VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

April 29, 2002

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D. C. 20555-0001

Serial No. 02-265
SS&L/BAG
Docket Nos. 50-280
50-281
72-2
License Nos. DPR-32
DPR-37
SNM-2501

Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION UNITS 1 AND 2
INDEPENDENT SPENT FUEL STORAGE INSTALLATION
ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

Surry Units 1 and 2 Technical Specification 6.6.B.2 requires the submittal of an Annual Radiological Environmental Operating Report for Surry Power Station. Surry Independent Spent Fuel Storage Installation (ISFSI) Technical Specification Appendix C.1.3.1 requires that the Surry ISFSI be included in the environmental monitoring for the Surry Power Station. Accordingly, enclosed is the Surry Power Station Radiological Environmental Operating Report for the period of January 1, 2001 through December 31, 2001 which includes environmental monitoring for the Surry ISFSI.

If you have any questions or require additional information, please contact us.

Very truly yours,

R. H. Blount

Richard H. Blount, Site Vice President
Surry Power Station

Attachment

Commitments made in this letter: None

IE25

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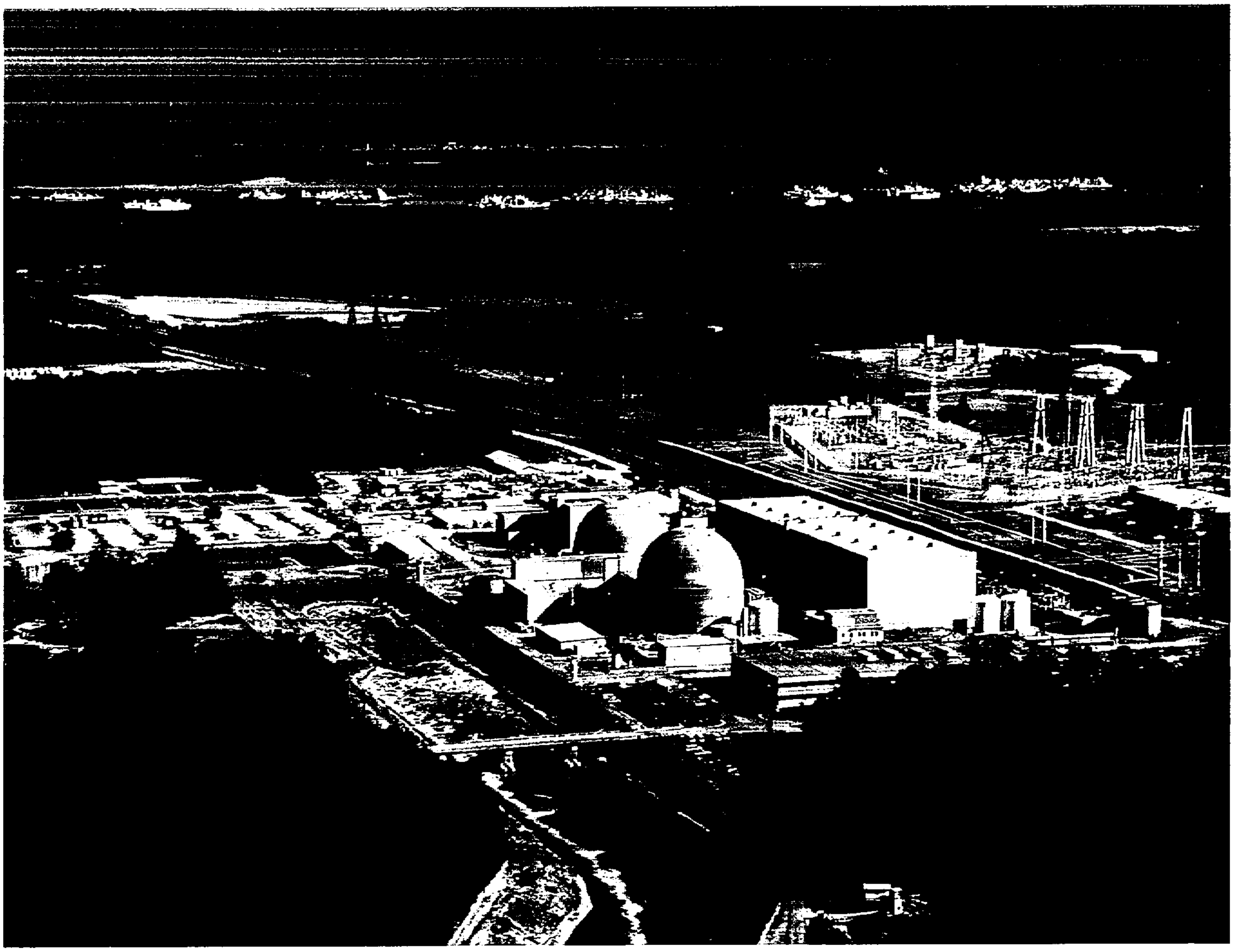
ATTACHMENT

2001 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

SURRY POWER STATION UNITS 1 AND 2
LICENSE NOS. DPR-32 AND DPR-37

INDEPENDENT SPENT FUEL STORAGE INSTALLATION
LICENSE NO. SNM-2501

Surry Power Station



2001 Annual Radiological Environmental Operating Report

Dominion

Dominion

Surry Power Station

Radiological Environmental Monitoring Program

January 1, 2001 to December 31, 2001

Prepared by

Dominion, Surry Power Station

and

Teledyne Brown Engineering

Annual Radiological Environmental Operating Report

Surry Power Station

January 1, 2001 to December 31, 2001

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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 2001 Surry Nuclear Power Station Radiological Environmental Monitoring Program (REMP). Radioactivity levels from January 1 through December 31, 2001, 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 are protected. The program also detects any unexpected environmental processes that could allow radiation accumulations in the environment or food pathway chains.

Radiation and radioactivity in the environment is constantly monitored within a 20-mile radius of the station. Surry Power Station personnel collect a variety of samples within this area. A number of sampling locations for each medium are selected using available meteorological, land use, and water use data. Two types of samples are obtained. The first type, control samples, are collected from areas that are beyond the measurable influence of Surry 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 be compared to the environment surrounding the station. Indicator samples are the second sample type obtained. These samples show how much radiation is contributed to the environment by the station. Indicator samples are taken from areas close to the station where any station contribution will be at the highest concentration.

Prior to station operation, samples were collected and analyzed 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, or causes such as the Chernobyl accident or natural variation.

Teledyne Brown Engineering provides radioanalyses for this program and ICN Biomedicals provides thermoluminescent dosimetry (TLD) services. Participation in an 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 (LLDs). This ensures that analyses are as accurate as possible. Samples with extremely low levels of radiation that cannot be detected are, therefore, reported as being below the LLD. The NRC also mandates a reporting level for certain radionuclides. Licensed nuclear facilities must report the radionuclide activities in those environmental samples that are equal to or greater than the specified 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 airborne, waterborne, aquatic, ingestion, and direct radiation exposure pathways. Each of these pathways is described below.

- The airborne exposure pathway includes radioactive airborne iodine and particulates. The 2001 results were similar to the previous years, as there was no notable increase in radioactive natural products and no detection of radioiodine. No man-made radioisotopes were detected in airborne particulates.

- The waterborne exposure pathway includes well water and river water. Five river water samples indicated the presence of tritium at 0.7% of the NRC reporting level. Naturally occurring potassium-40 was detected at average environmental levels. No man-made radioisotopes were detected in well water. This trend is consistent throughout the environmental operational monitoring program.

- The aquatic exposure pathway includes silt and shoreline sediment samples. Silt samples indicated the presence of cesium-137 and cobalt-60. The cesium-137 activity was present in the control and indicator locations and is attributable to global fallout from past nuclear weapons testing and nuclear accidents such as Chernobyl. The cobalt-60 was detected at the indicator location. There is no reporting level assigned for cobalt-60 and the trend over the past ten to fifteen year period continues to decrease. Shoreline sediment, which may provide a direct exposure pathway, contained no man-made radioisotopes.

- The ingestion exposure pathway includes milk, aquatic biota, and food product samples. Iodine-131 was not detected in any 2001 milk samples and has not been detected in milk prior to or since the 1986 Chernobyl accident. Strontium-90 was again detected in milk and this activity is attributable to past atmospheric nuclear weapons testing. A ten-year activity trend continues to indicate the slow decrease in Sr-90 activity. Naturally occurring potassium-40 and thorium-228 were detected at average environmental levels.

No man-made radioisotopes were detected in vegetation samples. Consistent with historical data, potassium-40 was detected.

- The aquatic biota exposure pathway includes samples taken from localized populations of crabs, fish, clams, and oysters. Naturally occurring potassium-40 was detected in seven of the eight aquatic biota samples at average environmental levels. No man-made radioisotopes were detected in aquatic samples.

- The direct exposure pathway measures environmental radiation doses by use of thermoluminescent dosimeters (TLDs). TLD results have indicated a steady trend in doses.

During 2001, as in previous years, operation of the Surry Power Station has created no adverse environmental effects or health hazards. The maximum dose calculated for a hypothetical individual at the station site boundary due to liquid and gaseous effluents released from the station during 2001 was 0.001 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 Surry Power Station.

I. INTRODUCTION

I. Introduction

The operational Radiological Environmental Monitoring Program (REMP) conducted for the year 2001 for Surry Power Station is provided in this report. The results of measurements and analyses of data obtained from samples collected from January 1, 2001 through December 31, 2001 are summarized.

A. The Dominion Surry Power Station 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 a 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 861 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 is reasonably achievable (ALARA). To ensure these criteria are met, the operating license for Surry Power Station includes Technical Specifications that address the release of radioactive effluents. In-plant 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 station environs is also included in Surry Power Station Technical Specifications.

C. Surry Power Station is responsible for collecting the various indicator and control environmental samples. ICN Biomedicals is responsible for processing the TLDs. Teledyne Brown Engineering is responsible for sample analysis and submitting reports of radioanalyses. The analyses 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 external events, such as cosmic ray bombardment, nuclear weapons test fallout and seasonal variations of naturally occurring radioisotopes. Data collected prior to station operation is used to indicate the degree of natural variation to be expected. This pre-operational data is compared with data collected during the operational phase to assist in evaluating any radiological impact of station operation.

D. Occasionally, samples of environmental media show the presence of man-made radioisotopes. 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-2103S, Offsite Dose Calculation Manual (Surry). 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 2001 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 member of the public resulting from station operations.

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

3. To identify changes in radioactivity in the environment.

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

II. SAMPLING AND ANALYSIS PROGRAM

II. Sampling and Analysis Program

A. **Sampling Program**

1. Table 1 summarizes the sampling program for Surry Power Station during 2001. The Surry Radiological Monitoring Locations map denotes the air sample and TLD locations for Surry Power Station. 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 CaF and LiF sensitive elements are deployed at each sampling location.

3. On June 30, 1998, the Commonwealth of Virginia, Department of Health, discontinued its comparative analysis (state split) program with Surry Power Station. Although the routine splitting of samples with the Commonwealth of Virginia has been discontinued, samples will be split at the request of the state. Surry Power Station personnel collect all samples listed in Table 1. All samples, with the exception of the TLDs, are shipped to Teledyne Brown Engineering, located in Knoxville, TN, for analysis. The TLDs are shipped to ICN Biomedicals, located in Costa Mesa, CA, for processing.

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

B. **Analysis Program**

- Table 2 summarizes the analysis program conducted by Teledyne Brown Engineering for Surry Power Station during the year 2001.

Table 1

(Page 1 of 3)
SURRY - 2001
RADIOLOGICAL SAMPLING STATION
DISTANCE AND DIRECTION FROM UNIT NO. 1

Sample Media	Location	Station	Distance Miles	Direction	Degrees	Collection Frequency	Remarks
Environmental (TLDs)	Control	(00)	-	-	-	Quarterly	Onsite*
	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)	0.29	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
	Bacon's Castle	(20)	4.45	SSW	202°	Quarterly	Apx. 5 mile
	Route 633	(21)	3.5	SW	224°	Quarterly	Apx. 5 mile
	Alliance	(22)	5.1	WSW	248°	Quarterly	Apx. 5 mile
	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
	Jamestown	(26)	6.3	NW	310°	Quarterly	Apx. 5 mile
	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
	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 outside the protected area.*

Table 1

(Page 2 of 3)
SURRY - 2001
RADIOLOGICAL SAMPLING STATION
DISTANCE AND DIRECTION FROM UNIT NO. 1

Sample Media	Location	Station	Distance Miles	Direction	Degrees	Collection Frequency	Remarks
Environmental (TLDs)	Water Plant	(33)	4.8	NE	41°	Quarterly	Apx. 5 mile
	BASF	(34)	5.1	ENE	70°	Quarterly	Apx. 5 mile
	Lee Hall	(35)	7.1	ENE	73°	Quarterly	Population Center
	Goose Island	(36)	5.0	E	88°	Quarterly	Apx. 5 mile
	Fort Eustis	(37)	4.8	ESE	107°	Quarterly	Population Center
	Newport News	(38)	16.5	ESE	122°	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	Control Location
	Rushmere	(42)	5.2	SSE	156°	Quarterly	Apx. 5 mile
	Route 628	(43)	5.0	S	177°	Quarterly	Apx. 5 mile
Air Charcoal and Particulate	Surry Station	(SS)	0.37	NNE	15°	Weekly	Site boundary location with highest D/Q
	Hog Island Reserve	(HIR)	2.0	NNE	26°	Weekly	
	Bacon's Castle	(BC)	4.5	SSW	202°	Weekly	
	Alliance	(ALL)	5.1	WSW	248°	Weekly	
	Colonial Parkway	(CP)	3.7	NNW	330°	Weekly	
	BASF	(BASF)	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 Station Discharge	(SD)	0.17	NW	325°	Monthly	
	Scotland Wharf	(SW)	5.0	WNW	285°	Monthly	Control Location
Well Water	Surry Station	(SS)	-	-		Quarterly	Onsite
	Hog Island Reserve	(HIR)	2.0	NNE	27°	Quarterly	
Shoreline Sediment	Hog Island Reserve	(HIR)	0.8	N	5°	Semi-Annually	
	Chickahominy River	(CHIC)	11.2	WNW	300°	Semi-Annually	Control Location

Table 1
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SURRY - 2001
RADIOLOGICAL SAMPLING STATION
DISTANCE AND DIRECTION FROM UNIT NO. 1

Sample Media	Location	Station	Distance Miles	Direction	Degrees	Collection Frequency	Remarks
Silt	Chickahominy River	(CHIC)	11.2	WNW	300°	Semi-Annually	Control Location
	Surry Station Discharge	(SD)	1.3	NNW	341°	Semi-Annually	
Milk	Colonial Parkway	(CP)	3.7	NNW	337°	Monthly	
	Pivarnik	(PIV)	17.6	NNE	25°	Monthly	Control Location
	Epp's	(EPPS)	4.8	SSW	201°	Monthly	
Oysters	Point of Shoals	(POS)	6.4	SSE	157°	Semi-Annually	
	Mulberry Point	(MP)	4.9	ESE	124°	Semi-Annually	
Clams	Chickahominy River	(CHIC)	11.2	WNW	300°	Semi-Annually	Control Location
	Surry Station Discharge	(SD)	1.3	NNW	341°	Semi-Annually	
	Hog Island Point	(HIP)	2.4	NE	52°	Semi-Annually	
	Lawne's Creek	(LC)	2.4	SE	131°	Semi-Annually	
Fish	Surry Station Discharge	(SD)	1.3	NNW	341°	Semi-Annually	
Crabs	Surry Station Discharge	(SD)	1.3	NNW	341°	Semi-Annually	
Crops	Brock's Farm	(BROCK'S)	3.8	S	188°	Annually	
(Corn, Peanuts, Soybeans)	Slade's Farm	(SLADE'S)	2.4	S	177°	Annually	

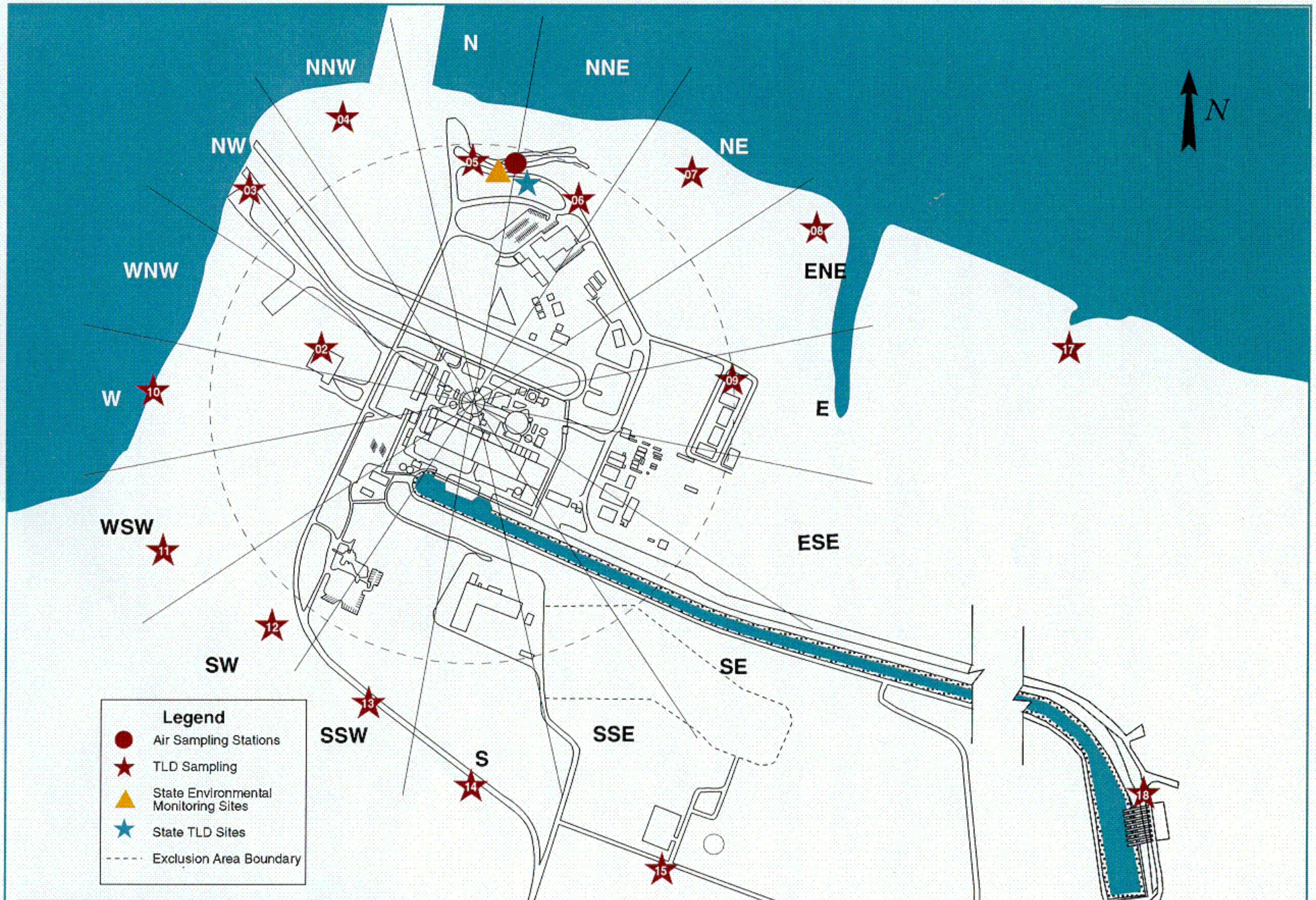

Figure 1. Surry Radiological Monitoring Locations

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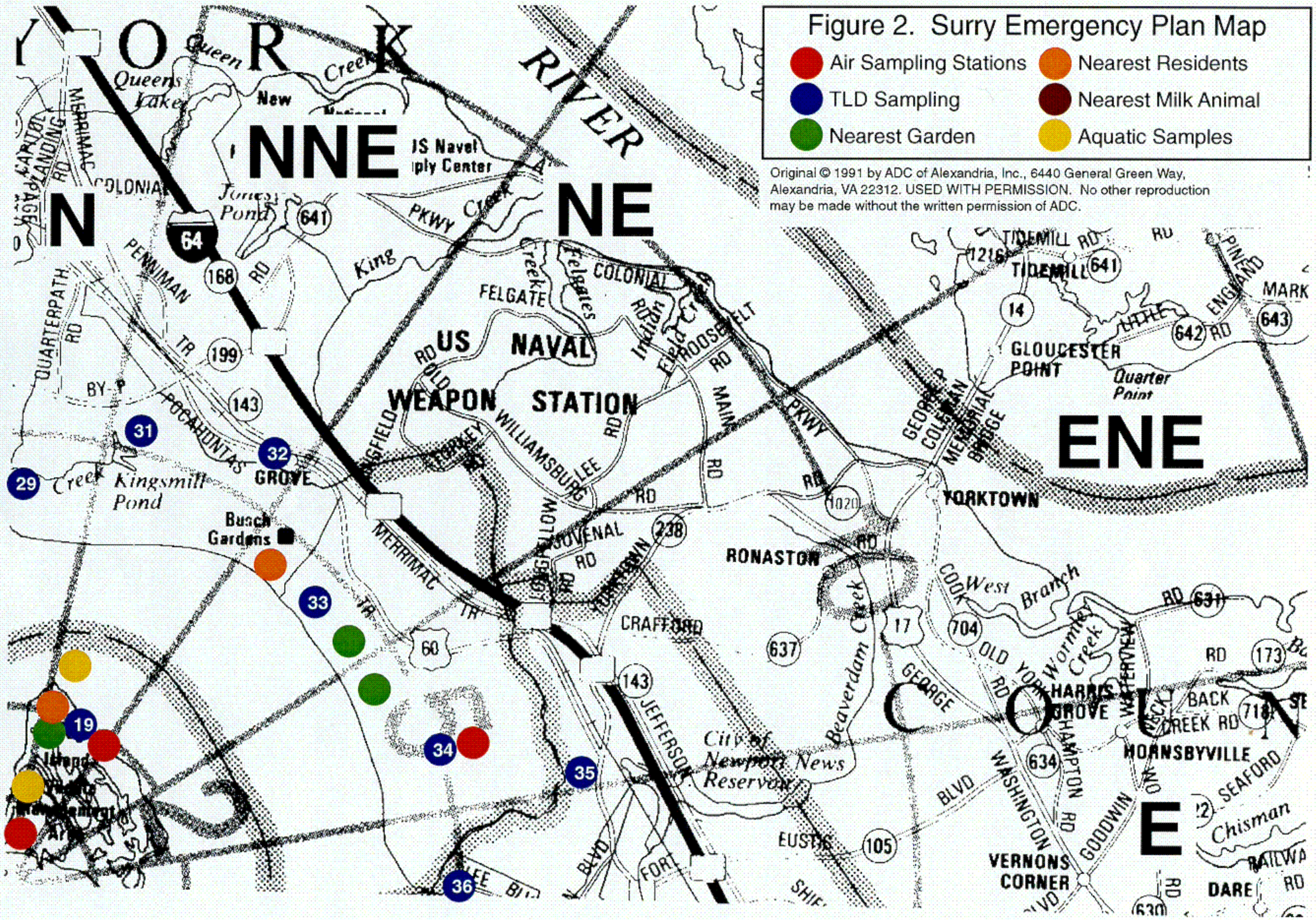
Figure 2. Surry Emergency Plan Map



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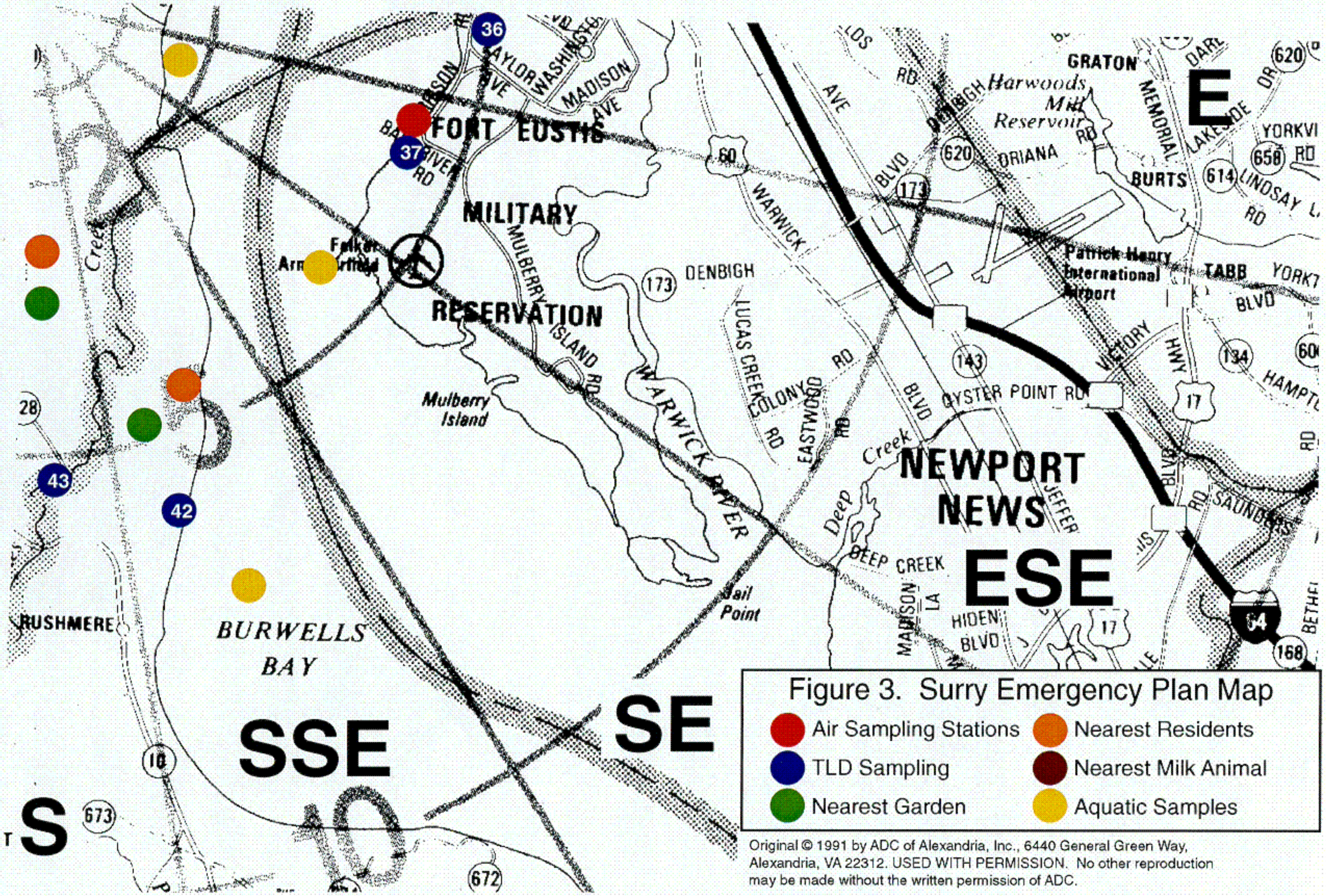

Figure 3. Surry Emergency Plan Map

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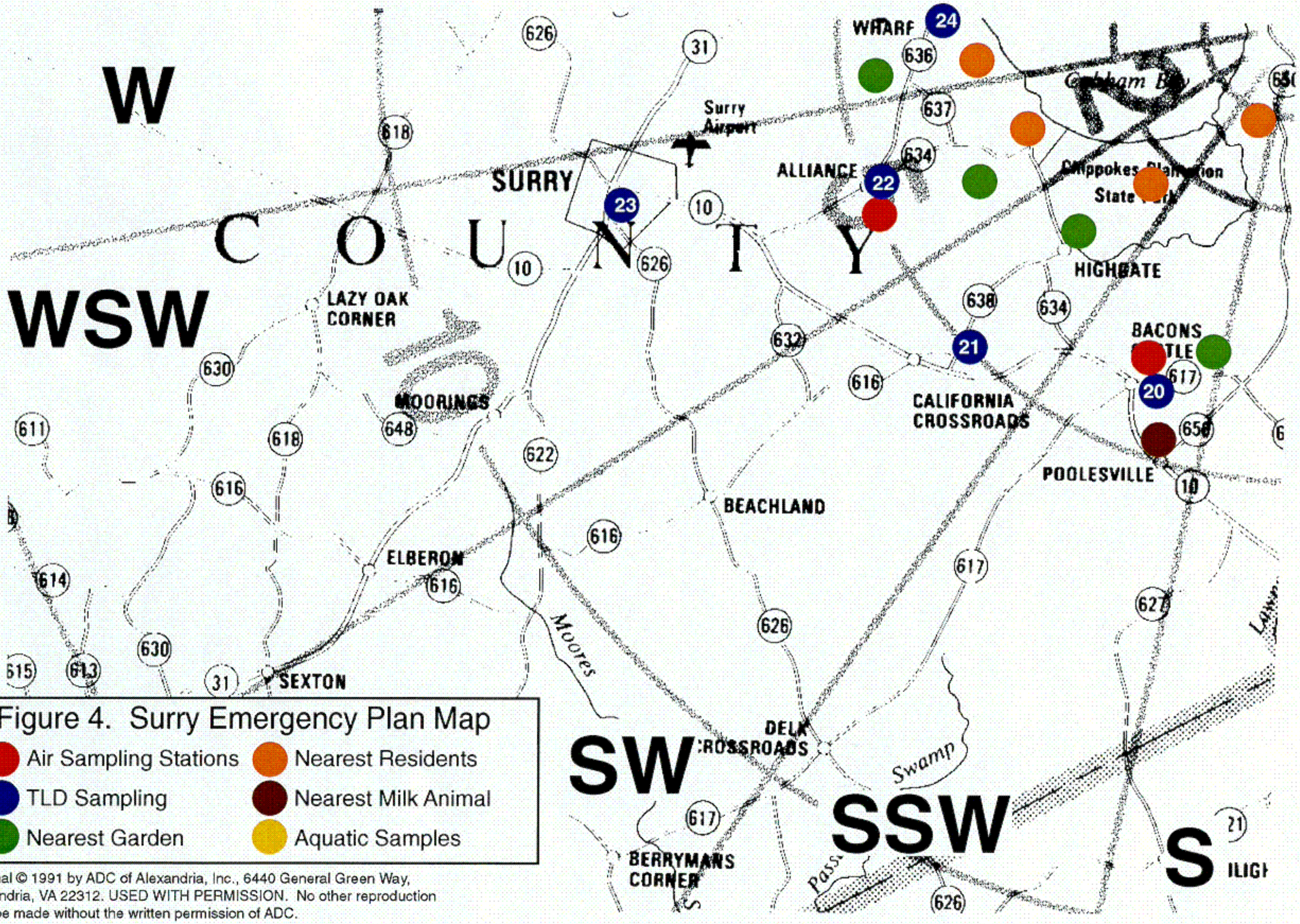

Figure 4. Surry Emergency Plan Map

- Air Sampling Stations
- Nearest Residents
- TLD Sampling
- Nearest Milk Animal
- Nearest Garden
- Aquatic Samples

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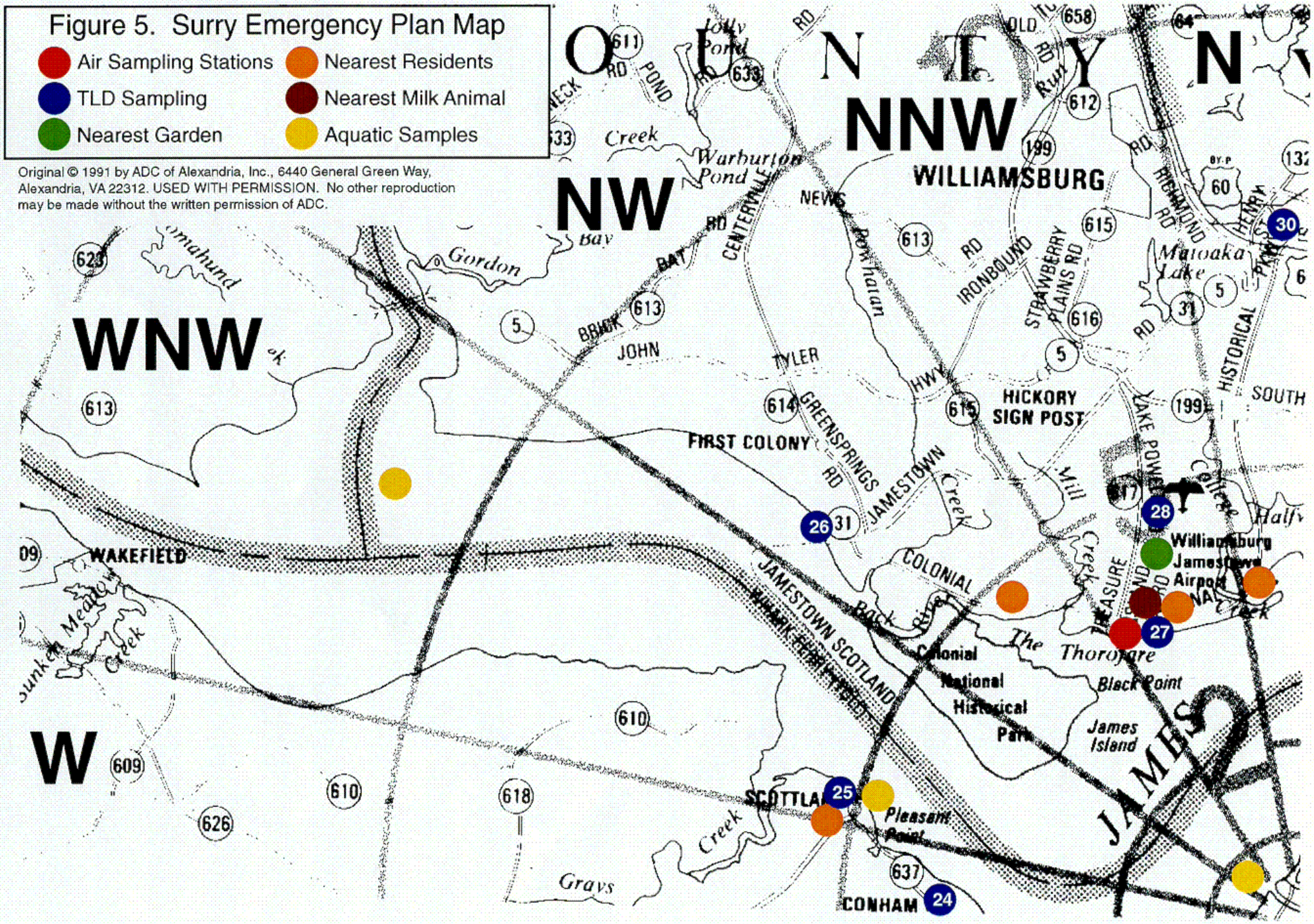

Figure 5. Surry Emergency Plan Map

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TABLE 2

SURRY POWER STATION

SAMPLE ANALYSIS PROGRAM

SAMPLE MEDIA	FREQUENCY	ANALYSIS	LLD*	REPORT UNITS
Thermoluminescent Dosimetry (TLD)	Quarterly	Gamma Dose	2	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	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 2 (Cont.)

(Page 2 of 3)

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	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	
Clams	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	
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 2 (Cont.)
(Page 3 of 3)
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 that can be detected and reported. Other peaks that are measurable and identifiable, together with the above nuclides, are also 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.

III. PROGRAM EXCEPTIONS

REMP Exceptions for Scheduled Sampling and Analysis During 2001 - Surry

Location	Description	Date of Sampling	Reason(s) for Loss/Exception
All	Air Iodine	12/26-01/02	Charcoal cartridges not analyzed for I-131 due to sample in-processing delay at TBE resulting in excessive sample decay.
CP	Milk	01/03	Ba/La-140 LLD not met due to excessive sample decay at TBE prior to lab analysis.
PIV	Milk	01/16	I-131 and Ba/La-140 LLDs not met due to sample preparation error and excessive sample decay at TBE lab.
EPPS	Milk	01/23	Sample not analyzed for I-131 and Ba/La-140 LLD not met due to excessive sample decay at TBE prior to lab analysis.
SD and SW	River Water	01/23	Ba/La-140 LLDs not met. Incorrect geometry used for analysis.
BROCK'S	Crop/ Peanuts	10/23	I-131 LLD not met due to geometry used for analysis and sample density.

IV. SUMMARY AND DISCUSSION OF 2001 ANALYTICAL RESULTS

IV. Summary and Discussion of 2001 Analytical Results

Data from the radiological analyses of environmental media collected during 2001 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 an 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 procedures and specifications followed in the laboratory for processing environmental TLDs are as required in the ICN Biomedicals Quality Assurance Manual. The results of the Interlaboratory Comparison Program 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 collection to time of counting. 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 Acceptable Program (November 1979, Revision 1) and the ODCM.

The following is a discussion and summary of the results of the environmental measurements taken during the 2001 reporting period.

A. Airborne Exposure Pathway

1. **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 pre-operational data and the results of samples taken prior to and after the 1986 accident in the Soviet Union at Chernobyl.

2. **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 indicators 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 ten years. Gross beta activity found during the pre-operational and early operating period of Surry Power Station was higher because of nuclear weapons testing. During that time, nearly 740 nuclear weapons were 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.

3. **Airborne Gamma Isotopic** - Air particulate filters are analyzed for isotopes that are gamma emitters. The results of the composite analyses are listed in Table B-3. No man-made radioisotopes were present. Three naturally occurring isotopes, beryllium-7, potassium-40 and thorium-228, were identified.

B. **Waterborne Exposure Pathway**

1. **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 the indicator location, Surry Station Discharge, and the control, Scotland Wharf.

   Surry Station Discharge and Scotland Wharf samples are analyzed by gamma spectroscopy and by a radiochemical procedure for iodine-131. These samples are also composited and analyzed for tritium on a quarterly basis.

   All samples were analyzed for gamma emitting radioisotopes. Naturally occurring potassium-40 was measured in six of the twenty-four samples with an average concentration of 134 pCi/liter (pCi/L) and a range of 61.9 to 293 pCi/L. Tritium was detected in five of the eight samples at an average concentration of 220 pCi/L and a range of 110 to 390 pCi/L. This activity represents 0.7% of the NRC reporting level. Iodine-131 was detected in two of twenty-four samples with an average concentration of 0.46 pCi/L and a range of 0.45 to 0.47 pCi/L. These activities were reported in the month of July for both the indicator and control locations. As iodine-131 was not a component of Surry Power Station liquid effluents for the month of July, the activities are not attributable to the station. In addition, the iodine activities are in the range of the Lower Limit of Detection (LLD) for the analytical equipment. The iodine-131 LLD range for river water analyses for the year 2001 was 0.2 to 0.7 pCi/L. The gamma spectroscopy analyses, performed several days before the iodine-131 radiochemical procedure, resulted in the detection of no radioisotopes above LLD. It is believed these sample results are anomalous and represent LLD activities or a cross-contamination event in the analysis laboratory.

Molybdenum-99 was reported in the February control sample with an activity of 12.7 pCi/L and a minimum detectable activity of 11.7 pCi/L for the sample. Cerium-141 was reported in the March indicator sample with an activity of 3.10 pCi/L and a minimum detectable activity of 3.07 pCi/L for the sample. Neither molybdenum-99 nor cerium-141 were components of Surry Power Station liquid effluents in 2001. No other radioisotopes were detected in these two samples. It is believed these sample results are anomalous and represent LLD activities.

Trending Graph #2 provides a comparison of average tritium concentrations measured in the downstream indicator location, Surry Station Discharge, and in the upstream control location, Scotland Wharf. Surry Station Discharge samples indicate a comparable trend to the control location over the past four years. The five to ten year trend indicates slightly higher activity in the indicator location. The water in the discharge canal is further diluted by the river water beyond the discharge structure.

2. **Well Water** - Well water is not considered to be affected by station operations because there are no discharges made to this pathway. However, Surry Power Station monitors well water quarterly and analyzes water samples from two indicator locations. The results of these sample analyses are presented in Table B-5.

Pre-operational samples were only analyzed for gross alpha and gross beta. The eight well water samples collected were analyzed by gamma spectroscopy and results indicated that there were no man-made radioisotopes present. Well water samples were also analyzed for tritium, and no tritium activity was detected. Naturally occurring radioisotopes, such as potassium-40, were not detected during 2001. This is a consistent trend since 1997.

C. Aquatic Exposure Pathway

1. **Silt** - Silt samples are taken to evaluate any buildup of radionuclides in the environment due to the operation of Surry Power Station. The radioactivity in silt would be 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. Build-up of radionuclides in silt could indirectly lead to increasing radioactivity levels in clams, oysters and fish.

   Silt samples are collected from two locations, upstream and downstream of Surry Power Station. These samples are analyzed for gamma emitting radioisotopes. The results of these analyses are presented in Table B-6. The NRC does not assign reporting levels to radioisotopes measured in this pathway. However, Surry Power Station's operating license requires that the concentrations of man-made and naturally occurring gamma emitters be tracked and trended.

   Pre-operational analyses from 1972 indicated the presence of cesium-137 in silt. Activities of 780 pCi/kg were detected in the upstream Chickahominy control location and 800 pCi/kg in the Station Discharge indicator location. Cesium-137 is the result of fallout from nuclear weapons testing and its global presence has been well documented. In 2001, cesium-137 was detected with an average indicator location concentration of 303 pCi/kg and an average control location concentration of 261 pCi/kg. These activities continue to represent fallout from nuclear weapons testing. Both indicator and control cesium-137 activities trend closely. The most recent five-year average activities are 308 and 257 pCi/kg, respectively, for the indicator and control locations.

   Cobalt-60 was detected in the indicator location with an average activity of 46.5 pCi/kg. This is the second detection of cobalt-60 in the past five years. In 1999, cobalt-60 was detected with an activity of 67 pCi/kg. The ten to fifteen year trend continues to reflect decreasing cobalt activity.

   Neptunium-239 was reported in the March indicator silt sample with an activity of 2.13E+04 pCi/kg and a minimum detectable activity of 1.17E+04 pCi/kg. Neptunium-239 was also reported in the March control silt sample with an activity of

2.21E+04 pCi/kg and a minimum detectable activity of 1.38E+04 pCi/kg. These activities are considered anomalous, as neptunium-239 was not a component of Surry Power Station liquid effluents in 2001. The activity may be more representative of an LLD activity as close to seven half-lives had occurred before the sample was analyzed.

2. **Shoreline Sediment** - Unlike river bottom silt, shoreline sediment may provide a direct dose to humans. Build-up of radioisotopes along the shoreline may provide a source of direct exposure for those using the area for commercial and recreational purposes. Samples were taken in February and August at the Hog Island Point Reserve and the Chickahominy River sample locations. The samples were analyzed by gamma spectroscopy, and the results are presented in Table B-7.

   This exposure pathway was not selected for analysis during the pre-operational years. No radioisotopes attributable to the operation of Surry Power Station were detected in 2001. Three naturally occurring radioisotopes, potassium-40, thorium-228 and radium-226, were detected in these samples. The activities of these radioisotopes indicate a steady trend over the recent past.

D. Ingestion Exposure Pathway

1. **Milk** - Milk samples are an important indicator for measuring the effect 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 are 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-8.

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

   Pre-operational data shows that cesium-137 was detected in this pathway. This is attributable to nuclear weapons testing fallout. Cesium-137 was not detected during 2001.

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

Strontium-90 was detected in all twelve samples analyzed for strontium-89 and strontium-90. Pre-operational data shows levels higher than present values. This year's average indicator location activity was 1.71 pCi/Liter. The long-term activity trend for Sr-90 continues to slowly decrease. It should be noted that strontium-90 is not a part of station effluents but, rather, a product of nuclear weapons testing fallout.

2. **Aquatic Biota** - All plants and animals have the ability to concentrate certain chemicals. Radioisotopes display the same chemical properties as their non-radioactive counterparts. Surry Power Station samples various aquatic biota to determine the accumulation of radioisotopes in the environment. The results of the sampling program for this pathway follow.

Clams were analyzed from four different locations. The results of the analyses are presented in Table B-9. Naturally occurring potassium-40 was detected in seven of the eight samples with and average activity of 445 pCi/kg. No other gamma emitting radioisotopes were detected. Oysters were also analyzed from two different locations. The results of the analyses are presented in Table B-10. As expected, naturally occurring potassium-40 was detected in all four of the samples with an average activity of 657 pCi/kg. The current average level of potassium-40 is comparable to the pre-operational average. No other gamma emitting radioisotopes were detected.

The trend of gamma emitting radioisotopes in clams and oysters over the recent past continues to decrease and is well below the lower limits of detection. There has been no detection of radioisotopes attributable to station effluents since 1991. This marked decrease coincides with the extensive steam generator replacement project completed in 1982 and improvements made to liquid effluent treatment systems that were completed in 1991.

A crab sample was collected in June from the discharge canal at the station and analyzed by gamma spectroscopy. The results of this analysis are presented in Table B-11. As expected, naturally occurring potassium-40 was detected. No other gamma emitting radioisotopes were detected in this sample. This is consistent with pre-operational data and data collected during the past ten years.

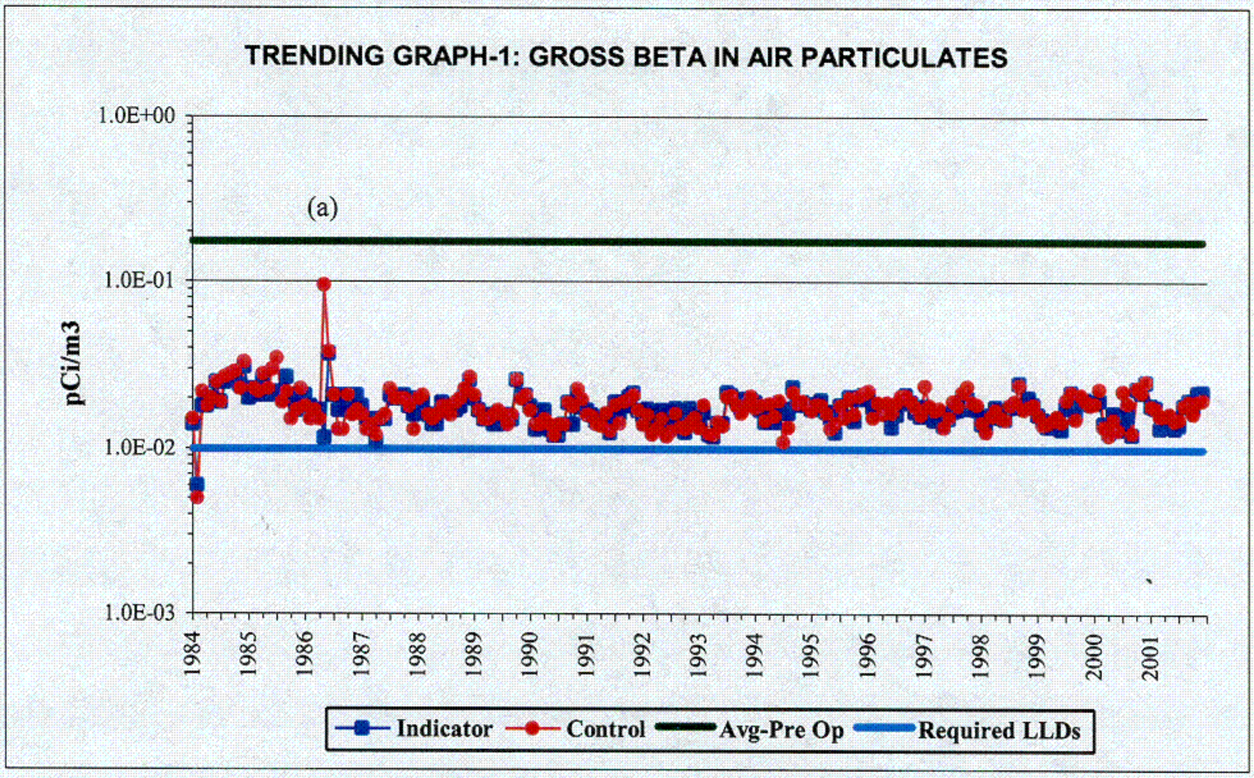
Two fish samples were collected in April and two in October from the station discharge canal and analyzed by gamma spectroscopy. The results of the analyses are presented in Table B-12. As expected, naturally occurring potassium-40 was detected in all four of the samples. No other gamma emitting radioisotopes were detected in these samples.

3. **Food Products and Vegetation** - Three samples were collected from two different locations 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. The average concentration is consistent with the previous five-year average. Potassium-40 is a naturally occurring primordial radioisotope. No other gamma emitters were detected.

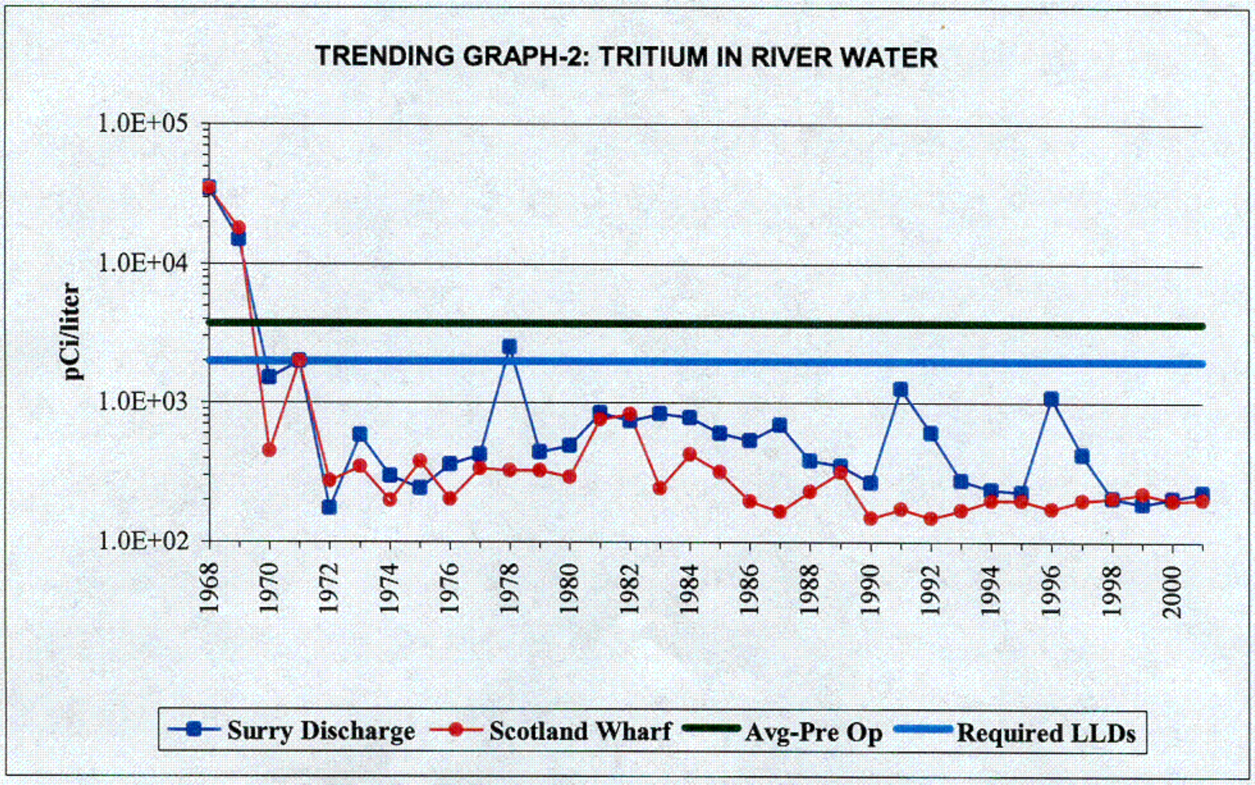
E. **Direct Radiation Exposure Pathway**

1. **TLDs** - A thermoluminescent dosimeter (TLD) is an inorganic crystal used to detect ambient radiation. TLDs are placed in two concentric rings around the station. The inner ring is located at the site boundary, and the outer ring is located at approximately five miles from the station. TLDs are also placed in special interest areas, such as population areas and nearby residences. Additional TLDs serve as controls. 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.

2. **Results** - The results of the analyses are presented in Table B-14. Control and indicator averages indicate a steady relationship. A new type TLD was placed in service in 2001. TLDs with CaF and LiF sensitive elements replaced the previously used CaSO4:Dy in Teflon TLDs. The dose trend with the replacement TLDs is lower than that of the previously used TLDs. This trend will continue to be monitored.

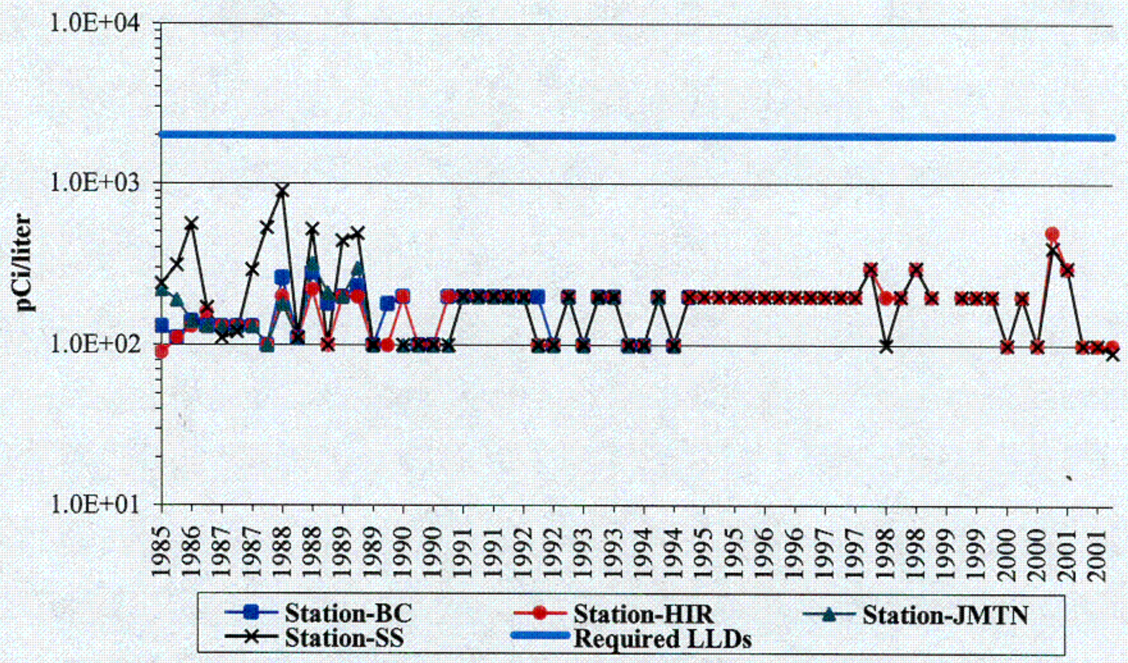


(a) Chernobyl



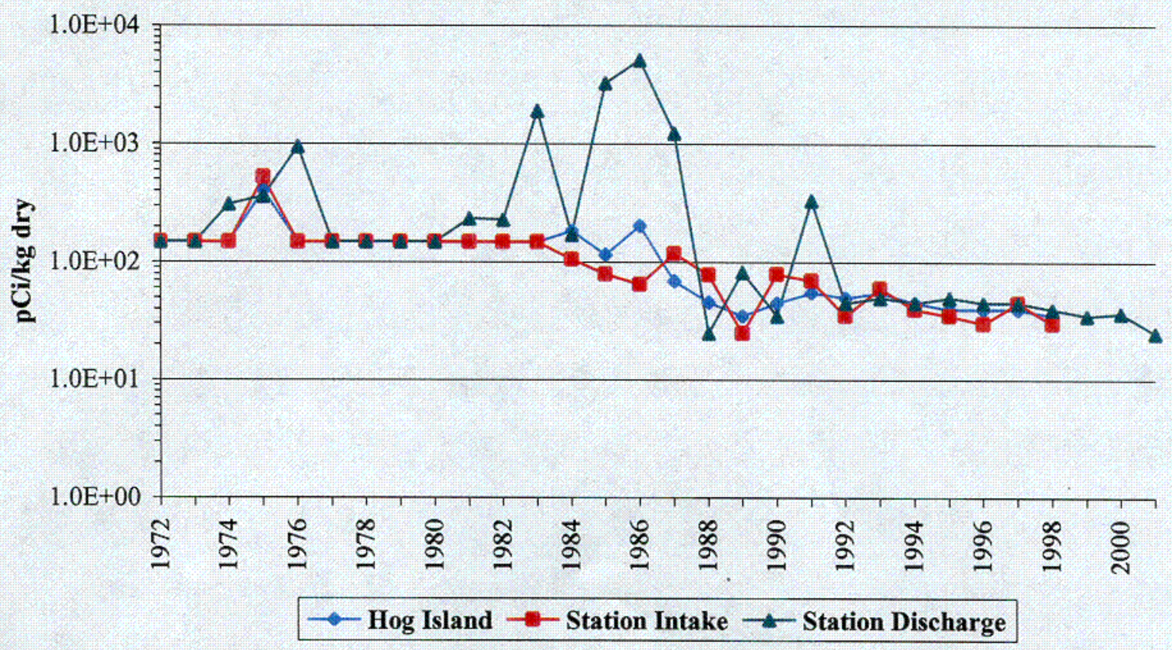
C06

TRENDING GRAPH-3: TRITIUM IN WELL WATER



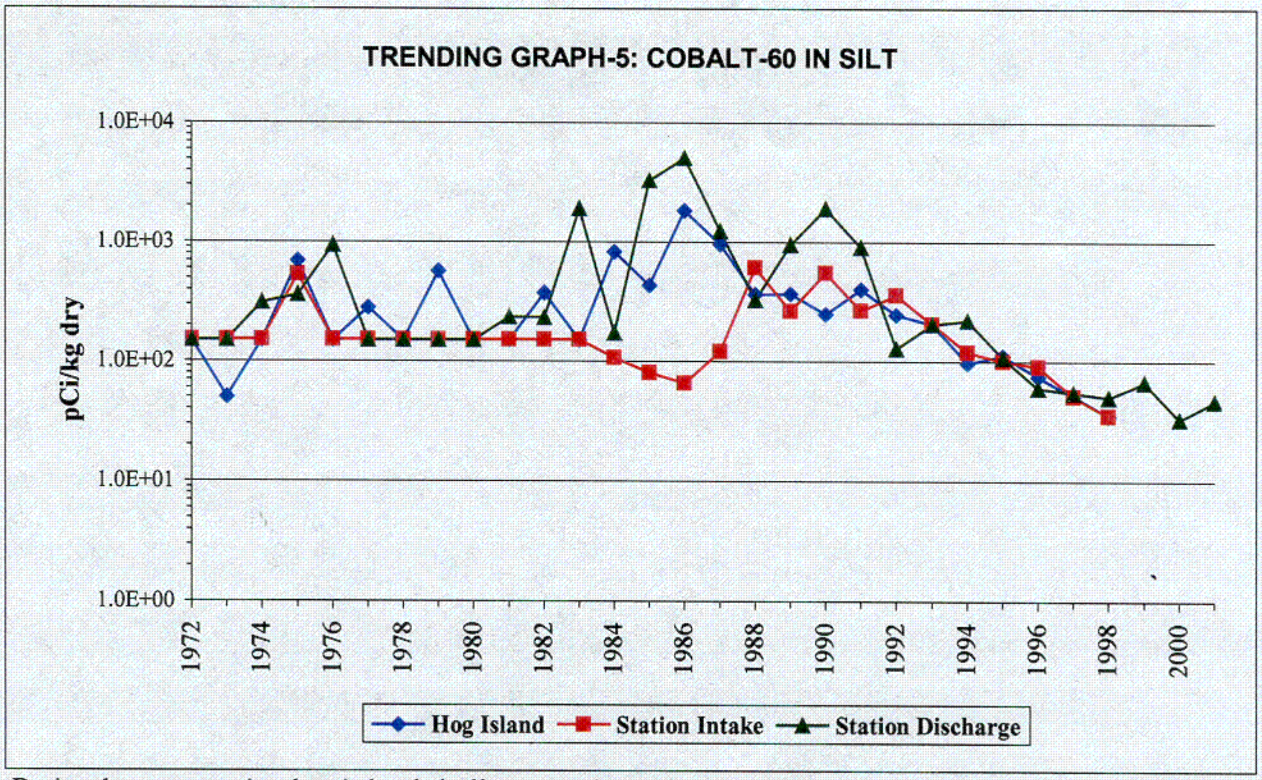
Stations BC and JMTN have been eliminated due to program change 12/94.

TRENDING GRAPH-4: COBALT-58 IN SILT

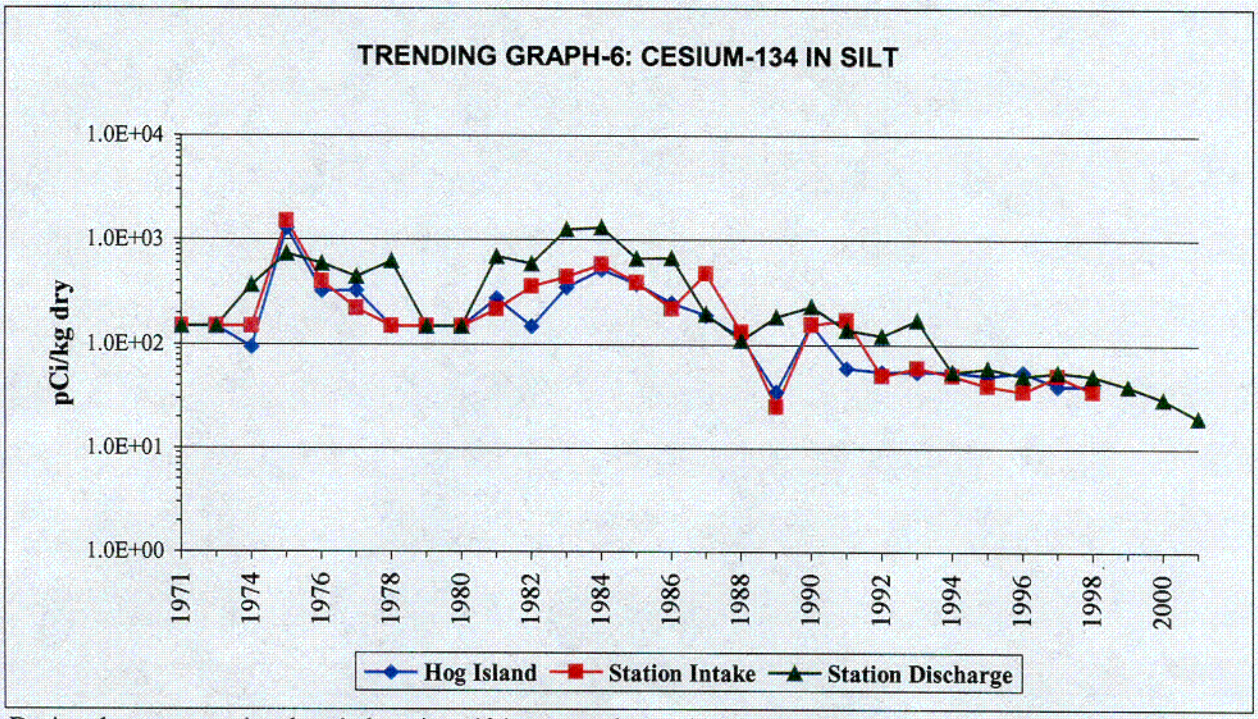


Stations Hog Island and Station Intake have been eliminated due to program change in 5/98.

C07

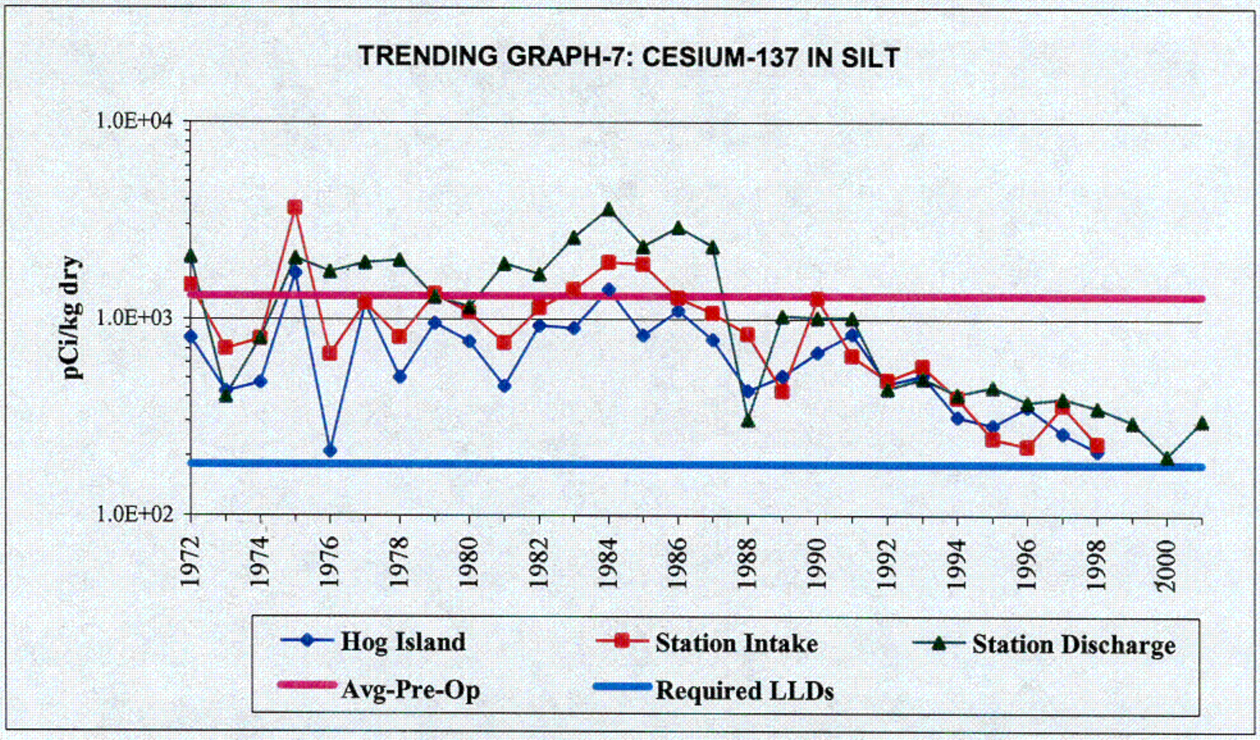


During the pre-operational period, cobalt-60 was not detected in the samples analyzed. Stations Hog Island and Station Intake have been eliminated due to program change in 5/98.

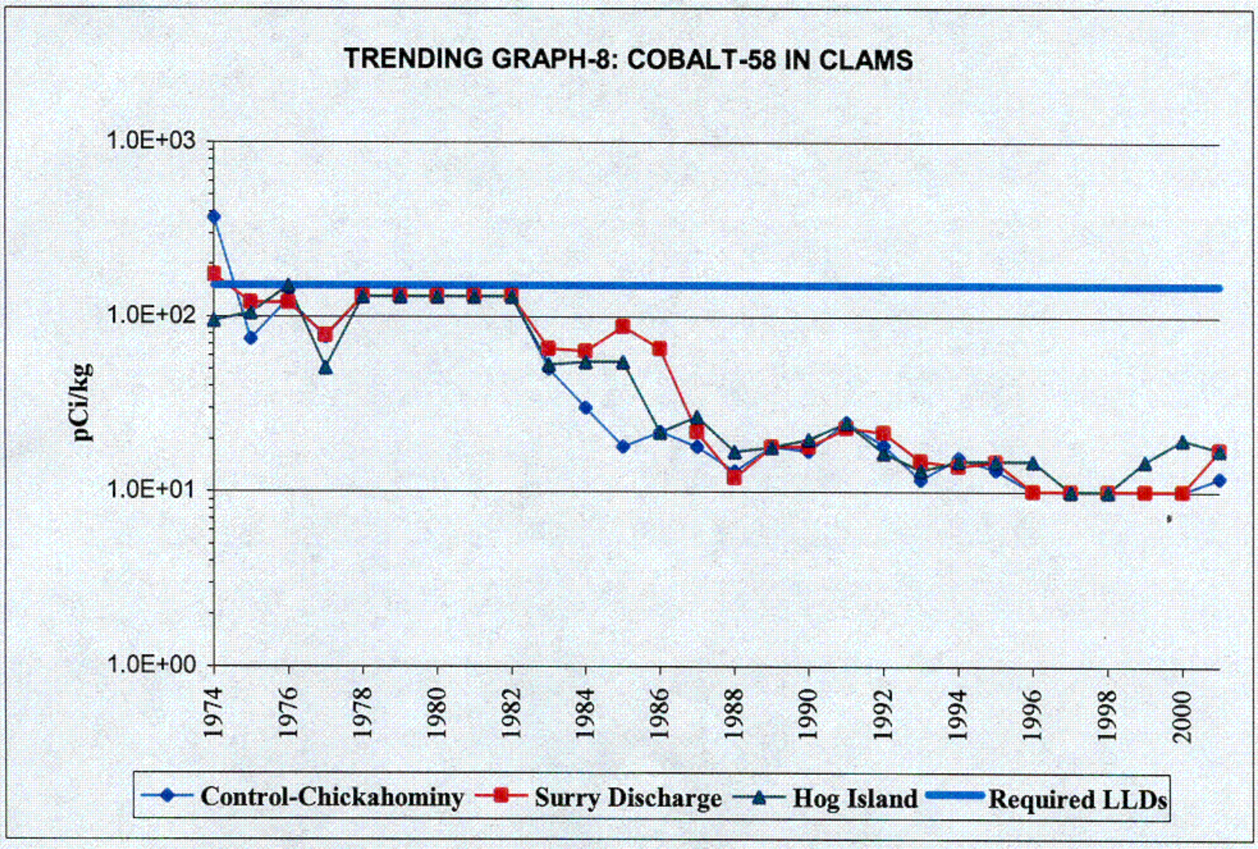


During the pre-operational period, cesium-134 was not detected in the samples analyzed. Stations Hog Island and Station Intake have been eliminated due to program change in 5/98.

C08

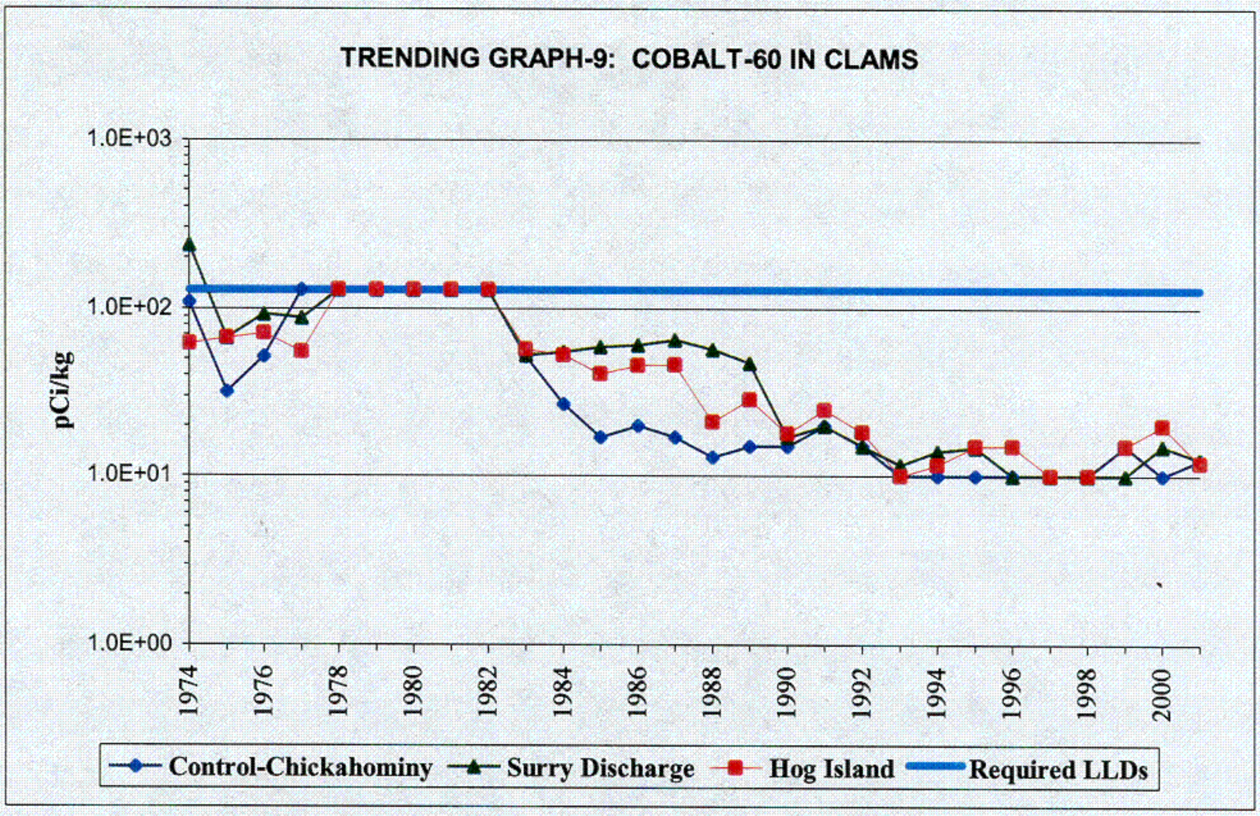


Stations Hog Island and Station Intake have been eliminated due to program change in 5/98.

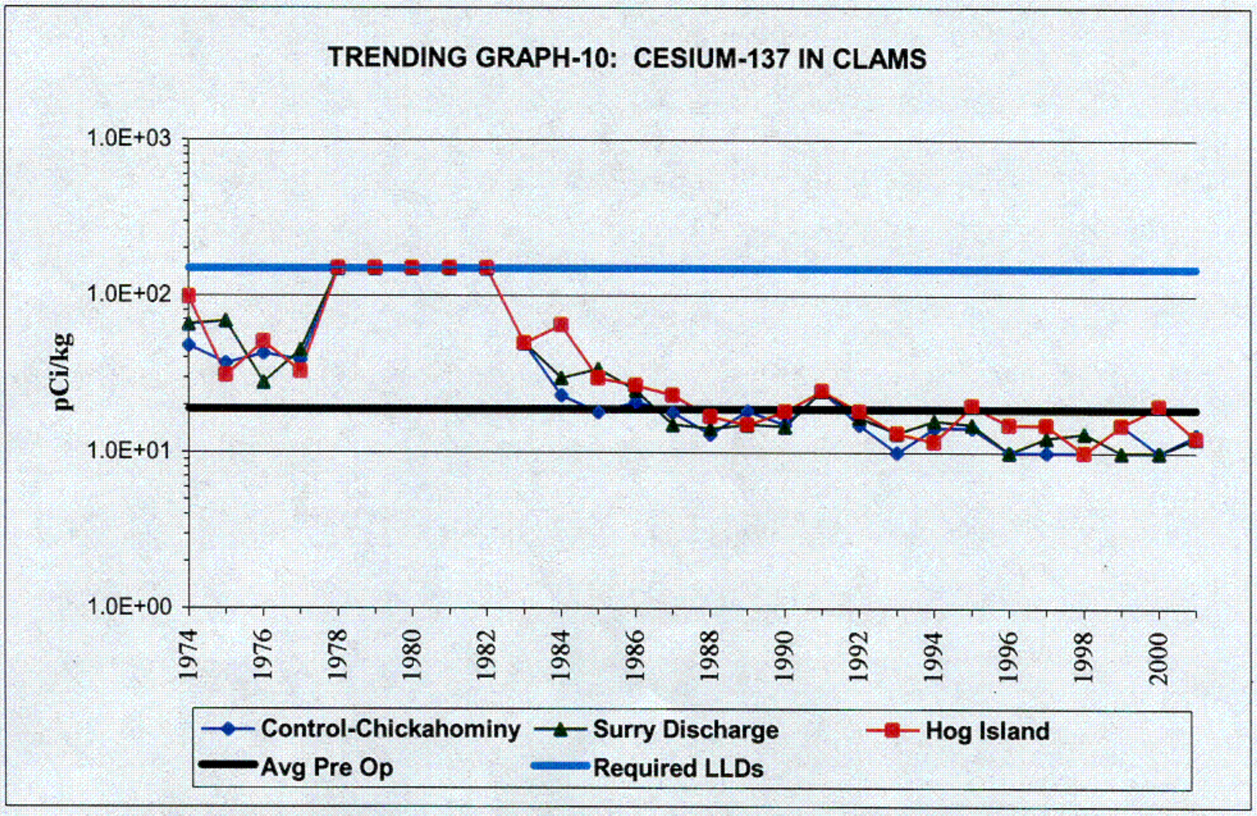


During the pre-operational period, cobalt-58 was not detected in the samples analyzed.

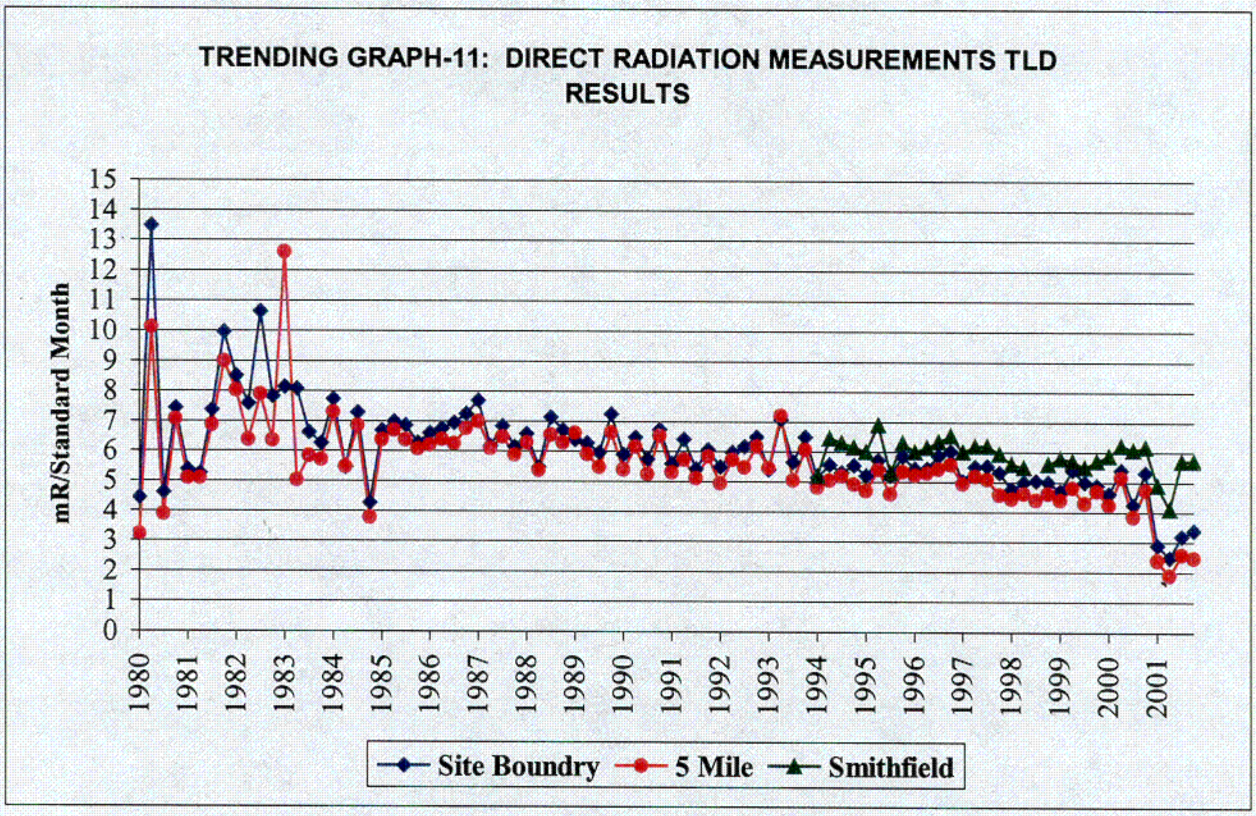
C09



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



C10



TRENDING GRAPH-11: DIRECT RADIATION MEASUREMENTS TLD RESULTS
mR/Standard Month
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
Site Boundry
5 Mile
Smithfield

C11

V. CONCLUSIONS

V. Conclusions

The results of the 2001 Radiological Environmental Monitoring Program (REMP) for Surry Nuclear Power Station have been presented. This section presents conclusions for each pathway individually. References and appendices that represent the REMP summary follow this section.

A. **Airborne Exposure Pathway** - Air particulate gross beta concentrations at all of the indicator locations for 2001 trend well with the control location. No man-made radioisotopes were present. The gross beta concentrations indicate a steady trend when compared to the levels found during the previous twelve years. Gamma isotopic analysis of the particulate samples identified natural background radioactivity at expected levels.

B. **Waterborne Exposure Pathway** - All river water samples were analyzed for gamma emitting radioisotopes. Naturally occurring potassium-40 was detected. Tritium was detected in five of the eight samples analyzed for 2001 at 0.7% of the NRC reporting level.

C. **Well Water** - Well water samples were analyzed and indicated that there were no man-made radioisotopes present. This trend is consistent throughout the monitoring period. No radioactivity attributable to the operation of the station was identified.

D. **Silt** - The NRC does not assign reporting levels to radioisotopes measured in this pathway. Cobalt-60 was detected in the indicator sample location; however, the long-term trend continues to reflect decreasing activity.

E. **Shoreline Sediment** - Only naturally occurring radioisotopes were detected, at concentrations equivalent to normal background activities. There were no radioisotopes attributable to the operation of Surry Power Station found in any sample.

F. **Milk** - Milk samples are an important indicator measuring the effect of radioactive iodine and radioisotopes in airborne releases. Cesium-137 and iodine-131 were not detected in any of the thirty-six samples. Naturally occurring potassium-40 was detected at a similar level when compared to the average of the previous year.

The concentration of strontium-90 in this year's analysis was 1.71 pCi/L. Strontium-90 is not a part of station effluent, but rather a product of nuclear weapons testing fallout. The long-term activity trend continues to decrease.

G. **Aquatic Biota**

1. **Clams and Oysters** - Naturally occurring potassium-40 was detected in seven of the eight clam samples, in four oyster samples and in the crab sample. A review of the previous ten 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 pre-operational data.

2. **Fish** - As expected, naturally occurring potassium-40 was detected in all four samples. There were no other gamma emitting radioisotopes detected in any of the fish samples.

H. **Food Products and Vegetation** - As expected, naturally occurring potassium-40 was detected in all three samples. In the past, cesium-137 has occasionally been detected in these samples and is attributable to global fallout from past nuclear weapons testing. Cesium-137 and beryllium-7 were not detected in any of the three samples collected in 2001.

I. **Direct Radiation Exposure Pathway** - Control and indicator location averages continue to indicate a decreasing trend in ambient radiation levels over the long term. A new type of TLD was placed in the field in 2001. The ambient dose trend has reduced from that of the previously used TLD. This trend will continue to be monitored and evaluated.

VI. REFERENCES

VI. References

1. NUREG-0472, "Radiological Effluent Technical Specifications for PWRs", Draft Rev. 3, March 1982.

2. 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.

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

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

5. Virginia Power, Station Administrative Procedure, VPAP-2103S, "Offsite Dose Calculation Manual (Surry)".

6. Virginia Electric and Power Company, Surry Power Station Technical Specifications, Units 1 and 2.

VII. APPENDICES

APPENDIX A

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY TABLES

YEAR 2001

Surry Nuclear Power Station, Surry County, Virginia - 2001
Docket No. 5-280-281 Page 1 of 4

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/m^3)	I-131	416	0.07	-(0/364)	N/A			-(0/52)	0
Air Particulate ($1E^{-03}$ pCi/m^3)	Gross Beta	424	10	17.3(371/371) (8.8-33)	ALL	5.1 mi. WSW	18.5(53/53) (9.8-33)	17.2(53/53) (9.2-25)	0
	Gamma	32							
	Be-7	32		110(28/28) (56.4-142)	BC	4.5 mi. SSW	121(4/4) (104-128)	111(4/4) (95-119)	0
	K-40	32		4.44(6/28) (3.10-6.18)	FE	4.8 MI. ESE	4.81(3/4) (3.10-6.18)	6.04(1/4)	0
	Cs-137	32	60	-(0/28)	N/A			-(0/4)	0
	Co-60	32		-(0/28)	N/A			-(0/4)	0
	Th-228	32		0.44(2/28) (0.36-0.63)	FE	4.8 MI. ESE	0.63(1/4)	0.59(1/4)	0
River Water (pCi/liter)	Gamma	24							
	K-40	24		131(4/12) (61.9-293)	SW	5.0 mi. WNW	139(2/12) (92.6-186)	139(2/12) (92.6-186)	0
	I-131	24	10	0.47(1/12)	SD	0.17 mi. NW	0.47(1/12)	0.45(1/12)	0
	H-3	8	2000	230(3/4) (110-390)	SD	0.17 mi. NW	230(3/4) (110-390)	205(2/4) (200-210)	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.*

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
Well Water	Gamma	8							
(pCi/liter)	K-40	8		-(0/4)	N/A			-(0/4)	0
	H-3	8	2000	-(0/4)	N/A			-(0/4)	0
Silt (pCi/kg dry)	Gamma	4							
	K-40	4		16250(2/2) (15200-17300)	CHIC	11.2 mi. WNW	17050(2/2) (16500-17600)	17050(2/2) (16500-17600)	0
	Cs-134	4	150	-(0/2)	N/A			-(0/2)	0
	Cs-137	4	180	303(2/2) (275-331)	SD	1.3 mi. NNW	303(2/2) (275-331)	261(2/2) (238-284)	0
	Ra-226	4		1609(2/2) (777-2440)	CHIC	11.2 mi. WNW	1807(2/2) (884-2730)	1807(2/2) (884-2730)	0
	Th-228	4		1130(2/2) (1100-1160)	CHIC	11.2 mi. WNW	1225(2/2) (1210-1240)	1225(2/2) (1210-1240)	0
Shoreline Sediment	Gamma	4							
(pCi/kg dry)	K-40	4		7750(2/2) (7620-7880)	HIR	0.8 mi. N	7750(2/2) (7620-7880)	2295(2/2) (1630-2960)	0
	Ra-226	4		146(1/2)	CHIC	11.2 mi. WNW	1460(1/2)	1460(1/2)	0
	Th-228	4		151(2/2) (99.8-202)	CHIC	11.2 mi. WNW	1027(2/2) (83.8-1970)	1027(2/2) (83.8-1970)	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.*

Medium or Pathway Sampled (Unit)	Analysis		LLD*	All Indicator Locations	Location with Highest Mean			Control Location	Non-Routine Reported Measurements
	Type	Total No.		Mean Range	Name	Distance Direction	Mean Range	Mean Range	
Shoreline Sediment	Gamma	4							
(pCi/kg dry)	Cs-134	4	150	-(0/2)	N/A			-(0/2)	0
	Cs-137	4	180	-(0/2)	N/A			-(0/2)	0
Milk	Gamma	36							
(pCi/liter)	K-40	36		1301(24/24) (657-1470)	CP	3.7 mi. NNW	1363(12/12) (1300-1470)	1229(12/12) (1030-1400)	0
	I-131	35	1	-(0/23)	N/A			-(0/12)	0
	Sr-89	12		-(0/8)	N/A			-(0/4)	0
	Sr-90	12		1.71(8/8) (0.55-3.2)	CP	3.7 mi. NNW	2.38(4/4) (1.7-3.2)	1.00(4/4) (0.69-1.4)	0
	Th-228	36		9.01(1/24)	EPPS	4.8 mi. SSW	9.01(1/24)	-(0/12)	0
Clams	Gamma	8							
(pCi/kg wet)	K-40	8		466(6/6) (366-480)	HIP	2.4 mi. NE	553(2/2) (480-626)	316(1/2)	0
	Th-228	8		-(0/0)	N/A			-(0/0)	0
Oysters	Gamma	4							
(pCi/kg wet)	K-40	4		657(4/4) (540-1030)	POS	6.4 mi. SSE	785(2/2) (540-1030)	-(0/0)	0
Crabs	Gamma	1							
(pCi/kg wet)	K-40	1		1890(1/1)	SD	1.3 mi. NNW	1890(1/1)	-(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.*

Surry Nuclear Power Station, Surry County, Virginia - 2001
Docket No. 5-280-281 Page 4 of 4

Medium or Pathway Sampled (Unit)	Analysis		LLD*	All Indicator Locations	Location with Highest Mean			Control Location	Non-Routine Reported Measurements
	Type	Total No.		Mean Range	Name	Distance Direction	Mean Range	Mean Range	
Fish (pCi/kg wet)	Gamma	4							
	K-40	4		722(4/4) (505-837)	SD	1.3 mi. NNW	722(4/4) (505-837)	-(0/0)	0
	Cs-137	4	150	(-0/4)	N/A			-(0/0)	0
Vegetation (pCi/kg wet)	Gamma	3							
	Be-7	3		-(0/3)	N/A			-(0/0)	0
	K-40	3		7580(3/3) (2430-14600)	Slade's Farm	2.4 mi. S	14600(1/1)	-(0/0)	0
	Cs-137	3	80	-(0/3)	N/A			-(0/0)	0
Direct Radiation TLD (mR/ std.month)	Gamma	168	2	2.7(156/156) (1.2-5.9)	STA-41	11.5 mi. S	5.1(4/4) (4.1-5.7)	3.5(12/12) (1.6-5.7)	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.*

APPENDIX B

DATA TABLES

YEAR 2001

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

Surry Nuclear Power Station, Surry County, Virginia - 2001

pCi/m^3 ± 2 Sigma

COLLECTION DATE	STATIONS SS	HIR	BC	ALL	CP	BASF	FE	NN
JANUARY								
12/26/00 - 01/02/01	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
01/02/01 - 01/09/01	< 0.016	< 0.016	< 0.016	< 0.016	< 0.009	< 0.019	< 0.018	< 0.018
01/09/01 - 01/16/01	< 0.014	< 0.014	< 0.014	< 0.014	< 0.010	< 0.017	< 0.017	< 0.013
01/16/01 - 01/23/01	< 0.021	< 0.021	< 0.021	< 0.021	< 0.013	< 0.019	< 0.019	< 0.019
01/23/01 - 01/30/01	< 0.014	< 0.014	< 0.016	< 0.012	< 0.015	< 0.012	< 0.008	< 0.019
FEBRUARY								
01/30/01 - 02/06/01	< 0.015	< 0.017	< 0.019	< 0.014	< 0.018	< 0.015	< 0.022	< 0.022
02/06/01 - 02/13/01	< 0.019	< 0.019	< 0.018	< 0.047	< 0.020	< 0.022	< 0.011	< 0.020
02/13/01 - 02/20/01	< 0.020	< 0.027	< 0.012	< 0.018	< 0.014	< 0.010	< 0.013	< 0.011
02/20/01 - 02/27/01	< 0.015	< 0.015	< 0.017	< 0.017	< 0.015	< 0.014	< 0.018	< 0.025
MARCH								
02/27/01 - 03/06/01	< 0.026	< 0.026	< 0.016	< 0.017	< 0.023	< 0.018	< 0.022	< 0.014
03/06/01 - 03/13/01	< 0.028	< 0.028	< 0.017	< 0.018	< 0.023	< 0.017	< 0.021	< 0.022
03/13/01 - 03/20/01	< 0.009	< 0.010	< 0.011	< 0.009	< 0.014	< 0.010	< 0.012	< 0.013
03/20/01 - 03/27/01	< 0.006	< 0.006	< 0.007	< 0.005	< 0.007	< 0.006	< 0.006	< 0.008
APRIL								
03/27/01 - 04/03/01	< 0.016	< 0.018	< 0.019	< 0.023	< 0.020	< 0.021	< 0.023	< 0.018
04/03/01 - 04/10/01	< 0.013	< 0.014	< 0.015	< 0.020	< 0.022	< 0.019	< 0.027	< 0.021
04/10/01 - 04/17/01	< 0.013	< 0.014	< 0.016	< 0.018	< 0.016	< 0.018	< 0.020	< 0.014
04/17/01 - 04/24/01	< 0.016	< 0.016	< 0.016	< 0.016	< 0.017	< 0.016	< 0.023	< 0.023
04/24/01 - 05/01/01	< 0.015	< 0.013	< 0.015	< 0.011	< 0.015	< 0.013	< 0.014	< 0.016
MAY								
05/01/01 - 05/08/01	< 0.005	< 0.006	< 0.007	< 0.005	< 0.006	< 0.006	< 0.006	< 0.011
05/08/01 - 05/15/01	< 0.013	< 0.016	< 0.016	< 0.021	< 0.018	< 0.019	< 0.023	< 0.016
05/15/01 - 05/22/01	< 0.004	< 0.004	< 0.005	< 0.004	< 0.005	< 0.004	< 0.005	< 0.005
05/22/01 - 05/29/01	< 0.010	< 0.011	< 0.012	< 0.009	< 0.012	< 0.009	< 0.010	< 0.012
JUNE								
05/29/01 - 06/05/01	< 0.038	< 0.009	< 0.017	< 0.015	< 0.018	< 0.020	< 0.022	< 0.012
06/05/01 - 06/12/01	< 0.012	< 0.014	< 0.026	< 0.026	< 0.024	< 0.023	< 0.022	< 0.018
06/12/01 - 06/19/01	< 0.010	< 0.011	< 0.012	< 0.010	< 0.013	< 0.011	< 0.011	< 0.013
06/19/01 - 06/27/01	< 0.009	< 0.010	< 0.011	< 0.014	< 0.014	< 0.007	< 0.008	< 0.009

(a) Samples not analyzed due to excessive decay.

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

Surry Nuclear Power Station, Surry County, Virginia - 2001

pCi/m^3 ± 2 Sigma

COLLECTION DATE	STATIONS SS	HIR	BC	ALL	CP	BASF	FE	NN
JULY								
06/27/01 - 07/03/01	< 0.013	< 0.015	< 0.016	< 0.012	< 0.018	< 0.015	< 0.015	< 0.020
07/03/01 - 07/10/01	< 0.012	< 0.021	< 0.014	< 0.021	< 0.016	< 0.017	< 0.019	< 0.015
07/10/01 - 07/17/01	< 0.023	< 0.023	< 0.016	< 0.021	< 0.021	< 0.017	< 0.015	< 0.015
07/17/01 - 07/24/01	< 0.008	< 0.009	< 0.010	< 0.008	< 0.010	< 0.010	< 0.009	< 0.011
07/24/01 - 08/01/01	< 0.030	< 0.032	< 0.030	< 0.030	< 0.017	< 0.017	< 0.017	< 0.017
AUGUST								
08/01/01 - 08/07/01	< 0.027	< 0.028	< 0.027	< 0.027	< 0.033	< 0.033	< 0.033	< 0.032
08/07/01 - 08/14/01	< 0.035	< 0.034	< 0.033	< 0.033	< 0.030	< 0.030	< 0.030	< 0.030
08/14/01 - 08/21/01	< 0.026	< 0.026	< 0.026	< 0.025	< 0.025	< 0.028	< 0.028	< 0.028
08/21/01 - 08/28/01	< 0.011	< 0.012	< 0.013	< 0.010	< 0.012	< 0.012	< 0.012	< 0.014
SEPTEMBER								
08/28/01 - 09/04/01	< 0.015	< 0.019	< 0.017	< 0.018	< 0.019	< 0.015	< 0.014	< 0.008
09/04/01 - 09/11/01	< 0.010	< 0.010	< 0.010	< 0.010	< 0.009	< 0.009	< 0.008	< 0.011
09/11/01 - 09/18/01	< 0.008	< 0.008	< 0.008	< 0.008	< 0.005	< 0.005	< 0.005	< 0.005
09/18/01 - 09/25/01	< 0.015	< 0.015	< 0.015	< 0.015	< 0.026	< 0.026	< 0.026	< 0.026
OCTOBER								
09/25/01 - 10/02/01	< 0.011	< 0.011	< 0.011	< 0.011	< 0.013	< 0.013	< 0.012	< 0.013
10/02/01 - 10/10/01	< 0.010	< 0.010	< 0.011	< 0.009	< 0.011	< 0.012	< 0.009	< 0.011
10/10/01 - 10/16/01	< 0.009	< 0.010	< 0.010	< 0.009	< 0.010	< 0.011	< 0.009	< 0.011
10/16/01 - 10/23/01	< 0.010	< 0.010	< 0.010	< 0.011	< 0.010	< 0.010	< 0.010	< 0.010
10/23/01 - 10/30/01	< 0.011	< 0.011	< 0.011	< 0.011	< 0.009	< 0.009	< 0.009	< 0.009
NOVEMBER								
10/30/01 - 11/06/01	< 0.037	< 0.037	< 0.037	< 0.038	< 0.025	< 0.025	< 0.025	< 0.025
11/06/01 - 11/13/01	< 0.039	< 0.039	< 0.028	< 0.035	< 0.034	< 0.034	< 0.034	< 0.024
11/13/01 - 11/20/01	< 0.026	< 0.026	< 0.026	< 0.026	< 0.030	< 0.030	< 0.030	< 0.030
11/20/01 - 11/28/01	< 0.031	< 0.031	< 0.031	< 0.031	< 0.033	< 0.033	< 0.033	< 0.033
DECEMBER								
11/28/01 - 12/04/01	< 0.050	< 0.050	< 0.051	< 0.051	< 0.035	< 0.035	< 0.035	< 0.035
12/04/01 - 12/11/01	< 0.029	< 0.028	< 0.028	< 0.028	< 0.026	< 0.025	< 0.025	< 0.026
12/11/01 - 12/18/01	< 0.036	< 0.036	< 0.036	< 0.036	< 0.034	< 0.034	< 0.034	< 0.033
12/18/01 - 12/26/01	< 0.040	< 0.039	< 0.040	< 0.040	< 0.027	< 0.027	< 0.027	< 0.027
12/26/01 - 01/02/02	< 0.025	< 0.025	< 0.025	< 0.025	< 0.035	< 0.034	< 0.035	< 0.035

TABLE B-2: GROSS BETA CONCENTRATIONS IN AIR PARTICULATES

Surry Nuclear Power Station, Surry County, Virginia - 2001

1.0 E^{-03} pCi/m^3 ± 2 Sigma Page 1 of 2

COLLECTION DATE	SS	HIR	BC	ALL	CP	BASF	FE	NN	Average 2 Sigma
JANUARY									
12/26 - 01/02	21 ± 2	16 ± 2	18 ± 2	20 ± 2	19 ± 2	17 ± 2	20 ± 2	19 ± 2	19 ± 3
01/02 - 01/09	18 ± 2	15 ± 2	15 ± 2	17 ± 2	15 ± 2	14 ± 2	16 ± 2	16 ± 2	16 ± 2
01/09 - 01/16	17 ± 2	18 ± 2	17 ± 2	16 ± 2	17 ± 2	13 ± 2	18 ± 2	16 ± 2	17 ± 2
01/16 - 01/23	18 ± 2	17 ± 2	17 ± 2	18 ± 2	18 ± 2	17 ± 2	18 ± 2	16 ± 2	17 ± 2
01/23 - 01/30	23 ± 2	23 ± 2	25 ± 2	24 ± 2	22 ± 2	19 ± 2	25 ± 2	24 ± 2	23 ± 2
FEBRUARY									
01/30 - 02/06	18 ± 2	20 ± 2	22 ± 2	22 ± 2	20 ± 2	20 ± 2	20 ± 2	19 ± 2	20 ± 3
02/06 - 02/13	13 ± 2	15 ± 2	17 ± 2	14 ± 2	15 ± 2	15 ± 2	15 ± 2	14 ± 2	15 ± 3
02/13 - 02/20	16 ± 2	20 ± 2	21 ± 2	16 ± 2	20 ± 2	18 ± 2	21 ± 2	19 ± 2	19 ± 4
02/20 - 02/27	15 ± 2	17 ± 2	18 ± 2	19 ± 2	18 ± 2	19 ± 2	16 ± 2	18 ± 2	18 ± 3
MARCH									
02/27 - 03/06	14 ± 2	17 ± 2	17 ± 2	17 ± 2	15 ± 2	16 ± 2	17 ± 2	18 ± 2	16 ± 3
03/06 - 03/13	11 ± 2	12 ± 2	12 ± 2	12 ± 2	12 ± 2	12 ± 2	14 ± 2	12 ± 2	12 ± 2
03/13 - 03/20	11 ± 2	9.0 ± 1.4	11 ± 2	12 ± 2	13 ± 2	9.4 ± 1.4	11 ± 2	12 ± 2	11 ± 3
03/20 - 03/27	13 ± 2	14 ± 2	14 ± 2	16 ± 2	13 ± 2	14 ± 2	16 ± 2	21 ± 2	15 ± 6
Qtr. Avg. ± 2 s.d.	**16 ± 7.3**	**16 ± 7.2**	**17 ± 7.8**	**17 ± 7.1**	**17 ± 6.2**	**16 ± 6.2**	**17 ± 7.1**	**17 ± 6.8**	**17 ± 7**
APRIL									
03/27 - 04/03	8.8 ± 1.4	11 ± 2	9.9 ± 1.5	9.8 ± 1.5	10 ± 1	10 ± 1	11 ± 2	9.2 ± 1.4	10 ± 2
04/03 - 04/10	16 ± 2	16 ± 2	14 ± 2	15 ± 2	14 ± 2	14 ± 2	16 ± 2	16 ± 2	15 ± 2
04/10 - 04/17	12 ± 2	14 ± 2	14 ± 2	15 ± 2	13 ± 2	15 ± 2	14 ± 2	16 ± 2	14 ± 3
04/17 - 04/24	20 ± 2	20 ± 2	21 ± 2	24 ± 2	18 ± 2	19 ± 2	20 ± 2	20 ± 2	20 ± 4
04/24 - 05/01	15 ± 2	17 ± 2	15 ± 2	17 ± 2	17 ± 2	16 ± 2	17 ± 2	18 ± 2	17 ± 2
MAY									
05/01 - 05/08	15 ± 2	18 ± 2	20 ± 2	19 ± 2	17 ± 2	18 ± 2	17 ± 2	19 ± 2	18 ± 3
05/08 - 05/15	16 ± 2	14 ± 2	18 ± 2	20 ± 2	16 ± 2	17 ± 2	17 ± 2	17 ± 2	17 ± 4
05/15 - 05/22	11 ± 2	13 ± 2	15 ± 2	13 ± 2	10 ± 2	13 ± 2	10 ± 2	12 ± 2	12 ± 4
05/22 - 05/29	14 ± 2	15 ± 2	16 ± 2	15 ± 2	12 ± 2	13 ± 2	16 ± 2	17 ± 2	15 ± 3
JUNE									
05/29 - 06/05	11 ± 1	11 ± 2	12 ± 2	13 ± 2	11 ± 2	11 ± 2	12 ± 2	13 ± 2	12 ± 2
06/05 - 06/12	13 ± 2	12 ± 2	13 ± 2	14 ± 2	13 ± 2	14 ± 2	13 ± 2	15 ± 2	13 ± 2
06/12 - 06/19	13 ± 2	12 ± 2	15 ± 2	17 ± 2	13 ± 2	13 ± 2	15 ± 2	14 ± 2	14 ± 3
06/19 - 06/27	12 ± 1	13 ± 2	16 ± 2	13 ± 2	17 ± 2	18 ± 2	14 ± 2	17 ± 2	15 ± 4
Qtr. Avg. ± 2 s.d.	**14 ± 5.7**	**14 ± 5.6**	**15 ± 6.1**	**16 ± 7.4**	**14 ± 5.6**	**15 ± 5.6**	**15 ± 5.6**	**16 ± 6**	**15 ± 6**

TABLE B-2: GROSS BETA CONCENTRATIONS IN AIR PARTICULATES

Surry Nuclear Power Station, Surry County, Virginia - 2001

1.0 E^{-03} pCi/m^3 ± 2 Sigma

COLLECTION DATE	SS	HIR	BC	STATIONS ALL	CP	BASF	FE	NN	Average 2 Sigma
JULY									
06/27 - 07/03	14 ± 2	14 ± 2	17 ± 2	14 ± 2	15 ± 2	14 ± 2	15 ± 2	16 ± 2	15 ± 2
07/03 - 07/10	14 ± 2	14 ± 2	14 ± 2	14 ± 2	14 ± 2	15 ± 2	15 ± 2	15 ± 2	14 ± 1
07/10 - 07/17	14 ± 2	14 ± 2	16 ± 2	14 ± 2	14 ± 2	15 ± 2	12 ± 2	16 ± 2	14 ± 3
07/17 - 07/24	15 ± 2	17 ± 2	17 ± 2	15 ± 2	16 ± 2	14 ± 2	16 ± 2	17 ± 2	16 ± 2
07/24 - 08/01	11 ± 1	12 ± 1	13 ± 1	11 ± 1	10 ± 1	11 ± 1	12 ± 1	12 ± 1	12 ± 2
AUGUST									
08/01 - 08/07	10 ± 1	13 ± 2	14 ± 2	11 ± 1	12 ± 1	13 ± 1	12 ± 1	12 ± 1	12 ± 3
08/07 - 08/14	20 ± 2	20 ± 2	20 ± 2	21 ± 2	19 ± 2	17 ± 2	21 ± 2	21 ± 2	20 ± 2
08/14 - 08/21	19 ± 2	23 ± 2	22 ± 2	18 ± 2	21 ± 2	20 ± 2	22 ± 2	20 ± 2	21 ± 4
08/21 - 08/28	20 ± 2	20 ± 2	24 ± 2	20 ± 2	18 ± 2	20 ± 2	22 ± 2	20 ± 2	21 ± 4
SEPTEMBER									
08/28 - 09/04	19 ± 2	22 ± 2	25 ± 2	20 ± 2	20 ± 2	23 ± 2	23 ± 2	22 ± 2	22 ± 4
09/04 - 09/11	15 ± 2	17 ± 2	19 ± 2	16 ± 2	17 ± 2	17 ± 2	17 ± 2	16 ± 2	17 ± 3
09/11 - 09/18	14 ± 2	14 ± 2	19 ± 2	17 ± 2	18 ± 2	17 ± 2	17 ± 2	17 ± 2	17 ± 4
09/18 - 09/25	22 ± 2	23 ± 2	27 ± 2	24 ± 2	23 ± 2	24 ± 2	24 ± 2	22 ± 2	24 ± 3
Qtr. Avg. ± 2 s.d.	**16 ± 7.4**	**17 ± 8**	**19 ± 8.9**	**17 ± 7.9**	**17 ± 7.4**	**17 ± 7.8**	**18 ± 8.8**	**17 ± 6.8**	**17 ± 8**
OCTOBER									
09/25 - 10/02	13 ± 2	12 ± 2	15 ± 2	14 ± 2	14 ± 2	16 ± 2	15 ± 2	13 ± 2	14 ± 2
10/02 - 10/10	25 ± 2	25 ± 2	26 ± 2	26 ± 2	24 ± 2	28 ± 2	23 ± 2	22 ± 2	25 ± 3
10/10 - 10/16	15 ± 2	18 ± 2	15 ± 2	17 ± 2	16 ± 2	17 ± 2	15 ± 2	18 ± 2	16 ± 3
10/16 - 10/23	13 ± 2	17 ± 2	18 ± 2	19 ± 2	17 ± 2	21 ± 2	16 ± 2	16 ± 2	17 ± 4
10/23 - 10/30	12 ± 2	14 ± 2	15 ± 2	18 ± 2	13 ± 2	14 ± 2	17 ± 2	13 ± 2	15 ± 4
NOVEMBER									
10/30 - 11/06	20 ± 2	21 ± 2	24 ± 2	27 ± 2	21 ± 2	22 ± 2	27 ± 2	21 ± 2	23 ± 6
11/06 - 11/13	21 ± 2	22 ± 2	23 ± 2	31 ± 2	22 ± 2	25 ± 2	24 ± 2	22 ± 2	24 ± 7
11/13 - 11/20	20 ± 2	23 ± 2	23 ± 2	30 ± 2	22 ± 2	25 ± 2	25 ± 2	20 ± 2	24 ± 7
11/20 - 11/28	13 ± 1	15 ± 2	17 ± 2	21 ± 2	16 ± 2	17 ± 2	17 ± 2	14 ± 2	16 ± 5
DECEMBER									
11/28 - 12/04	19 ± 2	20 ± 2	23 ± 2	28 ± 2	21 ± 2	25 ± 2	22 ± 2	20 ± 2	22 ± 6
12/04 - 12/11	23 ± 2	22 ± 2	22 ± 2	28 ± 2	22 ± 2	23 ± 2	20 ± 2	19 ± 2	22 ± 6
12/11 - 12/18	18 ± 2	17 ± 2	17 ± 2	22 ± 2	20 ± 2	19 ± 2	20 ± 2	17 ± 2	19 ± 4
12/18 - 12/26	17 ± 2	20 ± 2	17 ± 2	25 ± 2	18 ± 2	20 ± 2	20 ± 2	18 ± 2	19 ± 6
12/26 - 01/02	25 ± 2	25 ± 2	24 ± 2	33 ± 2	24 ± 2	29 ± 2	31 ± 2	25 ± 2	27 ± 7
Qtr. Avg. ± 2 s.d.	**18 ± 9**	**19 ± 8**	**20 ± 7.9**	**24 ± 12**	**19 ± 7.2**	**22 ± 9.2**	**21 ± 9.6**	**18 ± 7.2**	**20 ± 9**
Annual Avg. ± 2 s.d.	**16 ± 8**	**17 ± 8**	**18 ± 8**	**19 ± 11**	**17 ± 8**	**17 ± 9**	**18 ± 9**	**17 ± 7**	**17 ± 9**

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

Surry Nuclear Power Station, Surry County, Virginia - 2001

1.0 E^{-03} pCi/m^3 ± 2 Sigma

STATION	NUCLIDE	First Quarter 12/26 - 03/27	Second Quarter 03/27 - 06/27	Third Quarter 06/27 - 09/25	Fourth Quarter 09/25 - 01/2	Average ± 2 s.d.
STA-SS	Be-7	79.4 ± 5.0	117 ± 7	108 ± 7	112 ± 6.6	104.1 ± 33.7
	K-40	< 3	< 4	< 3	< 3	
	Co-60	< 0.3	< 0.2	< 0.2	< 0.2	
	Cs-134	< 0.1	< 0.2	< 0.3	< 0.1	
	Cs-137	< 0.2	< 0.2	< 0.2	< 0.2	
	Th-228	< 0.2	< 0.3	< 0.3	< 0.3	
STA-HIR	Be-7	91.6 ± 5.8	118 ± 7	113 ± 6	115 ± 7	109 ± 24
	K-40	< 4	< 4	< 4	< 3	
	Co-60	< 0.2	< 0.2	< 0.2	< 0.2	
	Cs-134	< 0.2	< 0.2	< 0.2	< 0.2	
	Cs-137	< 0.2	< 0.2	< 0.2	< 0.2	
	Th-228	< 0.2	< 0.3	< 0.2	< 0.2	
STA-BC	Be-7	104 ± 7	128 ± 7	127 ± 7	124 ± 7	121 ± 23
	K-40	< 4	< 5	< 5	< 5	
	Co-60	< 0.2	< 0.2	< 0.2	< 0.2	
	Cs-134	< 0.2	< 0.2	< 0.2	< 0.2	
	Cs-137	< 0.2	< 0.2	< 0.2	< 0.2	
	Th-228	0.36 ± 0.29	< 0.4	< 0.3	< 0.3	
STA-ALL	Be-7	87.6 ± 5.4	122 ± 7	116 ± 6	142 ± 8	117 ± 45
	K-40	< 3	< 3	4.07 ± 1.58	3.77 ± 1.43	3.92 ± 0.42
	Co-60	< 0.2	< 0.3	< 0.2	< 0.2	
	Cs-134	< 0.1	< 0.1	< 0.1	< 0.1	
	Cs-137	< 0.1	< 0.2	< 0.1	< 0.1	
	Th-228	< 0.2	< 0.2	< 0.2	< 0.2	
STA-CP	Be-7	89.3 ± 5.8	123 ± 7	117 ± 7	114 ± 7	111 ± 30
	K-40	< 3	< 4	< 4	< 3	
	Co-60	< 0.3	< 0.2	< 0.2	< 0.2	
	Cs-134	< 0.3	< 0.2	< 0.2	< 0.2	
	Cs-137	< 0.3	< 0.2	< 0.2	< 0.2	
	Th-228	< 0.4	< 0.4	< 0.4	< 0.2	

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

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

Surry Nuclear Power Station, Surry County, Virginia - 2001

1.0 E^{-03} pCi/m^3 ± 2 Sigma

STATION	NUCLIDE	First Quarter 12/26 - 03/27	Second Quarter 03/27 - 06/27	Third Quarter 06/27 - 09/25	Fourth Quarter 09/25 - 01/02	Average ± 2 s.d.
STA-BASF	Be-7	85.2 ± 6.3	123 ± 7	117 ± 7	122 ± 7	112 ± 36
	K-40	4.39 ± 1.10	< 5	< 4	< 4	
	Co-60	< 0.2	< 0.2	< 0.2	< 0.2	
	Cs-134	< 0.3	< 0.2	< 0.2	< 0.2	
	Cs-137	< 0.3	< 0.2	< 0.2	< 0.2	
	Th-228	< 0.5	< 0.3	< 0.3	< 0.2	
STA-FE	Be-7	92.3 ± 6.7	56.4 ± 3.2	123 ± 7	119 ± 7	97.7 ± 61.4
	K-40	6.18 ± 1.29	< 5	3.10 ± 1.65	5.14 ± 1.61	4.81 ± 3.13
	Co-60	< 0.4	< 0.3	< 0.2	< 0.2	
	Cs-134	< 0.4	< 0.2	< 0.2	< 0.2	
	Cs-137	< 0.4	< 0.2	< 0.2	< 0.1	
	Th-228	0.63 ± 0.47	< 0.4	< 0.2	< 0.2	
STA-NN	Be-7	95.0 ± 8.5	119 ± 7	118 ± 7	111 ± 7	111 ± 22
	K-40	6.04 ± 1.53	< 3	< 4	< 4	
	Co-60	< 0.3	< 0.4	< 0.2	< 0.2	
	Cs-134	< 0.3	< 0.4	< 0.3	< 0.2	
	Cs-137	< 0.2	< 0.2	< 0.3	< 0.2	
	Th-228	0.59 ± 0.47	< 0.5	< 0.4	< 0.3	

* *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 - 2001

pCi/L ± 2 Sigma

Station	Collection Date	Be-7	K-40	I-131	Cs-137	Ba-140	La-140	Th-228	H-3
SD	01/23	< 120	293 ± 140	< 0.5	< 10	< 70 (a)	< 20 (a)	< 20	< 100
SW	01/23	< 110	< 250	< 0.5	< 10	< 70 (a)	< 20 (a)	< 20	< 100
SD	02/27	< 30	< 90	< 0.2	< 4	< 20	< 6	< 9	
SW	02/27	< 50	< 130	< 0.3	< 6	< 30	< 7	< 10	
SD	03/27	< 20	< 70	< 0.3	< 3	< 9	< 3	< 8	
SW	03/27	< 10	< 50	< 0.3	< 2	< 7	< 2	< 4	
SD	04/24	< 30	< 70	< 0.4	< 5	< 20	< 7	< 6	110 ± 70
SW	04/24	< 40	< 100	< 0.2	< 4	< 20	< 7	< 9	< 100
SD	05/29	< 50	< 80	< 0.3	< 6	< 30	< 10	< 10	
SW	05/29	< 50	< 90	< 0.3	< 6	< 30	< 9	< 9	
SD	06/27	< 50	< 100	< 0.2	< 7	< 30	< 8	< 10	
SW	06/27	< 40	< 140	< 0.3	< 5	< 20	< 7	< 7	
SD	07/24	< 40	< 90	0.47 ± 0.23	< 5	< 20	< 7	< 6	190 ± 60
SW	07/24	< 40	< 90	0.45 ± 0.25	< 5	< 20	< 8	< 7	210 ± 70
SD	08/28	< 30	61.9 ± 31	< 0.5	< 3	< 20	< 5	< 5	
SW	08/28	< 40	< 110	< 0.4	< 8	< 30	< 8	< 7	
SD	09/25	< 60	< 100	< 0.4	< 7	< 30	< 10	< 10	
SW	09/25	< 50	< 80	< 0.3	< 5	< 30	< 8	< 8	
SD	10/30	< 30	82.3 ± 34	< 0.3	< 3	< 20	< 5	< 5	390 ± 80
SW	10/30	< 30	< 80	< 0.3	< 4	< 20	< 7	< 6	200 ± 70
SD	11/28	< 40	< 100	< 0.4	< 5	< 20	< 7	< 7	
SW	11/28	< 40	92.6 ± 38	< 0.3	< 5	< 30	< 8	< 10	
SD	12/18	< 40	86.7 ± 34	< 0.7	< 4	< 20	< 7	< 30	
SW	12/18	< 40	186 ± 42	< 0.6	< 5	< 30	< 10	< 40	
Average ± 2 s.d.			**134 ± 178**	**0.46 ± 0.03**					**220 ± 206**

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

(a) *LLD was missed due to incorrect geometry and excessive sample decay.*

TABLE B-5: GAMMA EMITTER AND TRITIUM CONCENTRATIONS IN WELL WATER*

Surry Nuclear Power Station, Surry County, Virginia - 2001

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									
03/20/01	HIR	< 50	< 90	< 0.4	< 6	< 30	< 10	< 10	< 300
03/20/01	SS	< 60	< 110	< 0.4	< 7	< 40	< 10	< 10	< 300
SECOND QUARTER									
06/12/01	HIR	< 40	< 80	< 0.3	< 5	< 30	< 9	< 10	< 100
06/12/01	SS	< 40	< 70	< 0.3	< 5	< 30	< 8	< 9	< 100
THIRD QUARTER									
09/18/01	HIR	< 40	< 140	< 0.2	< 5	< 20	< 6	< 6	< 100
09/18/01	SS	< 30	< 70	< 0.3	< 3	< 10	< 4	< 5	< 100
FOURTH QUARTER									
12/12/01	HIR	< 40	< 90	< 0.2	< 5	< 20	< 8	< 10	< 100
12/12/01	SS	< 50	< 100	< 0.3	< 6	< 30	< 10	< 10	< 90

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

TABLE B-6: GAMMA EMITTER CONCENTRATIONS IN SILT*

Surry Nuclear Power station, Surry County, Virginia - 2001

pCi/kg (dry) ± 2 Sigma Page 1 of 1

Station Coll. Date	SD 03/14	CHIC 03/14	SD 09/05	CHIC 09/05	Average ± 2 s.d.
Be-7	< 200	379 ± 112	851 ± 94	338 ± 84	523 ± 570
K-40	17300 ± 700	17600 ± 710	15200 ± 570	16500 ± 640	16650 ± 2145
Mn-54	< 20	< 20	< 20	< 20	-
Co-58	< 30	< 30	< 20	< 20	-
Co-60	62.1 ± 8.7	< 30	30.8 ± 6.8	< 20	46.5 ± 44.3
Cs-134	< 20	< 20	< 20	< 20	-
Cs-137	331 ± 21	284 ± 21	275 ± 17	238 ± 17	282 ± 77
Ra-226	777 ± 26	884 ± 30	2440 ± 242	2730 ± 293	1708 ± 2042
Th-228	1160 ± 137	1240 ± 146	1100 ± 112	1210 ± 124	1178 ± 123

TABLE B-7: GAMMA EMITTER CONCENTRATIONS IN SHORELINE SEDIMENT*

Surry Nuclear Power Station, Surry County, Virginia - 2001

pCi/kg (dry) ± 2 Sigma Page 1 of 1

Station Coll. Date	HIR 02/27	CHIC 02/27	HIR 08/28	CHIC 08/28	Average ± 2 s.d.
Be-7	< 190	< 220	< 50	< 180	
K-40	7620 ± 381	2960 ± 195	7880 ± 281	1630 ± 129	5023 ± 6395
Co-60	< 20	< 20	< 20	< 20	-
Cs-134	< 20	< 20	< 10	< 30	-
Cs-137	< 20	< 10	< 20	< 20	-
Ra-226	< 430	< 370	146 ± 12	1460 ± 35	803 ± 1858
Th-228	202 ± 315	83.8 ± 8.7	99.8 ± 10.1	1970 ± 139	589 ± 1844

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

TABLE B-8: GAMMA EMITTER AND STRONTIUM-89, STRONTIUM-90 CONCENTRATIONS IN MILK*

Surry Nuclear Power Station, Surry County, Virginia - 2001

pCi/L ± 2 Sigma

NUCLIDE	EPPS	COLONIAL PARKWAY	PIVARNIK	Average ± 2 s.d.
JANUARY				
Sr-89	< 2	< 2	< 2	
Sr-90	1.4 ± 0.2	3.2 ± 0.3	0.98 ± 0.28	1.9 ± 2.4
K-40	1160 ± 76	1330 ± 79	1210 ± 52	1233 ± 175
Cs-137	< 6	< 6	< 6	
I-131	(a)	< 1	< 3 (b)	
Th-228	9.01 ± 3.08			
FEBRUARY				
K-40	1390 ± 84	1380 ± 81	1160 ± 74	1310 ± 260
Cs-137	< 6	< 6	< 6	
I-131	< 0.2	< 0.5	< 0.3	
MARCH				
K-40	1400 ± 63	1370 ± 78	1230 ± 79	1333 ± 181
Cs-137	< 2	< 5	< 6	
I-131	< 0.2	< 0.1	< 0.4	
APRIL				
Sr-89	< 1	< 2	< 2	
Sr-90	0.55 ± 0.17	1.7 ± 0.3	0.91 ± 0.20	1.1 ± 1.2
K-40	1350 ± 83	1300 ± 66	1150 ± 78	1267 ± 208
Cs-137	< 4	< 4	< 6	
I-131	< 0.3	< 0.2	< 0.09	
MAY				
K-40	657 ± 62	1330 ± 77	1260 ± 80	1082 ± 740
Cs-137	< 6	< 6	< 6	
I-131	< 0.3	< 0.3	< 0.2	
JUNE				
K-40	1290 ± 77	1470 ± 85	1270 ± 78	1343 ± 220
Cs-137	< 6	< 4	< 6	
I-131	< 0.3	< 0.3	< 0.2	

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

(a) Sample not analyzed due to excessive decay.

(b) LLD not met due to excessive decay prior to analysis.

TABLE B-8: GAMMA EMITTER AND STRONTIUM-89, STRONTIUM-90 CONCENTRATIONS IN MILK*

Surry Nuclear Power Station, Surry County, Virginia - 2001

pCi/L ± 2 Sigma

NUCLIDE	EPPS	COLONIAL PARKWAY	PIVARNIK	Average ± 2 s.d.
JULY				
Sr-89	< 1	< 3	< 2	
Sr-90	1.0 ± 0.2	2.5 ± 0.3	0.69 ± 0.29	1.4 ± 1.9
K-40	1210 ± 77	1360 ± 79	1300 ± 69	1290 ± 151
Cs-137	< 4	< 4	< 6	
I-131	< 0.4	< 0.4	< 0.4	
AUGUST				
K-40	1350 ± 76	1320 ± 77	1230 ± 76	1300 ± 125
Cs-137	< 7	< 8	< 6	
I-131	< 0.6	< 0.3	< 0.3	
SEPTEMBER				
K-40	1280 ± 71	1410 ± 64	1290 ± 65	1327 ± 145
Cs-137	< 6	< 4	< 3	
I-131	< 0.3	< 0.3	< 0.3	
OCTOBER				
Sr-89	< 2	< 2	< 2	
Sr-90	1.2 ± 0.4	2.1 ± 0.4	1.4 ± 0.3	1.6 ± 0.9
K-40	1290 ± 60	1380 ± 90	1220 ± 64	1297 ± 160
Cs-137	< 4	< 6	< 5	
I-131	< 0.6	< 0.4	< 0.5	
NOVEMBER				
K-40	1320 ± 75	1400 ± 80	1030 ± 72	1250 ± 389
Cs-137	< 4	< 4	< 6	
I-131	< 0.3	< 0.2	< 0.4	
DECEMBER				
K-40	1180 ± 73	1300 ± 75	1400 ± 75	1293 ± 220
Cs-137	< 6	< 5	< 5	
I-131	< 0.6	< 0.3	< 0.7	

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

TABLE B-9: GAMMA EMITTER CONCENTRATIONS IN CLAMS*

Surry Nuclear Power Station, Surry County, Virginia - 2001

pCi/kg (wet) ± 2 Sigma

Station Coll. Date	Type	Be-7	K-40	Co-58	Co-60	Cs-137	Ra-226	Th-228
CHIC								
03/14/01	Clams	< 30	316 ± 38	< 4	< 5	< 6	< 70	< 8
09/05/01	Clams	< 200	< 300	< 20	< 20	< 20	< 200	< 20
SD								
03/14/01	Clams	< 40	438 ± 50	< 5	< 5	< 5	< 90	< 8
09/05/01	Clams	< 300	423 ± 129	< 30	< 20	< 20	< 300	< 40
HIP								
03/14/01	Clams	< 40	480 ± 52	< 5	< 4	< 5	< 160	< 10
09/05/01	Clams	< 300	626 ± 139	< 30	< 20	< 20	< 400	< 20
LC								
03/14/01	Clams	< 60	366 ± 81	< 7	< 6	< 6	< 110	< 10
09/05/01	Clams	< 300	465 ± 219	< 40	< 20	< 20	< 600	< 50
Average ± 2 s.d.			**445 ± 196**					

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

TABLE B-10: GAMMA EMITTER CONCENTRATIONS IN OYSTERS*

Surry Nuclear Power Station, Surry County, Virginia - 2001

pCi/kg (wet) ± 2 Sigma

Station Coll. Date	Type	Be-7	K-40	Co-58	Co-60	Cs-137	Ra-226	Th-228
POS								
03/14/01	Oysters	< 40	540 ± 49	< 5	< 3	< 7	< 300	< 9
09/05/01	Oysters	< 300	1030 ± 160	< 30	< 20	< 20	< 600	< 200
MP								
03/14/01	Oysters	< 30	398 ± 52	< 4	< 3	< 3	< 100	< 10
09/05/01	Oysters	< 300	658 ± 170	< 30	< 20	< 20	< 400	< 30
Average ± 2 s.d.			**657 ± 541**					

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

TABLE B-11: GAMMA EMITTER CONCENTRATIONS IN CRABS*

Surry Nuclear Power Station, Surry County, Virginia - 2001

pCi/kg (wet) ± 2 Sigma Page 1 of 1

Station Coll. Date	Type	Be-7	K-40	Co-58	Co-60	Cs-137	Ra-226	Th-228
SD								
06/21/01	Crabs	< 300	1890 ± 200	< 30	< 10	< 10	< 50	< 20

*TABLE B-12: GAMMA EMITTER*CONCENTRATIONS IN FISH*

Surry Nuclear Power Station, Surry County, Virginia - 2001

pCi/kg (wet) ± 2 Sigma Page 1 of 1

Collection Date	Station	Sample Type	K-40	Co-58	Cs-134	Cs-137
04/24/01	SD	Catfish	832 ± 56	< 5	< 6	< 6
04/24/01	SD	White Perch	837 ± 68	< 6	< 6	< 6
10/09/01	SD	Catfish	505 ± 250	< 30	< 30	< 30
10/09/01	SD	White Perch	712 ± 208	< 30	< 30	< 30
Average ± 2 s.d.			**722 ± 311**			

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

TABLE B-13: GAMMA EMITTER CONCENTRATIONS IN VEGETATION*

Surry Nuclear Power Station, Surry County, Virginia - 2001

pCi/kg (wet) ± 2 Sigma

Station	Sample Type	Collection Date	Be-7	K-40	I-131	Cs-134	Cs-137
Brock's	Corn	10/23/01	< 90	2430 ± 149	< 40	< 10	< 10
Brock's	Peanuts	10/23/01	< 200	5710 ± 320	< 70 (a)	< 30	< 20
Slade's	Soybeans	11/28/01	< 80	14600 ± 430	< 30	< 10	< 10
Average ± 2 s.d.				**7580 ± 12594**			

* *All gamma emitters other than those listed were <LLD.*
(a) Unable to analyze to required LLD.

TABLE B-14: DIRECT RADIATION MEASUREMENTS - QUARTERLY TLD RESULTS

Surry Nuclear Power Station, Surry County, Virginia - 2001

mR/standard month ± 2 Sigma

Station Number	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Average 2 s.d.
02	3.4 ± 0.5	3.3 ± 1.4	3.7 ± 1.8	4.9 ± 0.6	3.8 ± 1.5
03	3.7 ± 0.4	3.7 ± 1.8	3.9 ± 1.3	5.2 ± 1.2	4.1 ± 1.4
04	3.5 ± 1.7	2.9 ± 0.4	3.8 ± 0.1	3.7 ± 2.5	3.5 ± 0.8
05	3.0 ± 0.1	2.8 ± 0.6	4.1 ± 0.6	3.4 ± 1.7	3.3 ± 1.1
06	3.5 ± 0.2	3.1 ± 0.3	4.7 ± 2.3	5.0 ± 1.1	4.1 ± 1.8
07	2.6 ± 0.2	2.3 ± 0.9	3.2 ± 1.7	4.0 ± 0.7	3.0 ± 1.5
08	2.7 ± 0.5	2.2 ± 0.7	3.1 ± 1.2	2.7 ± 0.8	2.7 ± 0.7
09	3.1 ± 0.4	2.2 ± 0.7	3.1 ± 1.1	3.5 ± 1.0	3.0 ± 1.1
10	2.3 ± 0.5	2.0 ± 0.2	2.4 ± 0.4	3.1 ± 0.6	2.5 ± 0.9
11	2.7 ± 0.4	2.8 ± 1.5	3.2 ± 0.9	4.0 ± 0.9	3.2 ± 1.2
12	2.9 ± 0.1	2.2 ± 0.7	3.3 ± 1.2	2.8 ± 0.6	2.8 ± 0.9
13	3.2 ± 1.1	2.4 ± 0.8	3.5 ± 1.9	3.0 ± 0.8	3.0 ± 0.9
14	3.5 ± 0.2	2.7 ± 0.5	3.7 ± 0.7	3.2 ± 0.5	3.3 ± 0.9
15	2.3 ± 0.5	2.3 ± 0.9	2.2 ± 0.3	2.8 ± 1.0	2.4 ± 0.5
16	2.8 ± 0.4	2.3 ± 0.9	2.8 ± 1.6	3.2 ± 1.1	2.8 ± 0.7
17	2.4 ± 0.2	2.0 ± 0.8	2.3 ± 0.8	2.1 ± 0.2	2.2 ± 0.4
18	2.6 ± 2.8	1.5 ± 0.3	1.6 ± 1.6	1.3 ± 0.3	1.8 ± 1.2
19	2.1 ± 0.5	2.4 ± 0.5	2.3 ± 1.2	2.4 ± 1.3	2.3 ± 0.3
20	1.9 ± 1.1	1.9 ± 0.5	2.6 ± 1.8	2.2 ± 1.3	2.1 ± 0.7
21	2.2 ± 0.6	2.1 ± 0.4	2.4 ± 1.4	1.9 ± 1.0	2.1 ± 0.4
22	1.7 ± 0.6	1.5 ± 0.6	2.0 ± 1.2	2.1 ± 0.7	1.8 ± 0.6
23	3.2 ± 0.3	2.7 ± 0.5	3.9 ± 0.9	2.7 ± 0.6	3.1 ± 1.1
24	2.7 ± 0.2	1.7 ± 0.5	2.0 ± 0.4	2.5 ± 1.3	2.2 ± 0.9
25	3.1 ± 0.9	2.0 ± 0.9	2.7 ± 1.0	3.2 ± 0.6	2.7 ± 1.1
26	2.5 ± 0.8	2.3 ± 1.2	2.5 ± 1.7	2.4 ± 0.9	2.4 ± 0.2
27	2.3 ± 0.6	1.9 ± 1.4	2.3 ± 1.5	2.1 ± 1.0	2.2 ± 0.4
28	2.3 ± 0.5	1.6 ± 1.7	2.2 ± 0.7	2.9 ± 0.6	2.2 ± 1.1
29	1.9 ± 0.6	1.2 ± 0.4	1.9 ± 1.3	2.1 ± 0.6	1.8 ± 0.8
30	2.4 ± 0.9	1.5 ± 0.4	2.7 ± 0.3	2.1 ± 1.6	2.2 ± 1.0
31	1.9 ± 0.2	1.5 ± 1.6	2.3 ± 0.9	1.9 ± 0.8	1.9 ± 0.7
32	2.2 ± 0.5	1.7 ± 0.3	2.7 ± 2.2	2.9 ± 0.5	2.4 ± 1.1
33	2.3 ± 0.4	2.1 ± 0.5	3.2 ± 1.2	2.3 ± 0.5	2.5 ± 1.0
34	2.7 ± 0.3	2.1 ± 0.3	3.0 ± 0.9	2.2 ± 0.4	2.5 ± 0.8
35	3.4 ± 0.3	2.7 ± 0.6	3.6 ± 1.7	2.8 ± 0.5	3.1 ± 0.9
36	3.3 ± 0.8	2.7 ± 0.3	3.6 ± 1.6	3.4 ± 1.6	3.3 ± 0.8
37	2.3 ± 0.4	1.7 ± 0.4	3.1 ± 1.9	3.1 ± 0.6	2.6 ± 1.4
38	4.7 ± 0.2	4.0 ± 0.2	5.0 ± 2.1	5.9 ± 0.4	4.9 ± 1.6
39	2.5 ± 0.3	1.6 ± 0.8	2.9 ± 0.7	2.7 ± 1.1	2.4 ± 1.1
40	3.1 ± 0.5	2.8 ± 1.2	3.1 ± 1.4	2.6 ± 0.5	2.9 ± 0.5
41	4.9 ± 1.2	4.1 ± 0.6	5.7 ± 2.5	5.7 ± 2.4	5.1 ± 1.5
42	2.5 ± 0.5	1.6 ± 0.4	3.5 ± 0.4	3.2 ± 0.7	2.7 ± 1.7
43	2.2 ± 0.3	2.5 ± 4.4	2.6 ± 1.0	2.9 ± 1.0	2.6 ± 0.6
Average ± 2 s.d.	2.8 ± 1.4	2.3 ± 1.3	3.1 ± 1.7	3.1 ± 2.1	2.8 ± 1.7

APPENDIX C

LAND USE CENSUS

Year 2001

*LAND USE CENSUS**

Surry Nuclear Power Station, Surry County, Virginia

January 1 to December 31, 2001 Page 1 of 1

Sector	Direction	Nearest Resident	Nearest Garden**	Nearest Cow	Nearest Goat
A	N	4.12 @ 8°	(a)	(a)	(a)
B	NNE	1.90 @ 34°	1.90 @ 34°	(a)	(a)
C	NE	4.60 @ 34°	4.91 @ 56°	(a)	(a)
D	ENE	(a)	4.91 @ 56°	(a)	(a)
E	E	(a)	(a)	(a)	(a)
F	ESE	(a)	(a)	(a)	(a)
G	SE	(a)	(a)	(a)	(a)
H	SSE	4.75 @ 152°	5.00 @ 160°	(a)	(a)
J	S	1.69 @ 182°	2.05 @ 183°	(a)	(a)
K	SSW	1.87 @ 193°	4.26 @ 195°	4.84 @ 201°	(a)
L	SW	2.28 @ 222°	3.65 @ 224°	(a)	(a)
M	WSW	2.82 @ 243°	3.57 @ 246°	(a)	(a)
N	W	3.15 @ 260°	4.14 @ 269°	(a)	(a)
P	WNW	4.79 @ 281°	(a)	(a)	(a)
Q	NW	4.84 @ 319°	(a)	(a)	(a)
R	NNW	3.73 @ 339°	4.39 @ 334°	3.65 @ 337°	(a)

* *Locations shown by statute miles and degree heading relative to true north from radium center.*

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

(a) *None*

APPENDIX D

SYNOPSIS OF ANALYTICAL PROCEDURES

YEAR 2001

SYNOPSIS OF ANALYTICAL PROCEDURES

Appendix D is a synopsis of the analytical procedures performed on samples collected for the Surry Power Station Radiological Environmental Monitoring Program. All analyses have been mutually agreed upon by Surry Power Station and Teledyne Brown Engineering and include those recommended by the USNRC Branch Technical Position, Rev. 1, November 1979. Environmental dosimetry is processed by ICN Biomedicals and satisfies NRC Regulatory Guide 4.13.

DETERMINATION OF GROSS BETA ACTIVITY
IN WATER SAMPLES

Introduction

The procedures described in this section are used to measure the overall radioactivity of water samples without identifying the radioactive species present. No chemical separation techniques are involved.

One liter of the sample is evaporated on a hot plate. A smaller volume may be used if the sample has a significant salt content as measured by a conductivity meter. If requested by the customer, the sample is filtered through No. 54 filter paper before evaporation, removing particles greater than 30 microns in size.

After evaporating to a small volume in a beaker, the sample is rinsed into a 2-inch diameter stainless steel planchette, which is stamped with a concentric ring pattern to distribute residue evenly. Final evaporation to dryness takes place under heat lamps.

Residue mass is determined by weighing the planchette before and after mounting the sample. The planchette is counted for beta activity on an automatic proportional counter. Results are calculated using empirical self-absorption curves that allow for the change in effective counting efficiency caused by the residue mass.

Detection Capability

Detection capability depends upon the sample volume actually represented on the planchette, the background and the efficiency of the counting instrument, and upon self-absorption of beta particles by the mounted sample. Because the radioactive species are not identified, no decay corrections are made and the reported activity refers to the counting time.

The minimum detectable level (MDL) for water samples is nominally 1.6 picoCuries per liter for gross beta at the 4.66 sigma level (1.0 pCi/L at the 2.83 sigma level), assuming that 1 liter of sample is used and that ½ gram of sample residue is mounted on the planchette. These figures are based upon a counting time of 50 minutes and upon representative values of counting efficiency and background of 0.2 cpm/dpm and 1.2 cpm, respectively.

The MDL becomes significantly lower as the mount weight decreases because of reduced self-absorption. At a zero mount weight, the 4.66 sigma MDL for gross beta is 0.9 picoCuries per liter. These values reflect a beta counting efficiency of 0.38 cpm/dpm.

GROSS BETA ANALYSIS OF SAMPLES

Air Particulates

After a delay of 5 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 of detection (LLD):

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

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

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

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 in-growth. 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 $SrCO_3$ 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 $SrNO_3$ 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 in-growth. 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 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.

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 hydrochloric acid. The mixture is filtered and strontium is precipitated from the liquid portion as phosphate. Strontium is precipitated as $Sr(NO_3)_2$ 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 in-growth. 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 $SrCO_3$ 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.

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 $SrNO_3$ 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 in-growth. 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 $SrCO_3$ 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.

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 $Sr(NO_3)_2$ 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 in-growth. 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 $SrCO_3$ 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 $= (N/\Delta t - B_C - B_A)/(2.22\ V\ Y_s\ DF_{Sr\text{-}89}\ E_{Sr\text{-}89})$

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

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

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:

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 in-growth of Y-90
	B_A	=	$0.016\ (K) + (K)\ E_{Y/abs})\ (IG_{Y\text{-}90})$
	Y_S	=	chemical yield of strontium
	$DF_{Sr\text{-}89}$	=	decay factor from the mid collection date to the counting date for Sr-89
	$E_{Sr\text{-}89}$	=	efficiency of the counter for Sr-89 with the 80 mg/cm^2 aluminum absorber
	K	=	$(N\Delta t - B_C)_{Y\text{-}90}/(E_{Y\text{-}90}\ IF_{Y\text{-}90}\ DF_{Y\text{-}90} Y_1)$
	$DF_{Y\text{-}90}$	=	the decay factor for Y-90 from the "milk" time to the mid count time
	$E_{Y\text{-}90}$	=	efficiency of the counter for Y-90
	$IF_{Y\text{-}90}$	=	in-growth factor for Y-90 from scavenge time to milking time
	$IG_{Y\text{-}90}$	=	the in-growth 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	=	in-growth 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 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):

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 (pCi/L)		=	$4.66(B/\Delta t)^{1/2}/(2.22\ E\ V\ Y\ DF)$
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 PdI_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 high purity germanium (HPGe) detector coupled to a personal computer (PC)-based data acquisition system that 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 1.0-liter Marinelli and weighed. The sample is then counted for approximately 1000 minutes with a shielded HPGe detector coupled to a PC-based data acquisition system that 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 HPGe detector coupled to a PC-based data acquisition system that 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 HPGe detector coupled to a PC-based data acquisition system that 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 HPGe detector and up to four on the side of the HPGe detector. Each HPGe detector is calibrated for both positions. The detection limit for iodine-131 of each charcoal cartridge can be determined (assuming no positive iodine-131) uniquely from the volume of air which passed through it. In the event iodine-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 Particulates

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 HPGe detector coupled to a PC-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

ICN Worldwide Dosimetry Services (ICN) uses a Harshaw/Bicron NE 210 thermoluminescent dosimeter (TLD). The TLD is composed of two CaF and two LiF sensitive elements. These materials have a high light output, negligible thermally induced fading and negligible self-dosing. The energy response curve and all other features satisfy NRC Reg. Guide 4.13. Transit doses are accounted for by using separate TLDs.

A Harshaw/Bicron NE 8800 Automatic TLD Reader processes the TLDs at ICN after each field exposure. The 8800 reader heats each element by passing hot nitrogen gas over the sensitive element causing the TLD to emit light. The reader records the light output. The ICN environmental algorithm is used and members of the ICN technical staff evaluate and investigate any irregularities before reporting to the client. The average and 2-sigma error are calculated for each station in the following manner:

$$E_{mon} = \frac{365.25\left(\sum_{i=1}^{N} R_i\right)}{12\Delta DN} \qquad 2\sigma = 2 \cdot \sqrt{\frac{\sum_{i=1}^{N}\left(R_i - E_{avg}\right)^2}{N-1}}$$

where:			
	E_{mon}	=	Element Average/Month
	R_i	=	Element Results
	N	=	Number of elements
	E_{avg}	=	Mean value of element results
	ΔD	=	Days of field exposure

APPENDIX E

INTERLABORATORY COMPARISON PROGRAM

YEAR 2001

INTERLABORATORY COMPARISON PROGRAM

The U.S. Environmental Protection Agency (EPA) discontinued its Interlaboratory Comparison Program in December 1998. In May of 2001, the National Institute of Standards and Technology (NIST) granted accreditation to Environmental Resource Associates' RadChem Proficiency Testing Program to complete the process of replacing the EPA EMSL-LV Nuclear Radiation Division program. Teledyne Brown Engineering (TBE) participates in the Environmental Resource Associates (ERA) and in the Analytics, Inc., interlaboratory comparison programs to the fullest extent possible for all radioactive isotopes prepared and at the maximum frequency of availability. The U.S. Department of Energy (DOE) Environmental Measurement Laboratory (EML) provides a comprehensive and extensive intercomparison/performance evaluation program. TBE also participates in the DOE/EML program.

Trending graphs are provided in this section for the Analytics, ERA and DOE/EML programs when there were two or more data points to plot.

<u>Exceptions 2001</u>

During 2001, three Interlaboratory Comparison Program (ICP) analyses were not performed as required by the ODCM. The omitted analyses occurred during the first half of 2001 while TBE facilities were in transition to the Knoxville, TN, facility. These analyses were successfully performed in the second half of 2001. The omissions are:

- Water analysis for iodine-131
- Milk analysis for strontium-89
- Milk analysis for strontium-90

In 2001, as a response to omitted ICP sample analyses in the year 2000, Dominion initiated internal commitment tracking by the Radiological Protection Department to verify ICP status and compliance by TBE on a quarterly basis. Contrary to initial communication by TBE that all ICP analyses for the first half of 2001 were performed, a review by Dominion identified the aforementioned omitted analyses. Beginning January 1, 2002, Dominion retained the DE&SE Laboratory for primary analytical services.

ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE QC SPIKE PROGRAM
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c)	Evaluation (d)
March, 2001	E2584-93	Milk	I-131	pCi/L	75	77	0.97	A
			Ce-141	pCi/L	166	162	1.03	A
			Cr-51	pCi/L	433	418	1.04	A
			Cs-134	pCi/L	212	223	0.95	A
			Cs-137	pCi/L	165	176	0.94	A
			Co-58	pCi/L	81	82	0.99	A
			Mn-54	pCi/L	172	175	0.98	A
			Fe-59	pCi/L	151	146	1.03	A
			Zn-65	pCi/L	314	322	0.98	A
			Co-60	pCi/L	254	254	1	A
May, 2001	A14428-55	Water	Sr-89	uCi/mL	2.50E-03	2.95E-03	0.85	A
			Sr-90	uCi/mL	2.00E-04	2.27E-04	0.88	A
	A14429-55	Water	Gr-Alpha	uCi/mL	1.70E-04	1.45E-04	1.17	A
	A14434-55	Water	Fe-55	uCi/mL	2.40E-04	2.53E-04	0.95	A
June, 2001	2707	Charcoal	I-131	pCi	104.5	81	1.29	W
	2708	Charcoal	I-131	pCi	84.8	72	1.18	A
	2709	Charcoal	I-131	pCi	99.6	92	1.08	A
August, 2001	E2755-396	Milk	Mn-54	pCi/L	131	124	1.06	A
			Co-58	pCi/L	68	68	1.00	A
			Fe-59	pCi/L	53	50	1.06	A
			Co-60	pCi/L	134	132	1.02	A
			Zn-65	pCi/L	172	162	1.06	A
			I-131	pCi/L	76	86	0.88	A
			Cs-134	pCi/L	141	128	1.10	A
			Cs-137	pCi/L	126	120	1.05	A
			Ce-141	pCi/L	72	76	0.95	A
August, 2001	E2757-396	AP Filter	Ce-141	pCi	79	74	1.07	A
			Cr-51	pCi	100	90	1.11	A
			Cs-134	pCi	109	125	0.87	A
			Cs-137	pCi	140	116	1.21	W
			Co-58	pCi	72	66	1.09	A
			Mn-54	pCi	161	134	1.20	A
			Fe-59	pCi	51	49	1.04	A
			Zn-65	pCi	200	158	1.27	W
			Co-60	pCi	148	128	1.16	A
August, 2001	E2756A-396	Charcoal	I-131	pCi	87	93	0.94	A

Footnotes are on page 3 of 3.

ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE QC SPIKE PROGRAM
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c)	Evaluation (d)
September, 2001	A14734-148	Liquid	Sr-89	Total uCi	1.30E-03	1.55E-03	0.84	A
			Sr-90	Total uCi	1.00E-04	1.12E-04	0.89	A
September, 2001	A14735-148	Gas	Xe-133	Total uCi	0.606	0.585	1.04	A
			Kr-85	Total uCi	8.53	8.42	1.01	A
September, 2001	A14736-148	Charcoal	I-131	Total uCi	0.483	0.495	0.98	A
September, 2001	A14737-148	Air Filter	Ce-141	Total uCi	4.99E-02	5.25E-02	0.95	A
			Cr-51	Total uCi	1.68E-01	1.85E-01	0.91	A
			Cs-134	Total uCi	2.47E-02	2.97E-02	0.83	A
			Cs-137	Total uCi	5.18E-02	5.73E-02	0.90	A
			Co-58	Total uCi	4.60E-02	4.75E-02	0.97	A
			Mn-54	Total uCi	3.96E-02	4.02E-02	0.99	A
			Fe-59	Total uCi	2.99E-02	2.92E-02	1.02	A
			Zn-65	Total uCi	5.22E-02	5.12E-02	1.02	A
			Co-60	Total uCi	4.71E-02	4.83E-02	0.98	A
September, 2001	A14738-148	Liquid	Gr-Alpha	Total uCi	5.80E-04	4.67E-04	1.24	A
September, 2001	A14286-148	Liquid	Gr-Alpha	uCi/cc	1.70E-04	1.45E-04	1.17	A
			H-3	uCi/cc	2.92E-03	1.77E-03	1.65	A
September, 2001	E2772-396	Milk	I-131	pCi/L	100	91	1.10	A
			Ce-141	pCi/L	126	121	1.04	A
			Cr-51	pCi/L	349	366	0.95	A
			Cs-134	pCi/L	147	160	0.92	A
			Cs-137	pCi/L	321	319	1.01	A
			Co-58	pCi/L	190	177	1.07	A
			Mn-54	pCi/L	205	205	1.00	A
			Fe-59	pCi/L	85	86	0.99	A
			Zn-65	pCi/L	246	254	0.98	A
			Co-60	pCi/L	261	266	0.98	A
September, 2001	E2773-396	Charcoal	I-131	pCi	68.6	67	1.02	A

Footnotes are on page 3 of 3.

ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE QC SPIKE PROGRAM
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c)	Evaluation (d)
September, 2001	E2774-396	Air Filter	Ce-141	pCi	118	116	1.02	A
			Cr-51	pCi	362	351	1.03	A
			Cs-134	pCi	135	153	0.88	A
			Cs-137	pCi	350	307	1.14	A
			Co-58	pCi	184	170	1.08	A
			Mn-54	pCi	230	197	1.17	A
			Fe-59	pCi	100	82	1.22	W
			Zn-65	pCi	305	244	1.25	W
			Co-60	pCi	267	255	1.05	A
December, 2001	E2980-396	Milk	Sr-89	pCi/L	75	85	0.96	A
			Sr-90	pCi/L	44	59	1.27	W
			Fe-55	pCi/L	108	99	1.09	A
December, 2001	E-2981-396	Milk	I-131	pCi/L	50	61	0.82	A
			Ce-141	pCi/L	352	379	0.93	A
			Cr-51	pCi/L	468	497	0.94	A
			Cs-134	pCi/L	173	199	0.87	A
			Cs-137	pCi/L	312	318	0.98	A
			Co-58	pCi/L	92	90	1.02	A
			Mn-54	pCi/L	148	149	0.99	A
			Fe-59	pCi/L	101	102	0.99	A
			Zn-65	pCi/L	192	206	0.93	A
			Co-60	pCi/L	322	353	0.93	A
December, 2001	E-2983-396	Air Filter	Ce-141	pCi	185	181	1.02	A
			Cr-51	pCi	190	237	0.80	A
			Cs-134	pCi	74	95	0.78	W
			Cs-137	pCi	163	152	1.07	A
			Co-58	pCi	46	43	1.07	A
			Mn-54	pCi	80	71	1.13	A
			Fe-59	pCi	57	49	1.16	A
			Zn-65	pCi	119	99	1.2	A
			Co-60	pCi	165	169	0.98	A
December, 2001	E-2982-396	Charcoal	I-131	pCi	89	92	0.93	A

(a) Teledyne Brown Engineering reported result.

(b) The Analytics known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation.

(c) Ratio of Teledyne Brown Engineering to Analytics results.

(d) Analytics evaluation: A= Acceptable. Reported result falls within ratio limits of 0.80-1.20. W=Acceptable with warning. Reported result falls within ratio limits of 0.70-0.79 and 1.21-1.30.

DOE/EML ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE QC SPIKE PROGRAM
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

Month/Year	Identification Number	Media	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/EML	Evaluation (d)
March, 2001	QAP 103	Air Filter	Mn-54	Bq/filter	6.96	6.52	1.07	A
			Co-60	Bq/filter	19.4	19.44	1.00	A
			Cs-134	Bq/filter	2.59	2.83	0.92	A
			Cs-137	Bq/filter	9.52	8.76	1.09	A
			Gr-Alpha	Bq/filter	3.33	3.97	0.84	A
			Gr-Beta	Bq/filter	2.26	2.58	0.88	W
			Sr-90	Bq/filter	7.46	7.1	1.05	A
March, 2001	QAP 103	Water	Co-60	Bq/L	100.3	98.2	1.02	A
			Cs-137	Bq/L	75.8	73	1.04	A
			Gr-Alpha	Bq/L	1600	1900	0.84	A
			Gr-Beta	Bq/L	1200	1297	0.93	A
May, 2001			Sr-90	Bq/L	4.57	4.4	1.04	A
			H-3	Bq/L	61.0	79.3	0.77	W
June, 2001	QAP 2009	Air Filters	Mn-54	Bq/filter	49.5	43.2	1.15	A
			Co-57	Bq/filter	15.2	14.5	1.05	A
			Co-60	Bq/filter	8.79	8.43	1.04	A
			Cs-137	Bq/filter	8.26	7.41	1.11	A
			Gr-Alpha	Bq/filter	2.31	2.35	0.98	A
			Gr-Beta	Bq/filter	1.79	1.52	1.18	A
June, 2001	QAP 2009	Water	Co-60	Bq/L	75.7	73.7	1.03	A
			Cs-137	Bq/L	69.3	67.0	1.03	A
September, 2001	QAP 0109	Air Filters	Mn-54	Bq/filter	97.1	81.15	1.197	A
			Co-60	Bq/filter	18.8	17.5	1.074	A
			Cs-134	Bq/filter	12.7	12.95	0.981	A
			Cs-137	Bq/filter	20.8	17.1	1.216	W
			Gr-Alpha	Bq/filter	5.42	5.362	1.011	A
			Gr-Beta	Bq/filter	12.0	12.77	0.94	A
			Sr-90	Bq/filter	2.56	3.481	0.735	W
September, 2001	QAP 0109	Water	Co-60	Bq/L	207.3	209.0	0.992	A
			Cs-137	Bq/L	47.7	45.133	1.057	A
			Gr-Alpha	Bq/L	1333.0	1150.0	1.159	W
			Gr-Beta	Bq/L	8533.0	7970.0	1.071	A
			Sr-90	Bq/L	4.76	3.729	1.276	W
			H-3	Bq/L	212.3	207.0	1.026	A

(a) Teledyne Brown Engineering reported result.
(b) The DOE/EML known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation.
(c) Ratio of Teledyne Brown Engineering to DOE/EML results.
(d) DOE/EML evaluation: A=acceptable, W=acceptable with warning, N=not acceptable.

ERA* ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE QC SPIKE PROGRAM
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

Month/Year	Identification Number	Media	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/ERA	Evaluation (d)
February, 2001	Rad-29	Water	Co-60	pCi/L	95.5	91.1	1.05	A
			Cs-134	pCi/L	60.5	59.8	1.01	A
			Cs-137	pCi/L	48	45	1.07	A
September, 2001	Rad-38	Water	Ba-133	pCi/L	35.5	36	0.99	A
			Co-60	pCi/L	47.6	46.8	1.02	A
			Cs-134	pCi/L	15.5	15.9	0.97	A
			Cs-137	pCi/L	206	197	1.05	A
			Zn-65	pCi/L	35.4	36.2	0.98	A
August, 2001	Rad-39	Water	Total U	pCi/L	60.3	52.9	1.14	A
			Ra-226	pCi/L	14.7	15.4	0.95	A
September, 2001	Rad-40	Water	Sr-89	pCi/L	26.4	31.2	0.85	A
			Sr-90	pCi/L	28.2	25.9	1.09	A
August, 2001	Rad-41	Water	Gr-Alpha	pCi/L	15.2	17.8	0.85	A
			Gr-Beta	pCi/L	52.0	53.0	0.98	A
September, 2001	Rad-42	Water	H-3	pCi/L	2370	2730	0.87	A
December, 2001	12130109	Water	I-131	pCi/L	3.77	4.38	0.86	A

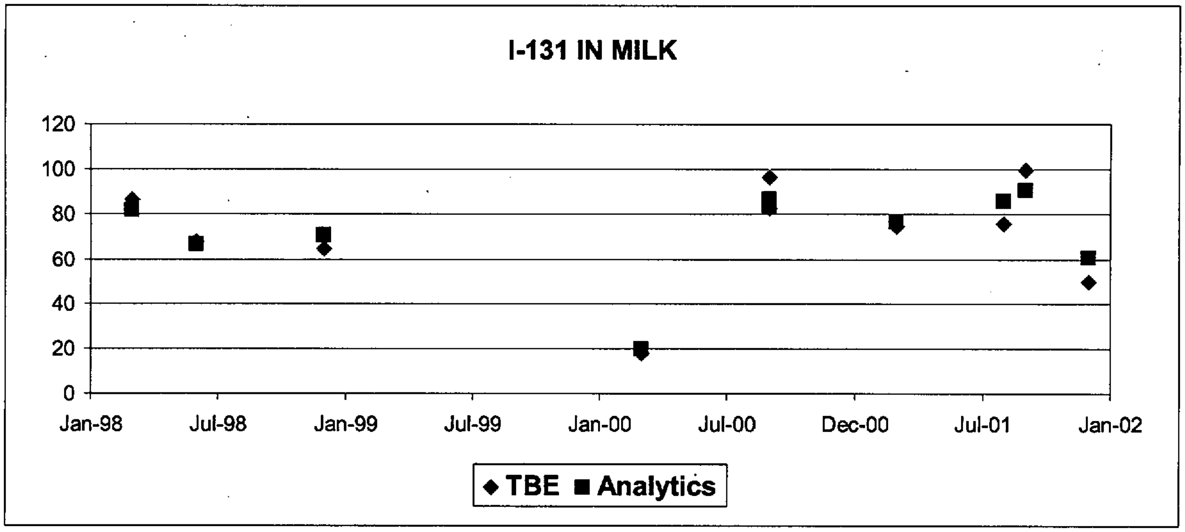
* *All ERA samples are water.*

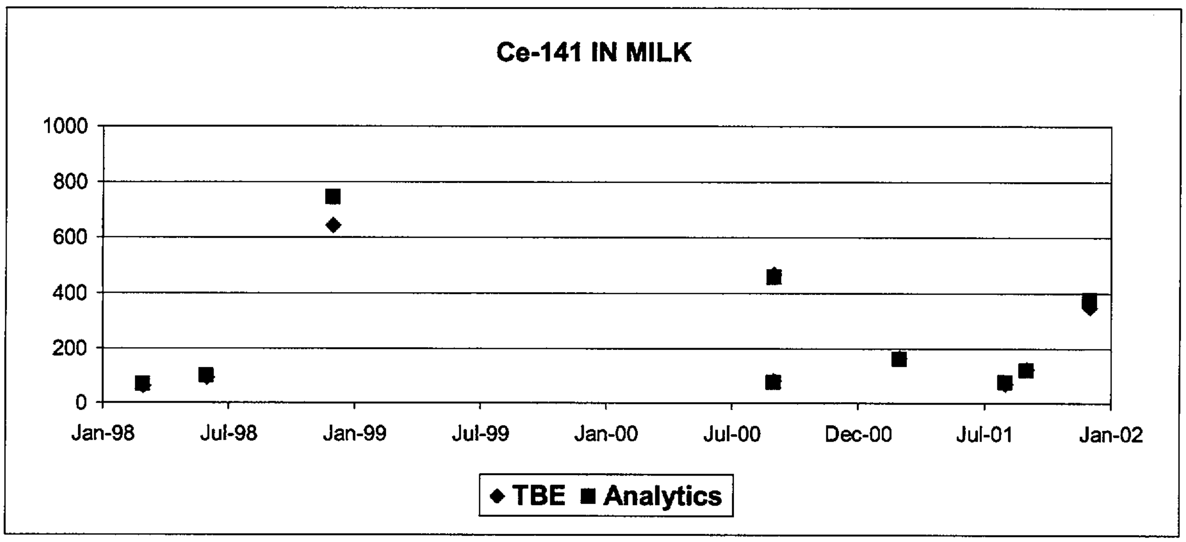
(a) *Teledyne Brown Engineering reported result.*

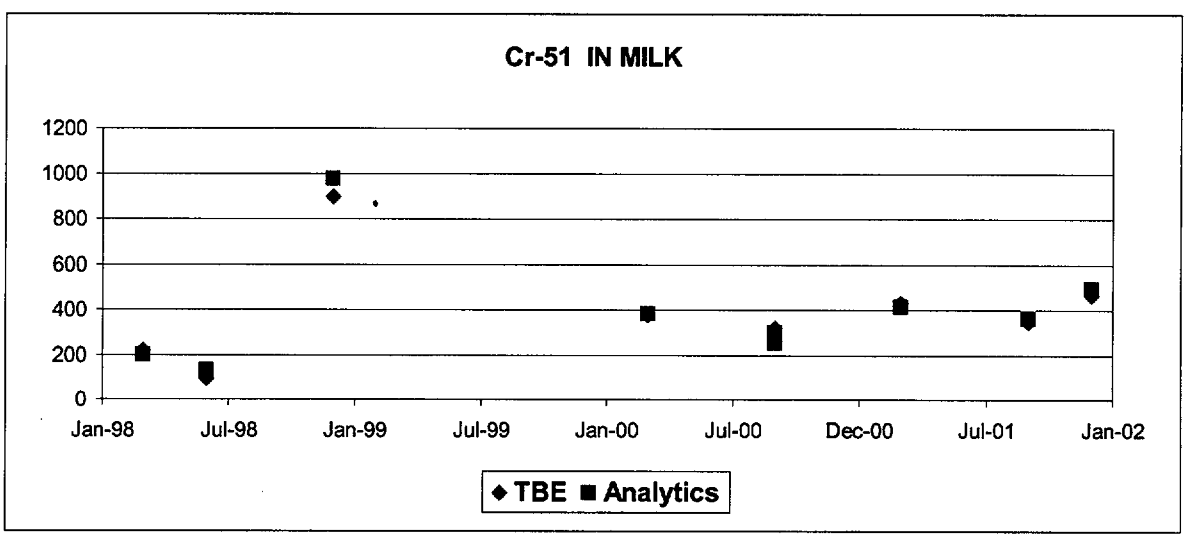
(b) *The ERA known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation.*

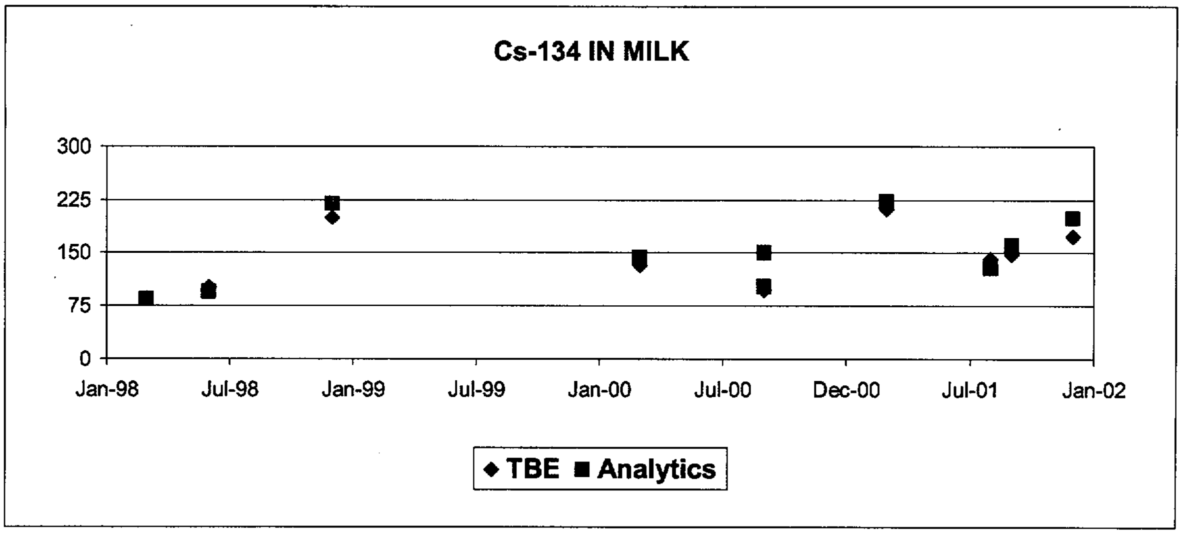
(c) *Ratio of Teledyne Brown Engineering to ERA results.*

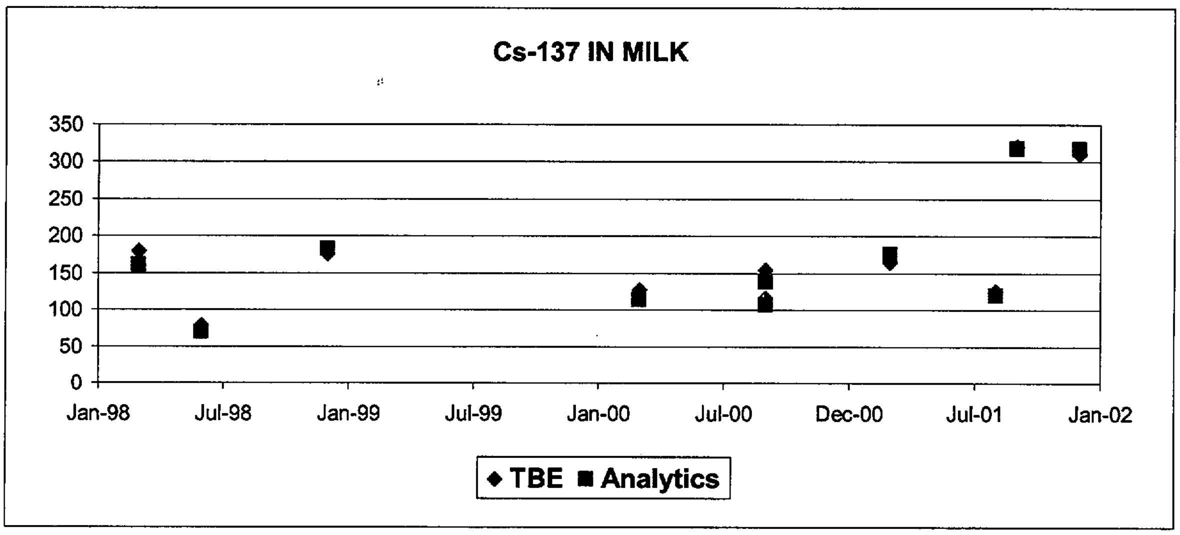
(d) *ERA evaluation: A=acceptable. Reported result falls within the Warning Limits. NA=not acceptable. Reported result falls outside of the Control Limits. CE=check for Error. Reported result falls within the Control Limits and outside of the Warning Limits.*

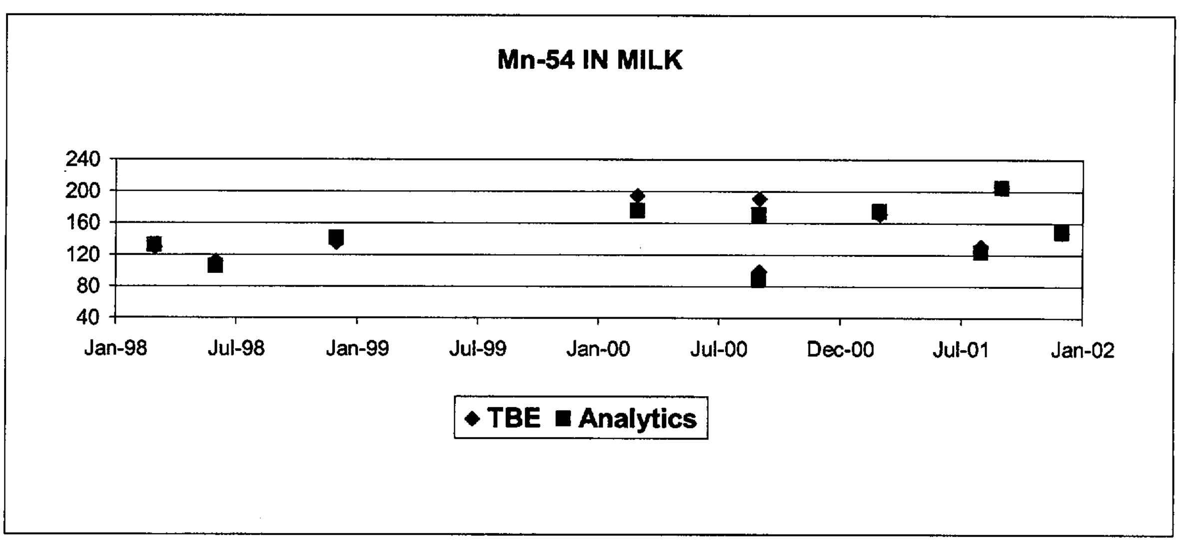

I-131 IN MILK
120
100
80
60
40
20
0
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Dec-00
Jul-01
Jan-02
◆ TBE ■ Analytics

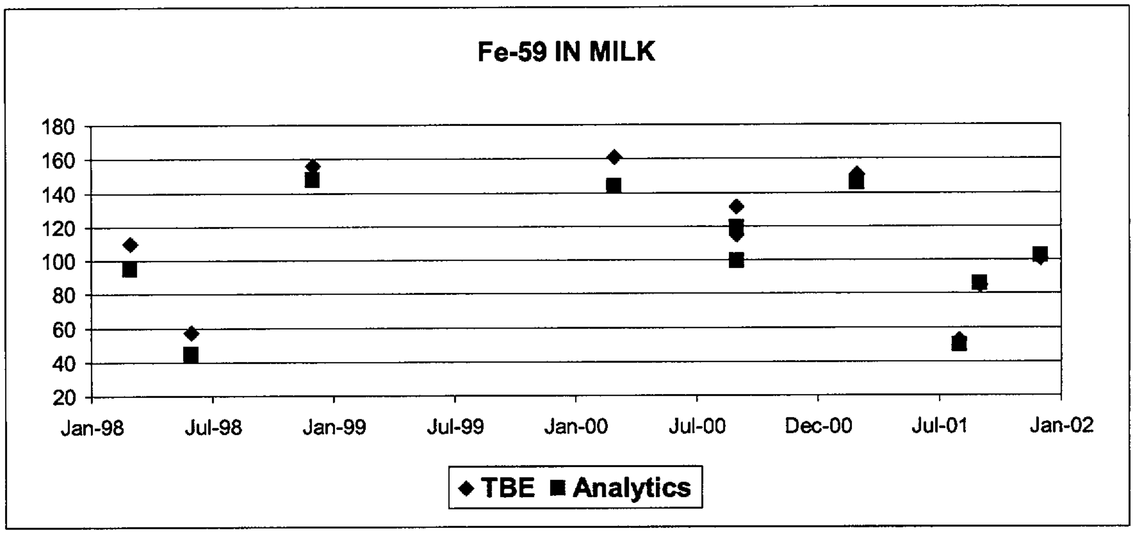

Ce-141 IN MILK
1000
800
600
400
200
0
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Dec-00
Jul-01
Jan-02
◆ TBE ■ Analytics

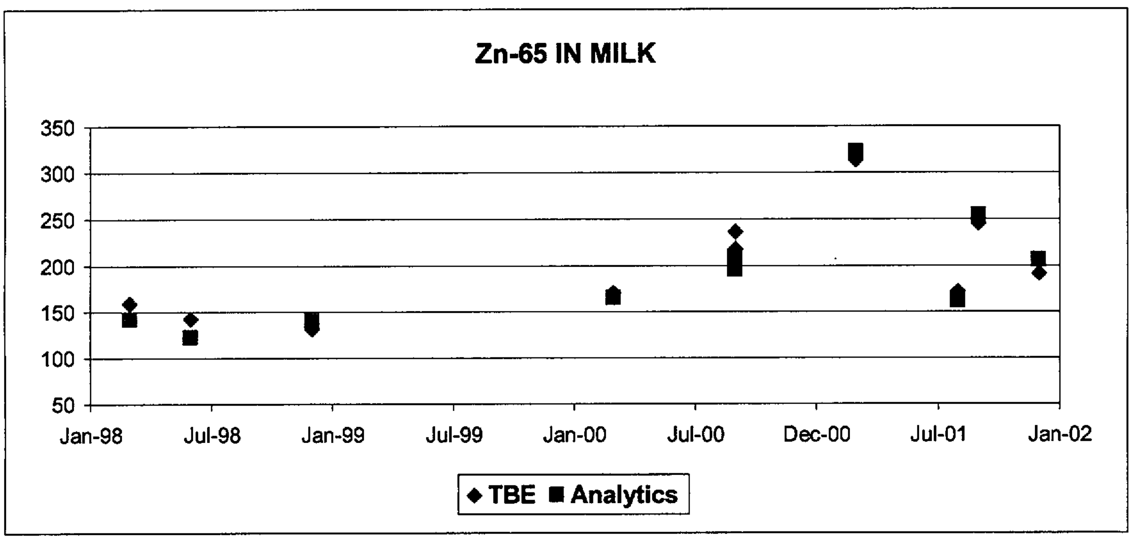

Cr-51 IN MILK
1200
1000
800
600
400
200
0
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Dec-00
Jul-01
Jan-02
◆ TBE ■ Analytics

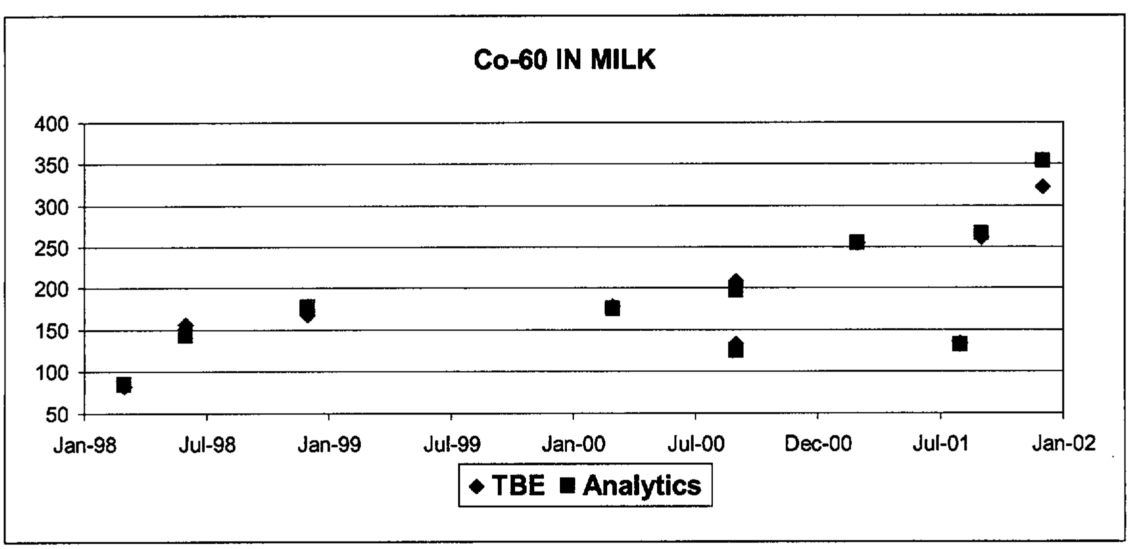

Cs-134 IN MILK
300
225
150
75
0
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Dec-00
Jul-01
Jan-02
TBE
Analytics

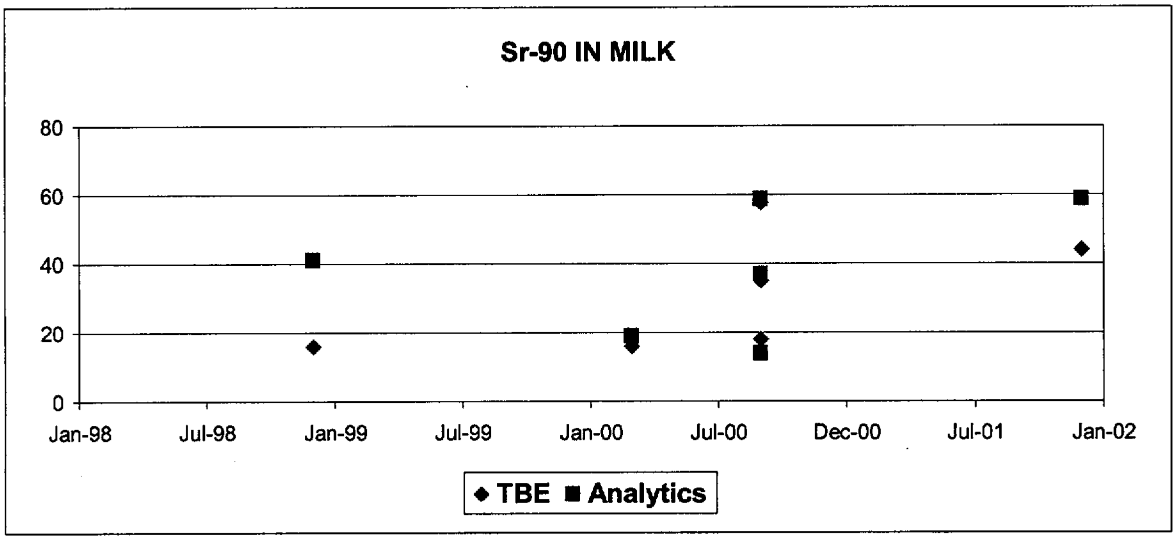

Cs-137 IN MILK
350
300
250
200
150
100
50
0
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Dec-00
Jul-01
Jan-02
TBE
Analytics

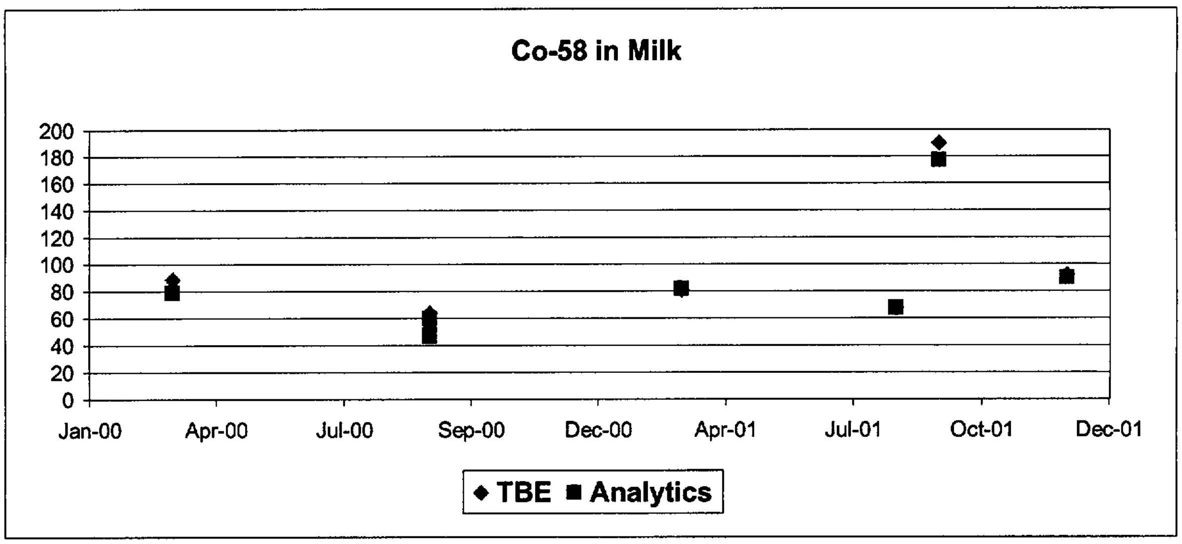

Mn-54 IN MILK
240
200
160
120
80
40
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Dec-00
Jul-01
Jan-02
TBE
Analytics

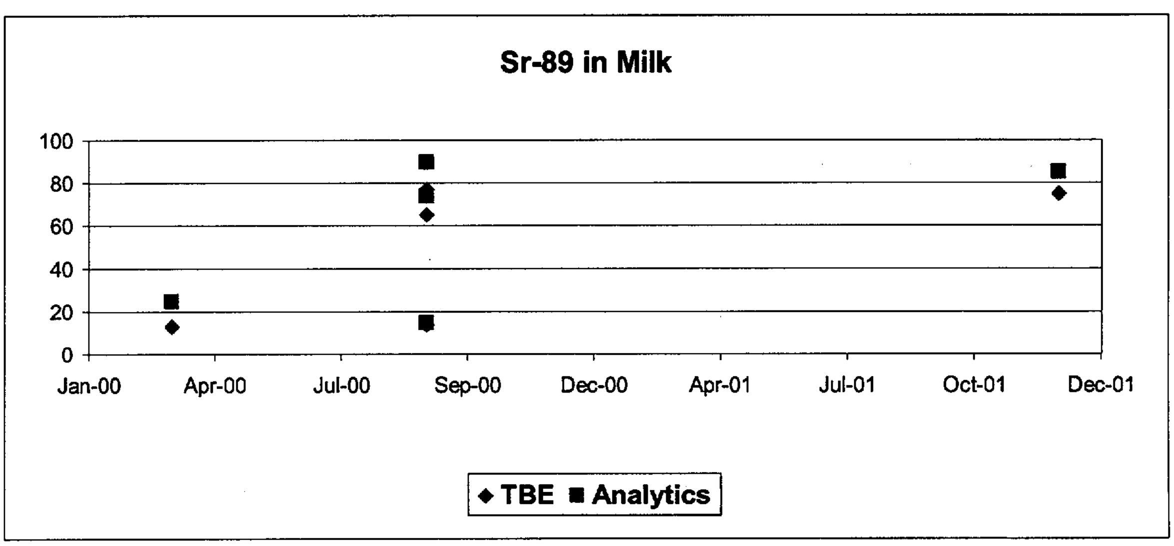

Fe-59 IN MILK
180
160
140
120
100
80
60
40
20
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Dec-00
Jul-01
Jan-02
TBE
Analytics

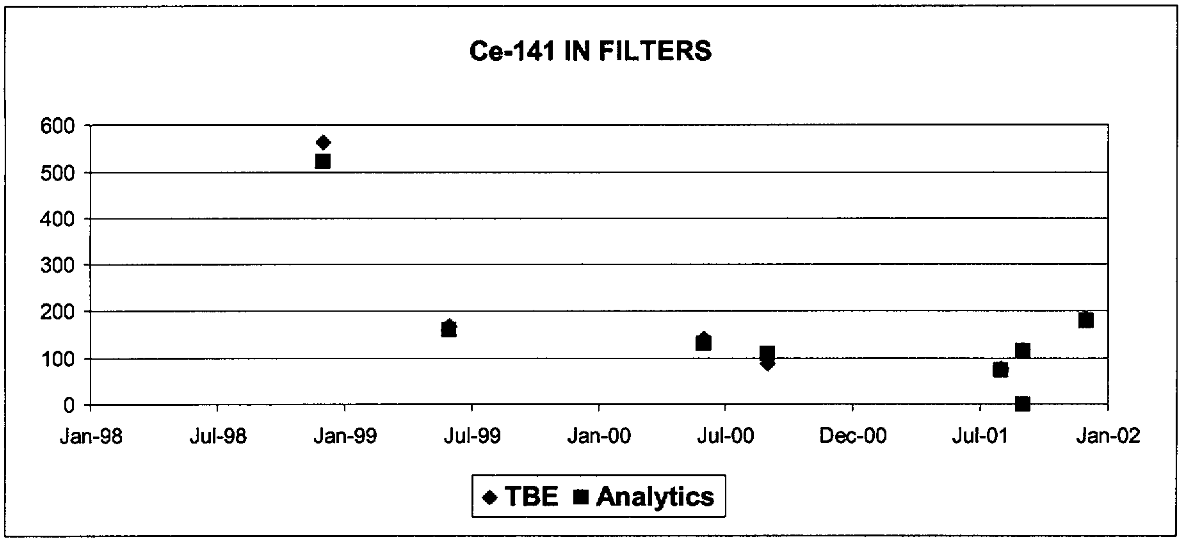

Zn-65 IN MILK
350
300
250
200
150
100
50
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Dec-00
Jul-01
Jan-02
TBE
Analytics

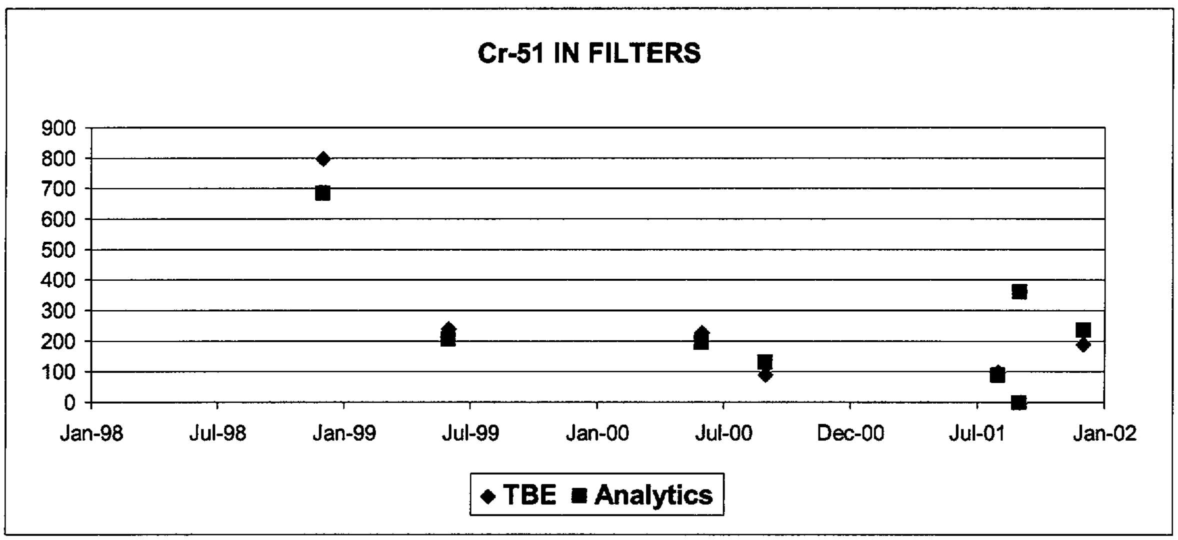

Co-60 IN MILK
400
350
300
250
200
150
100
50
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Dec-00
Jul-01
Jan-02
TBE
Analytics

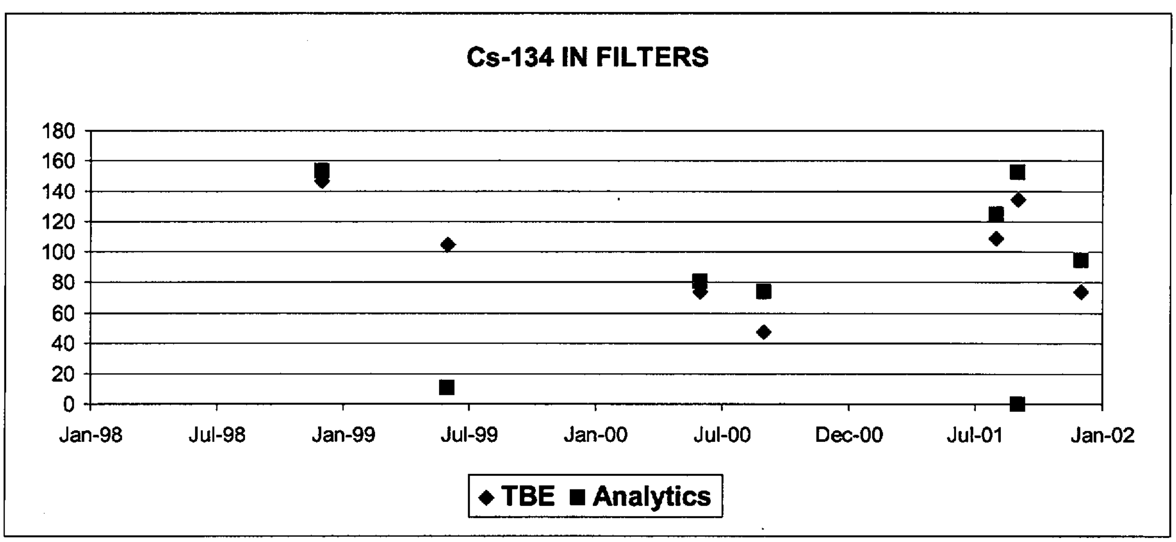

Sr-90 IN MILK
80
60
40
20
0
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Dec-00
Jul-01
Jan-02
◆ TBE ■ Analytics

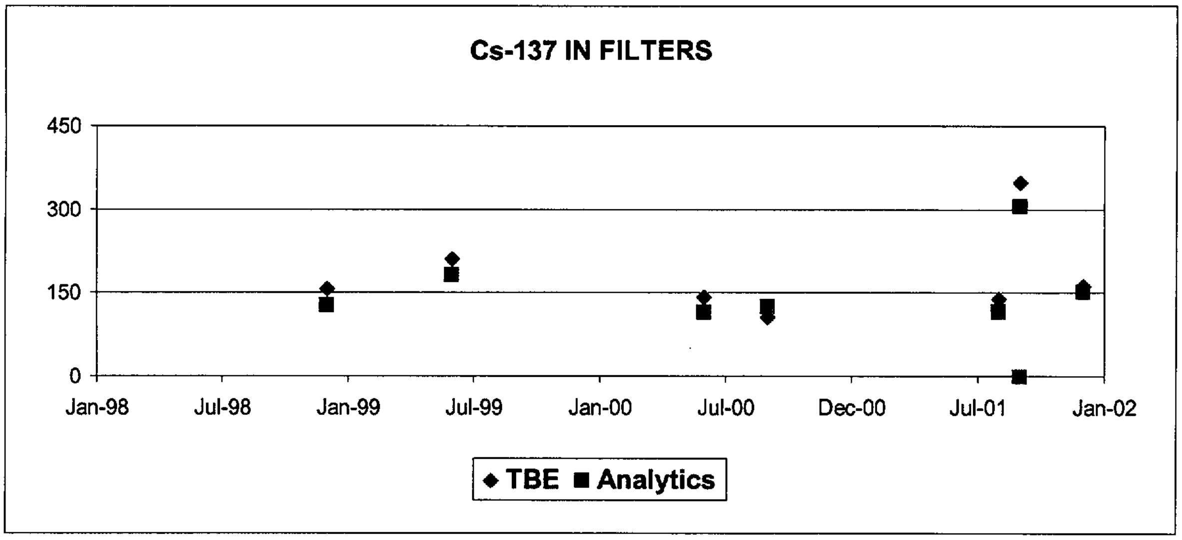

Co-58 in Milk
200
180
160
140
120
100
80
60
40
20
0
Jan-00
Apr-00
Jul-00
Sep-00
Dec-00
Apr-01
Jul-01
Oct-01
Dec-01
◆ TBE ■ Analytics

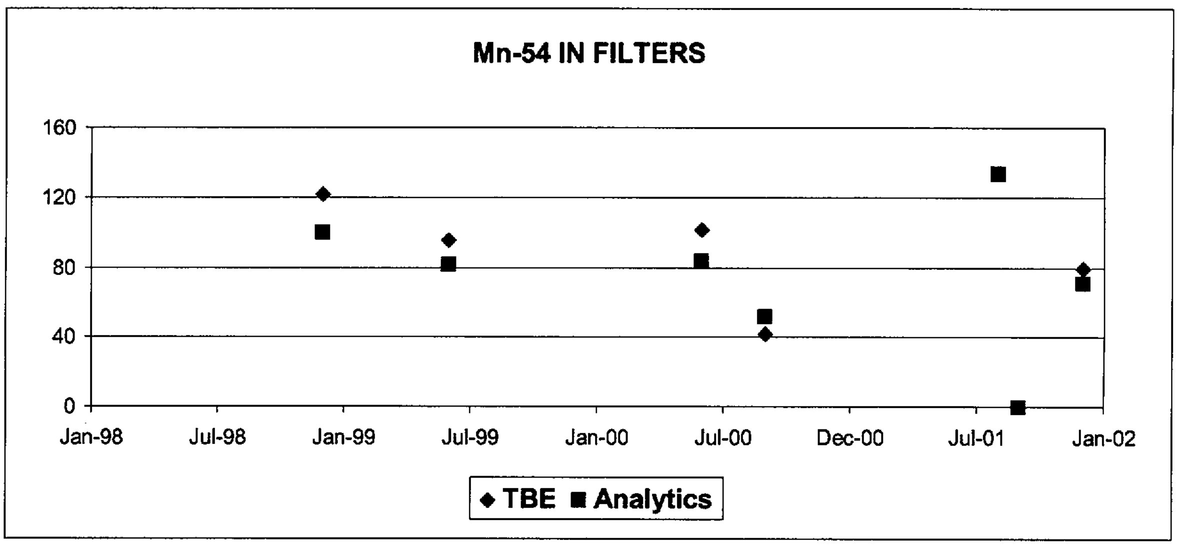

Sr-89 in Milk
100
80
60
40
20
0
Jan-00
Apr-00
Jul-00
Sep-00
Dec-00
Apr-01
Jul-01
Oct-01
Dec-01
◆ TBE ■ Analytics

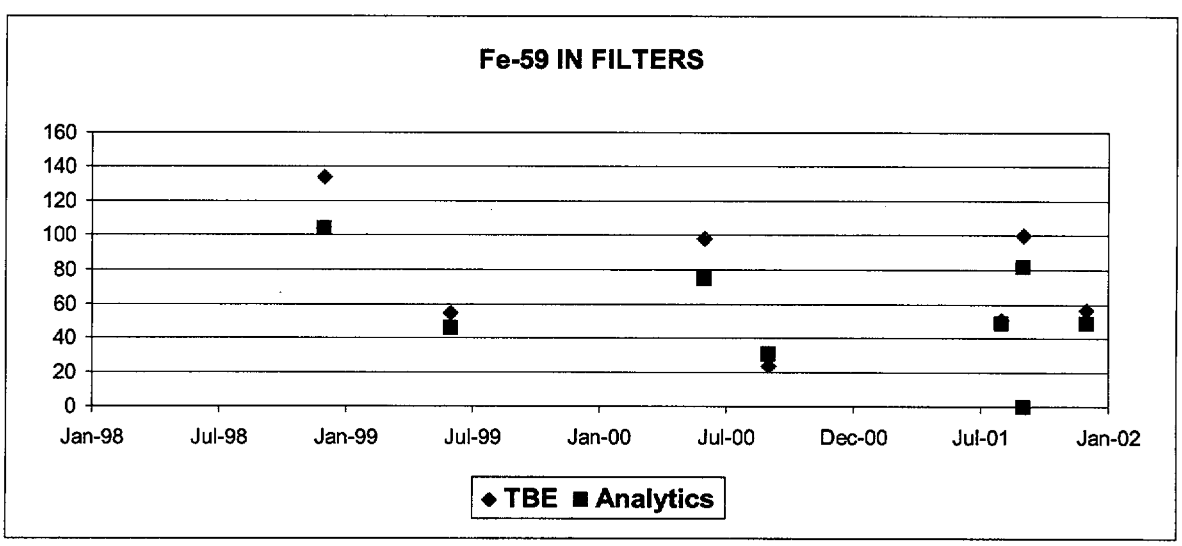

Ce-141 IN FILTERS
600
500
400
300
200
100
0
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Dec-00
Jul-01
Jan-02
◆ TBE ■ Analytics

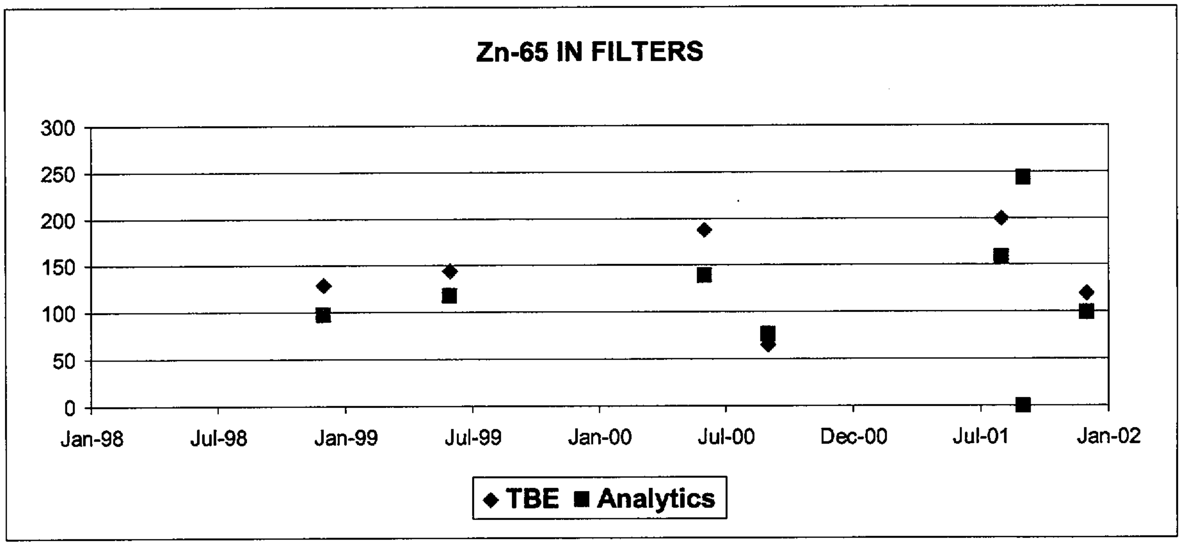

Cr-51 IN FILTERS
900
800
700
600
500
400
300
200
100
0
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Dec-00
Jul-01
Jan-02
◆ TBE ■ Analytics


Cs-134 IN FILTERS
180
160
140
120
100
80
60
40
20
0
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Dec-00
Jul-01
Jan-02
◆ TBE ■ Analytics

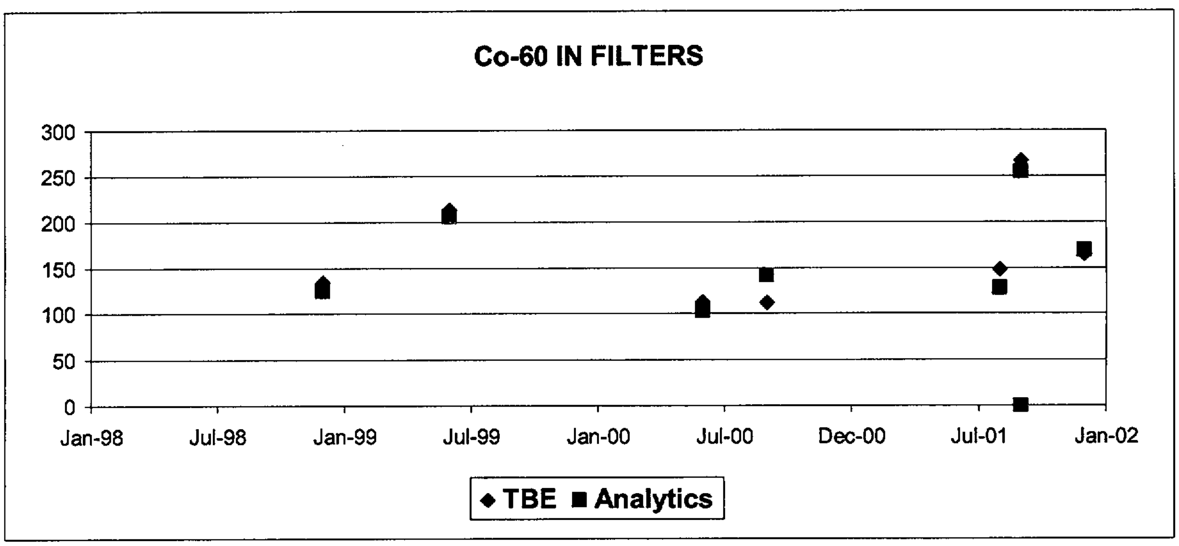

Cs-137 IN FILTERS
450
300
150
0
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Dec-00
Jul-01
Jan-02
TBE
Analytics


Mn-54 IN FILTERS
160
120
80
40
0
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Dec-00
Jul-01
Jan-02
TBE
Analytics

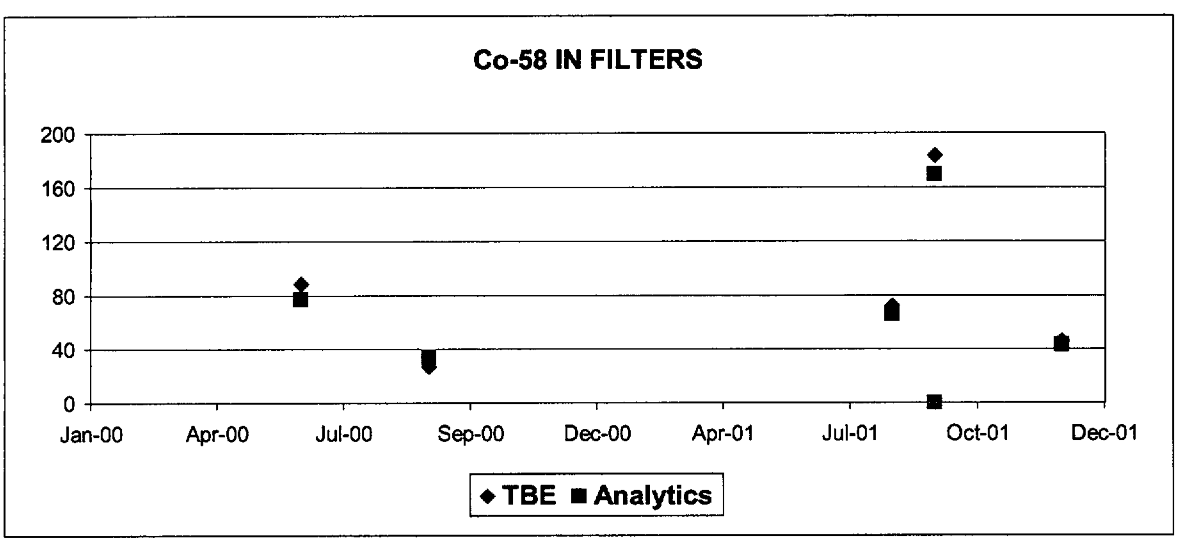

Fe-59 IN FILTERS
160
140
120
100
80
60
40
20
0
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Dec-00
Jul-01
Jan-02
TBE
Analytics



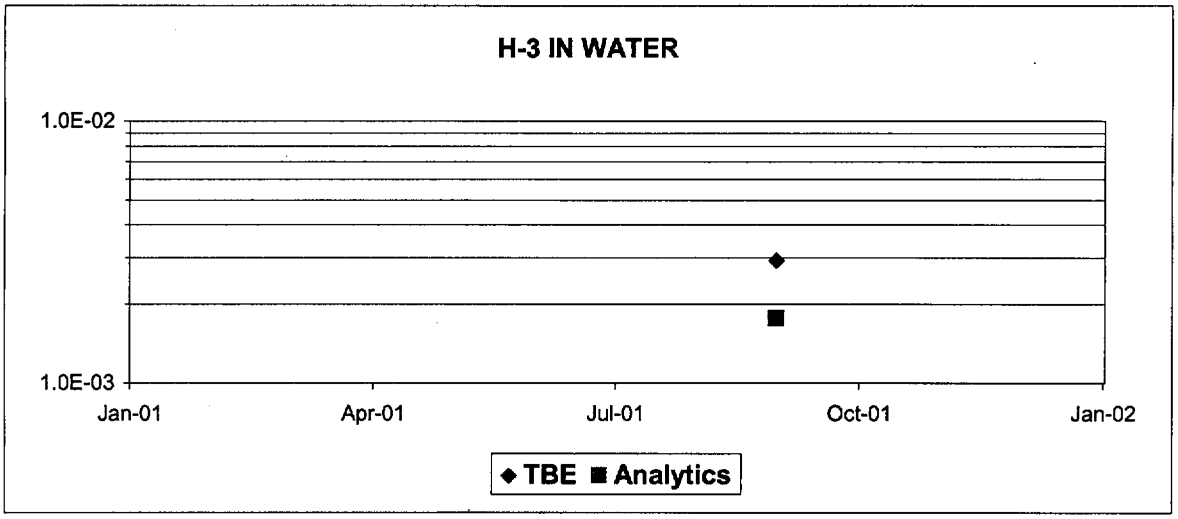
Zn-65 IN FILTERS
300
250
200
150
100
50
0
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Dec-00
Jul-01
Jan-02
TBE
Analytics

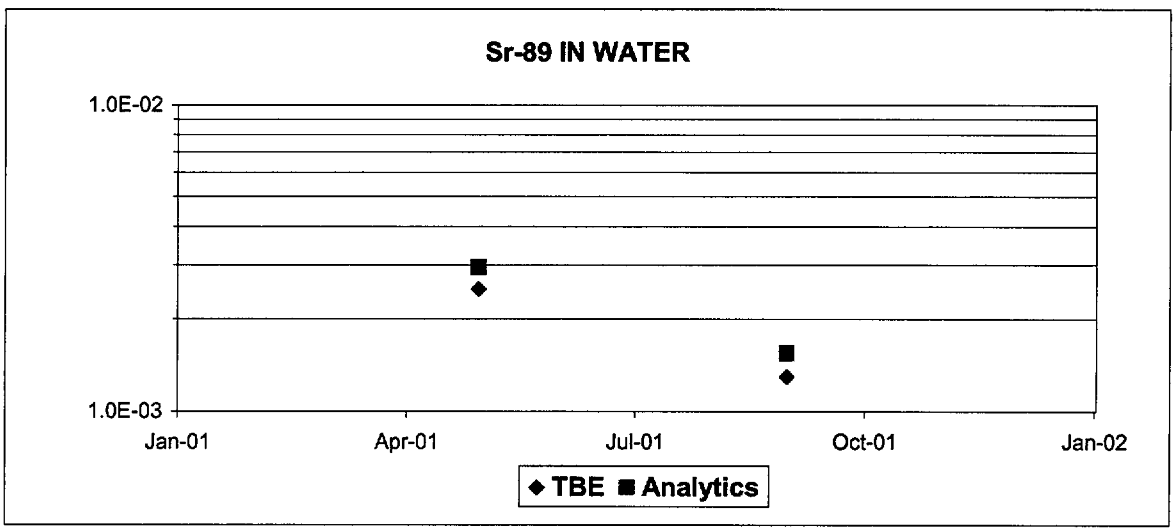


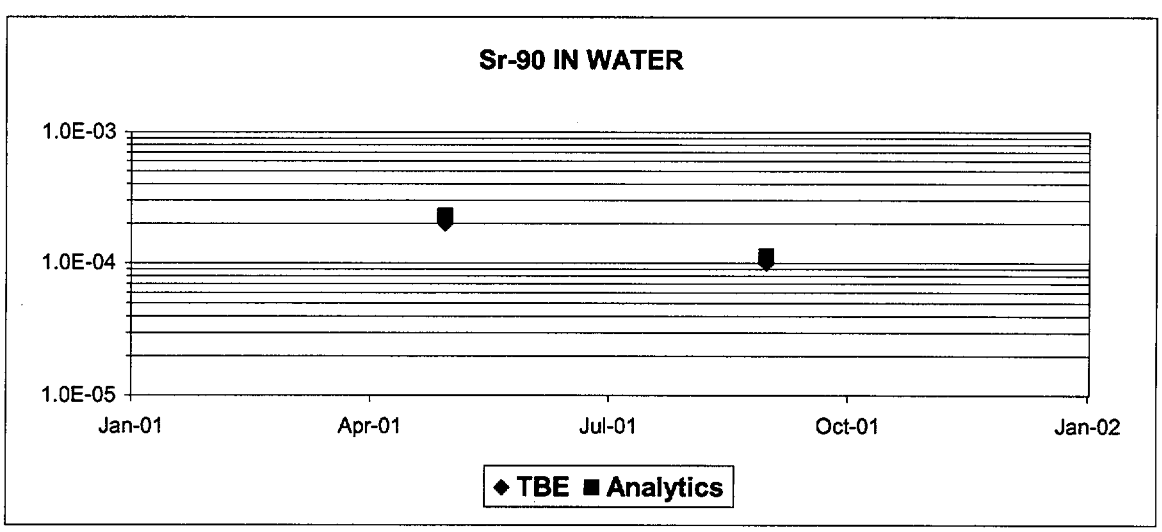
Co-60 IN FILTERS
300
250
200
150
100
50
0
Jan-98
Jul-98
Jan-99
Jul-99
Jan-00
Jul-00
Dec-00
Jul-01
Jan-02
TBE
Analytics

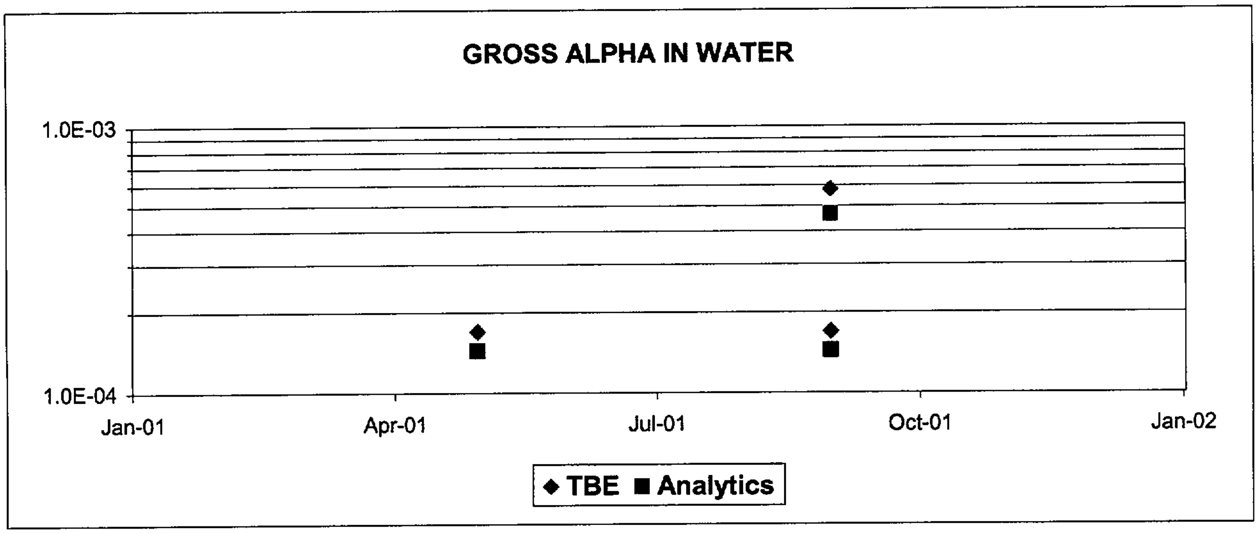


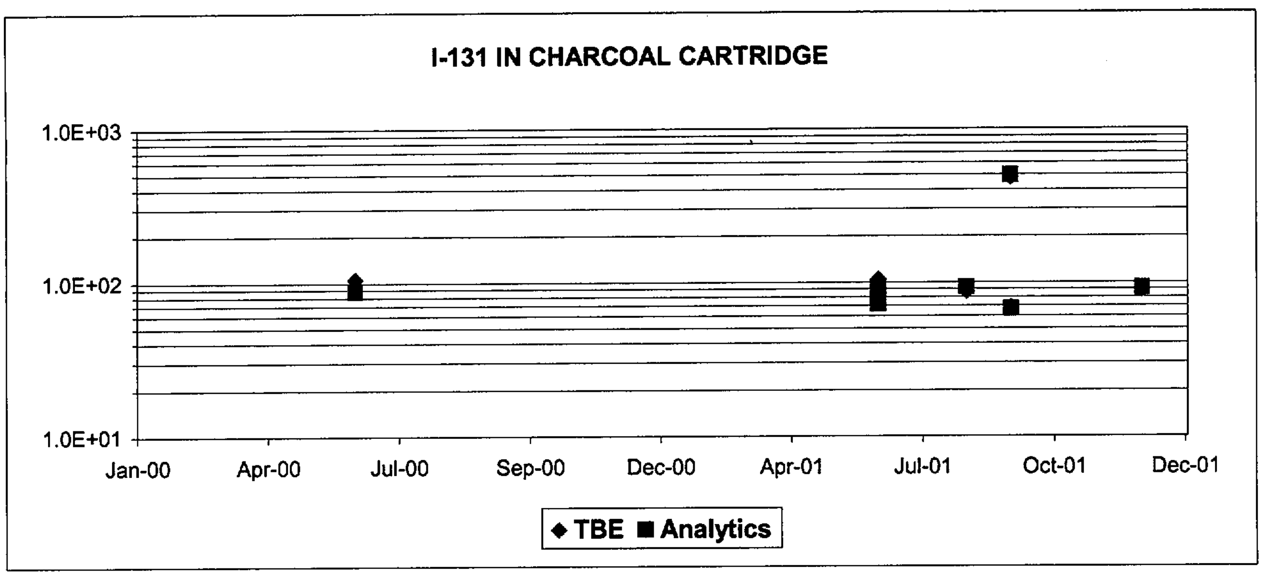
Co-58 IN FILTERS
200
160
120
80
40
0
Jan-00
Apr-00
Jul-00
Sep-00
Dec-00
Apr-01
Jul-01
Oct-01
Dec-01
TBE
Analytics

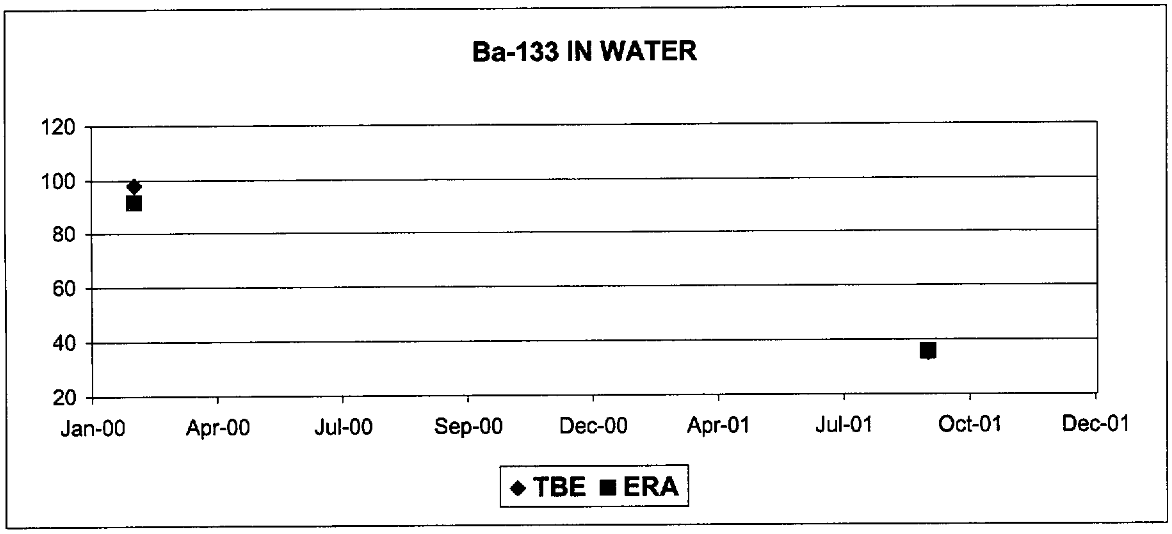

H-3 IN WATER
1.0E-02
1.0E-03
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
◆ TBE ■ Analytics

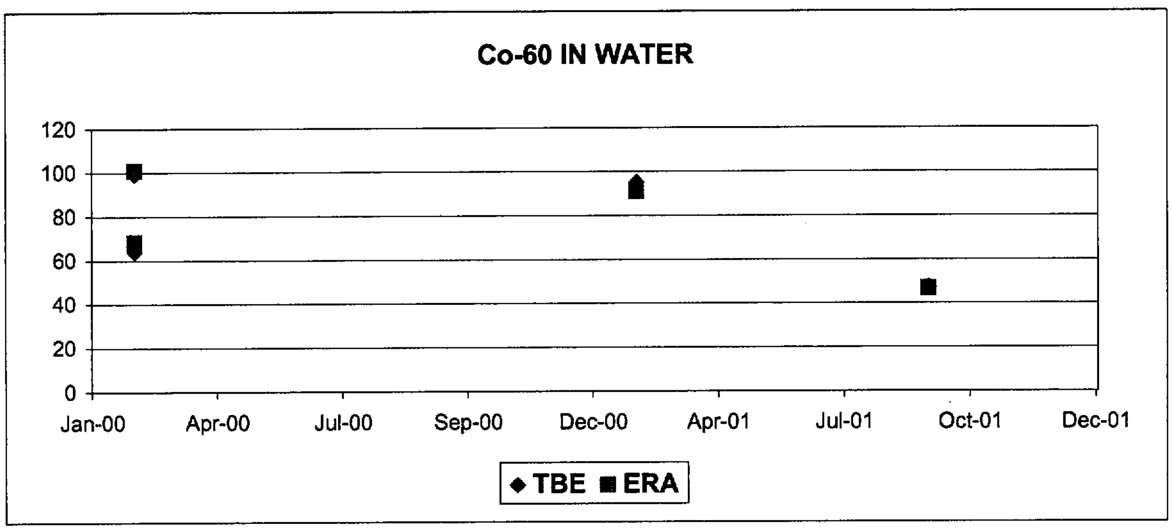

Sr-89 IN WATER
1.0E-02
1.0E-03
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
◆ TBE ■ Analytics

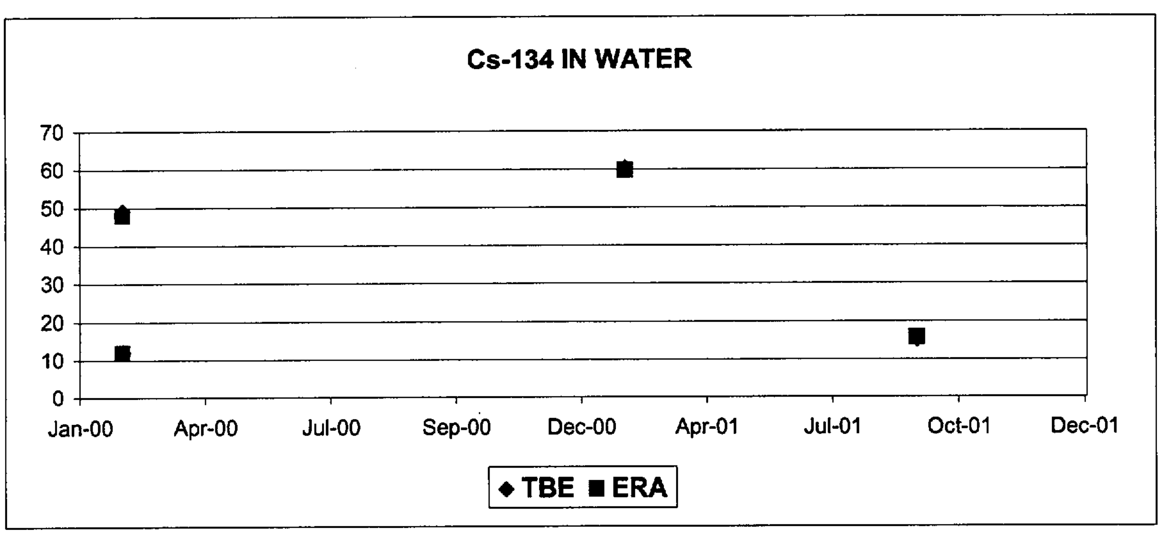

Sr-90 IN WATER
1.0E-03
1.0E-04
1.0E-05
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
◆ TBE ■ Analytics

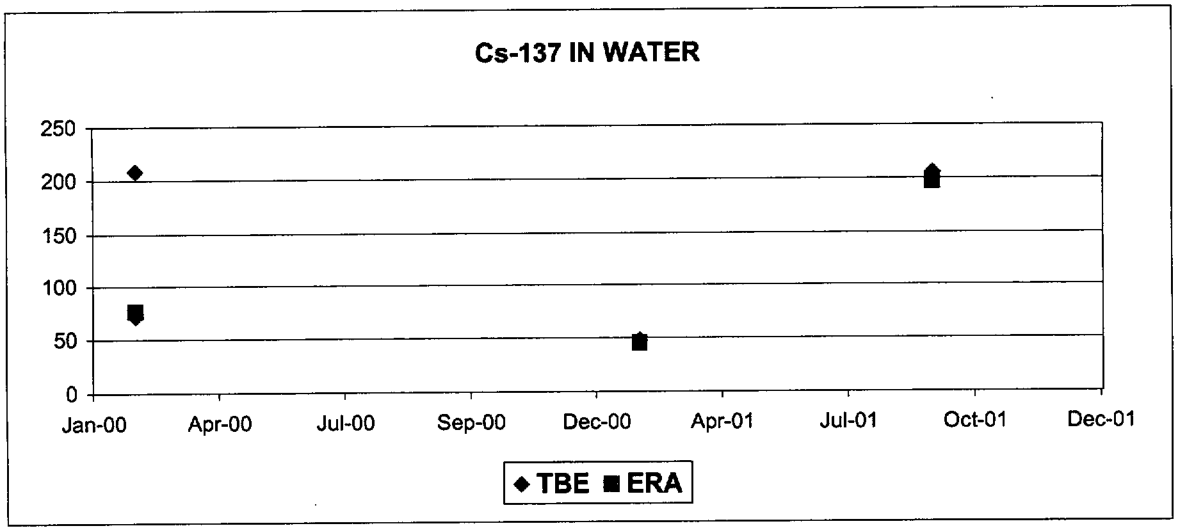

GROSS ALPHA IN WATER
1.0E-03
1.0E-04
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
◆ TBE ■ Analytics

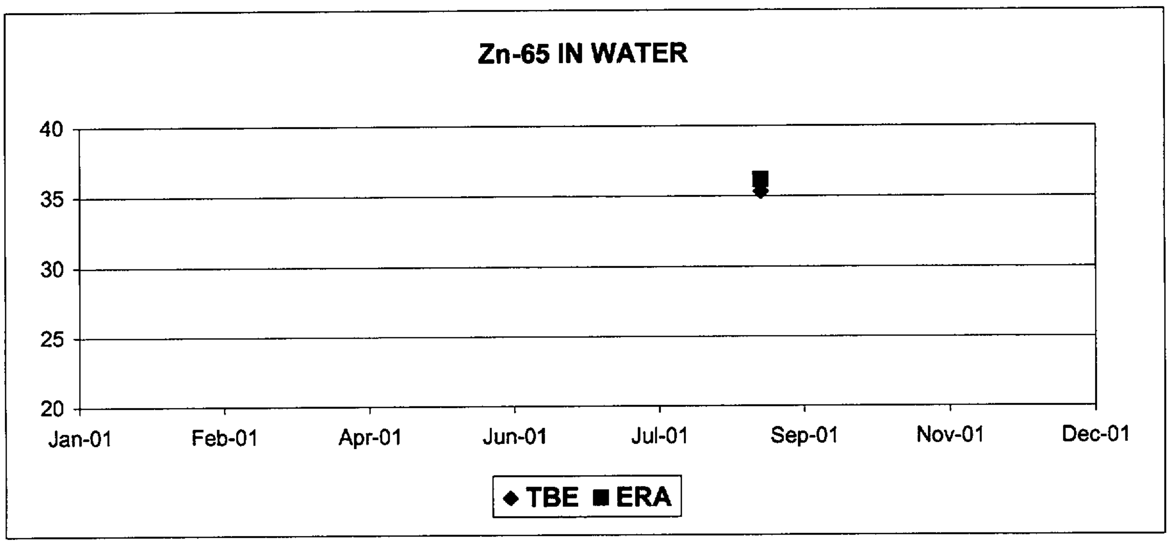

I-131 IN CHARCOAL CARTRIDGE
1.0E+03
1.0E+02
1.0E+01
Jan-00
Apr-00
Jul-00
Sep-00
Dec-00
Apr-01
Jul-01
Oct-01
Dec-01
◆ TBE ■ Analytics

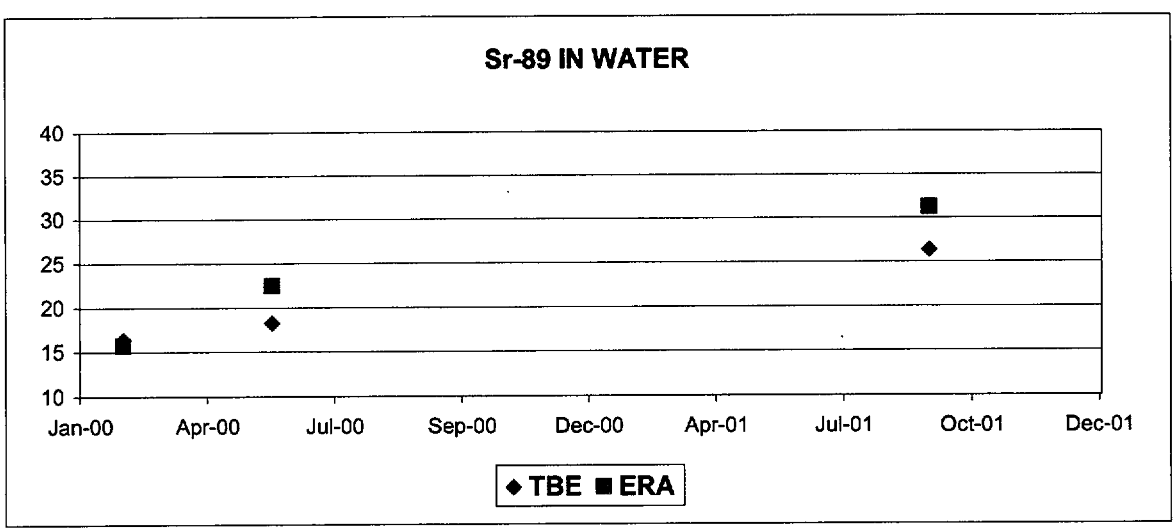

Ba-133 IN WATER
120
100
80
60
40
20
Jan-00
Apr-00
Jul-00
Sep-00
Dec-00
Apr-01
Jul-01
Oct-01
Dec-01
TBE ERA

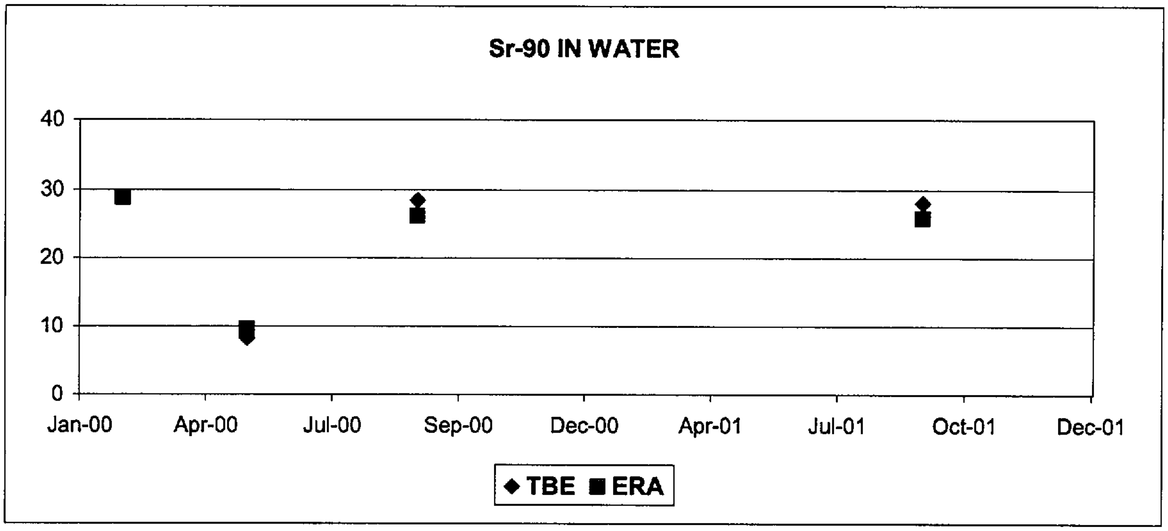

Co-60 IN WATER
120
100
80
60
40
20
0
Jan-00
Apr-00
Jul-00
Sep-00
Dec-00
Apr-01
Jul-01
Oct-01
Dec-01
TBE ERA

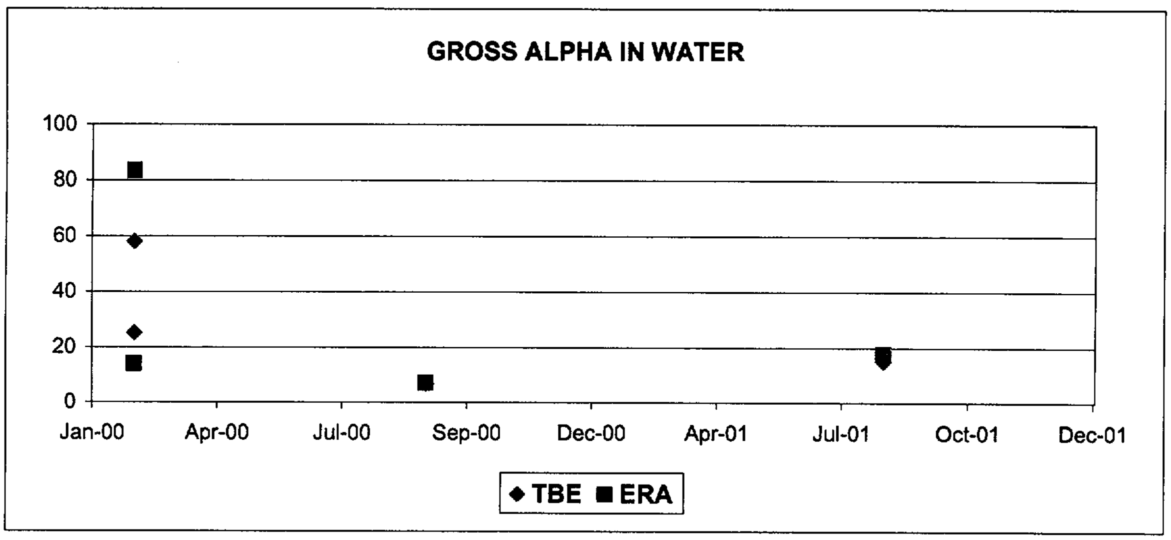

Cs-134 IN WATER
70
60
50
40
30
20
10
0
Jan-00
Apr-00
Jul-00
Sep-00
Dec-00
Apr-01
Jul-01
Oct-01
Dec-01
TBE ERA

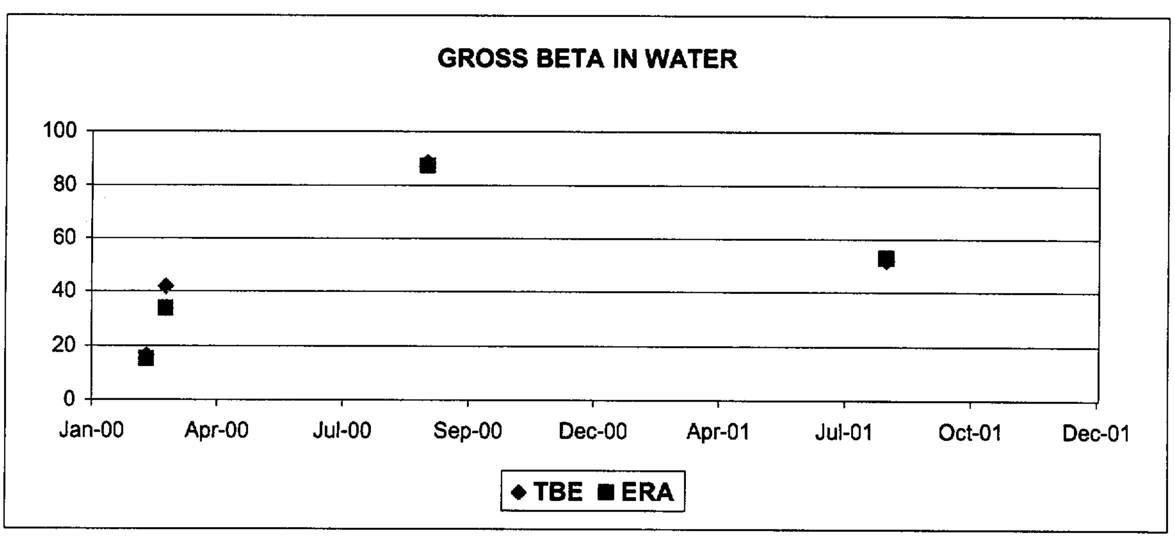

Cs-137 IN WATER
250
200
150
100
50
0
Jan-00
Apr-00
Jul-00
Sep-00
Dec-00
Apr-01
Jul-01
Oct-01
Dec-01
TBE
ERA

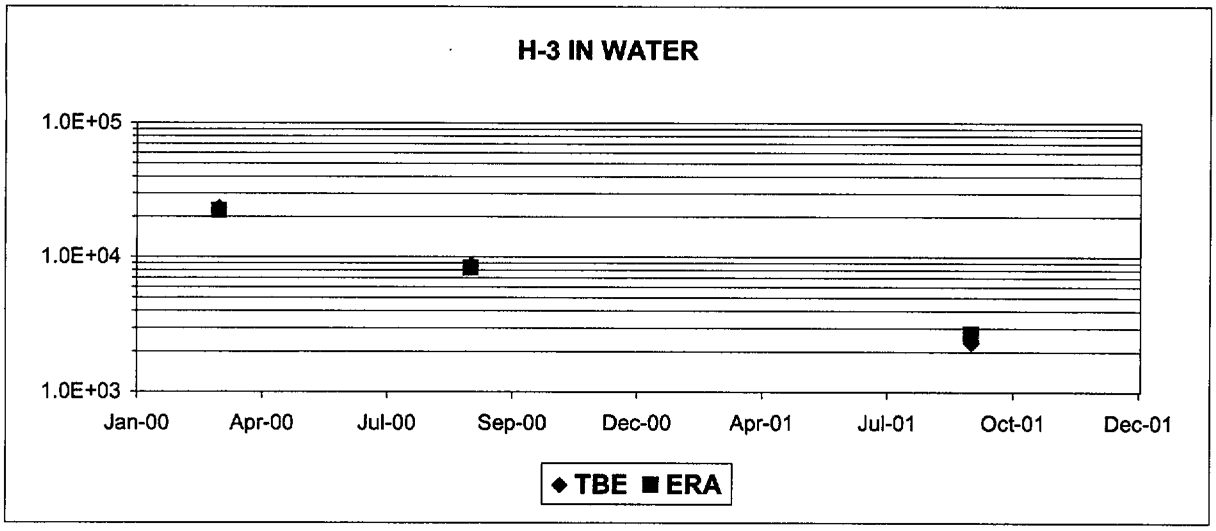

Zn-65 IN WATER
40
35
30
25
20
Jan-01
Feb-01
Apr-01
Jun-01
Jul-01
Sep-01
Nov-01
Dec-01
TBE
ERA

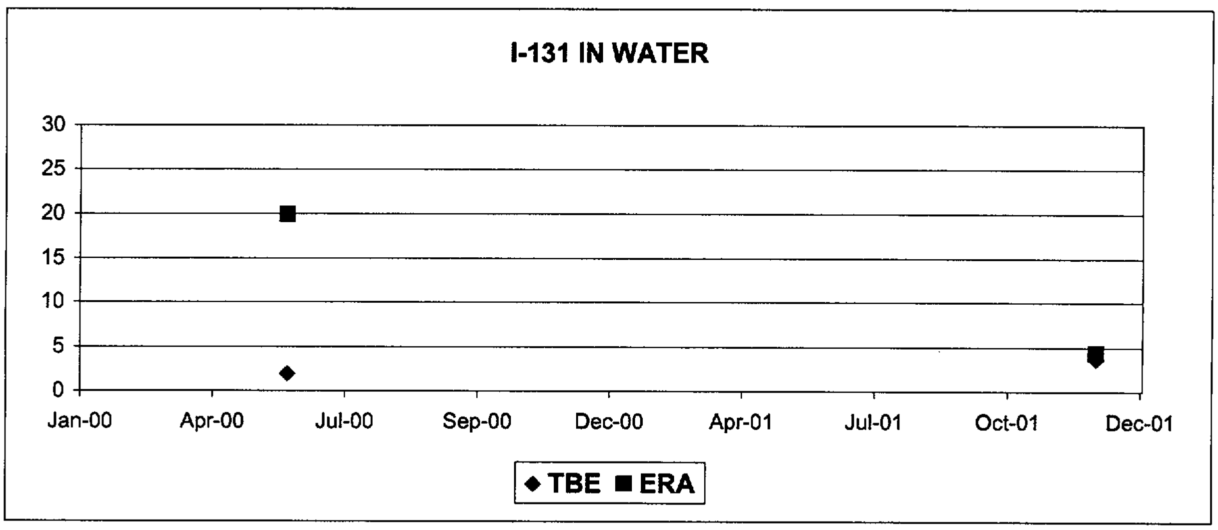

Sr-89 IN WATER
40
35
30
25
20
15
10
Jan-00
Apr-00
Jul-00
Sep-00
Dec-00
Apr-01
Jul-01
Oct-01
Dec-01
TBE
ERA

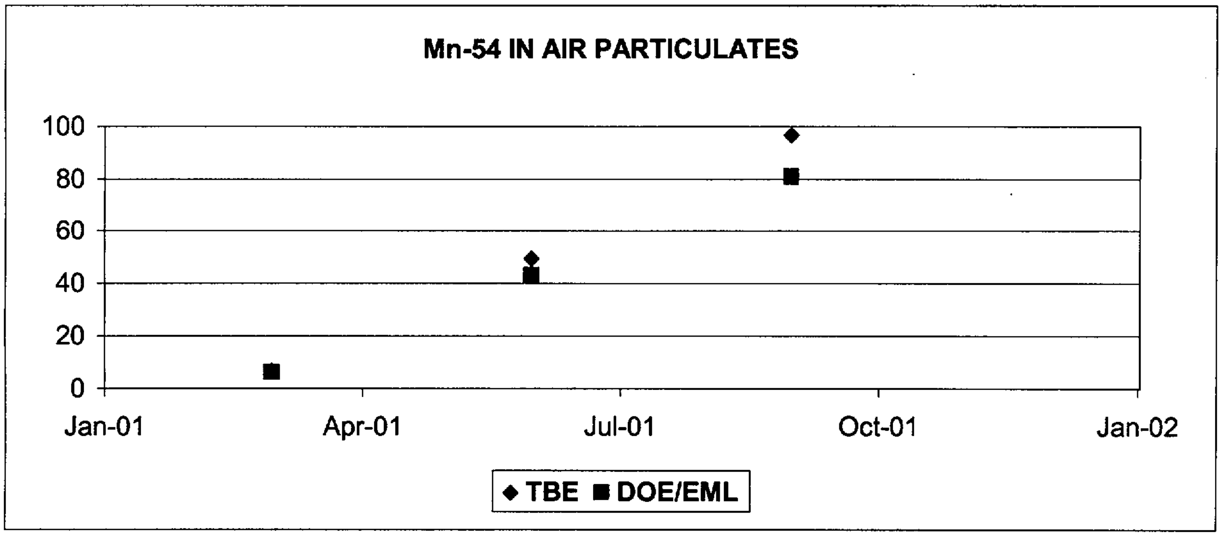

Sr-90 IN WATER
40
30
20
10
0
Jan-00
Apr-00
Jul-00
Sep-00
Dec-00
Apr-01
Jul-01
Oct-01
Dec-01
◆ TBE ■ ERA

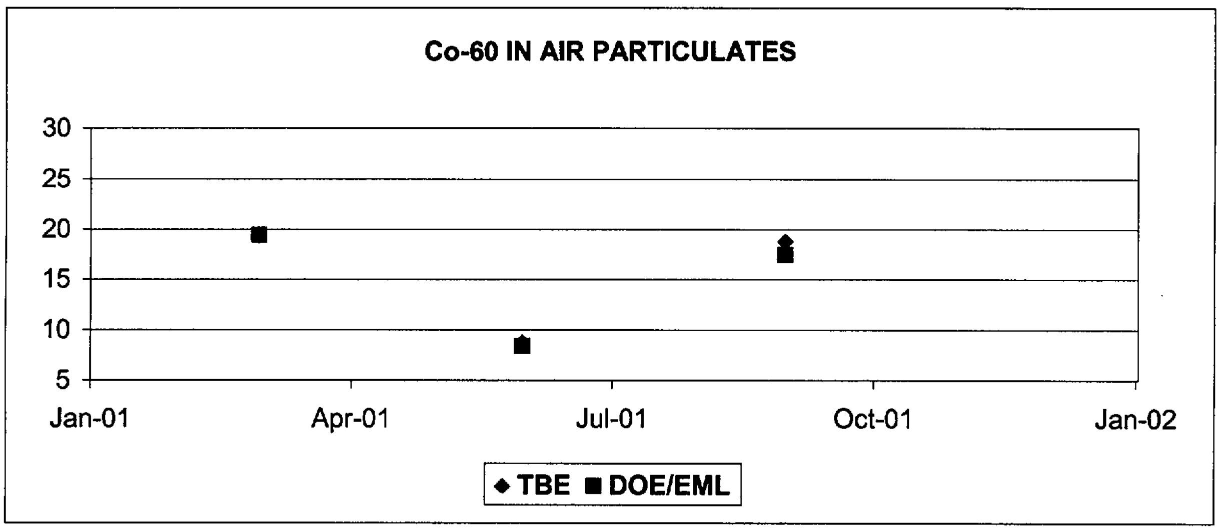

GROSS ALPHA IN WATER
100
80
60
40
20
0
Jan-00
Apr-00
Jul-00
Sep-00
Dec-00
Apr-01
Jul-01
Oct-01
Dec-01
◆ TBE ■ ERA

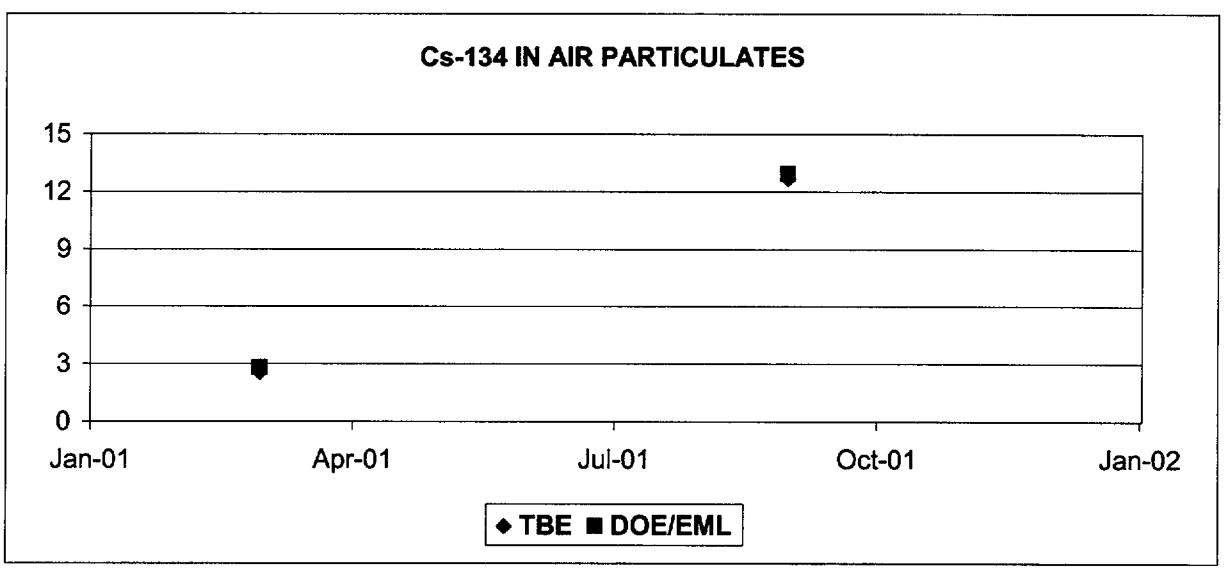

GROSS BETA IN WATER
100
80
60
40
20
0
Jan-00
Apr-00
Jul-00
Sep-00
Dec-00
Apr-01
Jul-01
Oct-01
Dec-01
◆ TBE ■ ERA

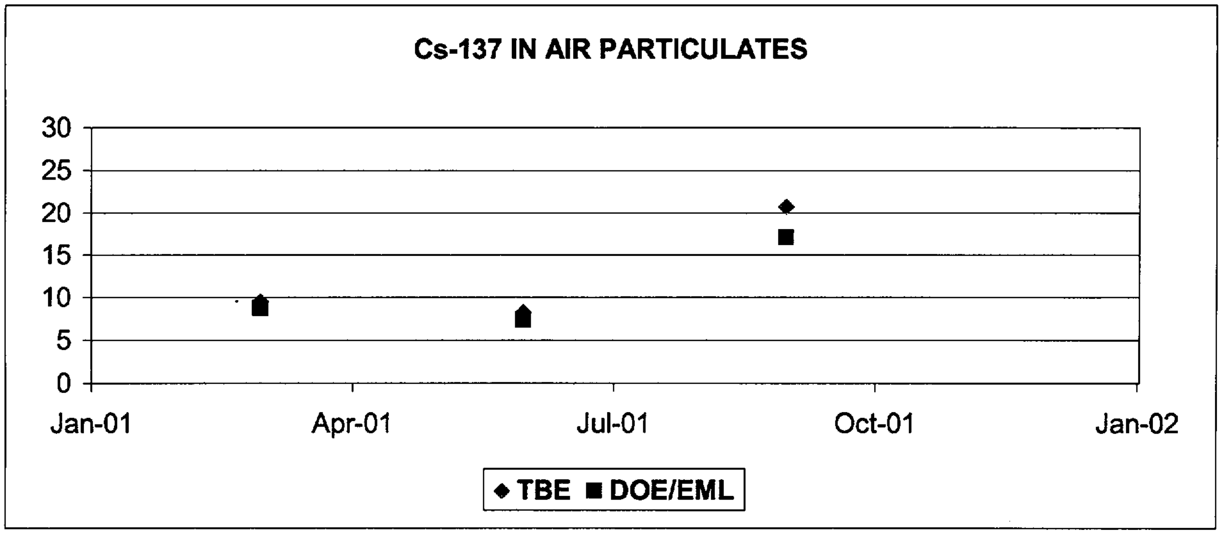

H-3 IN WATER
1.0E+05
1.0E+04
1.0E+03
Jan-00
Apr-00
Jul-00
Sep-00
Dec-00
Apr-01
Jul-01
Oct-01
Dec-01
TBE
ERA

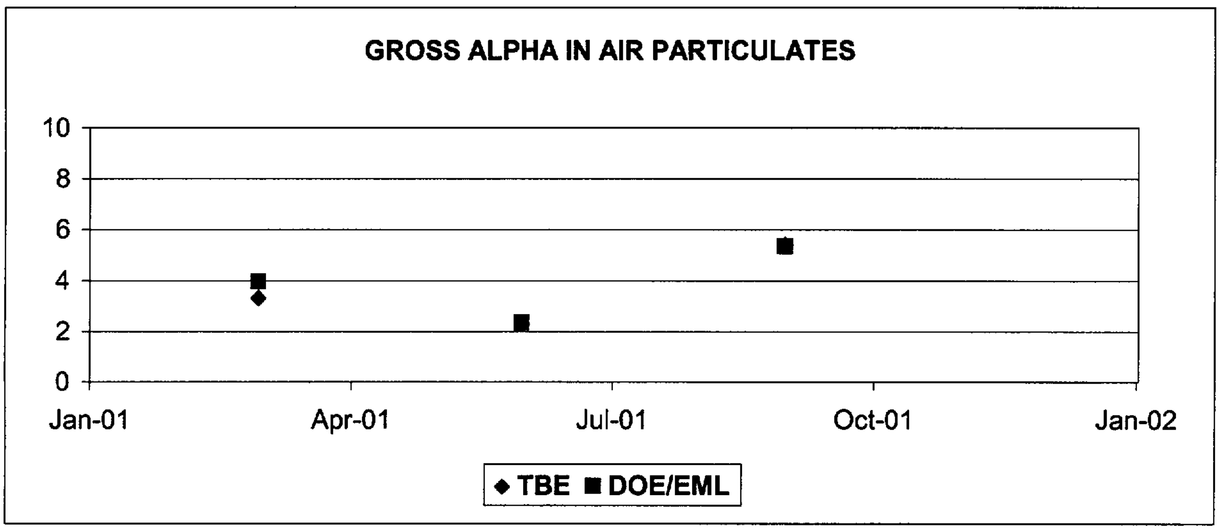

I-131 IN WATER
30
25
20
15
10
5
0
Jan-00
Apr-00
Jul-00
Sep-00
Dec-00
Apr-01
Jul-01
Oct-01
Dec-01
TBE
ERA

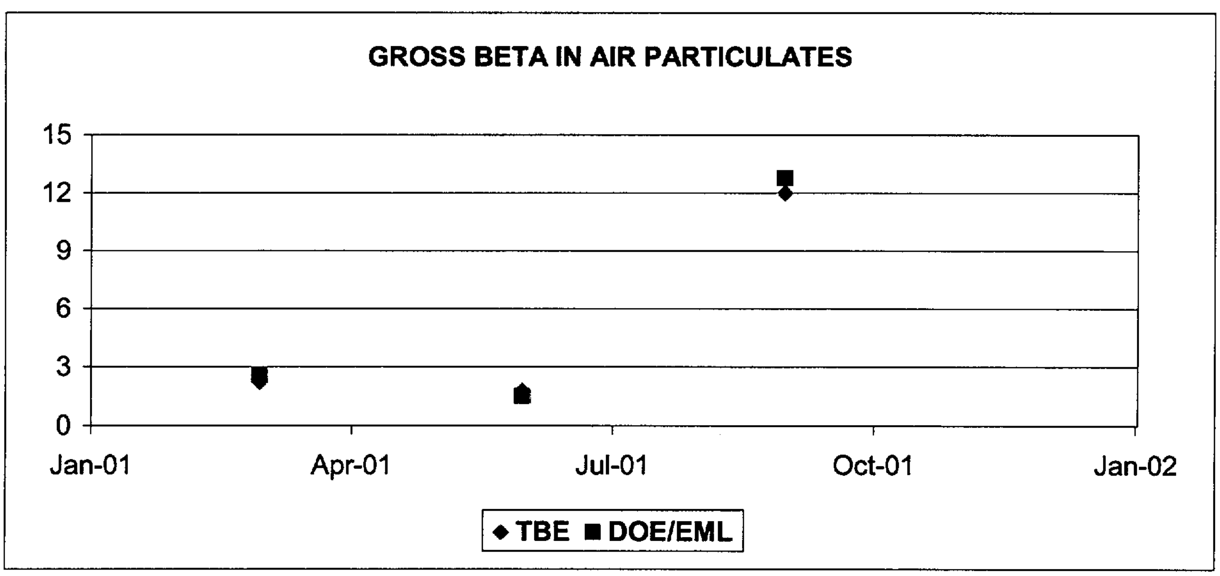

Mn-54 IN AIR PARTICULATES
100
80
60
40
20
0
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
TBE
DOE/EML

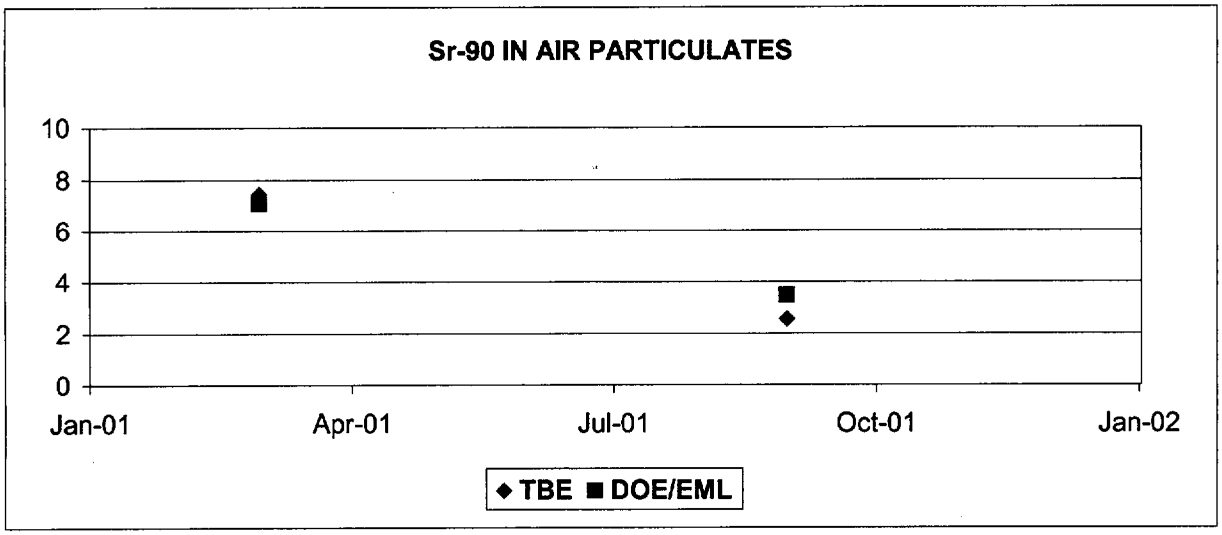

Co-60 IN AIR PARTICULATES
30
25
20
15
10
5
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
TBE
DOE/EML

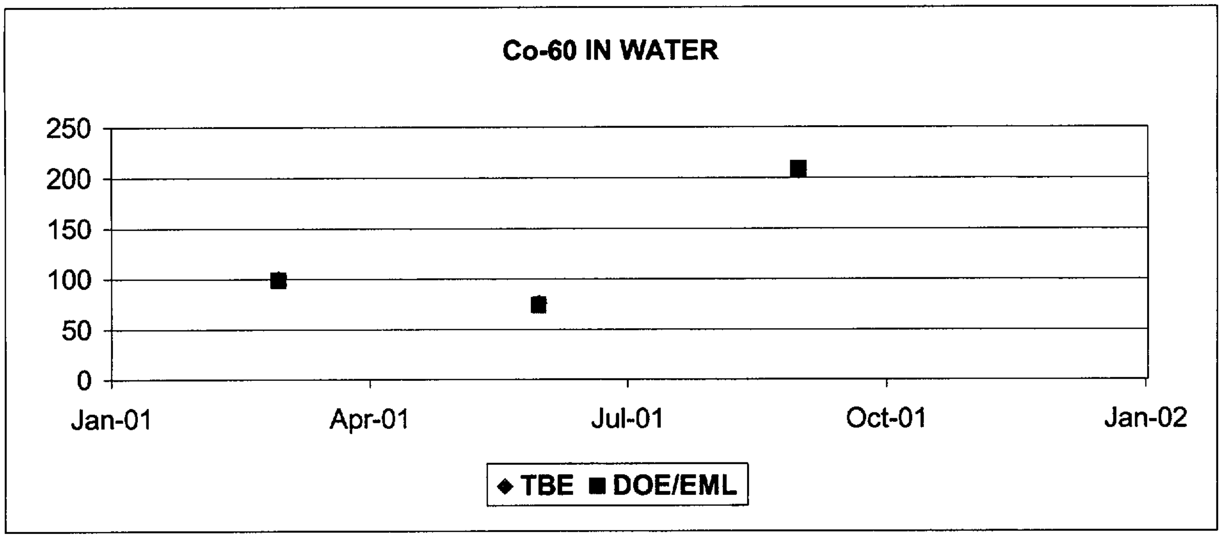

Cs-134 IN AIR PARTICULATES
15
12
9
6
3
0
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
TBE
DOE/EML

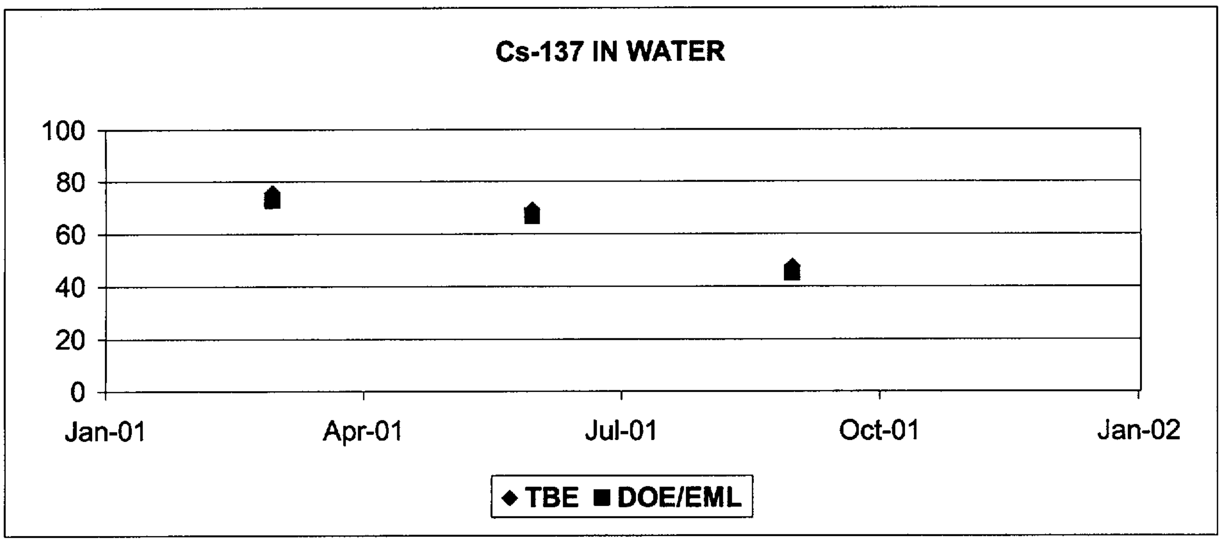

Cs-137 IN AIR PARTICULATES
30
25
20
15
10
5
0
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
TBE
DOE/EML

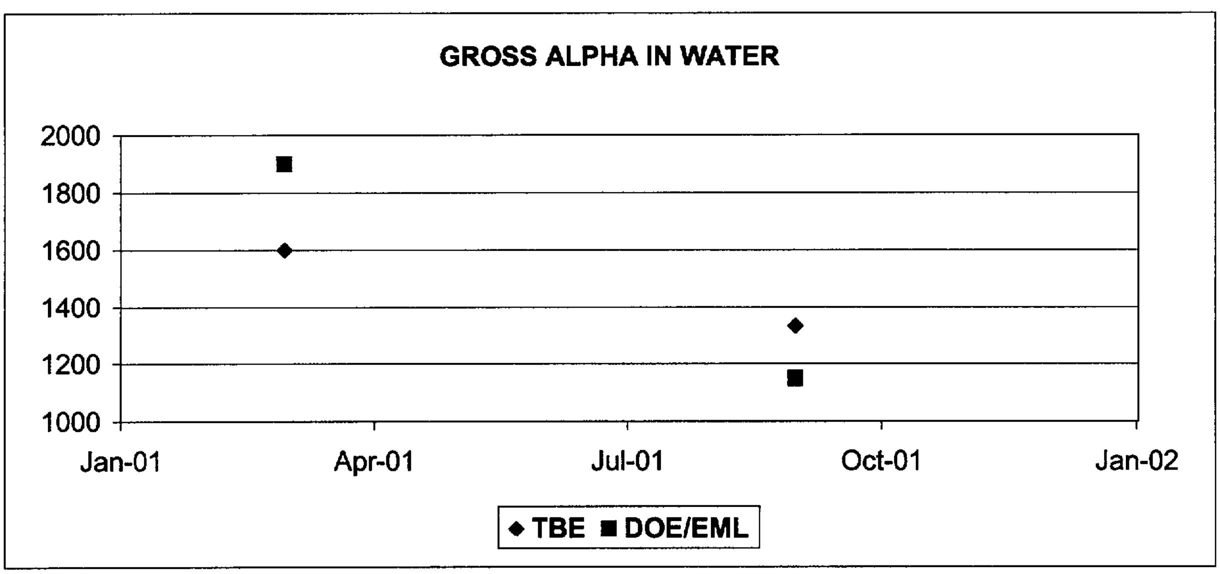

GROSS ALPHA IN AIR PARTICULATES
10
8
6
4
2
0
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
TBE
DOE/EML

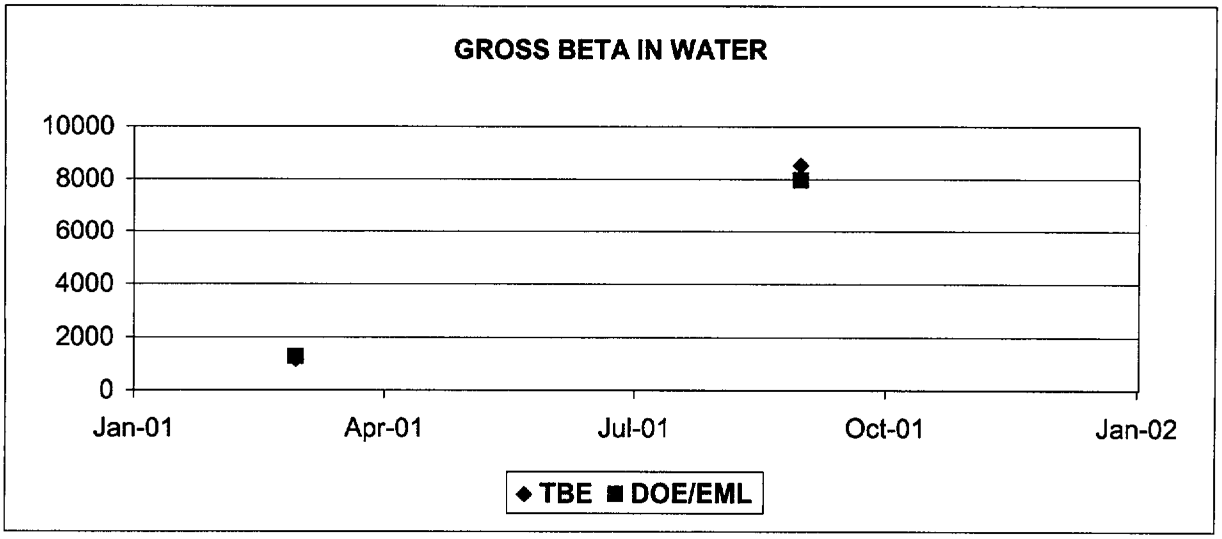

GROSS BETA IN AIR PARTICULATES
15
12
9
6
3
0
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
TBE
DOE/EML

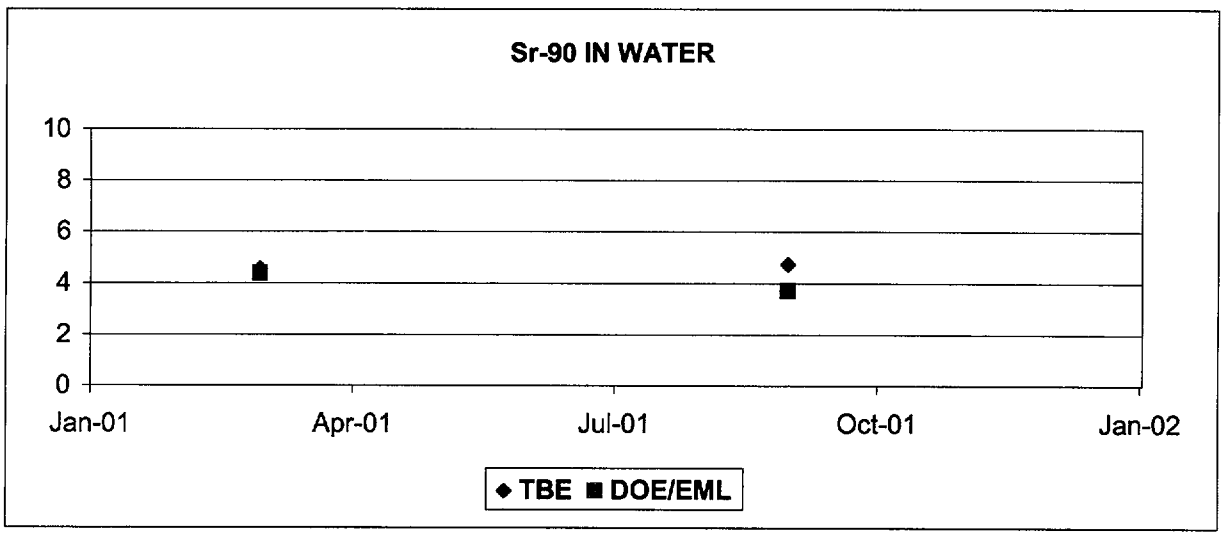

Sr-90 IN AIR PARTICULATES
10
8
6
4
2
0
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
◆ TBE ■ DOE/EML

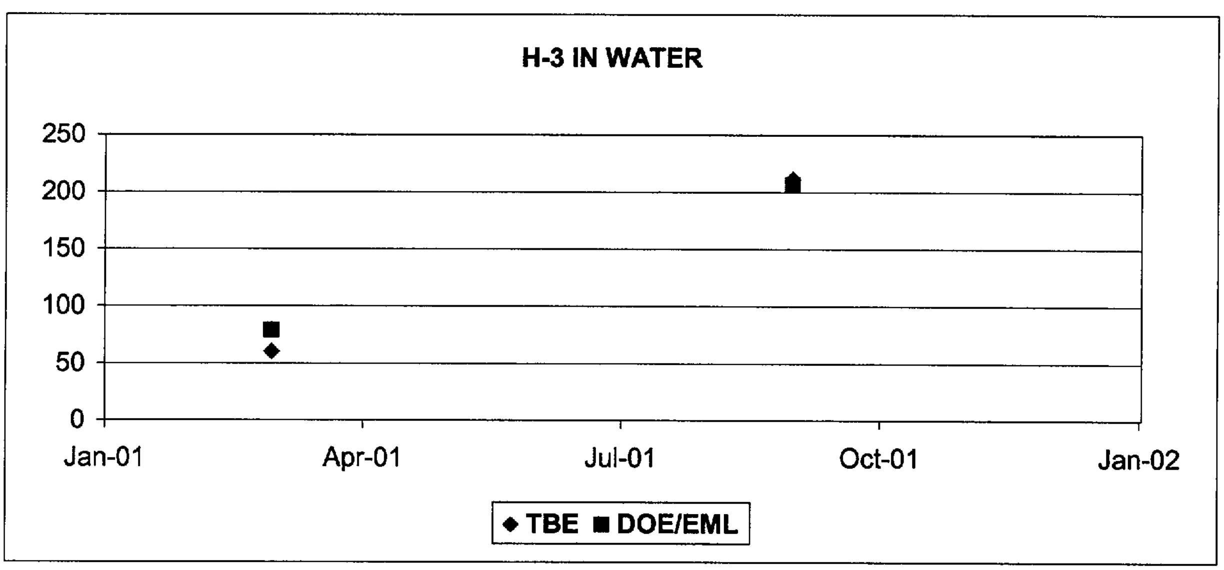

Co-60 IN WATER
250
200
150
100
50
0
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
TBE
DOE/EML


Cs-137 IN WATER
100
80
60
40
20
0
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
TBE
DOE/EML


GROSS ALPHA IN WATER
2000
1800
1600
1400
1200
1000
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
TBE
DOE/EML


GROSS BETA IN WATER
10000
8000
6000
4000
2000
0
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
TBE
DOE/EML


Sr-90 IN WATER
10
8
6
4
2
0
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
TBE
DOE/EML


H-3 IN WATER
250
200
150
100
50
0
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
TBE
DOE/EML