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AMERICAN ELECTRIC POWER SERVICE CORPORATION

Donald C. Cook Nuclear Plant

RADIOLOGICAL ENVIRONMENTAL MONITORING

Annual Report

1983

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ABSTRACT

This report presents the data obtained from the analyses of environmental samples collected for the American Electric Power Service Corporation Donald C. Cook Nuclear Station Environmental Radiological Surveillance Program for the period 01 January 1983 through 31 December 1983.

The activity present above the detection limits in the routinely collected sample media was observed to be of natural and atomospheric origin. In no case did radioactivity from the Cook Nuclear Plant exceed the design objectives of the Cook Radiological Environmental Technical specifications.

INTRODUCTION

The Donald C. Cook Nuclear Station of American Electric Power Service Corporation consists of two Westinghouse PWR units (Unit 1 and Unit 2). Each unit consists of a presurized water reactor (PWR) which generates about 3250 megawatts (MW) of heat to generate about 1100 MW of electricity. The station is located in Benton Harbor, Michigan.

The D.C. Cook Plant utilizes a pressurized water reactor with a radwaste hold-up and treatment system that has been designed to keep radioactive releases to as low as is practible levels. However, small quantities of noble gases and radioiodine may be released to the surrounding environment. The quantities of radionuclides released to the environment are expected to be minisule and insignificant as a source of potential exposure to flora and fauna in the area. However, direct radiation exposure to man and radionuclide accumulations in various components of food chains to man are carefully monitored.

The environmental radiological monitoring program is intended to serve the following purposes:

a) To yield average values of radiation levels and concentrations of radioactive material in various media of the environment.

b) To identify sample locations and/or types of samples that deviate from the averages.

c) To document seasonal variations that could be erroneously interpreted when the power station is operating.

d) To indicate the range of values that should be considered "background" for various types of samples.

The basic approach for the Donald C. Cook Nuclear Plant is to control the release of radioactive material at levels far below that which would be expected to cause detrimental impact on the environment. The environmental radioactivity surveillance program will be closely coordinated with conditions of plant operation and subject to periodic review.

Levels of environmental radioactivity are subject to change for reasons in no way related to the operation of the D.C. Cook Nuclear Plant. Therefore, the radioactivity surveillance program has been designed to include reference or "background" stations as well as "indicator" stations. The program is summarized in Table I.

This report contains a compilation of the results of analyses of various types of samples collected during the period January 1983 through December 1983.

SECTION 2

SAMPLING PROGRAM

All samples are collected by Eberline personnel and shipped to Eberline, Albuquerque Laboratory in New Mexico. The sample collection procedures remained the same as those detailed in the semi-annual report for the period 01 January through 30 June 1973.

Upon receipt of the samples, the Laboratory staff enters the samples in a log book identifying them as to sample type, collection date, and sample code number of location, then verifies the specific analyses to be performed on each sample. The samples are then stored, awaiting analysis, on shelves expressly for this purpose to assure accountability through the Laboratory processes.

Table 1 lists the sample analysis program - sample type, frequency, and the type of analysis required.

Table 2 lists the LLD's (Lower Limits of Detection) for the analytical program. These LLD's are based on the Regulatory Guide 4.8. For analyses not listed in Regulatory Guide 4.8, Federal EPA, former requirements for similar programs or other appropriate guides are used. The LLD's are calculated at the 3σ (99% confidence) level.

The Guide specifically states that the LLD's are priori, not a posteriori (after the fact) limit for a particular measurement. When however, RG 4.8 or other LLD's have not been achieved, a footnote giving a brief explanation has been inserted.

Maps of sampling locations are shown on pages 11-13. Figure I gives the air sampling locations, Figure II shows other sampling locations and TLD monitoring locations.

TABLE 1

ENVIRONMENTAL MONITORING PROGRAM

DONALD C. COOK NUCLEAR PLANT

Sample Type	No. Station Ind.	Bkg.	Collection Frequency	Analysis Frequency	Type Analysis	Remarks
Air Particulate	6	4	Weekly	Weekly	Gross Beta	
	6	4	-	Monthly	Gamma Isotopic Composite of weekly collections	(a)
Airborne I-131	6	4	Weekly	Weekly	Gamma Isotopic	
Precipitation	6	4	Monthly	Monthly	Gamma Isotopic Composite, 2 Samples	By indicator and background samples.
Lake Water	3	4	Monthly	Monthly	Gamma Isotopic Composite, 2 Samples	By indicator and background samples.
Well Water	4	3	Every 18 wks.	Every 18 wks.	Gamma Isotopic Tritium	
Fish	2	2	Semi-annual	Semi-annual	Gamma Isotopic	Edible portion only.

TABLE 1 (Cont'd)

ENVIRONMENTAL MONITORING PROGRAM

DONALD C. COOK NUCLEAR PLANT

Sample Type	No. Stations Ind.	Bkg.	Collection Frequency	Analysis Frequency	Type Analysis	Remarks
Milk	3	2	Monthly	Monthly	Gamma Isotopic I-131	
Sediment	2	2	Semi-annual	Semi-annual	Gamma Isotopic	
TLD	(c)	(c)	Quarterly	Quarterly	Total Dose	
Food Crops	1	1	Annualy	Annualy	Gamma Isotopic	

(a) January-March the monthly composites of indicator and Background were analyzed for gamma emmitters as as 2 samples. Beginning April 1983 composites of individual stations were analyzed for gamma emitters.

(b) Deleted from the program beginning April 1983.

(c) Back up TLD badge for each location was placed and analyzed during 1983.

Table 2

LOWER LIMITS OF DETECTION
(LLD's)

Sample Class	Analysis	LLD	Units
Air Particulates	Gross Beta	0.01	pCi/m^3
	Gamma Isotopic	0.01	pCi/m^3
Airborne Iodine	I-131	0.1	pCi/m^3
Milk	I-131	0.5	pCi/m^3
	Gamma Isotopic	10	pCi/l
	Sr-89	5	pCi/l
	Sr-90	1	pCi/l
Well Water	LS Tritium	1000	pCi/l
	Gamma Isotopic	10	pCi/l
Precipitation	Gamma Isotopic	10	pCi/l
Lake Water	Gamma Isotopic	10	pCi/l
Sediment	Gamma Isotopic	0.15	pCi/g dry
Fish	Gamma Isotopic	0.13	pCi/g wet
Food Crops	Gamma Isotopic	0.06	pCi/g wet
Background Radiation(TLD)	Gamma Dose	-	mR/week

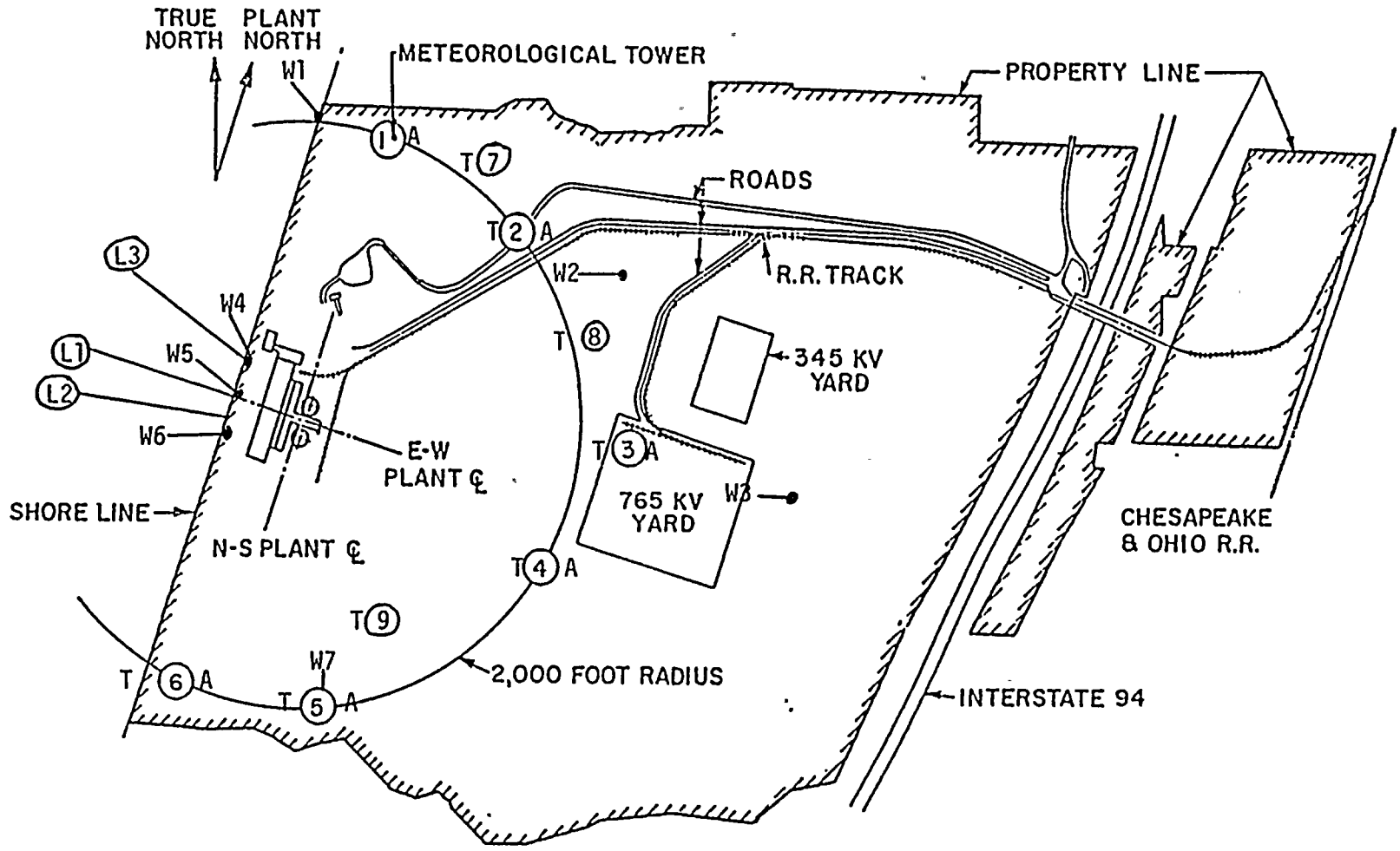


FIGURE I

LOCATIONS
OF INDICATOR AIR SAMPLING STATIONS

A ' Air, Precipitation

T TLD Station

W Well Water

L Lake Water (taken at shoreline)

A - Air, Precipitation, TLD Stations
L - Lake Water Sample Stations
M - Milk Sample Stations

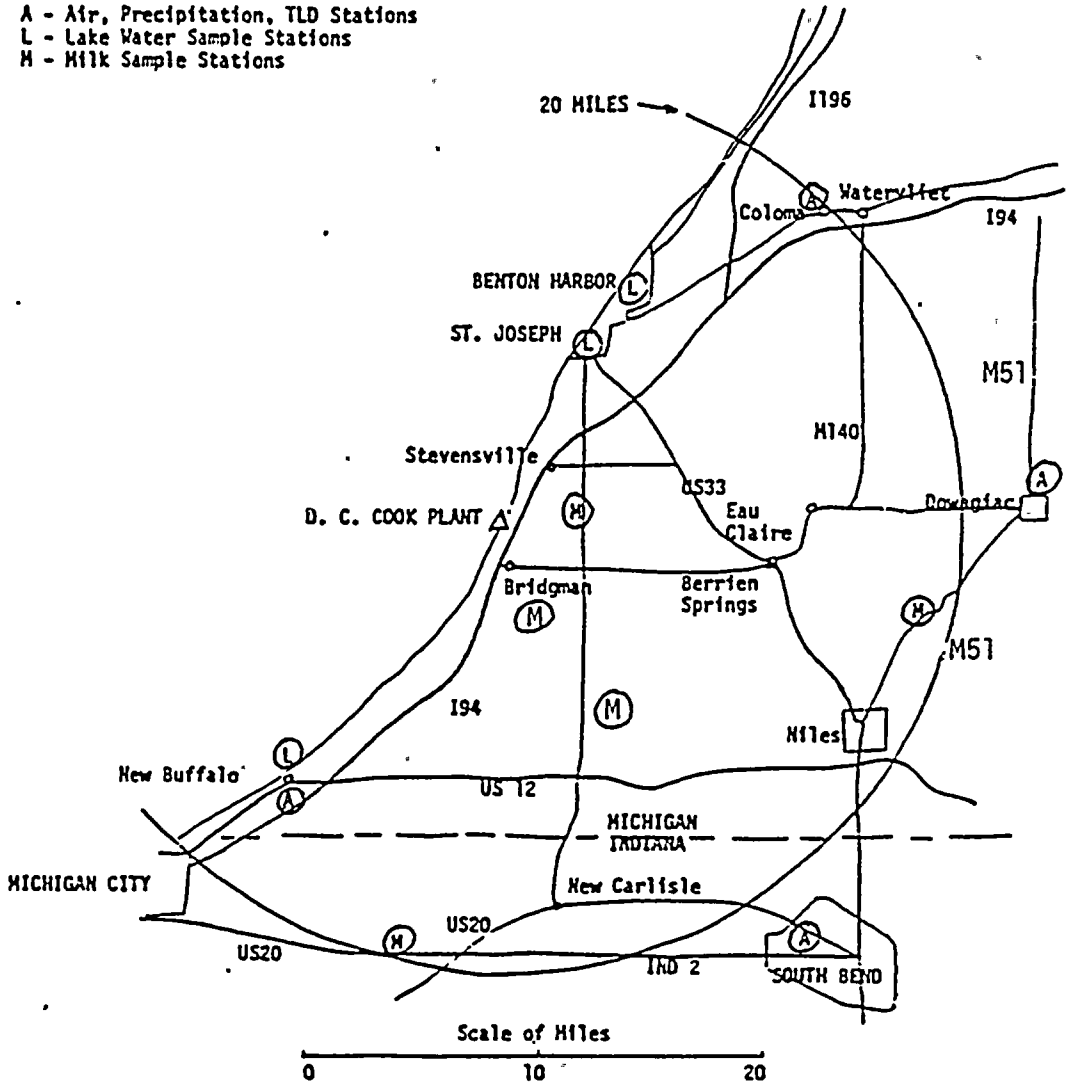
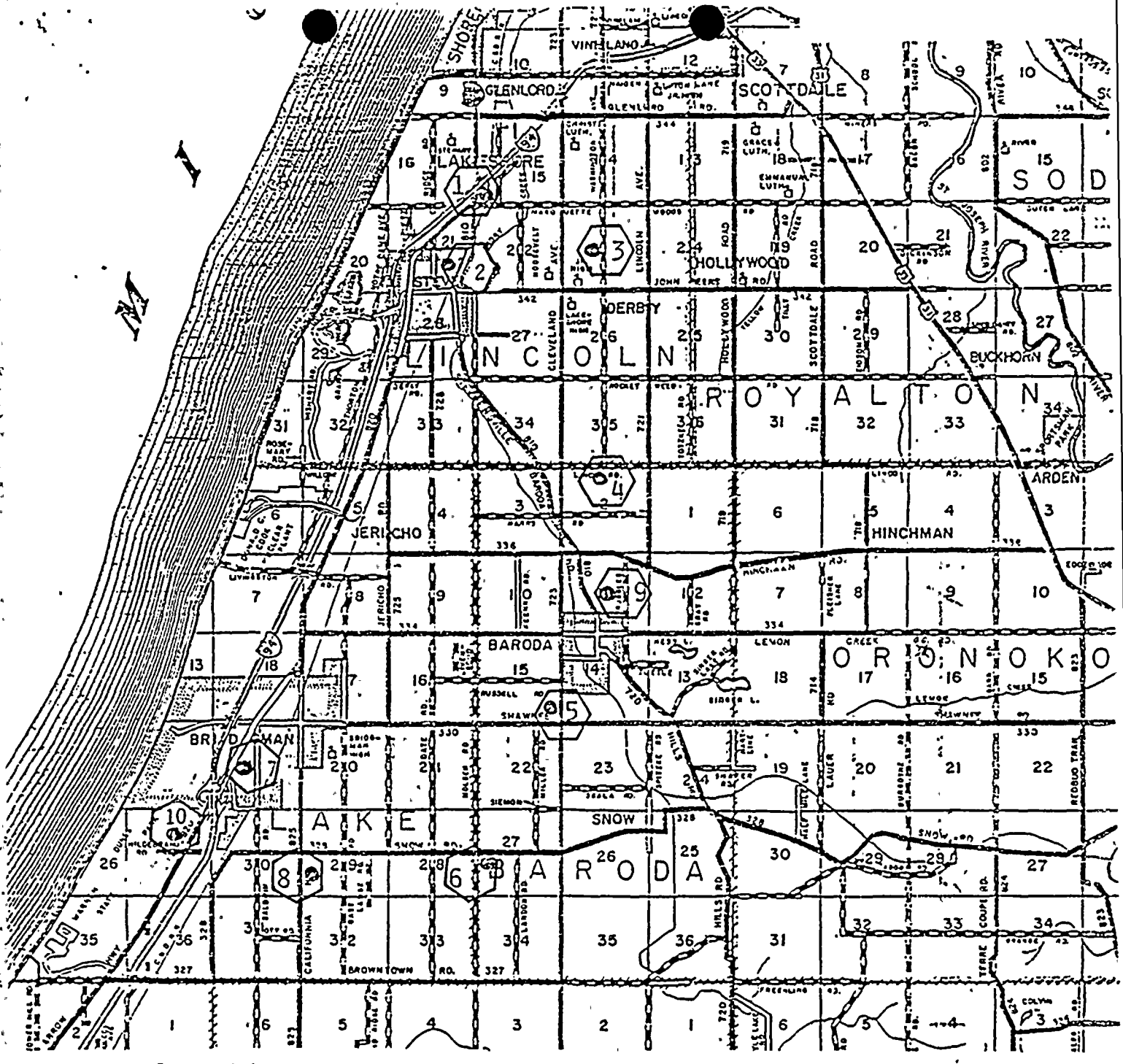


FIGURE II
OFF-SITE
LOCATIONS OF SAMPLING STATIONS



1. Red Arrow Highway and vicinity of I-94 overpass.
2. Stevensville Sub Station.
3. Washington Avenue midway between Brentwood Drive and Kingman Drive.
4. Washington Avenue and Linco Road.
5. Cleveland Avenue and Shawnee Road.
6. Holden Road and Snow Road.
7. Bridgman Sub Station.
8. California Road between Browntown and Snow Roads.
9. Ruggles Road between Hinchman and Lemon Creek Roads.
10. At intersection of Hildebrant Road and Red Arrow Highway.

FIGURE III

TLD MONITOR LOCATIONS
LOCATED ON THE FIVE MILE
RADIUS FROM THE PLANT

SECTION 3

ANALYSIS PROGRAM

ANALYTICAL PROCEDURES

Samples received at the laboratory are analyzed for the various radioactive components by standard radiochemical methods. These methods are equal to, and in most cases, identical with, those of the U.S.D.O.E.[1] or those of the Federal E.P.A.[2]

Brief descriptions of analytical procedures are available in the Laboratory Procedures Manual available at the Cook Nuclear Plant and the radioanalytical contractor's laboratory.

AIR PARTICULATE FILTERS

Gross Beta - Exposed air particulate filters are counted in low background Geiger or proportional flow beta counters using anti-coincidence background suppression after the short-lived naturally occurring radon and thoron daughters have decayed. Filters are counted long enough to ensure that the required sensitivity (LLD) is met.

Gamma Isotopic - Monthly composites of air particulate filters grouped by indicator and background stations into two samples are counted in high resolution (GeLi) gamma spectrometers for periods of time long enough to ensure that the required program sensitivity (LLD) is met.

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[1]HASL Procedures Manual, edited by John H. Harley, Health and Safety Laboratory, US Atomic Energy Commission, 1972 edition, revised annually.

[2]National Environmental Research Center, Environmental Protection Agency; Handbook of Radiochemical Analytical Methods. Program Element 1HA 325. Office of Research and Development, Las Vegas, Nevada 89114.

CHARCOAL CARTRIDGE SAMPLES --IODINE I-131

The iodine is extracted from the charcoal, chemically separated using iodine carrier, precipitated as Ag I, and counted in a low level beta counter. The chemical recovery of iodine is measured gravimetrically.

WATER SAMPLES (Includes Lake, Well, Precipitation)

Gamma Isotopic - A measured aliquot of the sample is evaporated to a small controlled volume and counted in a standard geometry in a high resolution (GeLi) gamma spectrometer long enough to ensure meeting the sensitivity requirements of the program. See also the Introduction to Data Tables.

Tritium - Tritium as tritiated water is analyzed by liquid scintillation counting after distillation. If high sensitivity is not required (ie. LLD ~500 pCi/l) the sample is distilled, mixed with the appropriate counting phosphors and counted with no further treatment. If higher sensitivity is required (ie. <~300 pCi/l) the sample is isotopically enriched in tritium concentration prior to liquid scintillation counting. Isotopic enrichment is done by the classical method of Ostlund which involves alkaline electrolysis of a purified aliquot of sample under controlled conditions of temperature and electrode current density.

MILK SAMPLES

I-131 - Measured amounts of carrier iodide are added to a known volume of milk and the iodine extracted on anion exchange resin. The iodine is recovered and purified by classical iodine chemistry methods which are similar to those given in former Regulatory Guide 4.3. The yield or recovery of iodine is measured gravimetrically and the precipitated sample is mounted and counted in a low level beta detector for a long enough period to ensure that the required LLD is met.

Gamma Isotopic - A measured aliquot of sample is evaporated and oven-dried to a standard volume and counted in a fixed geometry in a high resolution (GeLi) gamma spectrometer for a long enough period to ensure that the required LLDs are reached (see also Introduction to Data Tables).

Strontium-89 and Strontium-90 - Stable strontium carrier is added to an aliquot of the sample which is then dried and ashed at high temperature (>700°c). The ash is dissolved and the solution treated from this point on in the same manner as are air particulate samples.

ORGANIC SAMPLES (Aquatic Organisms, Food Crops, Fish)

Gamma Isotopic - A measured aliquot of sample is oven-dried or ashed as appropriate, placed in a controlled geometry and counted in a high resolution (GeLi) gamma spectrometer for a period long enough to ensure that the LLDs of the program will be set (see also Introduction to Date Tables).

SEDIMENT SAMPLES

Gamma Isotopic - The sample is oven-dried to facilitate handling and then sieved to removed pieces of stone and/or other large pieces of material. An appropriate sized, weighed aliquot of the sample is then transferred into a standard geometry container and counted for a period long enough to ensure that the LLDs of the program will be met (See also Introduction to Data Tables.)

THERMOLUMINISCENT DOSIMETERS

Environmental radiation doses are measured using badges comprizing five chips sealed in plastic protective holders having a density of 50 mg/cm^2. The TLD chips are 1/8" x 1/32 LiF (thallium activated) known commercially as Harshaw-100. The chips are all selected to provide uniform response to within five percent of the mean for the batch.

Prior to installation, the chips are annealed by a standard cycle of 60 minutes at 400^{o}c and immediate cooling to ambient temperature by placing the tray containing the annealed chips on an aluminum block 12"x12"x 1".

After exposure the chips are read on an Eberline Instrument Corporation Model TLR-6 reader. The system employs a preheat cycle which removes low temperature peaks and integrates and digitizes only the light output in a selected temperature range.

The dose is calculated from the average light output for the five chips and the statistical uncertainty is the standard deviation of the five readings. Control badges are used to detect any unusual exposure to the badge which might occur during shipment.

QUALITY ASSURANCE PROGRAM

A. Design of Plan

Quality of product or service has always been a primary key to increase in sales, customer satisfaction, and profit. The management of Eberline Instrument Corporation recognizes the ever increasing demand for higher quality and reliability for services related to protection of workers and the environment. It is our firm belief that in order to judge the worth of a support service, one must know the philosophy behind it. Eberline will provide only those services for which it is qualified and these will be provided in a manner that is reliable, with a quality assurance program that maintains a high degree of client confidence. This quality assurance program has been prepared consistent with the following specifications, per the Technical and Quality Assurance Requirements for Special Purposes.

ANSI-N45.2, American National Standard Institute
NRC Branch Technical Position of November 1979
NRC Regulatory Guide 4.15, Revision 1 of February 1979.

B. Intercomparison Program

Results of Eberline Albuquerque Laboratory's participation in the USEPA's Crosscheck Program are included in the monthly and annual reports provided to the client. Other intercomparisons in which we routinely participate include:

Environmental Protection Agency
Environmental Measurement Lab DOE Quality Assessment Program
Battelle Northwest Laboratories
IAEA Analytical Quality Control Service
US National Bureau of Standards

Each of the laboratory managers is responsible for preparing spikes and blanks to be run routinely. Every tenth samples is a spike, a blank, or a split sample.

Regualar QC reports are prepared by a laboratory manager on a monthly

schedule and forwarded to each client. Each report routinely includes:

results from EIC interlaboratory comparison,
results from EPA Crosscheck program, and
results from other intercomparison programs.

Results are reviewed by the laboratory manager. If a problem is indicated by the data, the nature of the problem is investigated and corrective steps taken immediately. A copy of each report is also provided to the Quality Assurance Manager of the Nuclear Services Division.

C. Quality Assurance Plan

The Quality Assurance Program follows the requirments of Company and Division Manuals. The discussion below outlines Quality Assurance Programs as conducted in the laboratory and as required in our QA Manual.

Procedure Approval

Each procedure goes through a vigorous evaluation and review process before it is incorporated into the EIC Procedures Manual. Established procedures of the Environmental Protection Agency (EPA) or the Environmental Measurements Laboratory of the US Department of Energy (EML) are used unless thorough testing has demonstrated that an alternate procedure is equal to or better than the EPA or EML procedure. Uniform procedures are used at both laboratories to the fullest extent possible, except when deviations are necessary to meet the specific requirements of the client. The manager of each laboratory and the quality assurance manager review and approve significant procedural changes before they are implemented.

Equipment Calibration and Maintenance

Equipment used for qualitative or quantitative measurements is carefully calibrated and maintained with records of each calibration or maintenance action kept in appropriate logbooks. To the extent possible, certified standards are used for all primary calibrations. The following standards are used for the application indicated:

Measurement	Calibration Standard
Gross Beta	Solution of Standard ^{137}Cs certified by NBS or Amersham Searle
Tritium	Solution standard of ^{3}H certified by NBS
Gamma Spectrometry	Solution standards of various gamma emitters certified by NBS or Amersham Searle. Standards are used to calibrate each counting geometry used.
Strontium-89 and 90	Solution standards of ^{90}Sr certified by Amersham Searle or NBS
Gross Alpha	Solution standards of ^{239}Pu certified by NBS or Amersham Searle.
Radiation Dose	^{137}Cs gamma source cross-referenced with NBS using R-meters. ^{226}Ra is used for some special application.

When suitable standards are not available for a specific gamma emitter, quantitative gamma isotopic analysis is based on an energy calibration of the gamma spectrometer and the gamma energy and abundance information provided in Table of Isotopes, Sixth Edition by Ledrer, Hollander, and Perlman.

The results of the Quality Control Programs are summarized in Section 6.

SECTION 4

RESULTS AND DISCUSSION

Environmental Radiological Monitoring Program

Name of Facility: Donald C. Cook Nuclear Station Docket Number: 50-315 and 50-316

Location of Facility: Berrien County, Michigan State Reporting Period: January - December 1983

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean[1] (Range)	Location with Highest Mean Name	Mean (Range)	Control Locations Mean[1] (Range)	Number of Non-routine Reported Measurements
Air Particulates (pCi/m^3)	Gross B 526	0.01	0.03 (284/317) 0.01-0.09	On Site 5 & 6	0.03 0.01-0.07	0.03(200/209) 0.01-0.08	0
	Ce-144 36	0.01	ALL LLD	Not Applicable		ALL LLD	0
	Zr-95 36	0.01	ALL LLD	Not Applicable		ALL LLD	0
	Nb-95 36	0.01	ALL LLD	Not Applicable		ALL LLD	0
	Ce-141 36	0.01	ALL LLD	Not Applicable		ALL LLD	0
	Ru-103 36	0.01	ALL LLD	Not Applicable		All LLD	0
	Other Gamma 36	0.01	ALL LLD	Not Applicable		ALL LLD	0
	Sr-89 2	0.002	ALL LLD	Not Applicable		ALL LLD	0
	Sr-90 2	0.001	ALL LLD	Not Applicable		ALL LLD	0
Airborne Iodine (pCi/m^3)	I-131 528	0.01	ALL LLD	Not Applicable		ALL LLD	0
Well Water (pCi/l)	Tritium 28	1000	2930 (10/16) 600/8400	On Site 4	4730 (3/4) 2600-8400	700 (1/12) (a)	0
	Gamma Spec. 28	10	ALL LLD	Not Applicable		ALL LLD	0

[1]Mean and range based on detectable measurements only Fractions indicated in parentheses.

(a) Range is not reported as only one detectable measurement was available.

Table 3 (Continued)

Facility: Donald C. Cook Nuclear Station

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean[1] (Range)	Location with Highest Mean Name	Mean (Range)	Control Locations Mean[1] (Range)	Number of Non-routine Reported Measurements
Milk (pCi/l)	I-131 109	0.5	ALL LLD	Not Applicable		ALL LLD	0
	Sr-89 20	5	ALL LLD	Not Applicable		ALL LLD	0
	Sr-90 20	1	2.0 (12/12) 1/5	Stevensville (4/4)	2.5 1-5	4.0 (12/12) 1-7	0
	Gamma Spec. 109	10	ALL LLD	Not Applicable		ALL LLD	0
Precipitation (pCi/l)	Gamma Spec. 8	10	ALL LLD	Not Applicable		ALL LLD	0
Lake Water (pCi/l)	Gamma Spec. 8	10	ALL LLD	Not Applicable		ALL LLD	0

[1]Mean and range based on dtectable measurements only. Franctions indicated in parentheses.

Table 3 (Continued)

Facility: Donald C. Cook Nuclear Station

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean[1] (Range)	Location with Highest Mean Name	Mean (Range)	Control Locations Mean[1] (Range)	Number of Non-routine Reported Measurements
Sediment (pCi/g dry)	Gamma Spec. 8	0.05	ALL LLD	Not Applicable		ALL LLD	0
Food Crops (pCi/g wet)	Gamma Spec. 2	0.06	ALL LLD	Not Applicable		ALL LLD	0
Fish (pCi/g wet)	Gamma Spec. 8	0.13	ALL LLD	Not Applicable		ALL LLD	0
Background Radiation (TLD) (mR/week)	Gamma Dose 92	0.1	1.1 (36/36) 0.9±1.5	On Site 1	1.2 (4/4) 1.0-1.5	1.2 (56/56) 0.9-1.6	0

[1]Mean and range based on detectable measurements only. Fractions indicated in parentheses.

Results of all the analyses for January through December 1983 are presented in full in section 5, Data Tables pages 33 through 48.

Table 3 summarizes the range and average concentrations for measurements at the indicator and control locations with the highest annual mean.

Specific finding for the various environmental media are discussed below.

AIR PARTICULATE SAMPLES

Atmospheric particulate matter at a field location is accumulated for a one-week on a glass fiber filter using a low-volume air sampler at a collection rate of one cubic foot per minute. This particulate matter contained on the filter is counted for beta activity in a low background counting system after the short-lived naturally-occurring radon and thoron daughters have decayed.

The average gross beta concentration for the year for all indicator stations was 0.03 pCi/m^3, and was 0.03 pCi/m^3 for the background stations. Data for anayses of individual filters are given on pages 33 through 36 in Section 5.

The following table summarizes the average gross beta concentrations for both indicator and background stations for each year from 1973 through 1983. The preoperational data were collected in 1973 and 1974; operational data were collected from 1975 through the present.

TABLE 3

	Indicator	Background
	pCi/m^3	
Preoperational		
1973	0.04	0.04
1974	0.16	0.16
Operational		
1975	0.08	0.09
1976	0.09	0.08
1977	0.22	0.22

	Indicator	Background
	pCi/m3	
Operational		
1978	0.12	0.11
1979	0.04	0.04
1980	0.04	0.04
1981	0.12	0.11
1982	0.03	0.03
1983	0.03	0.03

The elevated levels of gross beta activity at both indicator and background locations during preoperational and operational phases from 1974 through 1982 were mainly the result of nuclear test explosions in the atmosphere by the people's republic of China. Such tests took place on 27 June 1973, 17 June 1974, 23 January 1976, 26 September 1976, 17 November 1976, 17 September 1977, 13 March 1978, 14 December 1978 and October 1980.

The data indicate that there is significantly no difference between the levels of gross beta activity measured at the indicator and background locations for the operational and preoperational phases of the program.[1] The activity detected are not attributable to the operation of the Cook Plant.

Airborne I-131 concentration was less than 0.1 pCi/m^3 for all samples received.

The gamma spectrometry data for monthly composites of air particulate files begins on page 37 . Be-7, a naturally occurring nuclide formed by the cosmic ray interaction with nuclei in the upper atmosphere, was detected in the composites. These were generally in the range to be expected from measurement of this nuclide in this medium. No other gamma emitters were detected.

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[1] See Annual Environmental Monitoring Reports for D.C.Cook Plant from previous years for details.

Quarterly composites of air particulate filters were analyzed for Sr-89 and Sr-90. Sr-89 concentrations were below the detection limit of 0.002 pCi/m^3, and Sr-90 were also below the detection limit of 0.001 pCi/m^3 for both indicator and background locations. Data are presented on page 37. The Sr-89 and Sr-90 analyses were deleted from the program beginning second quarter 1983.

MILK SAMPLES

Milk samples were collected monthly and were analyzed for I-131, Sr-89, Sr-90 and gamma emitters. Sr-89 and Sr-90 analyses were deleted from the program beginning April 1983.

Sr-89 concentrations measured below the detection limit of 5 pCi/l in all samples collected during the year. Sr-90 concentrations continued to display considerable variation, which is typical for this type of sample. This nuclide is attributable to worldwide fallout from both recent and older nuclear thes programs. Data are given on page 39 .

I-131 concentrations were below the detection limits of the program. Data are presented on pages 39 and 41.

Gamma emitters other than those which occur in nature were not detected in all smaples at a measurement sensitivity of 10 pCi/l. Data age given on pages 40 and 42.

PRECIPITATION SAMPLES

Gamma isotopic analyses of monthly precipitation samples from indicator and background locations indicate the presence of no gamma emitters in concentrations exceeding 10 pCi/l (<3000 pCi/m^2). This sample type was deleted from the program beginning May 1983. Data are presented on page 43.

WELL WATER SAMPLES

Well water is collected from seven locations at 18 week intervals during the year and analyzed for tritium and gamma emitters.

Concentrations of tritium in the range of 600 to 8400 pCi/1 were detected in samples from all the indicator stations during the year. Some of the samples contained small amounts of hydrocarbons and these may have interfered with the measurement and contributed to the activity to some extent. It is possible that the tritium found in these samples is a result of plant operations. Gamma emitters were below the detection limit in all samples analyzed. Data are presented on page 45.

LAKE WATER SAMPLES

Samples of water from Lake Michigan are composited by indicator and background locations and analyzed for gamma emitters on a monthly basis. This sample type was deleted from the program beginning May 1983.

The gamma emitters in the monthly composites were measured to be less than the detection limit of 10 pCi/1 per nuclide for all samples. Data are given on page 44.

SEDIMENT SAMPLES

Sediment samples were collected twice during the year from areas north and south of the plant, at the on-site and off-site locations. The samples were analyzed for gamma emitters.

The gamma emitters were below the detection limit of 0.15 pCi/g (dry) in all samples. Data are given on page 46.

FISH SAMPLES

Fish samples collected from areas north and south of the plant, both on-site and off-site locations, were analyzed for gamma emitters.

For all samples, gamma emitters were below the detection limit of 0.13 pCi/g (wet). Data are given on page 46.

FOOD CROP SAMPLES

Broad leaf vegetables were collected during the fall harvest period from on-site and off-site locations and were analyzed for gamma emitters. They were found to be below the detection limit of 0.06 pCi/g (wet) at both on-site and off-site locations. Data are given on page 46.

GAMMA DOSE

Gamma radiation dose was measured with Thermoluminiscent Dosimeters (TLDs) on a quarterly schedule. A total of 23 locations (9 indicator and 14 background) were monitored during the year.

Throughout the year, there was no statistically significant difference in dose rates between indicator and background locations, nor do they differ significantly from dose rates measured in precious years. Data are presented on page 47.

SECTION 5

DATA TABLES

INTRODUCTION TO THE DATA TABLES

The following information will be helpful in understanding the presentation of the data in the tables in this section.

Wet Weight	a reporting unit used with organic tissue samples such as vegetation and animal samples in which the amount of sample is taken to be the weight as received from the field with no moisture removed.
Dry Weight	a reporting unit used for soil and sediment in which the amount of sample is taken to be the weight of the sample after removal of moisture by drying in an oven at about 110° for about 15 hours.
pCi/m^3	a reporting unit used with air particulate and radioiodine data which refers to the radioactivity content expressed in picocuries of the volume of air expressed in cubic meters passed through the filter and/or the charcoal trap. Note that the volumes are not corrected to standard conditions.
Gamma Emitters or Gamma Isotopic	samples were analyzed by high resolution (GeLi) gamma spectrometry. The resulting spectrum is analyzed by a computer program which scans from about 50 to 2000 kev and lists the energy peak of any nuclides present in concentrations exceeding the sensitivity limits set for that particular experiment.
NA, NS, NR	used in place of a concentration when a sample was not available (NS), or when a sample was not analyzed for some specific measurement (NA), or when an analysis is not required (NR).
Error Terms	figures following "±" are error terms based on counting uncertainties at the 2σ (95% confidence) level. Values preceded by the "<" symbol were below the stated concentration at the 3σ (99% confidence) level.
Exponents	Exponents necessary to prevent data tables from being cumbersome are handled in the conventional manner of including them in the column headings.
Sensitivity	In general, all analyses meet the sensitivity requirements of the program as given in Table 2. For the few samples that do not (because of inadequate sample quantities, analytical interferences, etc.) the sensitivity actually obtained in the analysis is given.
Comment	when all analyses of a particular type during the period resulted in concentrations below the sensitivity limits, a statement is made on the appropriate table rather than presenting a whole page of "<" data. If all but one or two data points are below the sensitivity limits, the previously mentioned convention is followed and the finite data are given as footnotes.

DONALD C. COOK

AIRBORNE IODINE-131* and GROSS BETA in AIR PARTICULATE FILTERS
(Weekly Collections)

Collection Date	ON-SITE 1 Volume (m^3)	ON-SITE 1 Gross β	ON-SITE 2 Volume (m^3)	ON-SITE 2 Gross β	ON-SITE 3 Volume (m^3)	ON-SITE 3 Gross β	ON-SITE 4 Volume (m^3)	ON-SITE 4 Gross β	ON-SITE 5 Volume (m^3)	ON-SITE 5 Gross β
		Gross Beta 10^{-2} pCi/m^3								
01/04/83	285	<1	400	1±1	250	5±1	325	3±1	215	4±2
01/11/83	270	<1	390	1±1	250	4±1	320	3±1	210	4±1
01/18/83	295	<1	335	<1	250	1±1	315	2±1	210	4±1
01/25/83	310	1±1	295	<1	250	2±1	315	2±1	265	3±1
02/01/83	445	2±1	250	1±1	250	1±1	365	2±1	580	1±1
02/08/83	435	1±1	200	5±1	250	4±1	370	6±1	485	2±1
02/15/83	435	<1	275	1±1	250	4±1	430	3±1	400	3±1
02/22/83	430	1±1	290	1±1	215	3±1	395	3±1	395	3±1
03/01/83	435	1±1	285	2±1	210	2±1	365	2±1	400	3±1
03/08/83	445	1±1	315	4±1	215	4±1	370	5±1	395	4±1
03/15/83	440	1±1	395	2±1	210	3±1	365	3±1	395	4±1
03/22/83	300	<1	310	<1	265	3±1	300	1±1	300	3±1
03/29/83	305	1±1	305	1±1	300	3±1	295	2±1	280	2±1
04/05/83	340	<1	325	<1	(a)	(a)	280	1±1	325	2±1
04/15/83	340	1±1	270	2±1	600	3±1	215	2±1	315	1±1
04/19/83	320	1±1	300	2±1	300	3±1	230	3±1	320	2±1
04/26/83	340	1±1	330	2±1	300	3±1	235	3±1	315	4±1
05/03/83	380	1±1	360	1±1	295	2±1	230	2±1	330	3±1
05/10/83	365	1±1	395	1±1	295	2±1	265	3±1	325	2±1
05/17/83	390	1±1	410	2±1	295	3±1	330	3±1	375	4±1
05/24/83	430	1±1	410	2±1	290	4±1	320	3±1	475	3±1
05/31/83	445	1±1	425	1±1	315	2±1	320	2±1	480	2±1
06/07/83	435	1±1	455	<1	320	2±1	320	1±1	475	1±1
06/14/83	405	1±1	435	1±1	345	3±1	325	4±1	450	4±1
06/21/83	360	1±1	375	1±1	325	2±1	310	2±1	400	2±1
06/28/83	350	<1	385	<1	325	2±1	335	3±1	400	3±1

* Iodine cartidges are sampled weekly. Concentrations are <0.10 pCi/m^3 unless otherwise noted.
** No power data in pCi/sample (a) see list of missed samples.

DONALD C. COOK

AIRBORNE IODINE-131* and GROSS BETA in AIR PARTICULATE FILTERS
(Weekly Collections)

	Gross Beta 10^{-2} pCi/m³									
	ON-SITE 1		ON-SITE 2		ON-SITE 3		ON-SITE 4		ON-SITE 5	
Collection Date	Volume (m³)	Gross β	Volume (m³)	Gross β	Volume (m³)	Gross β	Volume (m³)	Gross β	Volume (m³)	Gross β
07/05/83	335	1±1	345	2±1	330	2±1	330	2±1	390	2±1
07/12/83	335	1±1	375	<1	330	3±1	335	2±1	335	3±1
07/19/83	315	3±1	365	4±1	335	3±1	350	3±1	385	4±1
07/26/83	305	2±1	355	1±1	335	2±1	345	2±1	400	3±1
08/02/83	285	<1	255	<1	330	4±1	355	3±1	395	3±1
08/09/83	285	<1	270	<1	335	3±1	355	3±1	405	3±1
08/16/83	295	<1	255	<1	330	2±1	335	3±1	405	1±1
08/23/83	275	<1	215	<1	325	3±1	350	3±1	235	3±1
08/30/83	285	1±1	210	<1	360	4±1	390	4±1	455	4±1
09/06/83	340	<1	185	<1	340	3±1	380	<1	420	4±1
09/13/83	330	<1	290	<1	340	3±1	345	1±1	350	3±1
09/20/83	325	<1	290	1±1	345	3±1	335	1±1	330	3±1
09/27/83	315	1±1	280	<1	340	1±1	330	1±1	330	3±1
10/04/83	310	1±1	270	1±1	345	6±1	350	4±1	330	7±1
10/11/83	520	2±1	515	2±1	550	2±1	585	2±1	370	2±1
10/18/83	520	3±1	545	1±1	505	2±1	510	3±1	385	3±1
10/25/83	340	1±1	290	2±1	235	2±1	265	2±1	285	2±1
11/01/83	240	2±1	315	1±1	235	2±1	250	3±1	340	3±1
11/08/83	240	4±1	300	<1	235	3±1	250	4±1	340	4±1
11/15/83	230	3±1	290	1±1	235	4±1	250	4±1	270	4±1
11/22/83	200	3±1	240	4±1	245	4±1	340	3±1	260	3±1
11/29/83	210	3±1	270	3±1	345	2±1	260	2±1	275	2±1
12/06/83	250	2±1	80	1±1	270	5±2	265	2±1	260	3±1
12/13/83	255	4±1	300(a)	5±1	275	3±1	250	5±1	260	5±1
12/20/83	250	3±1	80	1	270	4±1	265	4±1	260	3±1
12/27/83	245	6±1	455	2±1	270	5±1	275	4±1	265	5±1
01/03/84	290	3±1	415	2±1	265	5±1	265	4±1	255	4±1

*Iodine cartridges are sampled weekly. Concentration are <0.10 unless otherwise noted.

(a) Estimated average volume

DONALD C. COOK

AIRBORNE IODINE-131* and GROSS BETA in AIR PARTICULATE FILTERS
(Weekly Collections)

	Gross Beta 10^{-2} pCi/m^3									
	ON-SITE 6			NEW BUFFALO		SOUTH BEND		DOWAGIAC		COLOMA	
Collection Date	Volume (m^3)	Gross Beta	Collection Date	Volume (m^3)	Gross Beta	Volume (m^3)	Gross Beta	Volume (m^3)	Gross Beta	Volume (m^3)	Gross Beta
01/04/83	380	3±1	01/01/83	355	1±1	355	1±1	345	3±1	315	3±1
01/11/83	90	2±1	01/08/83	320	6±1	250	<1	345	<1	310	3±1
01/18/83	360	3±1	01/15/83	295	3±1	425	(a)	300	4±1	335	2±1
01/25/83	255	2±1	01/22/83	300	2±1	400	<1	300	2±1	340	<1
02/01/83	255	5±1	01/29/83	300	2±1	405	2±1	305	3±1	325	3±1
02/08/83	250	4±1	02/05/83	295	1±1	355	3±1	290	3±1	320	3±1
02/15/83	255	3±1	02/12/83	270	3±1	320	3±1	300	3±1	310	2±1
02/22/83	315	3±1	02/19/83	275	3±1	320	1±1	325	2±1	280	2±1
03/01/83	295	3±1	02/26/83	300	3±1	285	2±1	335	2±1	290	2±1
03/08/83	320	4±1	03/05/83	285	5±1	280	5±1	340	5±1	280	5±1
03/15/83	380	2±1	03/12/83	285	3±1	275	3±1	345	3±1	280	2±1
03/22/83	280	3±1	03/19/83	290	4±1	265	1±1	360	1±1	265	1±1
03/29/83	280	3±1	03/26/83	280	4±1	265	2±1	355	3±1	285	1±1
04/05/83	325	1±1	04/02/83	275	2±1	225	2±1	330	2±1	295	2±1
04/12/83	290	2±1	04/09/83	290	3±1	245	3±1	285	4±1	285	4±1
04/19/83	280	2±1	04/16/83	215	2±1	280	1±1	295	1±1	260	1±1
04/26/83	270	3±1	04/23/83	310	2±1	265	(a)	285	2±1	325	1±1
05/03/83	335 (b)	2±1	04/30/83	285	2±1	250	3±1	295	3±1	325	4±1
05/10/83	265	3±1	05/07/83	290	1±1	270	2±1	285	2±1	320	1±1
05/17/83	345	3±1	05/14/83	305	4±1	295	2±1	300	3±1	315	4±1
05/24/83	385	3±1	05/21/83	315	1±1	290	3±1	310	3±1	335	2±1
05/31/83	390	2±1	05/28/83	300	1±1	310	1±1	320	2±1	335	1±1
06/07/83	385	1±1	06/04/83	330	1±1	315	1±1	325	1±1	320	1±1
06/14/83	380	4±1	06/11/83	340	2±1	310	2±1	330	2±1	330	1±1
06/21/83	380	2±1	06/18/83	320	3±1	295	3±1	335	3±1	325	2±1
06/28/83	390	1±1	06/25/83	325	2±1	310	2±1	335	2±1	335	3±1

* Iodine cartridges are sampled weekly. Concentrations are <0.10 pCi/m^3 unless otherwise noted.

(a) Missing filter. See list of missed samples.

(b) Estimated average weekly volume.

DONALD C. COOK

AIRBORNE IODINE-131* and GROSS BETA in AIR PARTICULATE FILTERS
(Weekly Collections)

	Gross Beta 10^{-2} pCi/m^3											
	ON-SITE 6			NEW BUFFALO		SOUTH BEND		DOWAGIAC		COLOMA	
Collection Date	Volume (m^3)	Gross Beta	Collection Date	Volume (m^3)	Gross Beta	Volume (m^3)	Gross Beta	Volume (m^3)	Gross Beta	Volume (m^3)	Gross Beta
07/05/83	380	1±1	07/02/83	335	3±1	305	2±1	330	2±1	320	2±1
07/12/83	335	3±1	07/09/83	350	2±1	300	2±1	330	1±1	325	1±1
07/19/83	380	4±1	07/16/83	325	4±1	315	3±1	315	3±1	320	3±1
07/26/83	380	2±1	07/23/83	355	3±1	295	4±1	320	3±1	315	3±1
08/02/83	375	3±1	07/30/83	350	3±1	315	3±1	325	3±1	300	5±1
08/09/83	390	2±1	08/06/83	350	3±1	310	2±1	325	2±1	320	1±1
08/16/83	375	2±1	08/13/83	365	3±1	315	1±1	320	2±1	325	2±1
08/23/83	370	3±1	08/20/83	370	4±1	340	1±1	320	3±1	310	3±1
08/30/83	400	4±1	08/27/83	380	3±1	325	4±1	335	3±1	320	<1
09/06/83	385	2±1	09/03/83	350	4±1	330	4±1	320	4±1	305	5±1
09/13/83	375	3±1	09/10/83	410	2±1	345	2±1	315	2±1	300	1±1
09/20/83	380	2±1	09/17/83	430	3±1	345	3±1	345	1±1	330	1±1
09/27/83	325	3±1	09/24/83	395	1±1	330	1±1	320	2±1	325	1±1
10/04/83	265	9±1	10/01/83	395	8±1	340	5±1	320	5±1	330	2±1
10/11/83	735	2±1	10/08/83	425	2±1	335	1±1	430	4±1	510	2±1
10/18/83	590	2±1	10/15/83	440	4±1	325	2±1	595	2±1	635	1±1
10/25/83	260	1±1	10/22/83	505	2±1	365	3±1	365	3±1	750	1±1
11/01/83	300	2±1	10/29/83	445	3±1	215	3±1	200	<1	520	1±1
11/08/83	280	4±1	11/05/83	345	5±1	300	3±1	255	3±1	265	2±1
11/15/83	305	4±1	11/12/83	415	4±1	310	3±1	255	3±1	245	1±1
11/22/83	315	4±1	11/19/83	420	4±1	305	2±1	250	1±1	400	1±1
11/29/83	345	<1	11/26/83	320	6±1	310	2±1	240	5±1	570	<1
12/06/83	275	4±1	12/03/83	525	2±1	255	3±1	250	2±1	300	2±1
12/13/83	310	6±1	12/10/83	575	4±1	275	2±1	250	4±1	260	1±1
12/20/83	275	4±1	12/17/83	525	2±1	255	3±2	250	1±1	300	2±1
12/27/83	275	5±1	12/24/83	430	4±1	270	4±3	255	1±1	(a)	(a)
01/03/84	250	5±1	12/31/83	470	<1	250	<1	240	1±1	600	2±1

*Iodine cartridges are sampled weekly. Concentrations are <0.10 unless otherwise noted.

(a) Sample was not available. See list of missed samples.

1983

DONALD C. COOK

GAMMA ISOTOPIC ANALYSIS OF MONTHLY AIR PARTICULATE COMPOSITES *

Month	Indicator Stations pCi/m³ Be-7	Indicator Stations pCi/m³ Other γ	Background Stations pCi/m³ Be-7	Background Stations pCi/m³ Other γ
January	0.22±0.07	<0.01	0.17±0.06	<0.01
February	0.23±0.05	<0.01	0.28±0.06	<0.01
March	0.34±0.04	<0.01	0.42±0.06	<0.01

(See following page for gamma isotopic analysis quarterly air particulate composites.)

STRONTIUM 89 AND STRONTIUM 90 ANALYSIS OF QUARTERLY AIR PARTICULATE COMPOSITES *

Collection Period	Indicator Stations pCi/m³ Sr-89	Indicator Stations pCi/m³ Sr-90	Background Stations pCi/m³ Sr-89	Background Stations pCi/m³ Sr-90
1st Quarter	<0.002	<0.001	<0.002	<0.001

* Analysis frequency changed to quarterly for gamma isotopic analysis by individual stations. Strontium-89 & 90 analysis was deleted. These changes were made effective April 1983.

1983

D.C. Cook Plant

Gamma Isotopic Analysis of Quarterly Air Particulate Filter Composites

Location	Collection Date	PCi/m^3 Be-7	PCi/m^3 Other Gamma
ONS-1	2nd Quarter	0.22±0.09	<0.01
ONS-2	"	0.43±0.12	<0.01
ONS-3	"	0.58±0.16	<0.01
ONS-4	"	0.70±0.18	<0.01
ONS-5	"	0.52±0.12	<0.01
ONS-6	"	0.46±0.13	<0.01
NBF	"	0.53±0.14	<0.01
SBN	"	0.51±0.17	<0.01
DOW	"	0.36±0.13	<0.01
COL	"	0.43±0.14	<0.01
ONS-1	3rd Quarter	<0.1	<0.01
ONS-2	"	<0.1	<0.01
ONS-3	"	0.4±0.1	<0.01
ONS-4	"	0.3±0.1	<0.01
ONS-5	"	0.4±0.1	<0.01
ONS-6	"	0.3±0.1	<0.01
NBF	"	0.3±0.1	<0.01
SBN	"	0.2±0.1	<0.01
DOW	"	0.3±0.1	<0.01
COL	"	0.1±0.1	<0.01
ONS-1	4th Quarter	0.5±0.1	<0.01
ONS-2	"	0.3±0.1	<0.01
ONS-3	"	0.6±0.1	<0.01
ONS-4	"	0.6±0.1	<0.01
ONS-5	"	0.4±0.1	<0.01
ONS-6	"	0.4±0.1	<0.01
NBF	"	0.5±0.1	<0.01
SBN	"	0.2±0.1	<0.01
DOW	"	0.2±0.1	<0.01
COL	"	0.2±0.1	<0.01

DONALD C. COOK

Sr-89*/90 and I-131 CONCENTRATIONS in MILK SAMPLES
(Monthly Collection)

Collection Site:	Indicator Stations			Background Stations	
	Bridgman K2	Stevensville K1	Galien	Dowagiac K1	South Bend K1
Collection Date	I-131 pCi/l				
01/08/83	<0.5	<0.5	<0.5	<0.5	<0.5
02/05/83	<0.5	<0.5	<0.5	<0.5	<0.5
03/05/83	<0.5	<0.5	<0.5	<0.5	<0.5
03/26/83	<0.5	<0.5	<0.5	<0.5	<0.5
04/16/83	<0.5	<0.5	<0.5	<0.5	<0.5
04/30/83	<0.5	<0.5	<0.5	<0.5	<0.5
05/14/83	<0.5	<0.5	<0.5	<0.5	<0.5
05/28/83	<0.5	<0.5	<0.5	<0.5	<0.5
06/11/83	<0.5	<0.5	<0.5	<0.5	(a)
06/25/83	<0.5	<0.5	<0.5	<0.5	<0.5
	Sr-90 pCi/l				
01/08/83	2±1	2±1	3±1	7±1	3±1
02/05/83	1±1	5±1	3±1	7±1	2±1
03/05/83	1±1	2±1	1±1	4±1	2±1
03/26/83	1±1	1±1	2±1	3±1	2±1

(Strontium-89 and 90 analyses were deleted from the program beginning were deleted from the program beginning April 1983.)

* Sr-89 was determined on each sample and was <5 pCi/l unless otherwise noted.
(a) Sample not available see listing of missed samples.

1983

DONALD C. COOK

RADIONUCLIDES in MILK SAMPLES
(Monthly Collections)

Collection Site:	Indicator Stations			Background Stations	
	Bridgman K2	Stevensville K1	Galien	Dowagiac K1	South Bend K1
Collection Date	Cs-137 pCi/l				
01/08/83	<10	<10	<10	<10	<10
02/05/83	<10	<10	<10	<10	<10
03/05/83	<10	<10	<10	<10	<10
03/26/83	<10	<10	<10	<10	<10
04/16/83	<10	<10	<10	<10	<10
04/30/83	<10	<10	<10	<10	<10
05/14/83	<10	<10	<10	<10	<10
05/28/83	<10	<10	<10	<10	<10
06/11/83	<10	<10	<10	<10	(a)
06/25/83	<10	<10	<10	<10	<10
	Other Gamma Emitters pCi/l				
01/08/83	<10	<10	<10	<10	<10
02/05/83	<10	<10	<10	<10	<10
03/05/83	<10	<10	<10	<10	<10
03/26/83	<10	<10	<10	<10	<10
04/16/83	<10	<10	<10	<10	<10
04/30/83	<10	<10	<10	<10	<10
05/14/83	<10	<10	<10	<10	<10
05/28/83	<10	<10	<10	<10	<10
06/11/83	<10	<10	<10	<10	(a)
06/25/83	<10	<10	<10	<10	<10

(a) Sample not available, see listing of missed samples.

DONALD C COOK

I-131 CONCENTRATIONS in MILK SAMPLES

(Collection every two weeks)

Collection Site:	Indicator Stations			Background Stations	
	Bridgman K2	Stevensville K1	Galien	Dowagiac K1	South Bend K1
Collection Date	I-131 pCi/l				
07/09/83	<0.5	<0.5	<0.5	<0.5	<0.5
07/23/83	<0.5	<0.5	<0.5	<0.5	<0.5
08/13/83	<0.5	<0.5	<0.5	<0.5	<0.5
08/27/83	<0.5	<0.5	<0.5	<0.5	<0.5
09/10/83	<0.5	<0.5	<0.5	<0.5	<0.5
09/24/83	<0.5	<0.5	<0.5	<0.5	<0.5
10/08/83	<0.5	<0.5	<0.5	<0.5	<0.5
10/22/83	<0.5	<0.5	<0.5	<0.5	<0.5
11/05/83	<0.5	<0.5	<0.5	<0.5	<0.5
11/19/83	<0.5	<0.5	<0.5	<0.5	<0.5
12/03/83	<0.5	<0.5	(a)	<0.5	<0.5
12/17/83	<0.5	<0.5	<0.5	<0.5	<0.5

(a) See list of missed samples.

DONALD C. COOK

RADIONUCLIDES in MILK SAMPLES.
(Monthly Collections)

Collection Site:	Indicator Stations			Background Stations	
	Bridgman K2	Stevensville K1	Galien	Dowagiac K1	South Bend K1
Collection Date	Cs-137 pCi/l				
07/09/83	<10	<10	<10	<10	<10
07/23/83	<10	<10	<10	<10	<10
08/13/83	<10	<10	<10	<10	<10
08/27/83	<10	<10	<10	<10	<10
09/10/83	<10	<10	<10	<10	<10
09/24/83	<10	<10	<10	<10	<10
10/08/83	<10	<10	<10	<10	<10
10/22/83	<10	<10	<10	<10	<10
11/05/83	<10	<10	<10	<10	<10
11/19/83	<10	<10	<10	<10	<10
12/03/83	<10	<10	(a)	<10	<10
12/17/83	<10	<10	<10	<10	<10
	Other Gamma Emitters pCi/l				
07/09/83	<10	<10	<10	<10	<10
07/23/83	<10	<10	<10	<10	<10
08/13/83	<10	<10	<10	<10	<10
08/27/83	<10	<10	<10	<10	<10
09/10/83	<10	<10	<10	<10	<10
09/24/83	<10	<10	<10	<10	<10
10/08/83	<10	<10	<10	<10	<10
10/22/83	<10	<10	<10	<10	<10
11/05/83	<10	<10	<10	<10	<10
11/19/83	<10	<10	<10	<10	<10
12/03/83	<10	<10	(a)	<10	<10
12/17/83	<10	<10	<10	<10	<10

(a) See list of missed samples.

1983

DONALD C. COOK

GAMMA ISOTOPIC ANALYSIS OF PRECIPITATION SAMPLES

(Monthly Collections)

Collection Sites:	Indicator		Background	
Collection Period	pCi/l	nCi/m^2	pCi/l	nCi/m^2
January	<10	<0.20	<10	<0.20
February	<10	<0.60	<10	<0.30
March	<10	<0.60	<10	<0.60
April	<10	<0.60	<10	<0.40

(Precipitation samples were deleted from the program beginning May 1983.)

1983

DONALD C. COOK

GAMMA EMITTERS IN LAKE WATER SAMPLES
(Monthly Composites of Indicator and Background Stations)

	Gamma Emitters pCi/l/nuclide	
Month	Indicator Composite	Background Composite
January	<10	<10
February	<10	<10
March	<10	<10
April	<10	<10

(Lake water collection has been deleted from the program beginning May 1983.)

1983

DONALD C. COOK

RADIONUCLIDES IN WELL WATER SAMPLES
(18-week Interval Collections)

Collection Site:	Background Stations			Indicator Stations			
	ONS 1	ONS 2	ONS 3	ONS 4	ONS 5	ONS 6	ONS 7
Collection Date	Tritium pCi/l						
02/10/83	<1000	<1000	<1000	3200±900	<1000	2200±900	<1000
05/10/83	<1000	<1000	<1000	<1000	<1000	<1000	<1000
08/11/83 (b)	<1000	<1000	<1000	2600±600	1500±600	4100±600	600±600
11/10/83 (c)	<1000	700±500	<1000	8400±600	3300±500	2800±500	600±500
	Gamma Emitters pCi/l						
02/10/83	<10	<10	<10	<10	<10	<10	<10
05/10/83(a)	<20	<20	<20	<20	<20	<20	<20
08/11/83 (b)	<10	<10	<10	<10	<10	<10	<10
11/10/83 (c)	<10	<10	<10	<10	<10	<10	<10

(a) Insufficient sample for more sensitive analysis.
(b) Sample from ONS-1 was collected only on 08/24/83 due to loss of power.
(c) Sample from ONS-3 was collected on 11/17/83 and from ONS-5 on 11/21/83.

DONALD C. COOK

RADIONUCLIDES IN SEDIMENT SAMPLES
(Semiannual Collections)

Collection Site	Collection Date	pCi/g (dry) Gamma Emitters	Cs-134	Cs-137
ONSN	05/24/83		<0.15	
ONSS	05/24/83		<0.15	
OFSN	05/24/83		<0.15	
OFSS	05/24/83		<0.15	
ONSN	10/18/83		<0.15	
ONSS	10/18/83		<0.15	
OFSN	10/18/83		<0.15	
OFSS	10/18/83		<0.15	

RADIONUCLIDES IN FISH SAMPLES
(Semiannual Collections)

Collection Site	Collection Date	pCi/g (wet) Gamma Emitters Cs-134, Cs-137 Co-58, Co-60, Mn-54	Fe, Zn-65
North on site	05/06/83	<0.13	<0.26
North off site	05/06/83	<0.13	<0.26
South on site	05/06/83	<0.13	<0.26
South off site	05/06/83	<0.13	<0.26
North on site	09/28/83	<0.13	<0.26
North off site	09/28/83	<0.13	<0.26
South on site	09/28/83	<0.13	<0.26
South off site	09/28/83	<0.13	<0.26

RADIONUCLIDES IN FOOD CROPS
(Annual Fall Harvest Collection)

Collection Date	Collection Site: Sample Type	ON Site pCi/g (wet) Gamma Emitters	OFF Site pCi/g (wet) Gamma Emitters
09/19/83	Broad Leaf Vegetable (grapes)	<0.06	<0.06

DONALD C. COOK

GAMMA RADIATION
(Quarterly)

(Measured using Thermoluminiscent Dosimeters)

	1st Qtr.		2nd Qtr.		3rd Qtr.		4th Qtr.	
Date Annealed:	12/13/82		03/21/83		06/22/83		09/23/83	
Date Read:	04/05/83		07/18/83		10/21/83		01/16/84	
	Main TLD	Backup TLD	Main TLD	Backup TLD	Main TLD	Backup TLD	Main TLD	Backup TLD
Location	Measured mR/week							
Indicator Stations								
On-Site 1	1.1±0.3	1.0±0.1	1.0±0.1	1.1±0.1	1.1±0.1	1.0±0.1	1.5±0.2	1.4±0.2
On-Site 2	1.0±0.1	1.1±0.1	1.1±0.1	1.0±0.1	1.1±0.1	1.0±0.2	1.4±0.2	1.4±0.1
On-Site 3	1.0±0.1	1.0±0.1	1.0±0.1	1.0±0.1	1.1±0.1	1.0±0.1	1.4±0.1	1.3±0.1
On-Site 4	1.0±0.2	1.0±0.1	1.0±0.1	1.0±0.1	1.0±0.2	1.0±0.1	1.4±0.2	1.4±0.1
On-Site 5	1.1±0.1	1.0±0.1	0.9±0.1	1.0±0.1	1.0±0.2	1.1±0.1	1.5±0.2	1.4±0.1
On-Site 6	0.9±0.2	0.9±0.1	1.0±0.1	1.0±0.1	1.0±0.1	1.0±0.1	1.2±0.2	1.4±0.2
On-Site 7	1.1±0.1	0.9±0.1	1.1±0.1	1.0±0.1	1.1±0.1	1.1±0.1	Missing	1.4±0.2
On-Site 8	1.0±0.2	1.0±0.2	1.0±0.1	0.9±0.1	1.0±0.2	1.1±0.1	1.4±0.1	1.3±0.1
On-Site 9	1.1±0.1	1.0±0.2	1.0±0.1	1.1±0.1	1.1±0.2	1.1±0.1	1.4±0.1	1.4±0.1
Background Stations								
Coloma	1.0±0.1	0.9±0.2	1.0±0.1	1.0±0.1	1.0±0.1	0.9±0.1	1.4±0.2	1.4±0.2
Dowagiac	1.0±0.1	0.9±0.1	1.0±0.1	1.0±0.1	1.0±0.1	1.0±0.1	1.4±0.1	1.4±0.2
New Buffalo	1.1±0.2	1.2±0.1	1.1±0.1	1.1±0.1	1.1±0.2	1.0±0.1	1.5±0.2	1.4±0.1
South Bend	1.2±0.1	1.1±0.3	1.1±0.1	1.0±0.1	1.0±0.1	0.9±0.1	1.6±0.2	1.3±0.1
Off-Site- 1	1.0±0.1	1.0±0.2	1.1±0.1	0.9±0.1	1.2±0.2	1.0±0.3	1.4±0.2	1.3±0.1
Off-Site- 2	1.0±0.1	1.0±0.1	1.1±0.1	1.0±0.1	1.0±0.1	1.1±0.1	1.4±0.2	1.3±0.1
Off-Site- 3	1.1±0.2	0.9±0.1	1.0±0.1	0.9±0.1	1.1±0.2	1.0±0.1	1.3±0.2	1.4±0.1
Off-Site- 4	1.1±0.2	1.1±0.1	1.1±0.1	1.1±0.1	1.1±0.2	1.1±0.1	1.6±0.2	1.4±0.2
Off-Site- 5	1.0±0.3	1.1±0.2	1.1±0.1	1.0±0.1	1.1±0.1	1.0±0.1	1.6±0.2	1.4±0.1
Off-Site- 6	1.1±0.1	1.1±0.2	1.0±0.1	1.0±0.1	1.1±0.1	1.1±0.1	1.5±0.2	1.5±0.1
Off-Site- 7	1.0±0.1	1.0±0.2	0.9±0.1	1.0±0.1	1.0±0.2	0.9±0.1	1.3±0.1	1.4±0.1
Off-Site- 8	1.2±0.1	1.2±0.3	1.0±0.1	1.1±0.1	1.1±0.1	1.2±0.1	1.3±0.2	1.6±0.2
Off-Site- 9	1.2±0.2	1.2±0.3	1.1±0.1	1.2±0.1	1.2±0.2	1.1±0.1	1.3±0.2	1.5±0.1
Off-Site-10	1.0±0.2	1.0±0.2	0.9±0.1	1.1±0.1	1.1±0.2	1.1±0.2	1.4±0.2	1.4±0.2

COOK

LISTING OF MISSED SAMPLES

1983

Sample Type	Location	Expected Collection Date	Reason
AP	SBN	01/15/83	Filter was lost in the wind.
AP/CC	ONS-3	04/05/83	Sample was lost
AP	SBN	04/23/83.	Filter was lost.
Milk	SBN	06/11/83	Not Available
AP/CC	Coloma	12/24/83	Not Available
Milk	GAL	12/03/83	Not Available

SECTION 6

QUALITY ASSURANCE DATA

1983 Quality Control Analyses Summary

The table below summarizes results of samples run for process quality control purposes during the subject year. These listings are in addition to such measurements as detector backgrounds, check source values, radiometric-gravimetric comparisons, system calibrations etc. Detailed listing of each measurement are maintained at the laboratory and are available for inspection if required.

Blank Samples

Nuclide Analyzed	Number of Determinations	Number of Analyses Exceeding the LLD for that Analysis
Gross Alpha	49	0
Gross Beta	101	0
H-3	90	0
U-234	17	0
Th-230	19	0
Ra-226	37	0
Pb-210	29	0
I-131	*	
Sr-89,90	81	0
Pu-239	32	0
Am-241	3	0

* Blank I-131 analyses are performed with each batch of samples processed all blank data were below the detection limit.

Spiked Samples

Nuclide Analyzed	Number of Det'ns	Within 2 sigma of known	Within 3 sigma of known	Differing from known by > 3 sigma
Gross Alpha	49	49	-	-
Gross Beta	101	101	-	-
H-3	90	90	-	-
U-234	17	17	-	-
Th-230	19	19	-	-
Ra-226	37	37	-	-
Pb-210	29	29	-	-
Sr-90	81	81	-	-
Pu-239	32	32	-	-
Am-241	3	3	-	-

Split Samples

Nuclide Analysed	Number of Det'ns	No. Agreeing Within 2 sigma	No. Agreeing Within 3 sigma	No. Differing by > 3 sigma
Gross Alpha	47	47	-	-
Gross Beta	142	142	-	-
H-3	151	151	-	-
U-234	12	12	-	-
Th-230	10	10	-	-
Ra-226	21	20	1	-
Pb-210	19	19	-	-
Sr-89	47	47	-	-
Sr-90	54	54	-	-
Pu-239	12	12	-	-
Am-241	3	2	1	-
Gamma	13	13	-	-

1983 USEPA - EBERLINE INTERCOMPARISON PROGRAM

Sample Type	Analysis	Value (EPA)	Value (EIC)	Units
Air Filter	Alpha	26±11.2	19±2	pCi/Filter
Air Filter	Beta	68±8.7	72±7	pCi/Filter
Air Filter	Sr-90	20±2.6	26±8	pCi/Filter
Air Filter	Cs-137	27±8.7	42±6	pCi/Filter
Air Filter	Alpha	13±8.7	9±1	pCi/Filter
Air Filter	Beta	36±8.7	41±4	pCi/Filter
Air Filter	Sr-90	10±2.6	12±5	pCi/Filter
Air Filter	Cs-137	15±8.7	10±2	pCi/Filter
Food	Sr-89	35±8.7	31±19	pCi/kg
Food	Sr-90	28±8.7	42±9	pCi/kg
Food	I-131	37±10.4	<27	pCi/kg
Food	Cs-137	31±8.7	52±23	pCi/kg
Milk	Sr-89	37±8.7	19±9	pCi/l
Milk	Sr-90	18±2.6	11±4	pCi/l
Milk	I-131	55±10.4	66±7	pCi/l
Milk	Cs-137	26±8.7	28±3	pCi/l
Milk	K	1512±131	1850±190	pCi/l
Milk	Sr-89	15±8.7	14±6	pCi/l
Milk	Sr-90	14±2.6	16±3	pCi/l
Milk	I-131	40±10.4	54±4	pCi/l
Milk	Cs-137	33±8.7	36±20	pCi/l
Milk	K	1550±135	1550±210	mg/l.
Water	Alpha	29±13	17±2	pCi/l
Water	Beta	31±8.7	44±6	pCi/l
Water	Alpha	11±8.7	17±3	pCi/l
Water	Beta	57±8.7	46±5	pCi/l
Water	Alpha	7±5.0	7±2	pCi/l
Water	Beta	22±5.0	24±2	pCi/l
Water	Alpha	14±8.7	13±2	pCi/l
Water	Beta	16±8.7	33±2	pCi/l
Water	U	31±10.4	27±5	pCi/l
Water	Sr-89	29.2±8.7	12±8	pCi/l
Water	Sr-90	17.2±2.6	22±4	pCi/l
Water	Sr-89	15±8.7	7±5	pCi/l
Water	Sr-90	10±2.6	5±2	pCi/l
Water	H-3	2560±612	3090±510	pCi/l
Water	H-3	1529±337	1600±600	pCi/l
Water	H-3	1210±570	1370±600	pCi/l
Water	Pu-239	8.6±1.5	9.0±0.5	pCi/l
Water	I-131	27±10.4	19±4	pCi/l
Water	I-131	14±6	16±2	pCi/l
Water	Cr-51	45±9	102±70	pCi/l

Sample Type	Analysis	Value (EPA)	Value (EIC)	Units
Water	Co-60	22±9	23±3	pCi/l
Water	Zn-65	21±9	20±3	pCi/l
Water	Ru-106	48±9	49±13	pCi/l
Water	Cs-134	20±9	21±3	pCi/l
Water	Cs-137	19±9	20±3	PCi/l
Water	Cr-51	51±8.7	42±37	pCi/l
Water	Co-60	19±8.7	21±3	pCi/l
Water	Zn-65	40±8.7	28±5	pCi/l
Water	Ru-106	52±8.7	46±17	pCi/l
Water	Cs-134	15±8.7	13±3	pCi/l
Water	Cs-137	22±8.7	22±3	pCi/l
Water	Ra-226	12.7±3.3	6.6±2.0	pCi/l
Water	Ra-228	0	<6.0	pCi/l
Water	Ra-226	4.8±0.7	4.4±1.3	pCi/l
Water	Ra-228	0	<2	pCi/l
Water	Ra-226	3.1±0.81	2.5±0.8	pCi/l
Water	Ra-228	2.0±0.52	<5.3	pCi/l
Water	Alpha	46±19.9	87±39	pCi/l
Water	Beta	143±12.4	138±54	pCi/l
Water	Sr-89	24±8.7	25±4	pCi/l
Water	Sr-90	13±2.6	20±4	pCi/l
Water	Ra-226	8.5±2.25	6.8±2.0	pCi/l
Water	Ra-228	4.7±1.21	<46	pCi/l
Water	Co-60	30±8.7	29±2	pCi/l
Water	Cs-134	33±8.7	29±4	pCi/l
Water	Cs-137	27±8.7	25±4	pCi/l
Water	U	25±10.4	19±1	pCi/l

NOTE: Includes all data received for 1983 samples up to 02/10/84.

TLD INTERCOMPARISON QC DATA

(Eberline-Battelle Pacific Northwest Labs)

1983

Total MR±2 Sigma

1st Quarter		2nd Quarter		3rd and 4th Quarter	
Actual	Measured	Actual	Measured	Actual	Measured
27	24±6	90	80±14	15	13±4
36	32±3	90	85±11	15	14±3
40	37±4	84	90±13	28	30±4
45	41±7	68	70±13	28	34±7
58	53±5	50	47±5	40	37±4
69	62±6	50	50±7	40	40±7
69	64±6	68	59±7	57	52±5
69	64±9	84	81±8	57	58±6
97	85±15	99	97±16	88	75±10
97	85±15	99	102±10	88	77±8