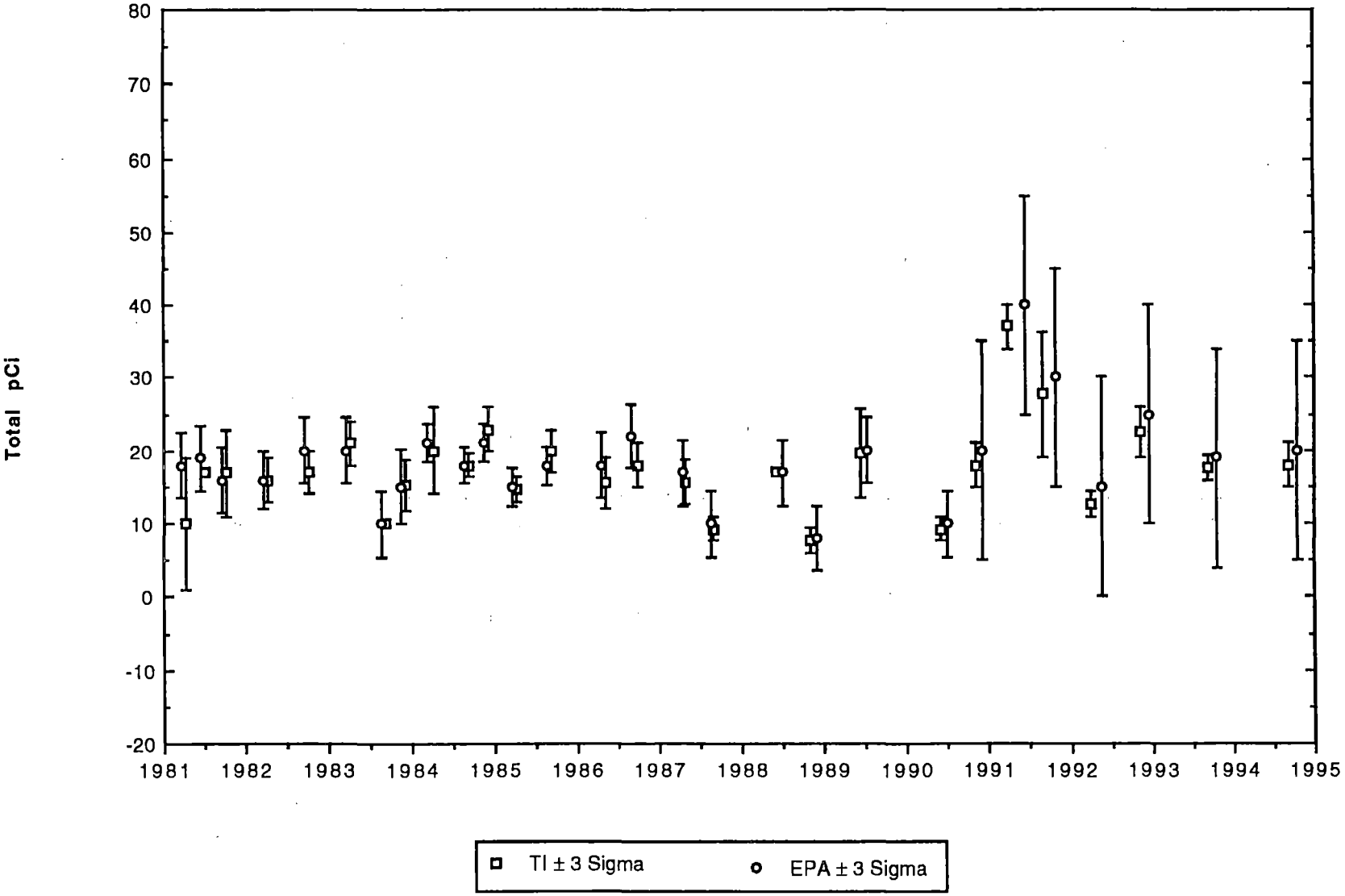
EPA CROSS CHECK PROGRAM

GROSS BETA IN AIR PARTICULATES (pg. 1 of 1)



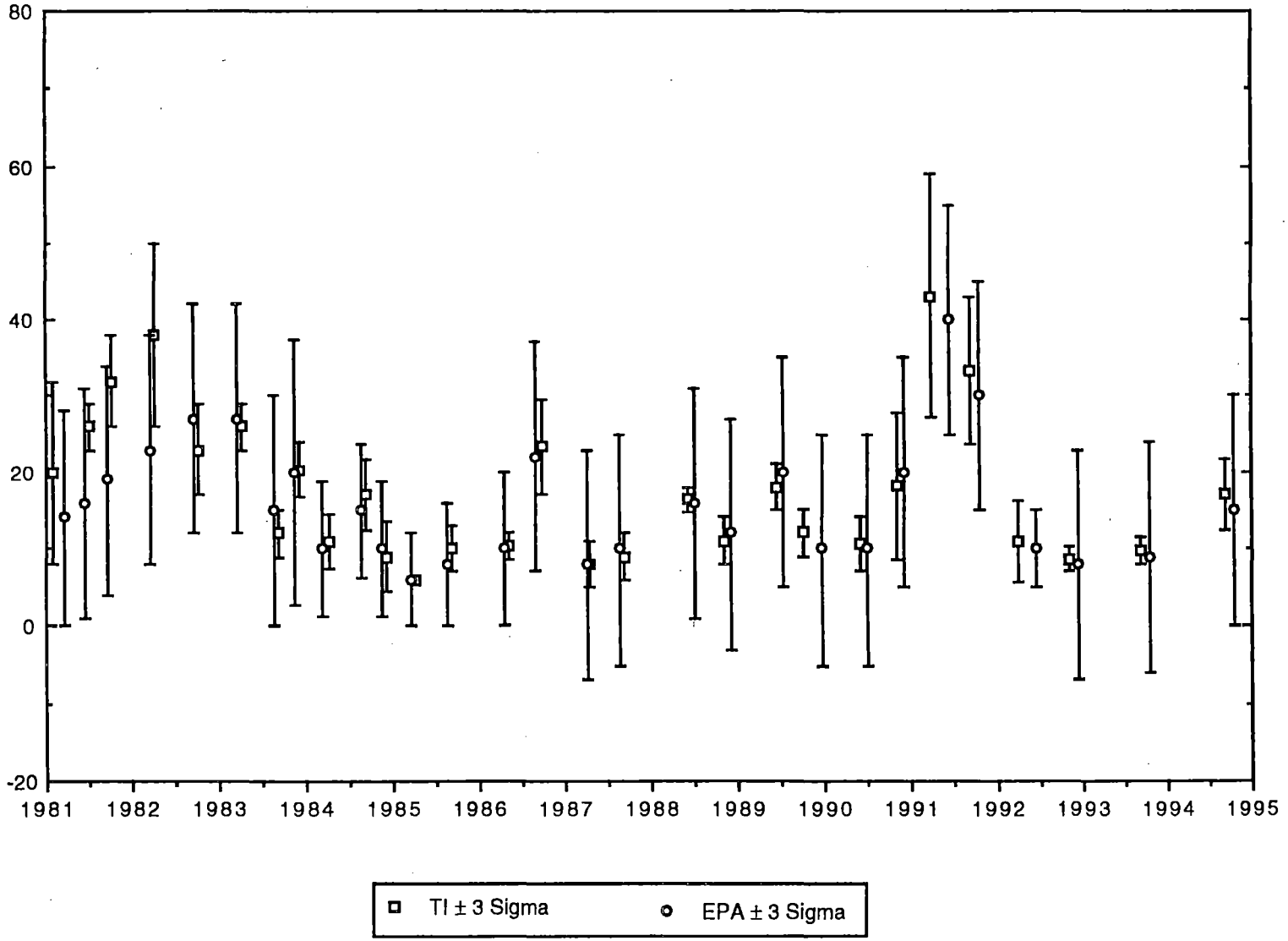
EPA CROSS CHECK PROGRAM

STRONTIUM-90 IN AIR PARTICULATES (pg. 1 of 1)



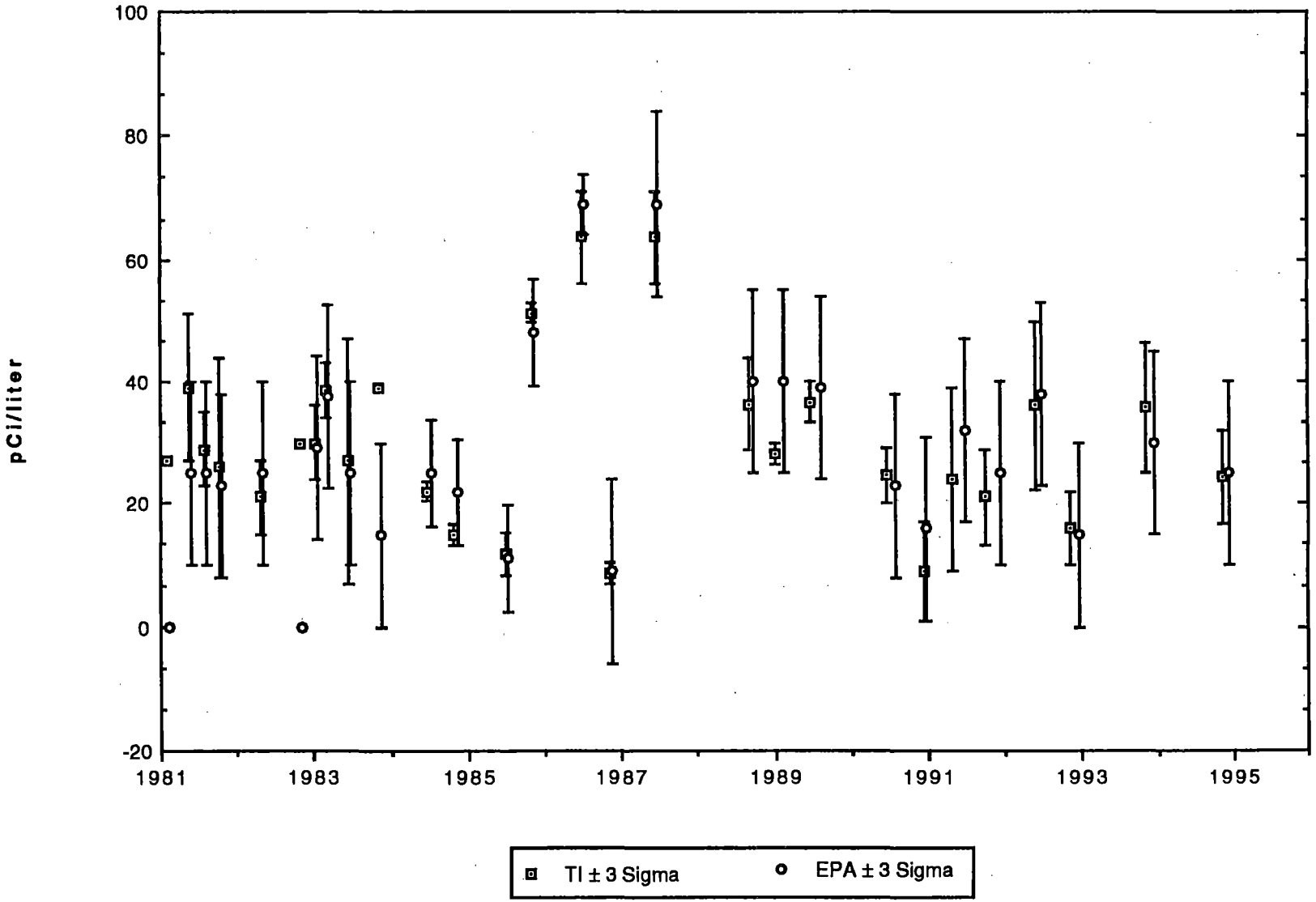
EPA CROSS CHECK PROGRAM

CESIUM-137 IN AIR PARTICULATES (pg. 1 of 1)



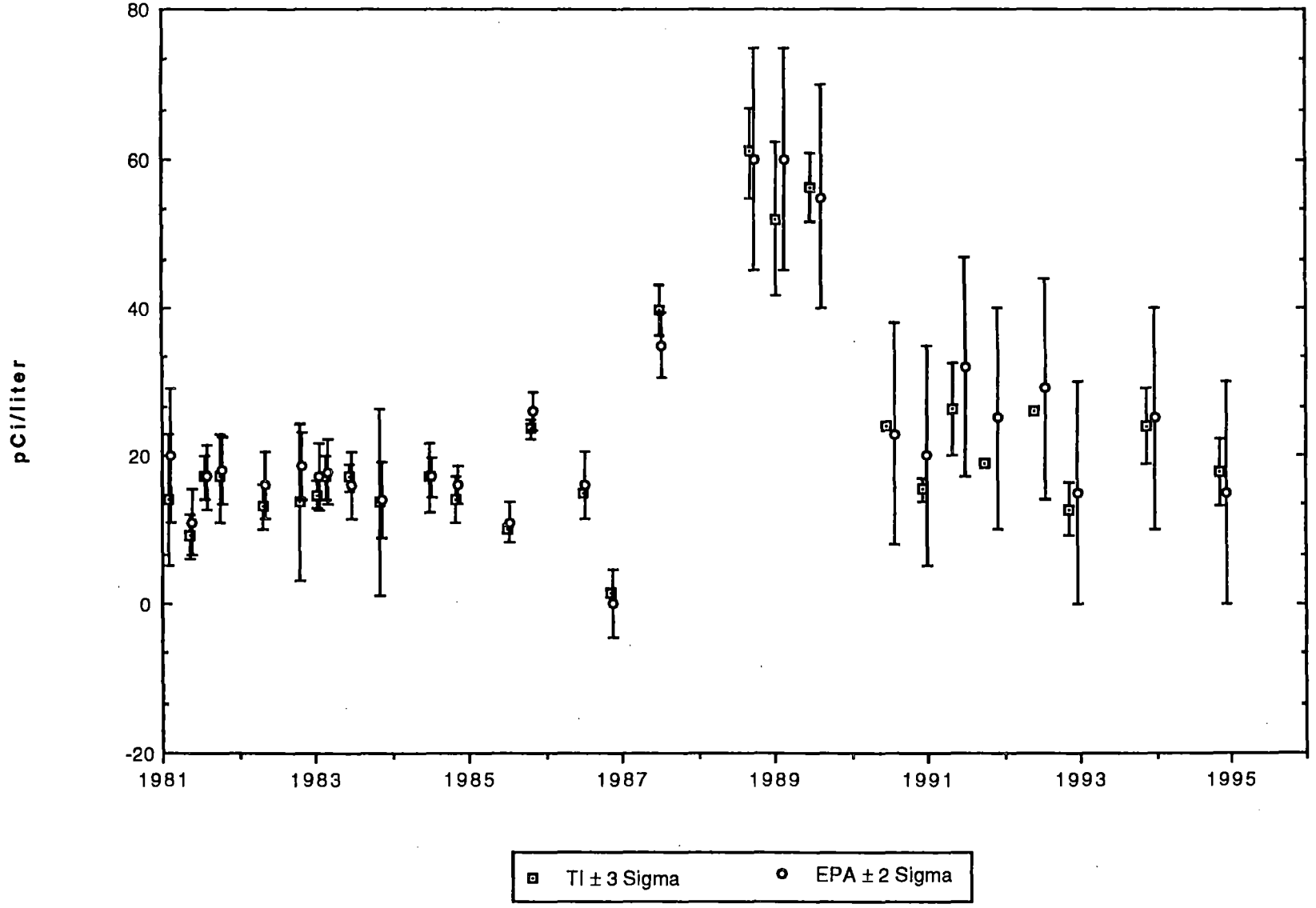
EPA CROSS CHECK PROGRAM

STRONTIUM-89 IN MILK (pg. 1 of 1)



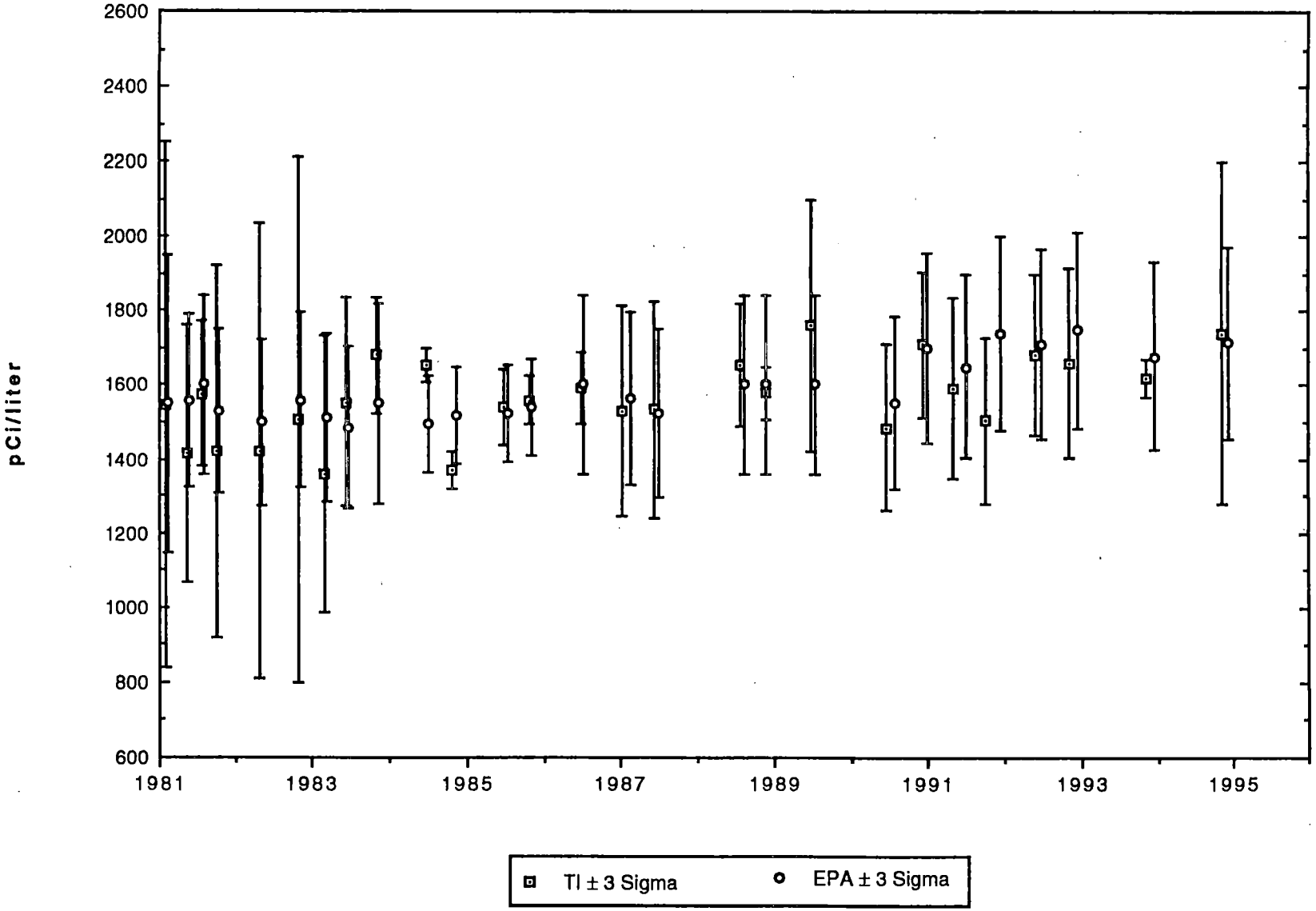
EPA CROSS CHECK PROGRAM

STRONTIUM-90 IN MILK (pg. 1 of 1)



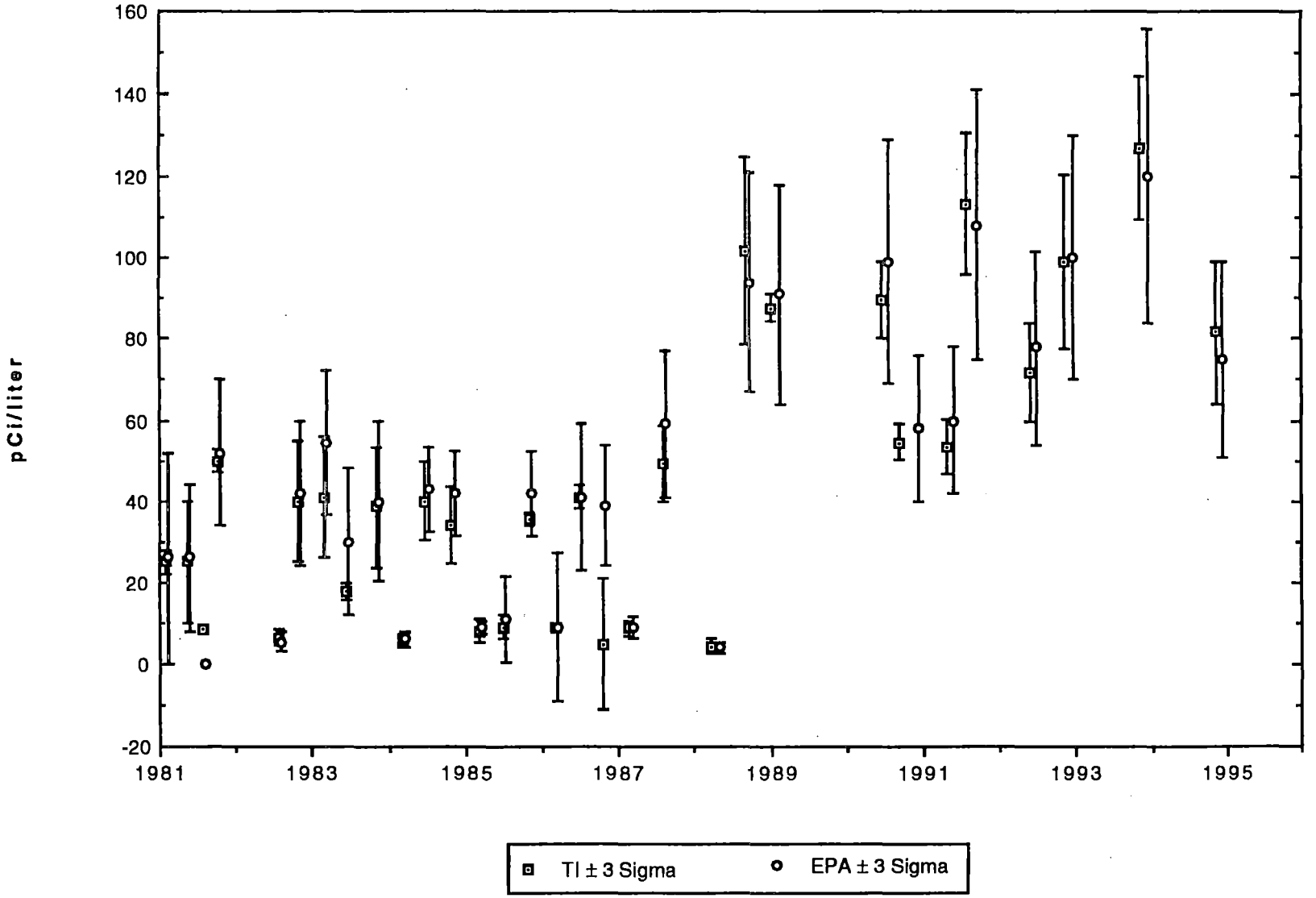
EPA CROSS CHECK PROGRAM

POTASSIUM-40 IN MILK (pg. 1 of 1)



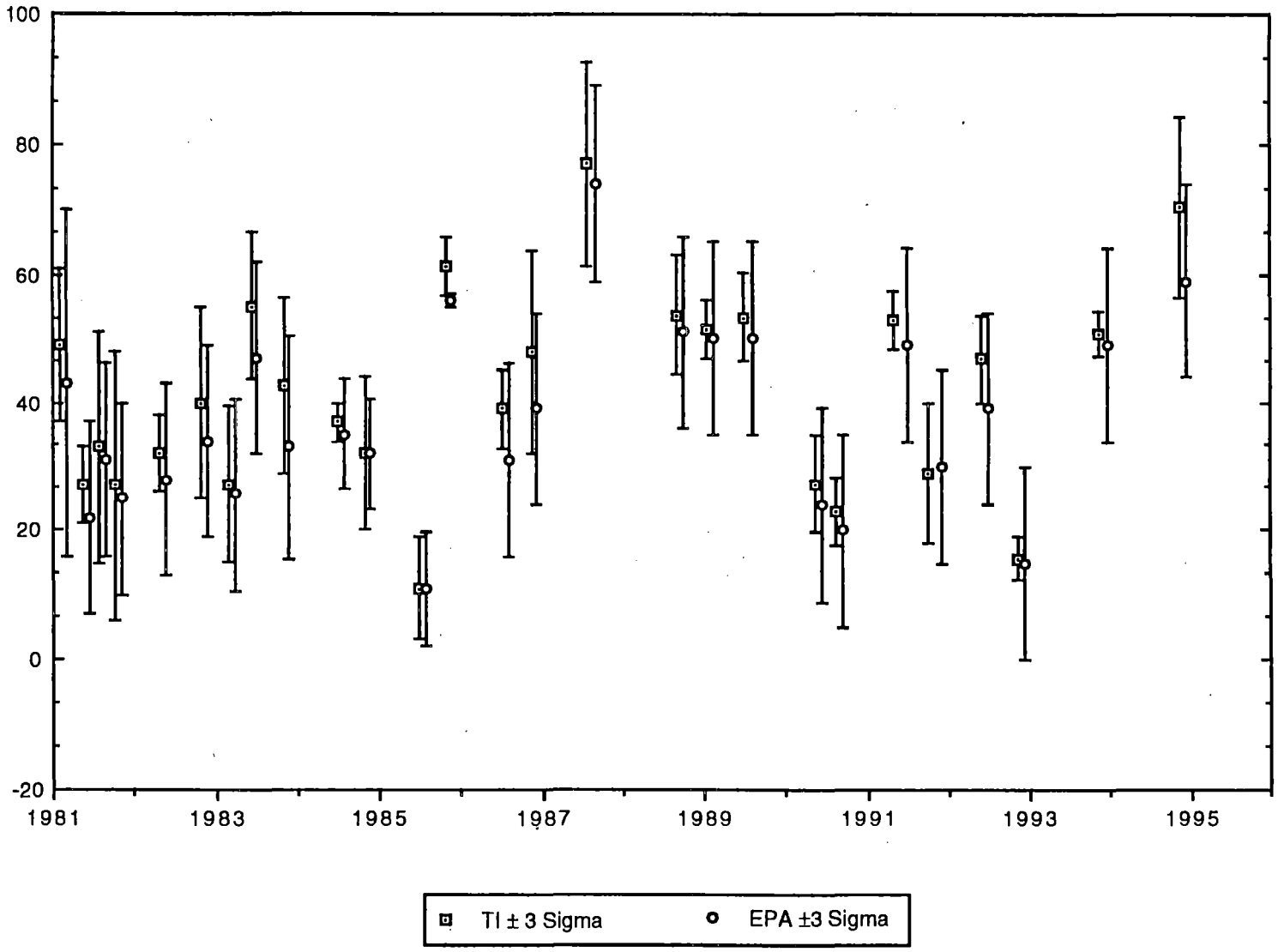
EPA CROSS CHECK PROGRAM

IODINE-131 IN MILK (pg. 1 of 1)



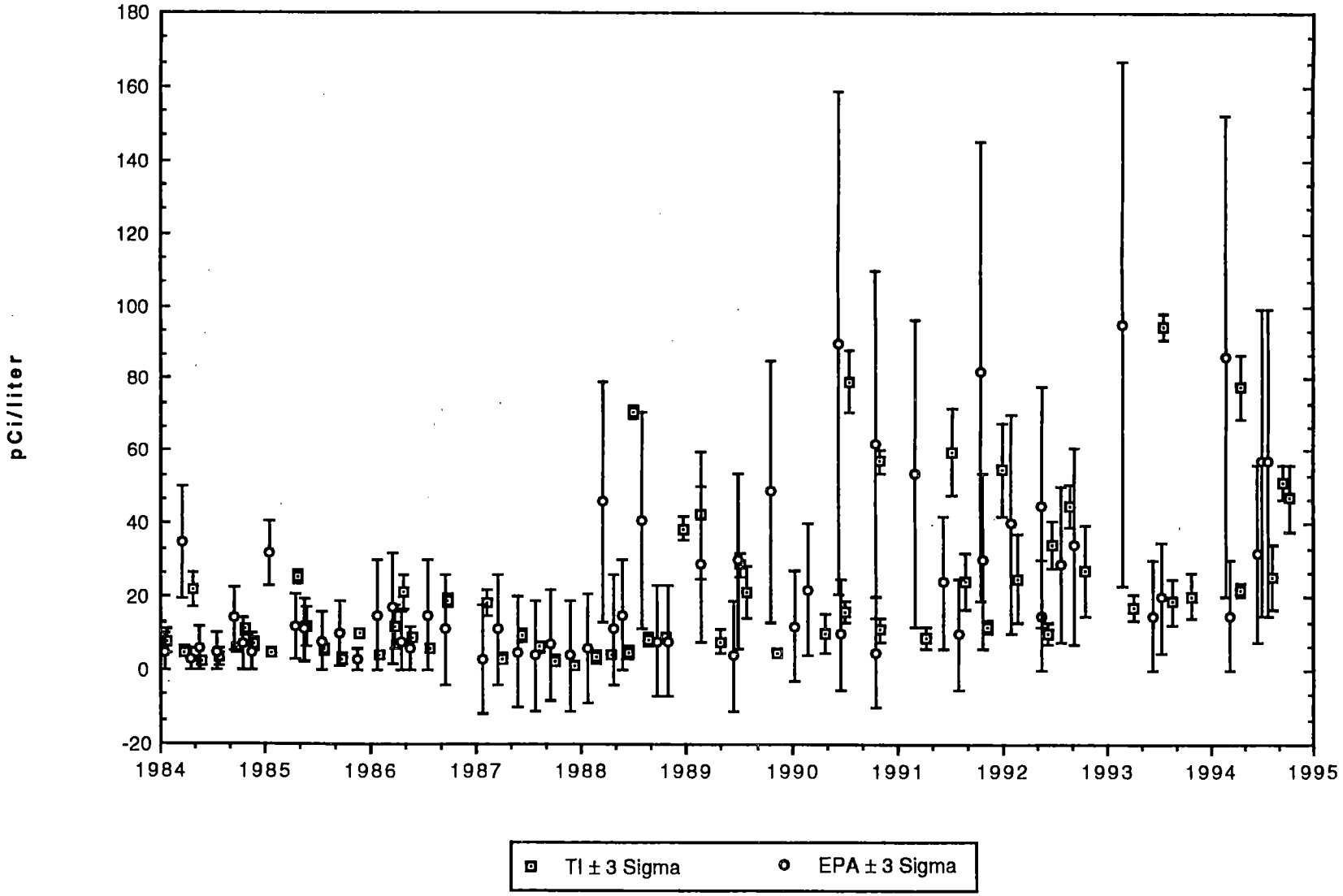
EPA CROSS CHECK PROGRAM

CESIUM-137 IN MILK (pg. 1 of 1)



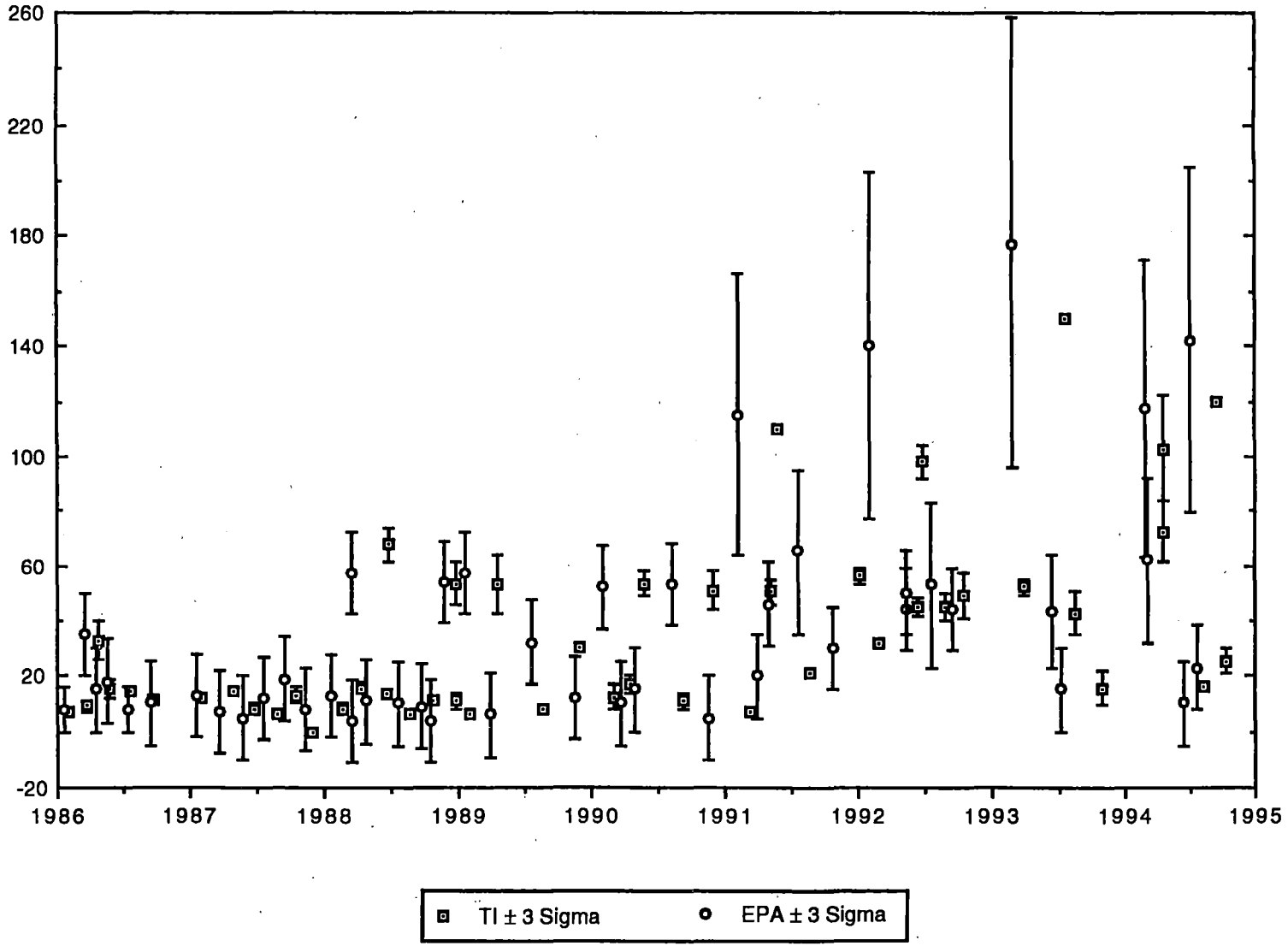
EPA CROSS CHECK PROGRAM

GROSS ALPHA IN WATER (pg. 1 of 1)



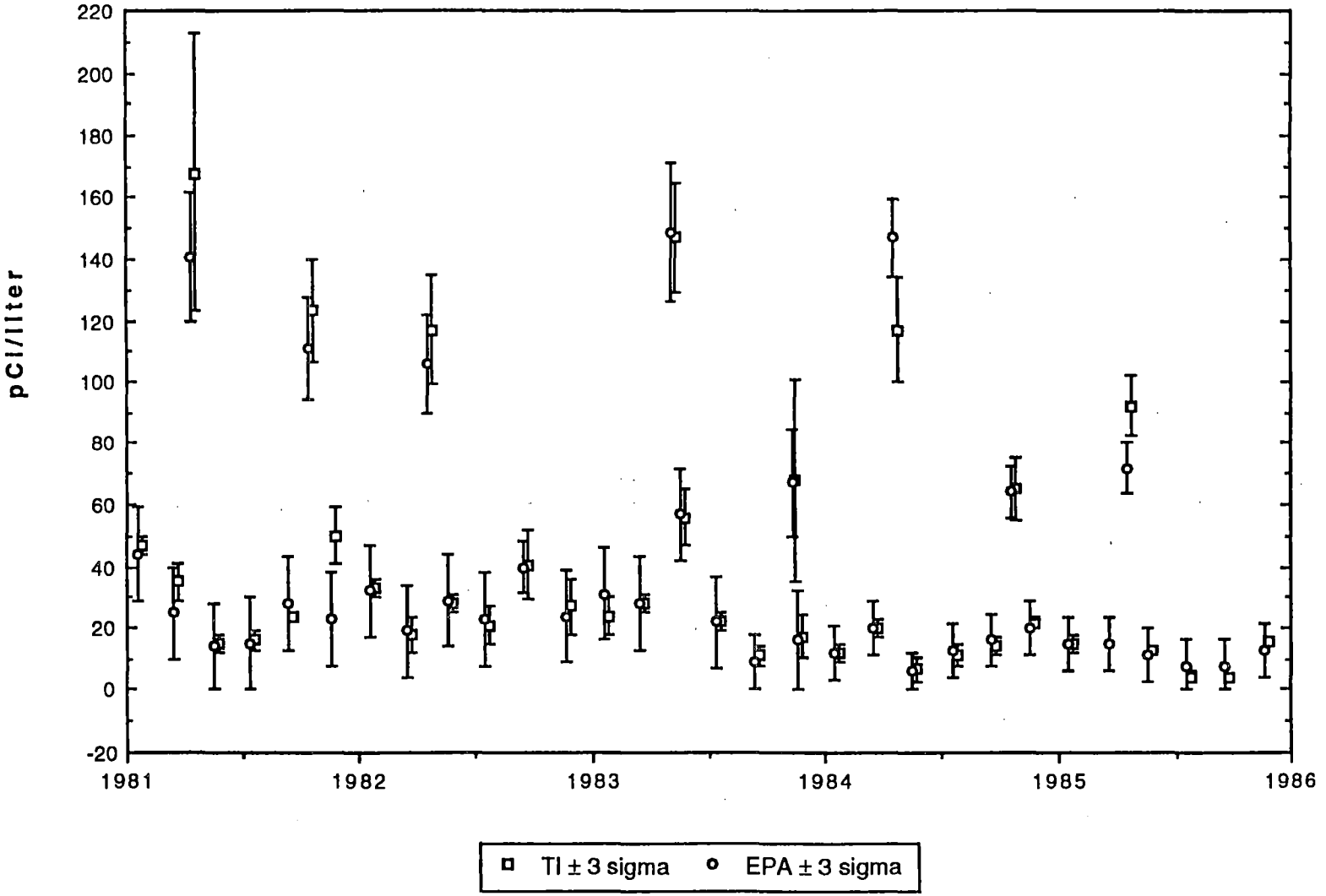
EPA CROSS CHECK PROGRAM

GROSS BETA IN WATER (pg. 2 of 2)



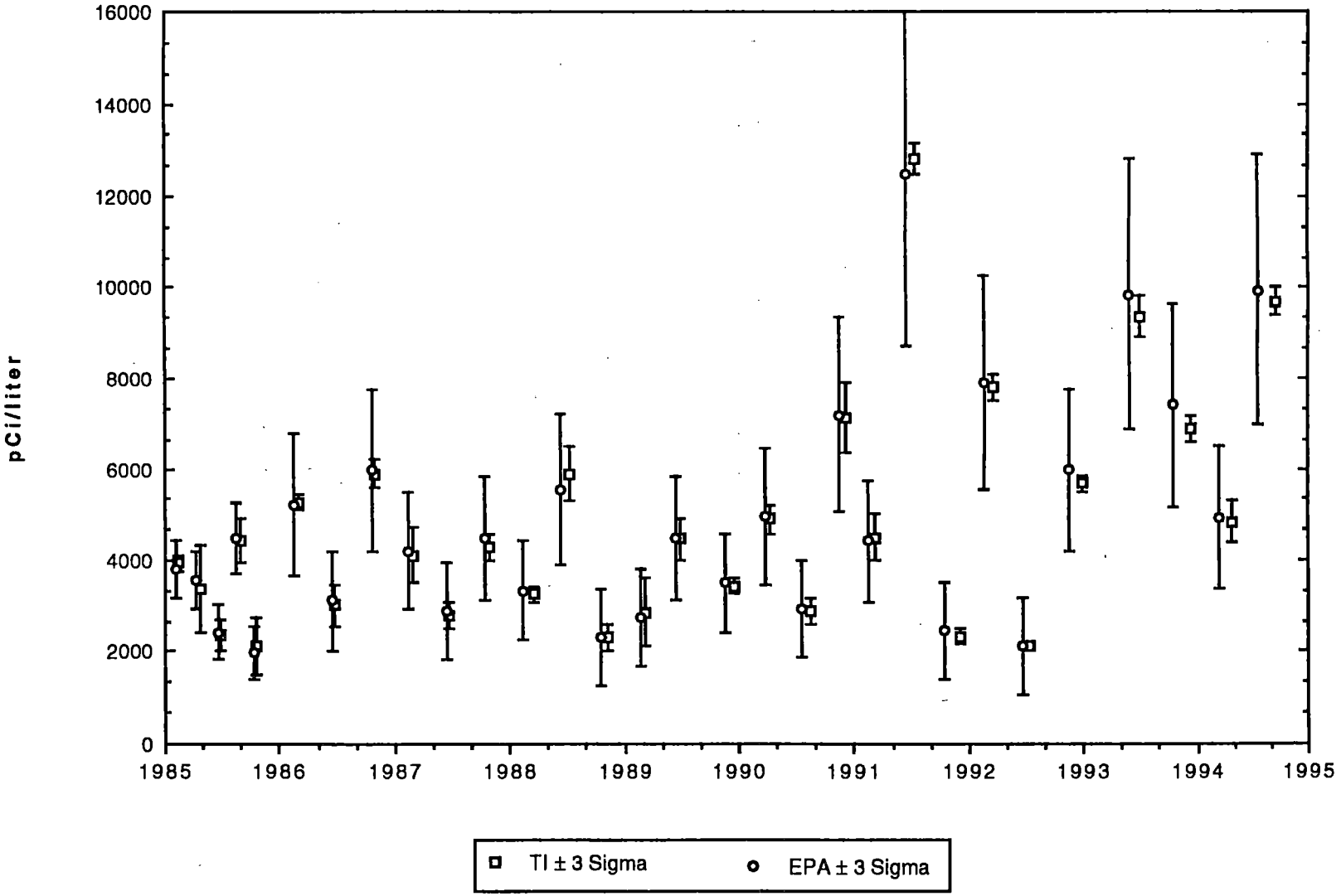
EPA CROSS CHECK PROGRAM

GROSS BETA IN WATER (pg. 1 of 2)



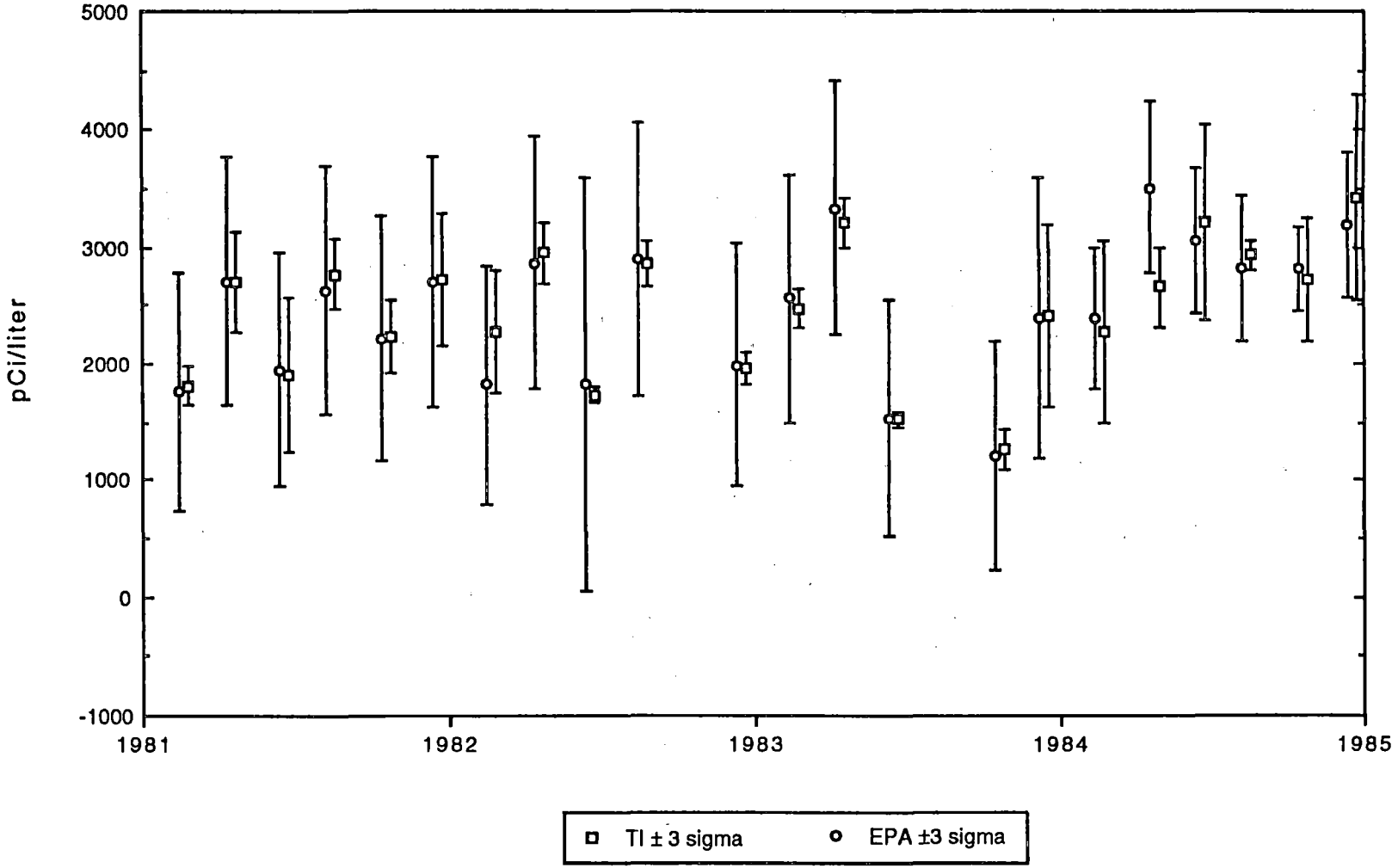
EPA CROSS CHECK PROGRAM

TRITIUM IN WATER (pg. 2 of 2)



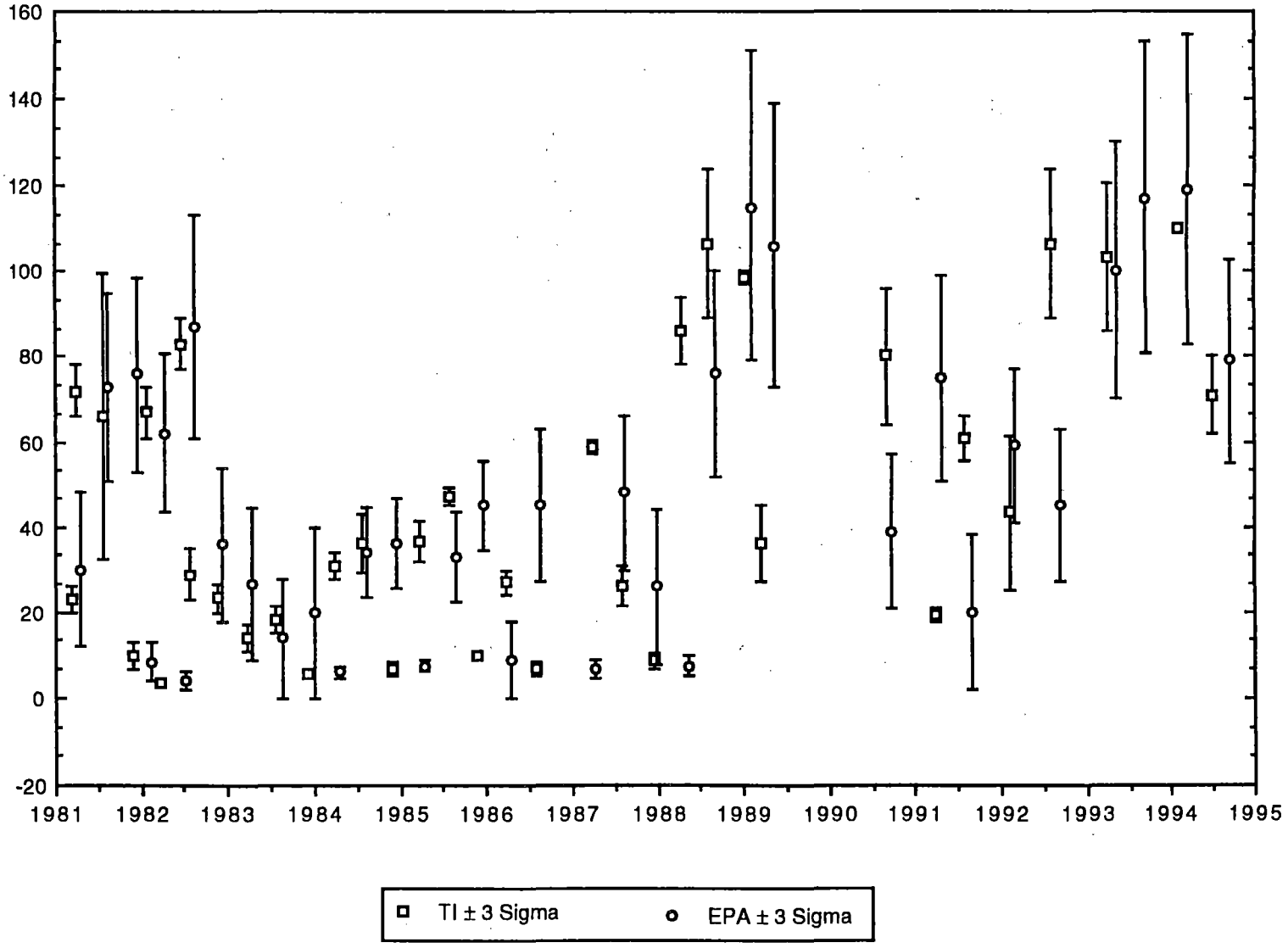
EPA CROSS CHECK PROGRAM

TRITIUM IN WATER (pg. 1 of 2)



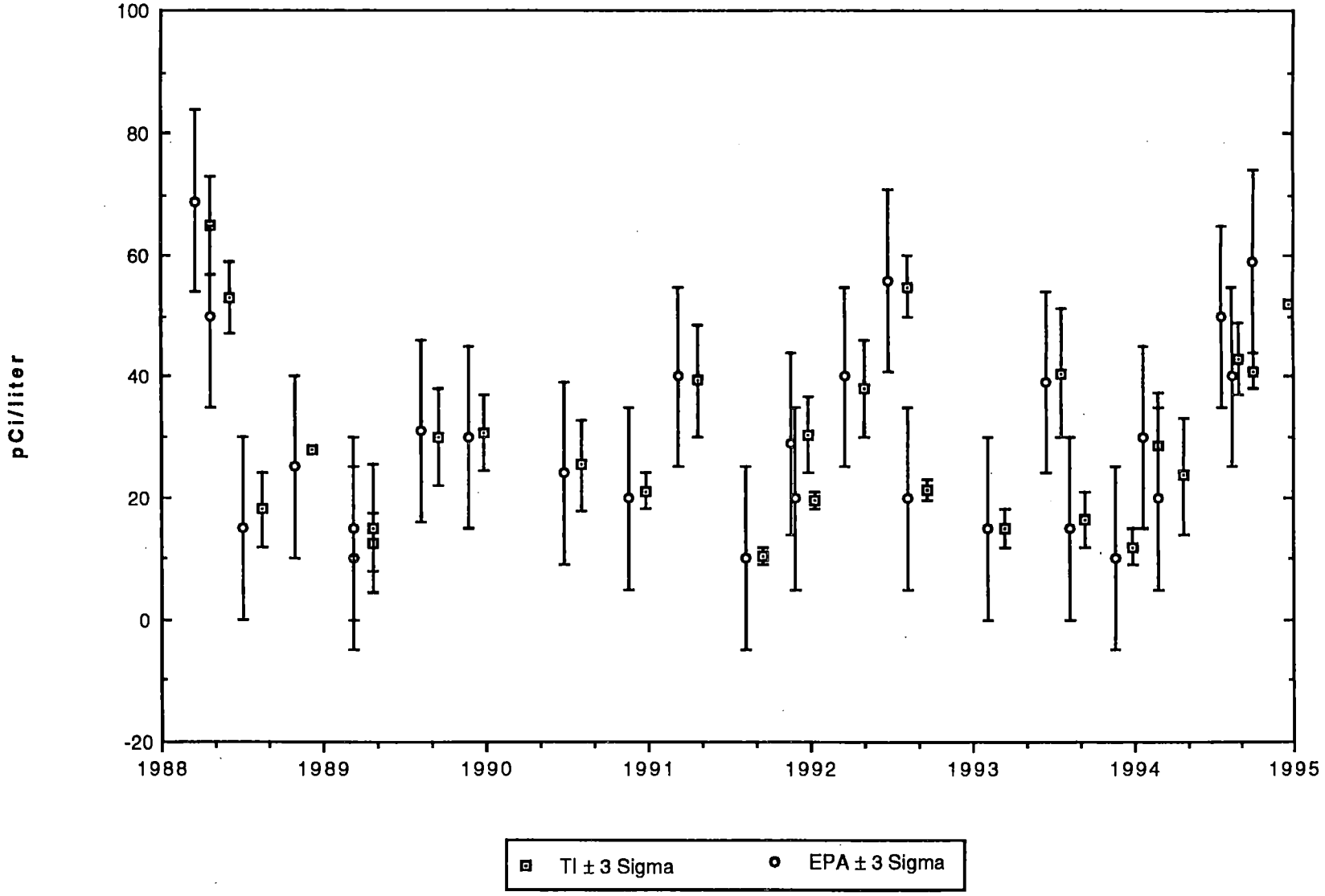
EPA CROSS CHECK PROGRAM

IODINE-131 IN WATER (pg. 1 of 1)



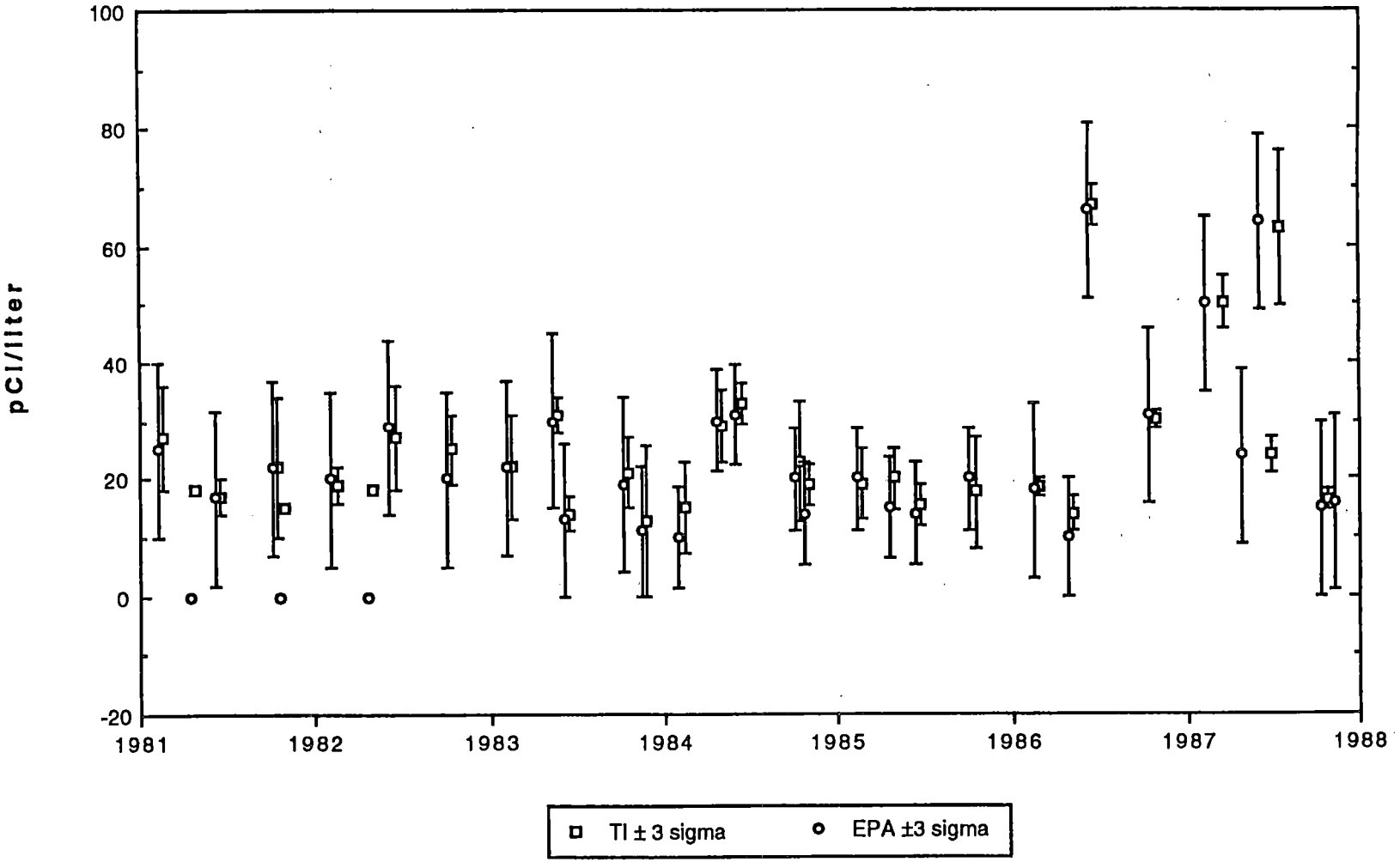
EPA CROSS CHECK PROGRAM

COBALT-60 IN WATER (pg. 2 of 2)



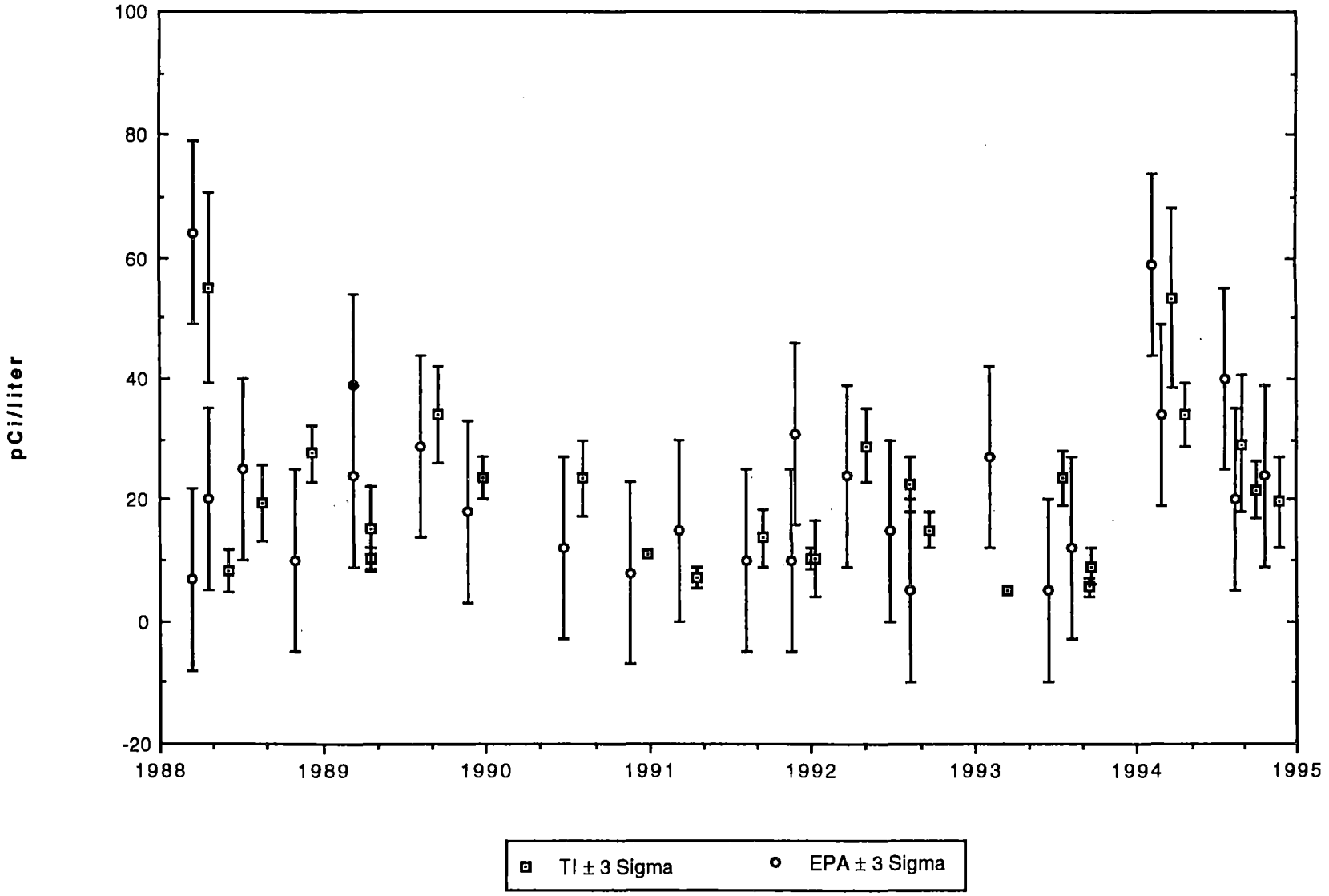
EPA CROSS CHECK PROGRAM

COBALT-60 IN WATER (pg 1 of 2)



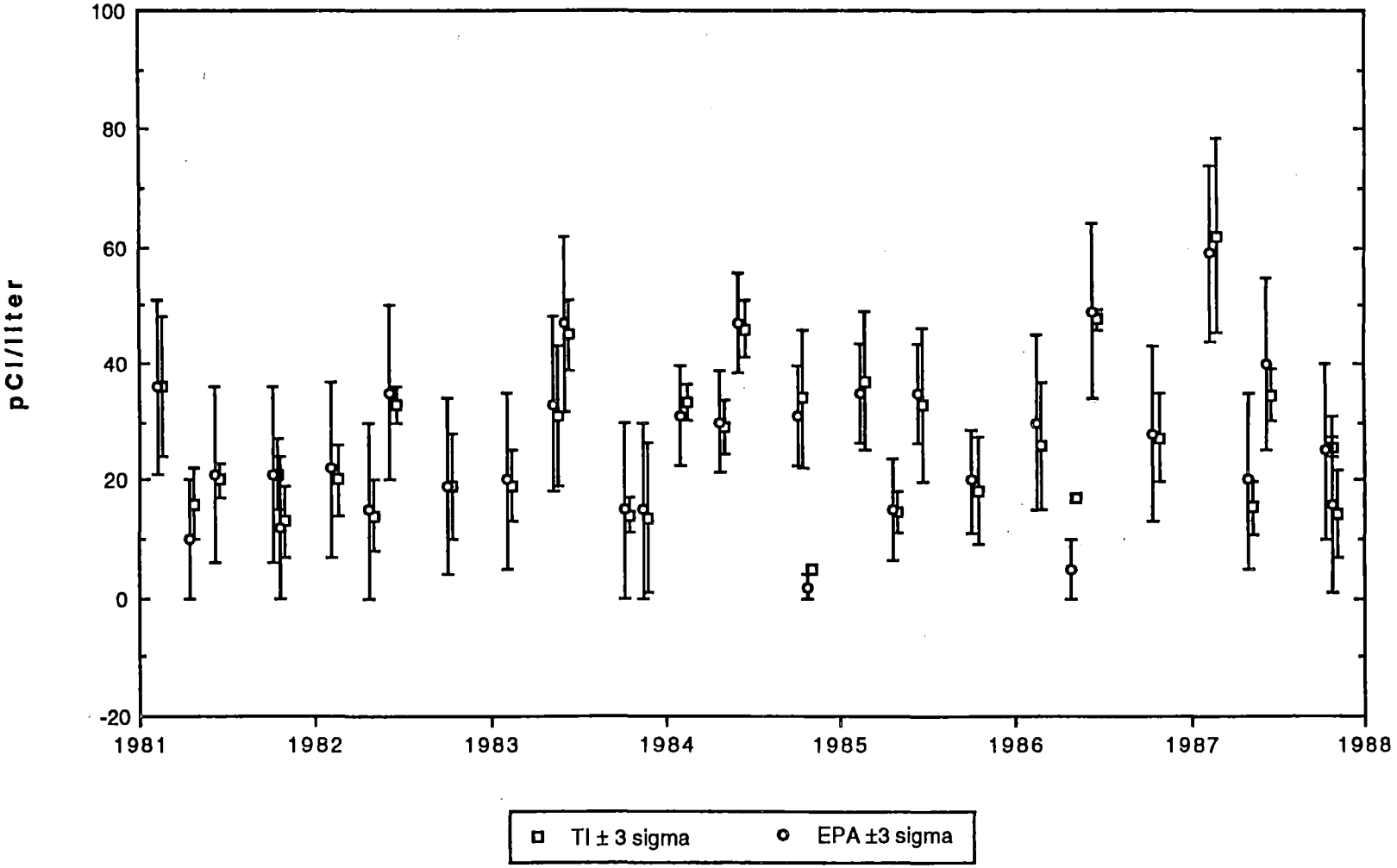
EPA CROSS CHECK PROGRAM

CESIUM-134 IN WATER (pg. 2 of 2)



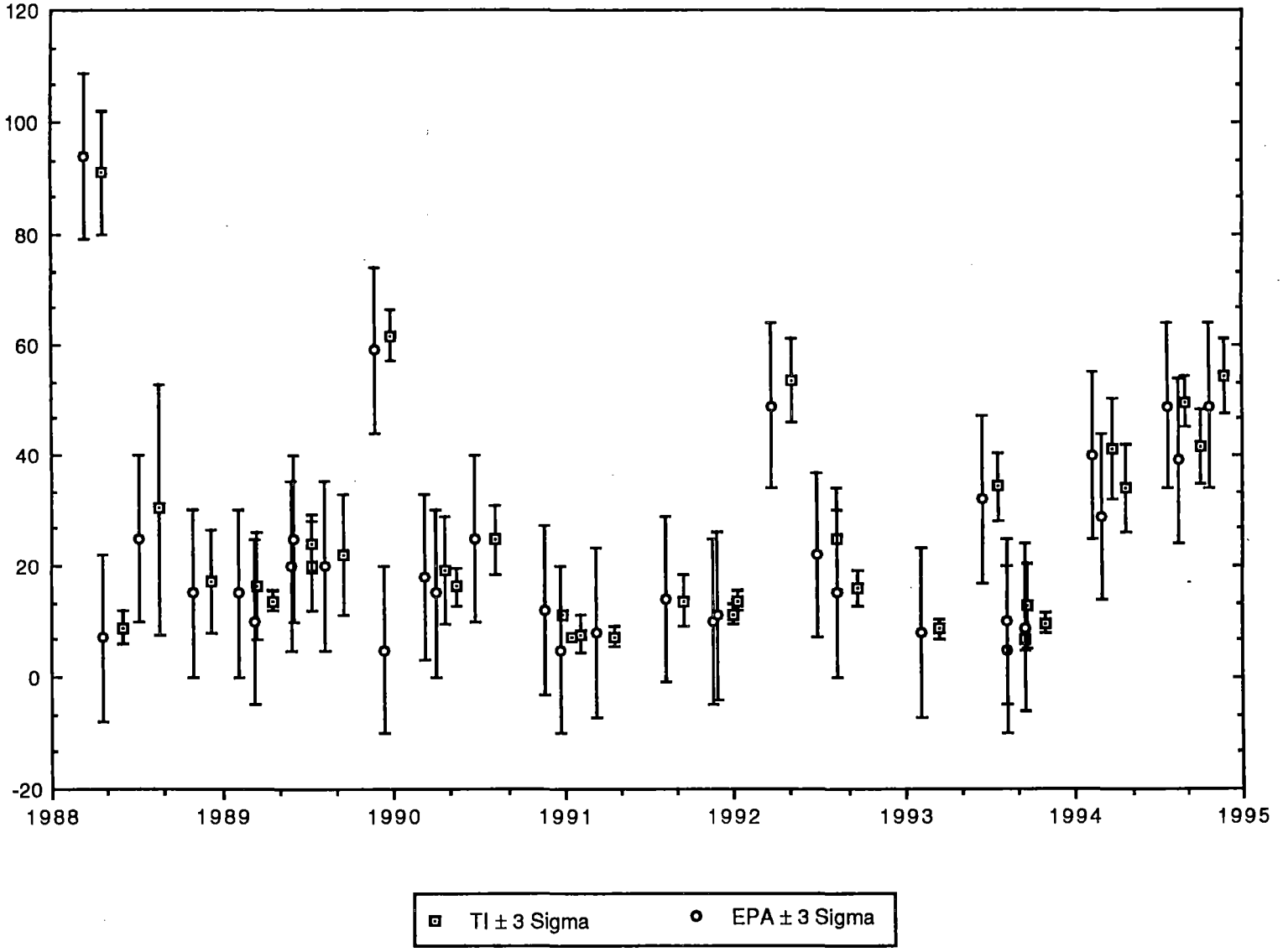
EPA CROSS CHECK PROGRAM

CESIUM-134 IN WATER (pg. 1 of 2)



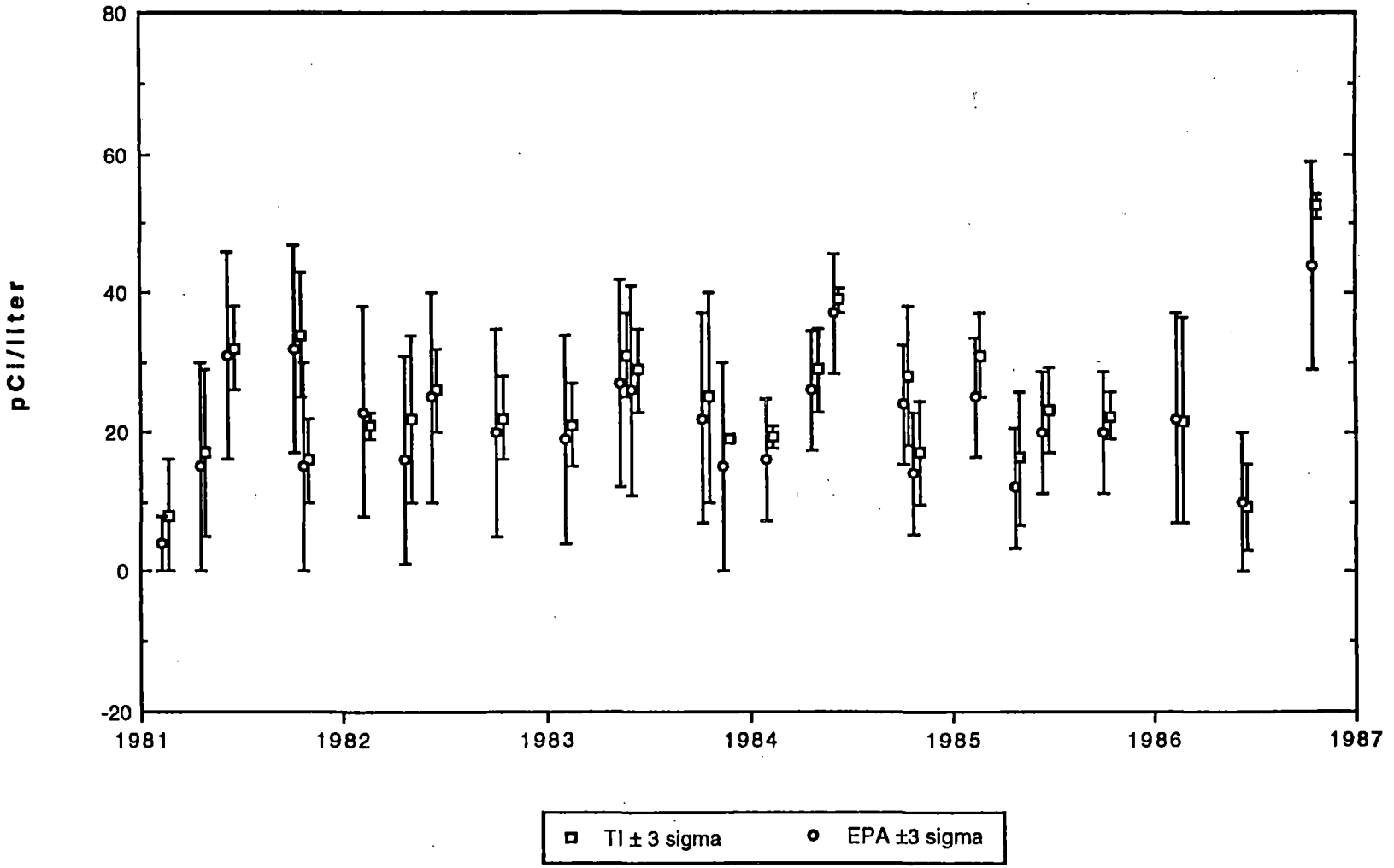
EPA CROSS CHECK PROGRAM

CESIUM-137 IN WATER (pg. 2 of 2)



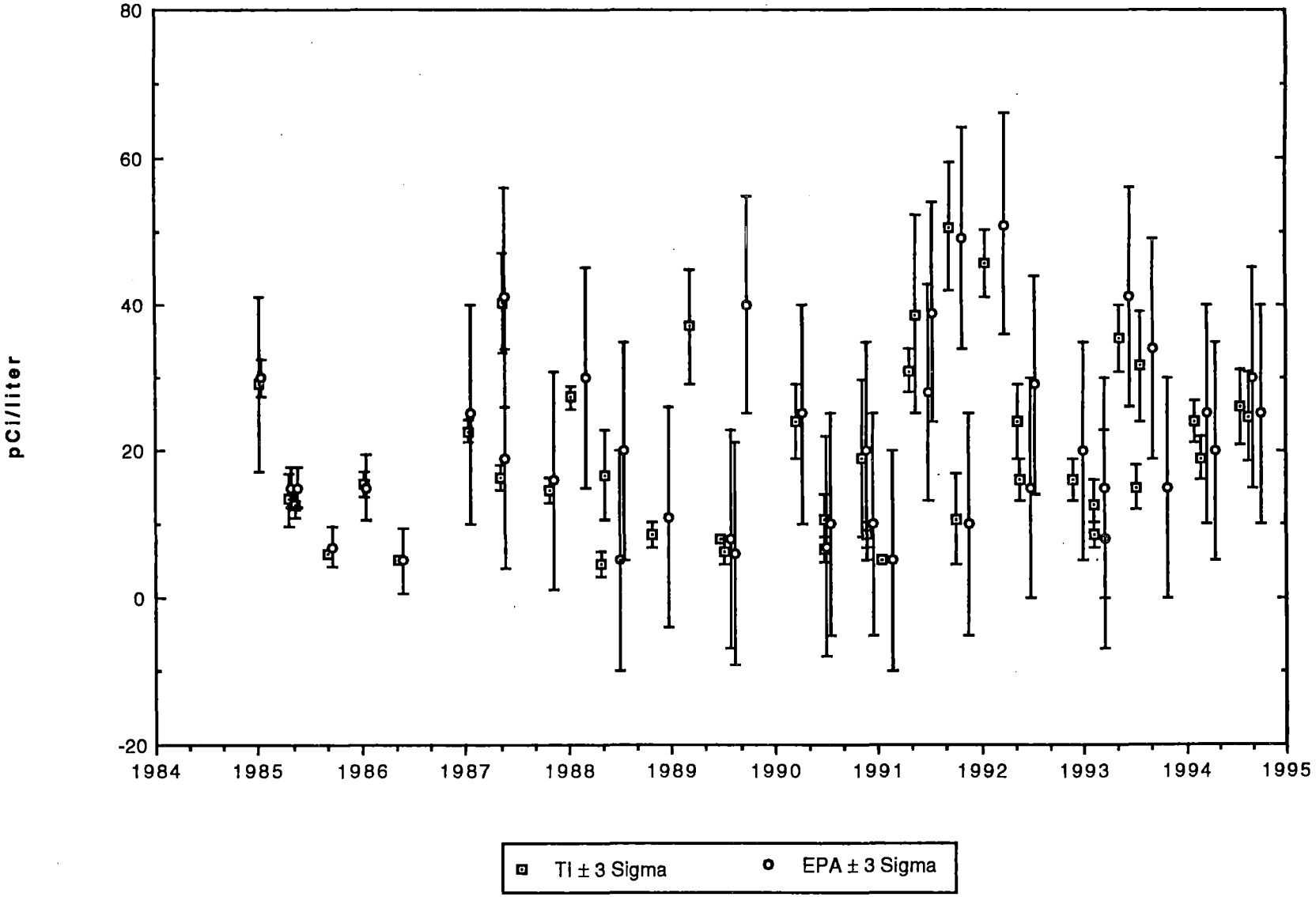
EPA CROSS CHECK PROGRAM

CESIUM-137 IN WATER (pg. 1 of 2)



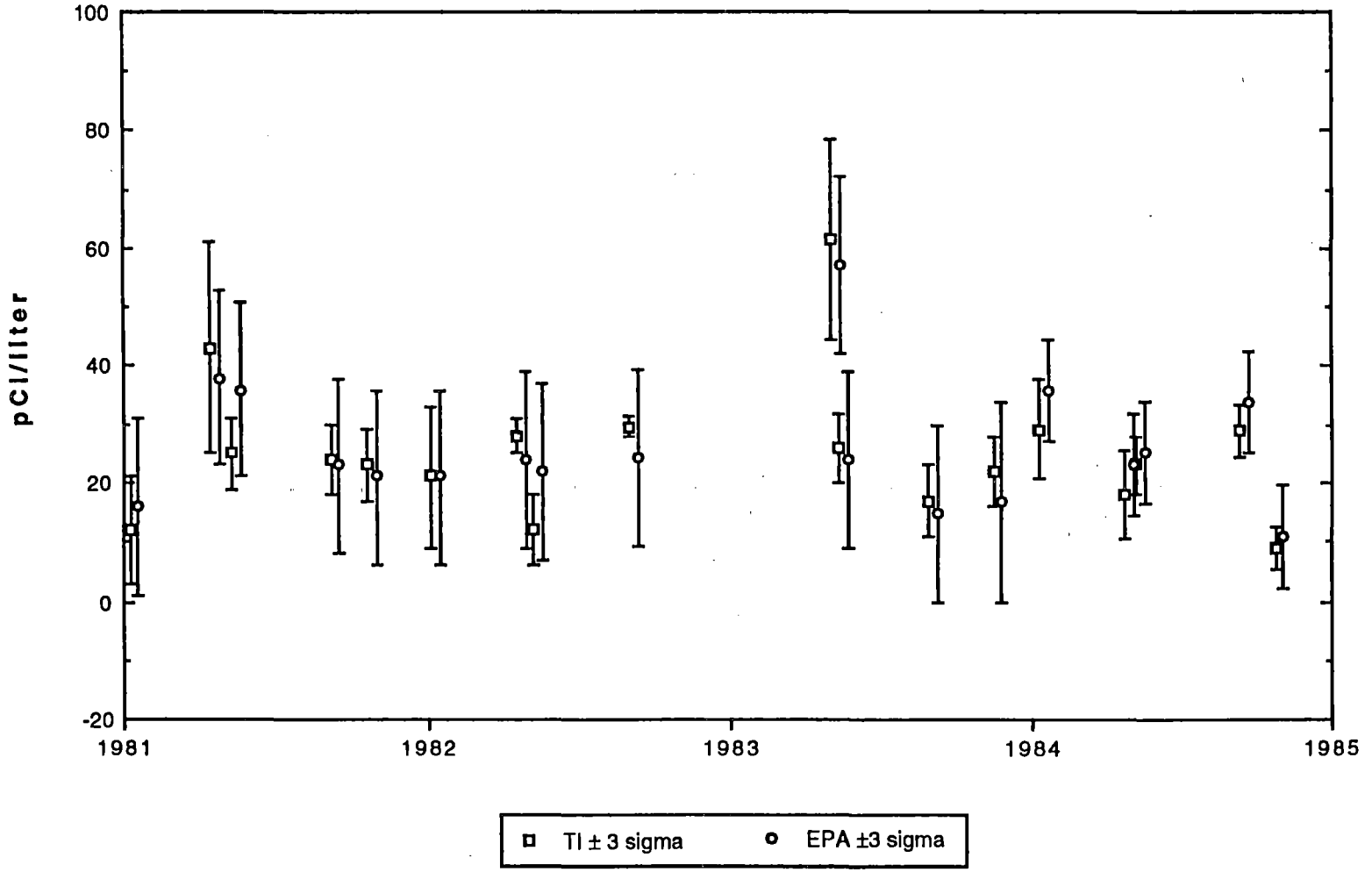
EPA CROSS CHECK PROGRAM

STRONTIUM-89 IN WATER (pg. 2 of 2)



EPA CROSS CHECK PROGRAM

STRONTIUM-89 IN WATER (pg. 1 of 2)



EPA CROSS CHECK PROGRAM

STRONTIUM-90 IN WATER (pg. 1 of 1)