Virginia Electric and Power Company
Richmond, Virginia 23261

April 27, 2001

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

Serial No. 01-243
NAPS: MPW
Docket Nos. 50-338
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License Nos. NPF-4
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SNM-2507

Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION UNITS 1 & 2
INDEPENDENT SPENT FUEL STORAGE INSTALLATION (ISFSI)
ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

North Anna Units 1 and 2 Technical Specifications 6.9.1.8 and North Ann Independent Spent Fuel Storage Installation Technical Specification 5.5.2b, require the submittal of an Annual Radiological Environmental Operating Report. Accordingly, enclosed is the Radiological Environmental Operating Report for the reporting period of January 1, 2000 through December 31, 2001. The report is not complete due to the vendor, Teledyne Brown Engineering, relocating their laboratory from New Jersey to Tennessee. Information not provided in this report includes:

1) 3rd and 4th quarter gamma analyses of air particulate composites
2) Second half tritium results in precipitation
3) 09/20/00 tritium results in precipitation
4) 3rd and 4th quarter tritium results in river water
5) 08/07/00 Sr-89/90 results in sediment/silt
6) Sr-89/90 results for 3rd and 4th quarter milk composites
7) Ground water tritium graph
8) Surface water tritium graph

The 2000 Annual Radiological Environmental Operating Report will be updated following receipt of final analyses from the vendor.

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

Very truly yours,

DAH

D. A. Heacock
Site Vice President

Enclosure

Commitments made by this letter:

1. The 2000 Annual Radiological Environmental Operating Report will be updated following receipt of final analyses from the vendor.

cc: U. S. Nuclear Regulatory Commission
Region II
Atlanta Federal Center
61 Forsyth St., SW, Suite 23T85
Atlanta, Georgia 30303

Director, Nuclear Material Safety and Safeguards
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Mr. M. J. Morgan
NRC Senior Resident Inspector
North Anna Power Station

DOMINION VIRGINIA POWER

NORTH ANNA POWER STATION

Radiological Environmental Monitoring Program

January 1, 2000 to December 31, 2000

Prepared by

DOMINION VIRGINIA POWER

and

TELEDYNE BROWN ENVIRONMENTAL SERVICES

Annual Radiological Environmental Operating Report

North Anna Power Station

January 1, 2000 to December 31, 2000

Prepared by: ______________________
James B. Breeden
Supervisor Radiological Analysis and Material Control

Reviewed by ______________________
Erich W. Dreyer
Supervisor Health Physics Technical Services

Approved by: ______________________
Alan H. Stafford
Manager Radiological Protection

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Preface

This report is submitted in accordance with North Anna Unit 1 and 2 Technical Specification 6.9.1.8 and North Anna Independent Spent Fuel Storage Installation (ISFSI) Technical Specification 5.5.2b.

EXECUTIVE SUMMARY

This document is a detailed report on the 2000 North Anna Nuclear Power Station Radiological Environmental Monitoring Program (REMP). Radioactivity levels from January 1 through December 31, 2000 in 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 ensure that radiological effluent releases are As Low As is Reasonably Achievable (ALARA), no undue environmental effects occur, and the health and safety of the public is protected. The program also detects any unexpected environmental processes which could allow radiation accumulations in the environment or food pathways chains.

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

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

Teledyne Brown Engineering provides sample analyses for various radioisotopes as appropriate for each sample media. Participation in 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 (LLD). This ensures that analyses are as accurate as possible. Samples with extreme low levels of radiation which cannot be detected are therefore reported as being below the LLD. The NRC also mandates a "reporting level." Licensed nuclear facilities must report any releases equal to or greater than this reporting level. Environmental radiation levels are sometimes referred to as a percent of the reporting level.

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

- The airborne exposure pathway includes airborne iodine, airborne particulate, precipitation, and soil samples. The overall 2000 airborne results were very similar to previous years and to preoperational levels. No increase was noted and there was no detection of fission products or other man-made isotopes in the airborne particulate media during 2000.

- The waterborne exposure pathways includes ground/well water, river water, and surface water samples. No man-made isotopes were detected in Lake Anna surface water except for tritium. The average tritium activity in surface water for 2000 was 3000 pCi/liter which was 10% of the reporting level for a water sample. The 1999 tritium level was 3975 pCi/liter. The preoperational level was 150 pCi/liter and has risen since 1997, though it has remained relatively consistent since 1986. Naturally occurring potassium-40 was measured in one of twenty-four samples at 39.8 pCi/liter. No other gamma emitters were detected.

- River water collected from the North Anna River, 5.8 miles downstream of the site had an average tritium level of 3100 pCi/liter. The average tritium level in 1999 was 3350 pCi/liter. Naturally occurring potassium-40 was measure in three out of twelve samples at an average concentration of 454 pCi/liter. No other gamma emitters were detected.

- The aquatic exposure pathway includes sediment/silt and shoreline samples. North Anna sediment contained some cesium-137. During the preoperational period, cesium-137 was detected. Sediment contamination, however, does not provide a direct dose pathway to man. In shoreline soil, which may provide a direct dose pathway, cesium-137 was measured in one of two samples at 167 pCi/kg (dry).

- The ingestion exposure pathway includes milk, fish, and food/vegetation samples. Iodine-131 was not detected in any 2000 milk samples. Although cesium-137 has been detected in the past, it was not detected in 2000 milk samples. Strontium-90 was detected at levels lower than 1999, and preoperational years. Both strontium-90 and cesium-137 are attributable to atmospheric nuclear weapons testing in the past. Naturally occurring potasium-40 was detected at normal environmental levels. Fish samples during 2000 contained cesium-137 at a slightly higher activity than preoperational levels. Steam generator repairs and better liquid waste processing, however, have reduced these activity levels from previous years. Vegetation samples were statistically similar to both control and preoperational levels.

- The direct radiation exposure pathway measures environmental radiation doses by use of thermoluminescent dosimeters (TLDs). The TLD results have remained essentially the same since the preoperational period in 1977.

During 2000, as in previous years, operation of the North Anna Nuclear Power Station and the Independent Spent Fuel Storage Installation (ISFSI) created no adverse environment affects or health hazards. The maximum total body dose calculated for a hypothetical individual at the North Anna Power Station site boundary due to liquid and gaseous effluents released from the site during 2000 would be approximately 0.38 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 to less than 0.1%. These results demonstrate not only compliance with federal and state regulations, but also demonstrate the adequacy of radioactive effluent control at the North Anna Nuclear Power Station.

I. INTRODUCTION

DOMINION VIRGINIA POWER COMPANY

NORTH ANNA POWER STATION

RADIOLOGICAL ENVIRONMENTAL OPERATING PROGRAM

I. INTRODUCTION

The operational radiological environmental monitoring program conducted for 2000 for the North Anna Power Station is provided in this report. The result of measurement and analyses of data obtained from samples collected from January 1, 2000 through December 31, 2000 are summarized.

A. The North Anna Power Station of Dominion Virginia Power Company is located on Lake Anna in Mineral, Virginia, approximately 35 miles southwest of Fredericksburg, Virginia. 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 was designed with a gross electrical output of 979 megawatts electric (MWe). Unit 1 achieved commercial operation on June 6, 1978 and Unit 2 on December 14, 1980. An independent spent fuel storage facility was licensed for dry cask storage of spent fuel in 1998.

B. The United States Nuclear Regulatory Commission (USNRC) regulations 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 North Anna Power Station includes Technical Specifications which address the release of radioactive effluents. Inplant monitoring is used to ensure release limits are not exceeded. As a precaution against unexpected or undefined environmental processes which might allow undue accumulation of radioactivity in the environment, a program for monitoring the plant environs is also included in North Anna Power Station Offsite Dose Calculation Manual (ODCM).

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

D. Occasional samples of environment media show the presence of man-made isotopes. As a method of referencing the measured radionuclide concentrations in the sample media to a dose consequence to man, the data is compared to the reporting level concentrations listed in the USNRC Regulatory Guide 4.8 and North Anna's ODCM. 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 2000 and satisfies the following objectives of the program:

1. Provides measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides that lead to the highest potential radiation exposure of the maximum exposed members of the public resulting from the station operation.

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

3. Identifies radioactivity changes in the environment.

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

II. SAMPLING AND ANALYSIS PROGRAM

SAMPLING AND ANALYSIS PROGRAM

A. Sampling Program

1. Table 1 summarizes the sampling program for environmental monitoring stations for North Anna Power Station during 2000. The relative location of these stations is shown.

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

3. In addition to the Radiological Environmental Monitoring Program required by North Anna Technical Specifications, samples are split if requested by the Commonwealth of Virginia. Routine splitting of Dominion Virginia Power Company samples with the Commonwealth of Virginia has been discontinued. All samples listed in Table 1 are shipped to Teledyne Brown Engineering located in Knoxville, TN.

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

TABLE 1
(Page 1 of 4)
NORTH ANNA POWER STATION - 2000
RADIOLOGICAL SAMPLING STATIONS
DISTANCE AND DIRECTION FROM UNIT NO. 1

Sample Media	Location	Station	Distance Miles	Compass Direction	Degrees	Collection Frequency	Remarks
Environmental Thermoluminescent Dosimetry (TLD)	NAPS Sewage Treatment Plant	01	0.20	NE	42°	Quarterly & Annually	
	Fredericks Hall	02	5.30	SSW	225°	Quarterly & Annually	
	Mineral, Va	03	7.10	WSW	243°	Quarterly & Annually	
	Wares Crossroads	04	5.10	WNW	287°	Quarterly & Annually	
	Route 752	05	4.20	NNE	20°	Quarterly & Annually	
	Sturgeon's Creek Marina	05A	3.20	N	11°	Quarterly & Annually	
	Levy, VA	06	4.70	ESE	115°	Quarterly & Annually	
	Bumpass, VA	07	7.30	SSE	167°	Quarterly & Annually	
	End of Route 685	21	1.00	WNW	301°	Quarterly & Annually	
	Route 700	22	1.00	WSW	242°	Quarterly & Annually	
	"Aspen Hills"	23	0.93	SSE	158°	Quarterly & Annually	
	Orange, VA	24	22.00	NW	325°	Quarterly & Annually	Control
	Bearing Cooling Tower	N-1/33	0.06	N	10°	Quarterly	
	Sturgeon's Creek Marina	N-2/34	3.20	N	11°	Quarterly	
	Parking Lot "C" (on-site)	NNE-3/35	0.24	NNE	32°	Quarterly	
	Good Hope Church	NNE-4/36	4.96	NNE	25°	Quarterly	
	Parking Lot "B"	NE-5/37	0.20	NE	42°	Quarterly	
	Lake Anna Marina	NE-6/38	1.46	NE	34°	Quarterly	
	Weather Tower Fence	ENE-7/39	0.36	ENE	74°	Quarterly	
	Route 689	ENE-8/40	2.43	ENE	65°	Quarterly	
	Near Training Facility	E-9/41	0.30	E	91°	Quarterly	

TABLE 1
(Page 2 of 4)
NORTH ANNA POWER STATION - 2000
RADIOLOGICAL SAMPLING STATIONS
DISTANCE AND DIRECTION FROM UNIT NO. 1

Sample Media	Location	Station	Distance Miles	Compass Direction	Degrees	Collection Frequency	Remarks
Environmental Thermoluminescent Dosimetry (TLD)	"Morning Glory Hill"	E-10/42	2.85	E	93°	Quarterly	
	Island Dike	ESE-11/43	0.12	ESE	103°	Quarterly	
	Route 622	ESE-12/44	4.70	ESE	115°	Quarterly	
	DVP Biology Lab	SE-13/45	0.75	SE	138°	Quarterly	
	Route 701 (Dam Entrance)	SE-14/46	5.88	SE	137°	Quarterly	
	"Aspen Hills"	SSE-15/47	0.93	SSE	158°	Quarterly	
	Elk Creek	SSE-16/48	2.33	SSE	165°	Quarterly	
	NAPS Access Rd.	S-17/49	0.47	S	173°	Quarterly	
	Elk Creek Church	S-18/50	1.55	S	178°	Quarterly	
	NAPS Access Rd.	SSW-19/51	0.42	SSW	197°	Quarterly	
	Route 618	SSW-20/52	5.30	SSW	205°	Quarterly	
	500kv Tower	SW-21/53	0.6	SW	218°	Quarterly	
	Route 700	SW-22/54	4.36	SW	232°	Quarterly	
	NAPS Radio Tower	WSW-23/55	0.38	WSW	237°	Quarterly	
	Route 700 (Exclusion Boundary)	WSW-24/56	1.00	WSW	242°	Quarterly	
	South Gate Switchyard	W-25/57	0.32	W	279°	Quarterly	
	Route 685	W-26/58	1.55	W	274°	Quarterly	
	End of Route 685	WNW-27/59	1.00	WNW	301°	Quarterly	
	Route 685	WNW-28/60	1.40	WNW	303°	Quarterly	
	North Gate - Construction Side Laydown Area	NW-29/61	0.45	NW	321°	Quarterly	
	Lake Anna Campground	NW-30/62	2.54	NW	319°	Quarterly	
	#1/#2 Intake	NNW-31/63	0.07	NNW	349°	Quarterly	
	Route 208	NNW-32/64	3.43	NNW	344°	Quarterly	
	Bumpass Post Office	C-1/2	7.30	SSE	167°	Quarterly	Control
	Orange, VA	C-3/4	22.00	NW	325°	Quarterly	Control
	Mineral, VA	C-5/6	7.10	WSW	243°	Quarterly	Control
	Louisa, VA	C-7/8	11.54	WSW	257°	Quarterly	Control

TABLE 1
(Page 3 of 4)
NORTH ANNA POWER STATION - 2000
RADIOLOGICAL SAMPLING STATIONS
DISTANCE AND DIRECTION FROM UNIT NO. 1

Sample Media	Location	Station	Distance Miles	Compass Direction	Degrees	Collection Frequency	Remarks
Airborne Particulate and Radioiodine	NAPS Sewage Treatment Plant	01	0.20	NE	42°	Weekly	
	Fredericks Hall	02	5.30	SSW	205°	Weekly	
	Mineral, VA	03	7.10	WSW	243°	Weekly	
	Wares Crossroads	04	5.10	WNW	287°	Weekly	
	Route 752	05	4.20	NNE	20°	Weekly	
	Sturgeon's Creek Marina	05A	3.20	N	11°	Weekly	
	Levy, VA	06	4.70	ESE	115°	Weekly	
	Bumpass, VA	07	7.30	SSE	167°	Weekly	
	End of Route 685	21	1.00	WNW	301°	Weekly	
	Route 700	22	1.00	WSW	242°	Weekly	
	"Aspen Hills"	23	0.93	SSE	158°	Weekly	
	Orange, VA	24	22.00	NW	325°	Weekly	Control
Surface Water	Waste Heat Treatment Facility (Second Cooling Lagoon)	08	1.10	SSE	148°	Monthly	
	*Lake Anna (upstream) (Route 208 Bridge)	09	2.20	NW	320°	Monthly	Control
	*Lake Anna (upstream) (Route 669 Bridge)	09A	12.90	WNW	295°	Monthly	Control
River Water	North Anna River (downstream)	11	5.80	SE	128°	Monthly	
Ground Water (Well Water)	Biology Lab	01A	0.75	SE	138°	Quarterly	
Precipitation	Biology Lab	01A	0.75	SE	138°	Monthly	
Aquatic Sediment	Waste Heat Treatment Facility (Second Cooling Lagoon)	08	1.10	SSE	148°	Semi-Annually	
	Lake Anna (upstream) (Route 669 Bridge)	09A	12.90	WNW	320°	Semi-Annually	Control
	North Anna River (Downstream)	11	5.80	SSE	128°	Semi-Annually	
Shoreline Soil	Waste Heat Treatment Facility (Second Cooling Lagoon)	08 **	1.10	SSE	148°	Semi-Annually	

* In October 1991 the Surface Water Sample location at station 09 was moved to 09A.
** Shoreline soil was changed from station 09 to 08 effective with the August 1996 sample.

TABLE 1

NORTH ANNA POWER STATION - 2000
RADIOLOGICAL SAMPLING STATIONS
DISTANCE AND DIRECTION FROM UNIT NO. 1

Sample Media	Location	Station	Distance Miles	Compass Direction	Degrees	Collection Frequency	Remarks
Soil	NAPS Sewage Treatment Plant	01	0.20	NE	42°	Once/3 years	
	Fredericks Hall	02	5.30	SSW	205°	Once/3 years	
	Mineral, VA	03	7.10	WSW	243°	Once/3 years	
	Wares Crossroads	04	5.10	WNW	287°	Once/3 years	
	Route 752	05	4.20	NNE	20°	Once/3 years	
	Sturgeon's Creek Marina	05A	3.20	N	11°	Once/3 years	
	Levy, VA	06	4.70	ESE	115°	Once/3 years	
	Bumpass, VA	07	7.30	SSE	167°	Once/3 years	
	End of Route 685	21	1.00	WNW	301°	Once/3 years	
	Route 700 (Exclusion Boundary)	22	1.00	WSW	242°	Once/3 years	
	"Aspen Hills"	23	0.93	SSE	158°	Once/3 years	
	Orange, VA	24	22.00	NW	325°	Once/3 years	Control
Milk	Holladay Dairy (R.C. Goodwin)	12	8.30	NW	310°	Monthly	
	Terrell's Dairy (Fredericks Hall)	13	5.60	SSW	205°	Monthly	
Fish	Waste Heat Treatment Facility (Second Cooling Lagoon)	08	1.10	SSE	148°	Semi-Annually	
	Lake Orange	25	16.5	NW	312°	Semi-Annually	Control
Food Products (Broadleaf or at harvest Vegetation)	Route 713	14	1.20	NE	43°	Monthly if available	
	Route 614	15	1.37	SE	133°	Monthly if available or at harvest	
	Route 629/522	16	12.60	NW	314°	Monthly if available or at harvest Control	
	End of Route 685	21	1.00	WNW	301°	Monthly if available or at harvest	
	Aspen Hills	23	0.93	SSE	158°	Monthly if available or at harvest	

Legend For The North Anna Power Station
Environmental Monitoring Stations Overview Maps

Map Designation		Environmental Station Identification	Map Designation	Environmental Station
1	(a)	01,NE-5/37	7/8	C-7/8
1A		01A,SE-13/45	1/33	N-1/33
2	(a)	02,SSW-20/52	31/63	NNW-31/63
3	(a)	03,C-5/16	29/61	NW-29/61
4	(a)	04	3/35	NNE-3/35
5	(a)	05	7/39	ENE-7/39
5A	(a)	05A,N-2/34	9/41	E-9/41
6	(a)	06,ESE-12/44	11/43	ESE-11/43
7	(a)	07,C-1&2	17/49	S-17/49
8		08-Water, Fish Sediment Shoreline Soil (d)	19/51	SSW-19/51
9		09	21/53	SW-21/53
9A		09A-Water sample, sediment	23/55	WSW-23/55
11		11-River Water, Sediment	25/57	W-25/57
12		12-Milk	16/48	SSE-16/48
13		13-Milk	18/50	S-18/50
14		14-Vegetation, NE-6/38	14/46	SE-14/46
15		Vegetation	22/54	SW-22/54
16		Vegetation	26/58	W-26/58
21	(a)	21,WNW-27/59	28/60	WNW-28/60
22	(a)	22,WSW-24/56	32/64	NNW-32/64
23	(a)	23-SSE-15/47	8/40	ENE-8/40
24	(a)(b)	24,C-3&4	4/36	NNE-40/36
25	(c)	25-Fish	10/42	E-10/42

(a) Indicates air sample station, annual and quarterly TLD, Triennial soil.
(b) In Orange
(c) In Lake Orange
(d) Station 09 changed to 08 effective August 1996.

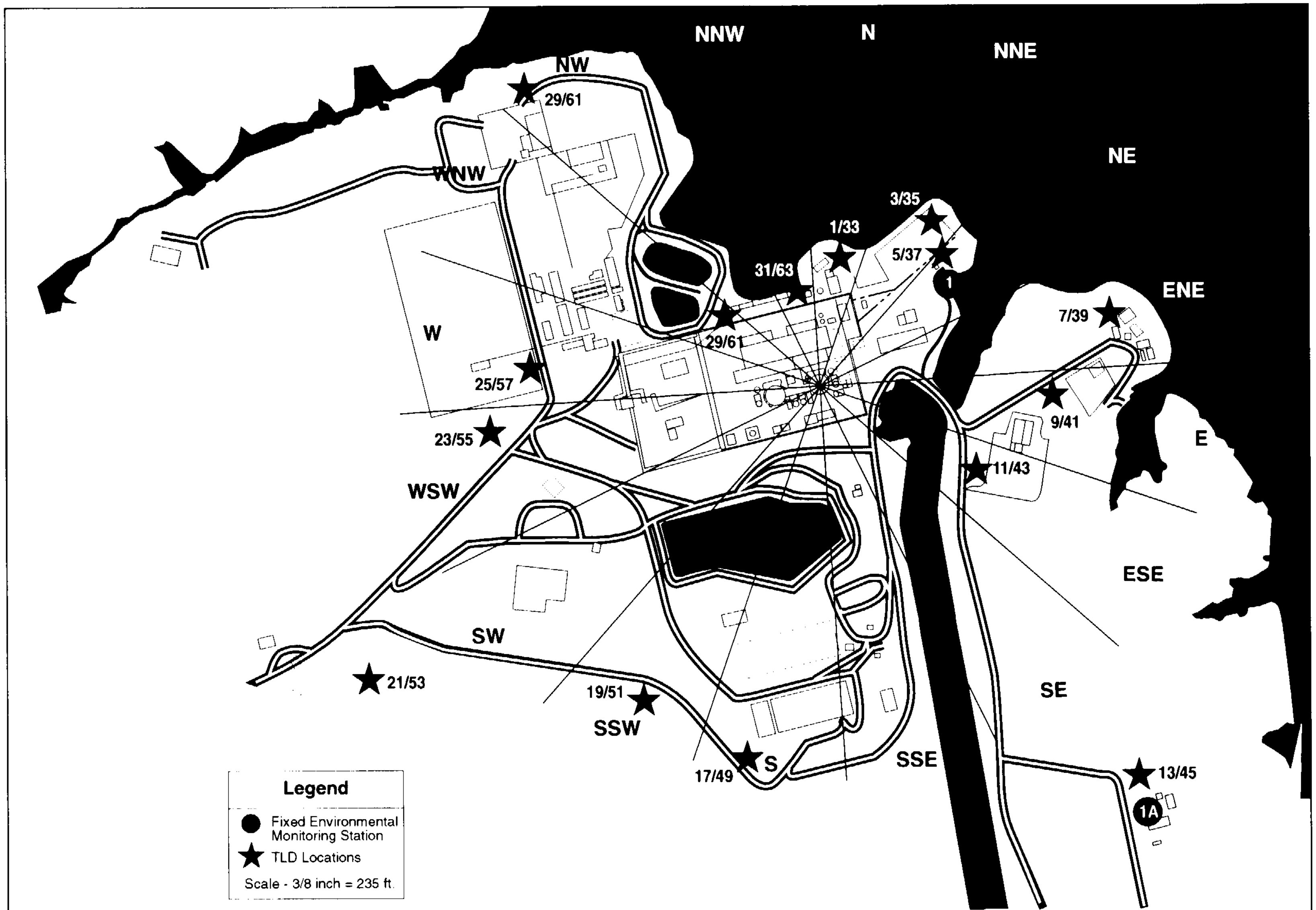

Figure 1. North Anna Site Radiological Monitoring Locations

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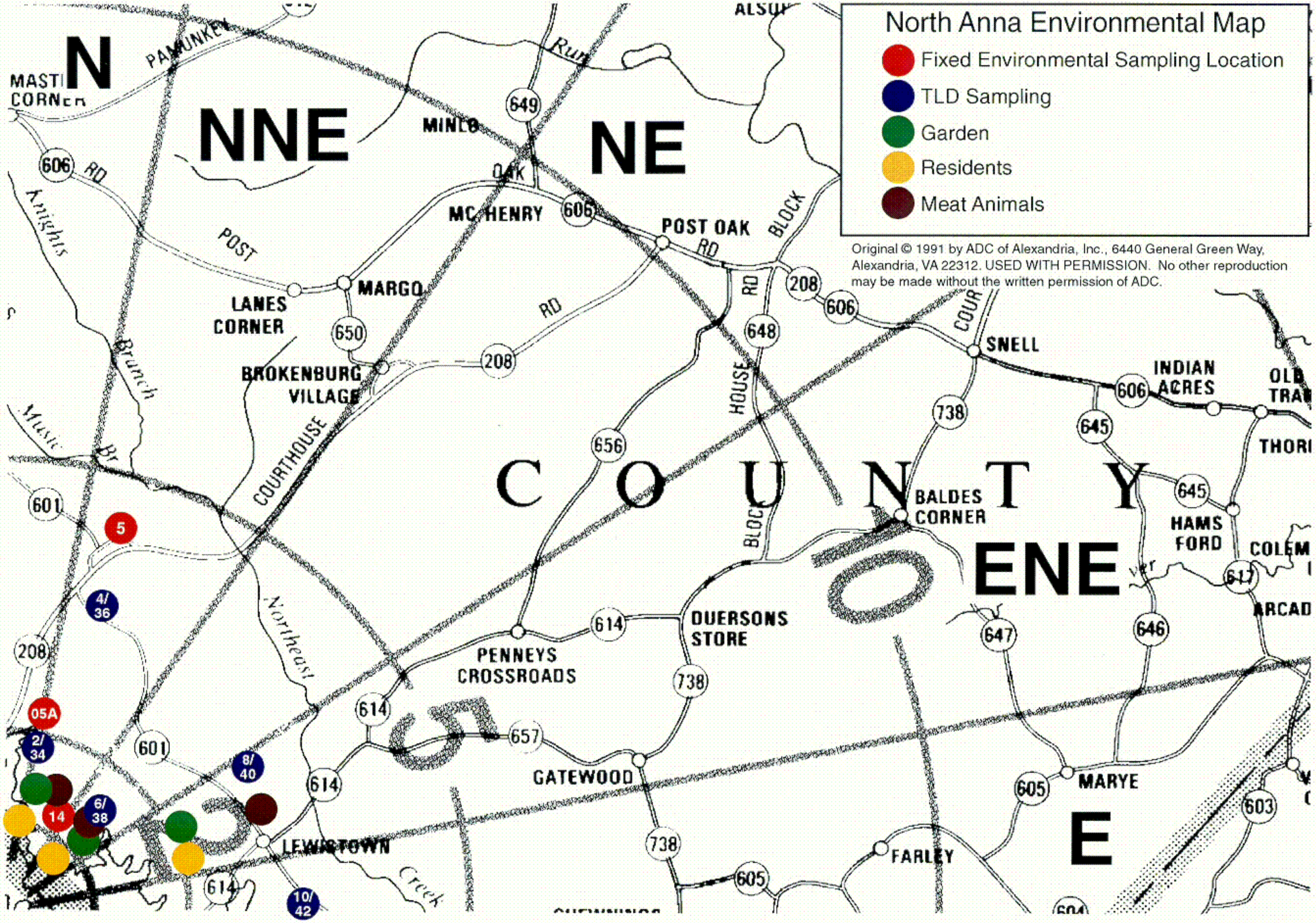
North Anna Environmental Map
Fixed Environmental Sampling Location
TLD Sampling
Garden
Residents
Meat Animals
Original © 1991 by ADC of Alexandria, Inc., 6440 General Green Way, Alexandria, VA 22312. USED WITH PERMISSION. No other reproduction may be made without the written permission of ADC.
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NE
ENE
E
COUNTY
PAMUNKEY
MINLO
OAK
MC HENRY
POST OAK
POST
RD
BLOCK
MARGO
LANES CORNER
BROKENBURG VILLAGE
COURTHOUSE
SNELL
INDIAN ACRES
BALDES CORNER
HAMS FORD
DUERSONS STORE
PENNEYS CROSSROADS
GATEWOOD
LEWISTOWN
MARYE
FARLEY
Knights
Branch
Northeast
Creek
606
649
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208
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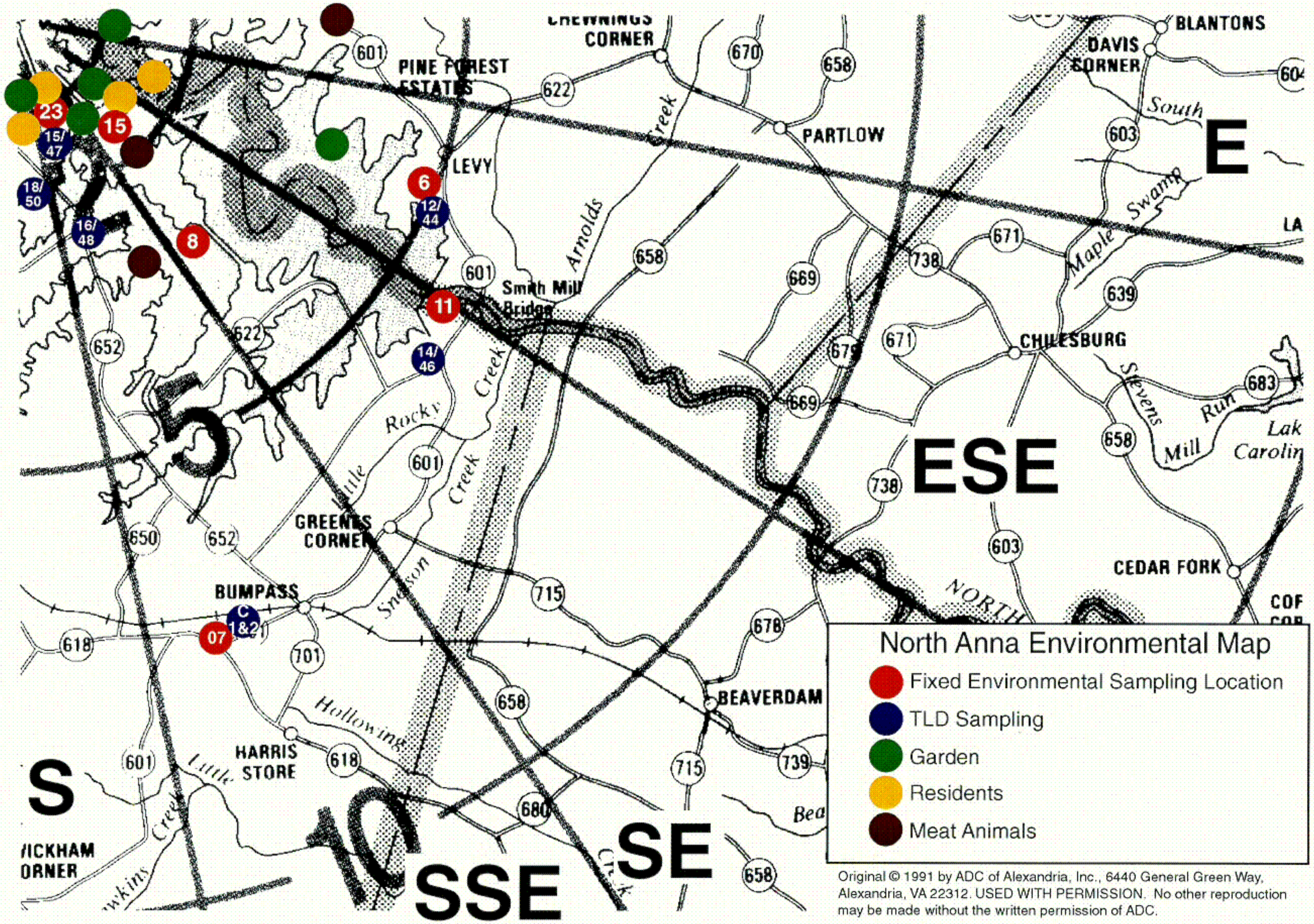
North Anna Environmental Map
Fixed Environmental Sampling Location
TLD Sampling
Garden
Residents
Meat Animals
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SE
SSE
S
BLANTONS
DAVIS CORNER
PINE FOREST ESTATES
PARTLOW
LEVY
Smith Mill Bridge
CHILESBURG
CEDAR FORK
GREENES CORNER
BUMPASS
BEAVERDAM
HARRIS STORE
Arnolds
Creek
South
Maple
Swamp
Stevens
Mill
Run
Rocky
Little
Snelson
Hollowing
NORTH
601
622
670
658
603
604
671
738
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669
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618
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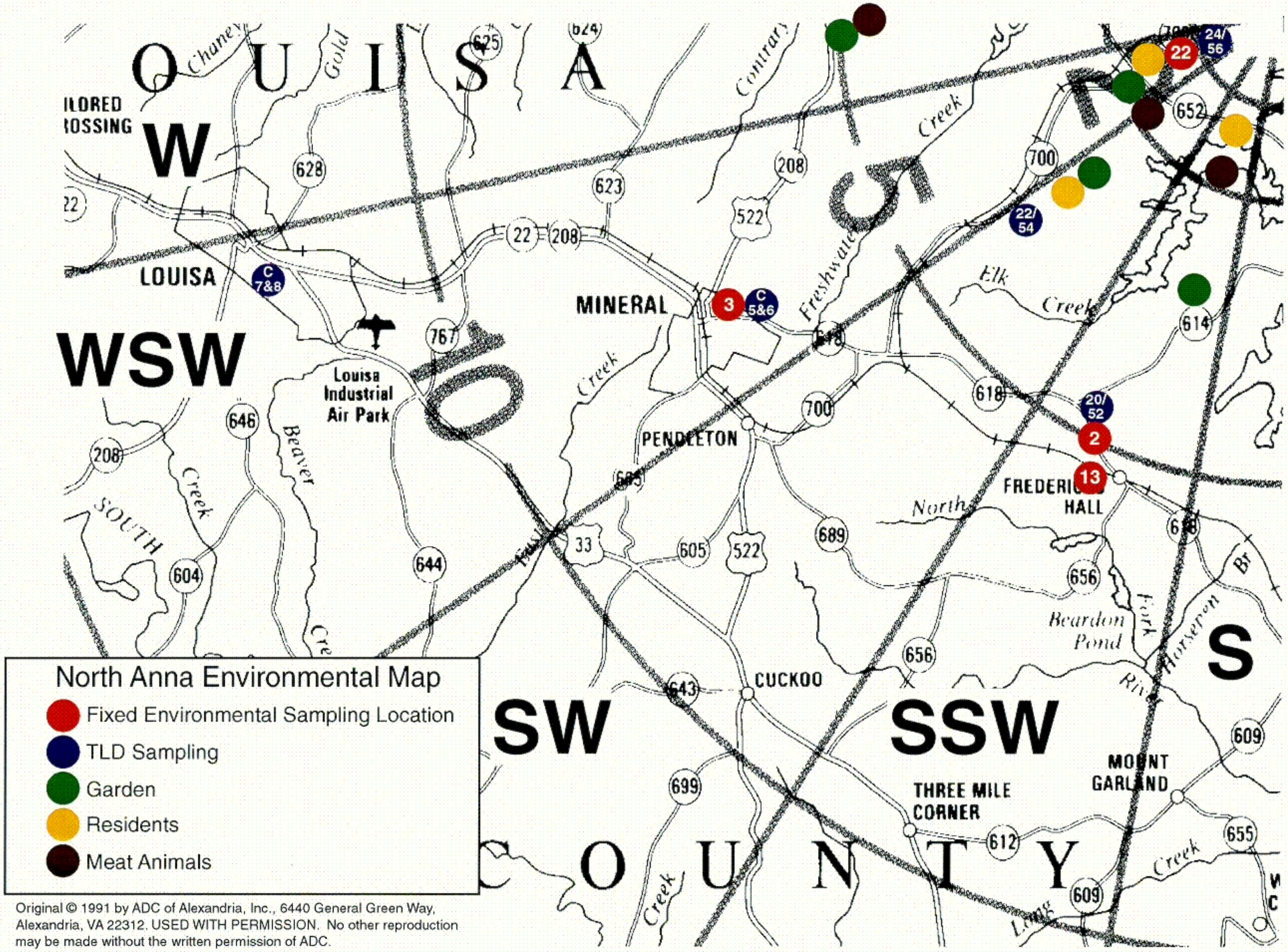
North Anna Environmental Map
Fixed Environmental Sampling Location
TLD Sampling
Garden
Residents
Meat Animals
LOUISA
COUNTY
W
WSW
SW
SSW
S
LOUISA
MINERAL
PENDLETON
FREDERICKS HALL
CUCKOO
THREE MILE CORNER
MOUNT GARLAND
Louisa Industrial Air Park
Beardon Pond
North
Elk Creek
Freshwater
Contrary
Creek
Beaver
SOUTH
Horseshoe
10
5
3
2
13
22
C 7&8
C 5&6
22/54
20/52
24/56
628
623
208
522
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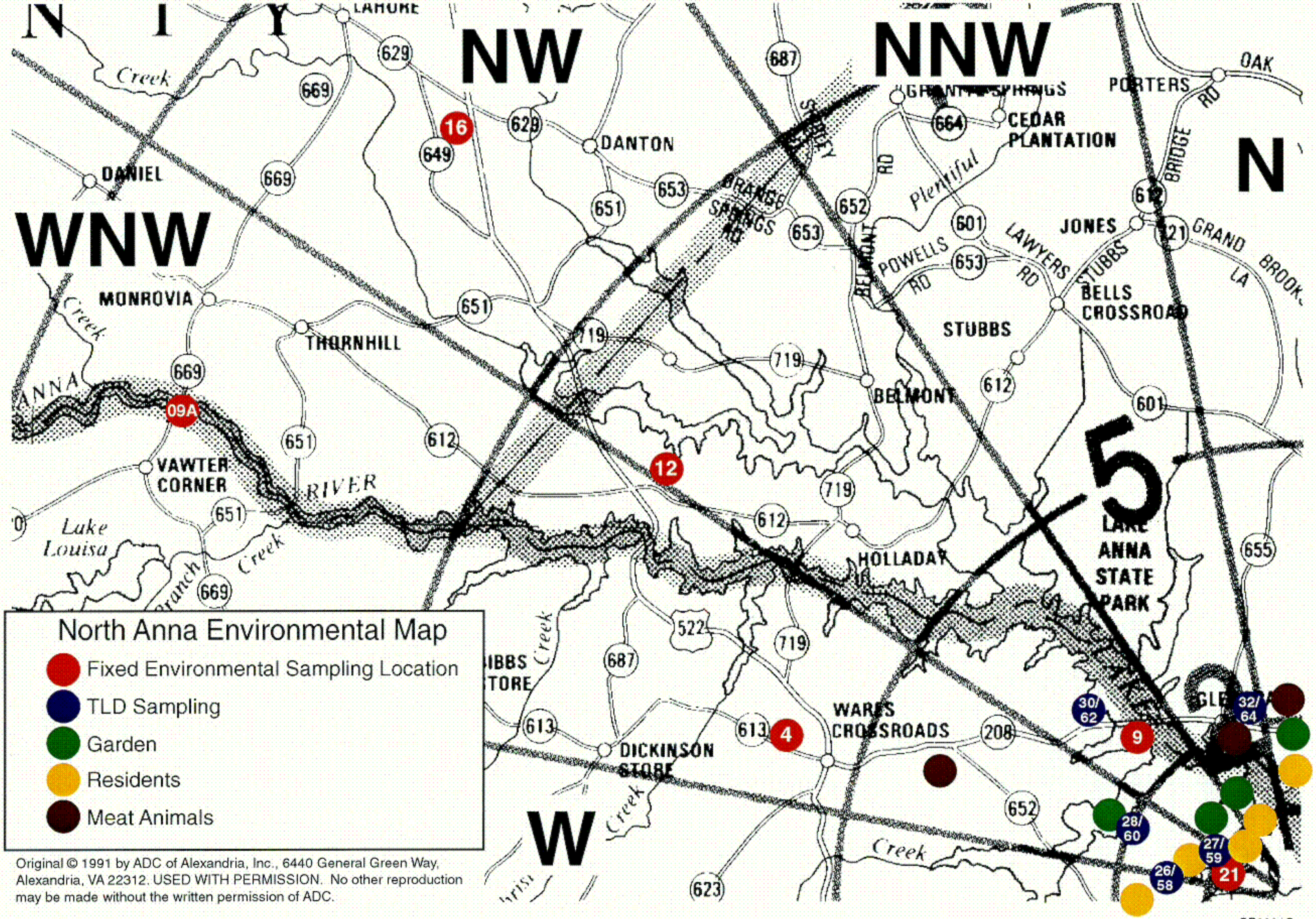

North Anna Environmental Map
Fixed Environmental Sampling Location
TLD Sampling
Garden
Residents
Meat Animals
NW
NNW
N
WNW
W
5

CB3281C

C-4

B. Analysis Program

1. Table 2 summarizes the analysis program conducted by Teledyne Brown Engineering for North Anna Power Station during 2000. 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 nuclides listed in Table 2, shall also be identified and reported.

TABLE 2
(Page 1 of 3)
NORTH ANNA POWER STATION
SAMPLE ANALYSIS PROGRAM

SAMPLE MEDIA	FREQUENCY	ANALYSIS	LLD*	REPORT UNITS
Thermoluminescent Dosimetry (TLD) (84 Routine Station TLD's)	Quarterly	Gamma Dose	2mR±2mR	mR/std. month
12 Station TLD's	Annually	Gamma Dose	2mR±2mR	mR/std. month
Airborne Radioiodine	Weekly	I-131	0.07	pCi/m^3
Airborne Particulate	Weekly	Gross Beta	0.01	pCi/m^3
	Quarterly (a)	Gamma Isotopic		pCi/m^3
		Cs-134	0.05	
		Cs-137	0.06	
	2nd Quarter	Sr-89	(c)	pCi/m3
	Composite	Sr-90	(c)	
Surface Water	Monthly	I-131	1(b)	pCi/l
		Gamma Isotopic		pCi/l
		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	
	Quarterly (a)	Tritium (H-3)	2000	pCi/l
	2nd Quarter	Sr-89	(c)	pCi/l
	Composite	Sr-90	(c)	

* LLD's indicate those levels that the environmental samples should be analyzed to, in accordance with the North Anna 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 samples are used for the required analysis.
(b) LLD for non-drinking water is 10 pCi/liter.
(c) There are no required LLD's for strontium-89/90. LLD's are those achieved by Teledyne Brown Engineering.

TABLE 2
(Page 2 of 3)
NORTH ANNA POWER STATION
SAMPLE ANALYSIS PROGRAM

SAMPLE MEDIA	FREQUENCY	ANALYSIS	LLD*	REPORTUNITS
River Water	Monthly	I-131	1(b)	pCi/l
		Gamma Isotopic		pCi/l
		Mn-54	15	
		Fe-59	30	
		Co-58/Co-60	15	
		Zn-65	30	
		Zr-95	30	
		Nb-95	15	
		Cs-134	15	
		Cs-137	18	
		Ba-140	60	
		La-140	15	
	Quarterly (a)	Tritium (H-3)	2000	pCi/l
	2nd Quarter	Sr-89	(c)	pCi/l
	Composite	Sr-90	(c)	
Ground Water (Well Water)	Quarterly	Gamma Isotopic		pCi/l
		Mn-54	15	
		Fe-59	30	
		Co-58/Co-60	15	
		Zn-65	30	
		Zr-95	30	
		Nb-95	15	
		I-131	1(b)	
		Cs-134	15	
		Cs-137	18	
		Ba-140	60	
		La-140	15	
	Quarterly	Tritium (H-3)	2000	pCi/l
	2nd Quarter	Sr-89	(c)	
		Sr-90	(c)	
Aquatic Sediment	Semi-Annually	Gamma Isotopic		pCi/kg (dry)
		Cs-134	150	
		Cs-137	180	
	Annually	Sr-89	(c)	pCi/kg (dry)
		Sr-90	(c)	
Precipitation	Monthly	Gross Beta		pCi/l
	Semi-Annual Composite	Gamma Isotopic		pCi/l

* LLD's indicate those levels that the environmental samples should be analyzed to, in accordance with the North Anna 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 samples are used for the required analysis.
(b) LLD for non-drinking water is 10 pCi/liter.
(c) There are no required LLD's for strontium-89/90. LLD's are those achieved by Teledyne Brown Engineering.

TABLE 2
(Page 3 of 3)
NORTH ANNA POWER STATION
SAMPLE ANALYSIS PROGRAM

SAMPLE MEDIA	FREQUENCY	ANALYSIS	LLD*	REPORT UNITS
Shoreline Soil	Semi-Annual	Gamma Isotopic		pCi/kg (dry)
		Cs-134	150	
		Cs-137	180	
	Annually	Sr-89	(a)	
		Sr-90	(a)	
Soil	Once per 3 yrs.	Gamma Isotopic		pCi/kg (dry)
		Cs-134	150	
		Cs-137	180	
		Sr-89	(a)	pCi/kg (dry)
		Sr-90	(a)	
Milk	Monthly	I-131	1	pCi/l
	Monthly	Gamma Isotopic		pCi/l
		Cs-134	15	
		Cs-137	18	
		Ba-140	60	
		La-140	15	
	Quarterly	Sr-89	(a)pCi/l	
		Sr-90	(a)	
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	
Food Products (Broadleaf Vegetation)	Monthly if available or at harvest	Gamma Isotopic		pCi/kg (wet)
		Cs-134	60	
		Cs-137	80	
		I-131	60	pCi/kg (wet)

* LLD's indicate those levels that the environmental samples should be analyzed to, in accordance with the North Anna 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 samples are used for the required analysis.
(b) LLD for non-drinking water is 10 pCi/liter.
(c) There are no required LLD's for strontium-89/90. LLD's are those achieved by Teledyne Brown Engineering.

III. PROGRAM EXCEPTIONS

REMP Exceptions For Scheduled Sampling And Analysis During 2000 - North Anna

Location	Description	Date of Sampling	Reason(s) for Loss/Exception
All Stations	Vegetation	01/19/00 02/16/00 03/15/00	Seasonal unavailability.
Sta 08	Aquatic Sediment	02/21/00	Possible cross-contamination at lab.
Sta 01, 02, 03, 04, 05, 05A.	Charcoal Filter	04/26/00	TBE instrument malfunction. Data lost.
All Stations	Vegetation	06/21/00	Low level Iodine not requested or performed.
Sta 24	Charcoal Filter	07/26/00	TBE lost during laboratory move.
Sta 06	Air Particulate	08/23/00	Low value. No particulates on filter.
Sta 24	Charcoal Filter	08/30/00	TBE lost sample.
Sta 14, 15, 16, 22, 23	Vegetation	10/18/00	I-131 LLD not met due to untimely analysis.
Sta 08, 09A	Surface Water	12/18/00	Ba-140 LLD not met due to untimely analysis.
Sta 11	River Water	12/18/00	Ba-140 LLD not met due to untimely analysis.
Sta 01A	Precipitation	12/27/00	Co-58, Fe-59, Zr-95, and Ba-140 LLDs not met due to untimely analysis.
All Stations	Annual Environmental TLDs	01/11/01	Removed annual TLD's 6 months early to reflect true annual dose from June to December with change of vendor.
All Stations	Vegetation	01/11/01	Seasonal unavailability.
All Stations	Vegetation	01/11/01	Seasonal unavailability.

In late September of 1999, Teledyne Brown Engineering announced that the laboratory would move from its 35 year home in Westwood, NJ and relocate to Knoxville, TN. Build out of the new laboratory in Knoxville, began in January of 2000 with a two-phase move from Westwood to Knoxville scheduled for June and September. Unfortunately construction delays prevented the June phase one occupancy forcing the laboratory into a one-phase move, a significant delay in NUPIC approval of the Knoxville facility, and the use of NUPIC approved sub-contract laboratories to analyze REMP samples. This change resulted in significant delays in analytical turnaround times, in obtaining necessary regulatory compliance approvals, and caused extraordinary difficulties for the laboratory and all of its customers. The most important consequences of this delay was the need to utilize two sub-contractor laboratories, Allegheny Environmental Services in Northbrook, IL and the Duke Engineering Laboratory in Marlborough, MA, to perform REMP analyses between October, 20000 and January, 2001

The Westwood laboratory ceased analytical operations in October and was closed on November 15; the Knoxville laboratory was ready to analyze samples by the middle of December, but was not scheduled for NUPIC audit until the end of January, 2001. During the period October 15 through December 15, 2000, the Knoxville laboratory under went several customer surveillances allowing it to perform some limited customer analyses. The Knoxville laboratory is now in full production, is NUPIC approved, and looks forward to another 35 years of partnership with our nuclear power colleagues.

IV. SUMMARY AND DISCUSSION OF 2000 ANALYTICAL RESULTS

IV. Summary And Discussion of 2000 Analytical Results

Data from the radiological analyses of environmental media collected during 2000 are tabulated and discussed below. The procedures and specifications followed in the laboratory for these analyses are as required in the Teledyne Brown Engineering Quality Assurance manual and are explained in the Teledyne Brown Engineering Analytical Procedures. A synopsis of analytical procedures used for the environmental samples is provided in Appendix D. In addition to internal quality control measures performed by Teledyne, the laboratory also participates in the Interlaboratory Comparison program. 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 counting to time of collection. Teledyne Brown Engineering's analytical methods meet the Lower Limit of Detection (LLD) requirements give in table 2 of the USNRC Branch Technical Position, Radiological Monitoring Acceptable Program (November 1979, Revision 1) and the ODCM.

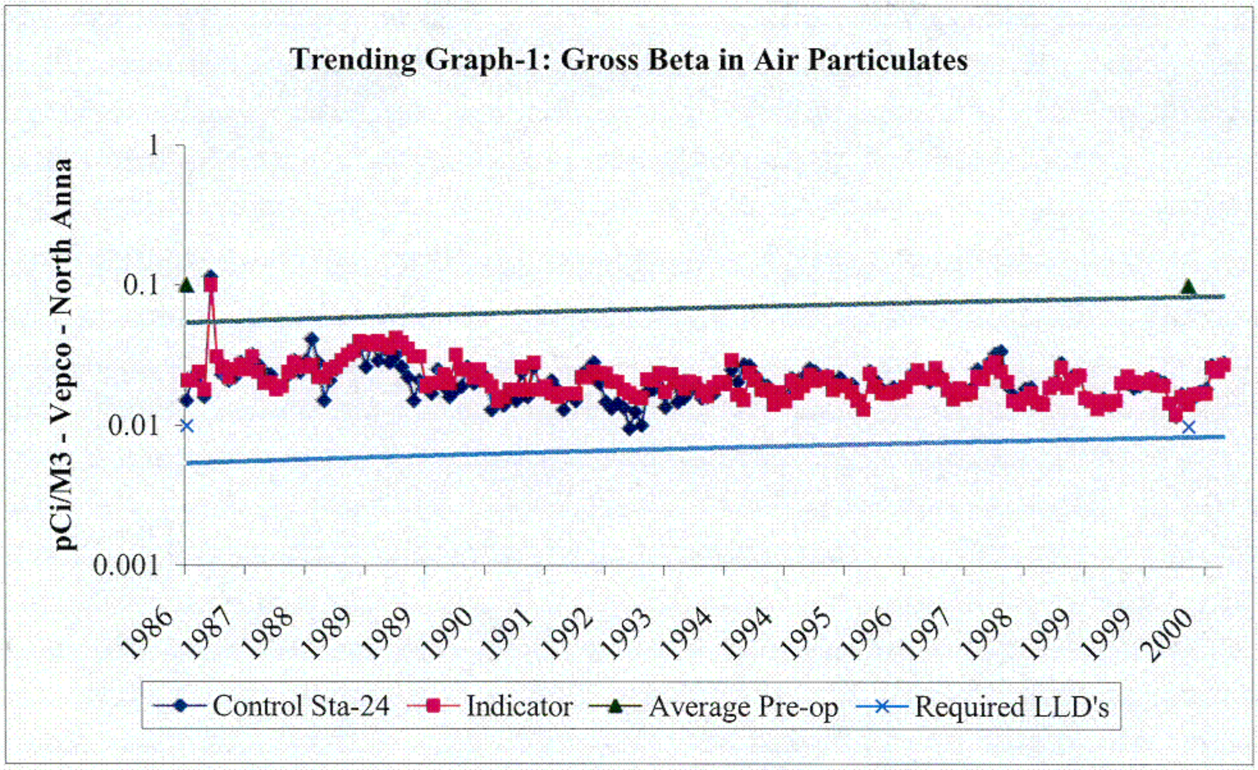
The following is a discussion and summary of the results of the environmental measurements taken during the 2000 reporting period.

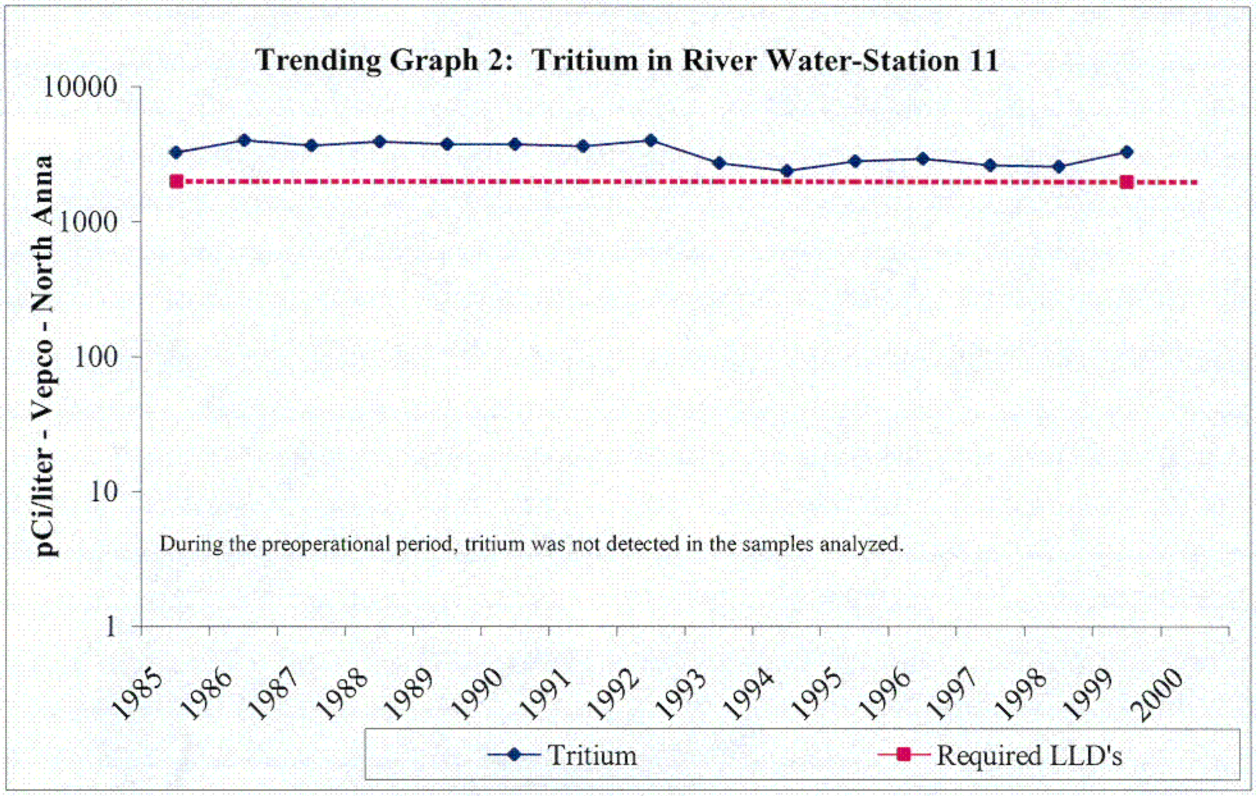
A. Airborne Exposure Pathway

1. Air Iodine/Particulates

Charcoal cartridges used to collect airborne iodine were collected weekly and analyzed by gamma spectrometry for iodine-131. The results are presented in Table B-1. All results were below the required lower limit of detection. For air particulates, gross beta activity was observed in all fifty-one control samples with an average concentration of 0.019 pCi/m^3 and a range of 0.007 to 0.040 pCi/m^3. The average measurement for the indicator locations was 0.019 pCi/m^3 with a range of 0.006 to 0.070 pCi/m^3. The results of the gross beta activities are presented in Table B-2. The gross beta activities for 2000 were comparable to levels measured in the 1982-1999 period. Prior to that period the gross beta activities were higher due to atmospheric nuclear weapons testing performed in other countries. During the preoperational period of July 1, 1974 through March 31, 1978 gross beta activities ranged from a low of 0.005 pCi/m^3 to a high of 0.75 pCi/m^3.

Air particulate filters were composited by locations on a quarterly basis and were analyzed by gamma ray spectroscopy. The results are listed in Table B-3. Beryllium-7, which is produced continuously in the upper atmosphere by cosmic radiation, was measured in all 23 of the 24 composite samples. The average measurement for the control location was 0.067 pCi/m^3 with a range of 0.066 to 0.067 pCi/m^3. The indicator locations had an average concentration of 0.061 pCi/m^3 and a range of 0.029 to 0.076 pCi/m^3. During the preoperational period, beryllium-7 was measured at comparable levels, as would be


Trending Graph-1: Gross Beta in Air Particulates
pCi/M3 - Vepco - North Anna
1
0.1
0.01
0.001
1986
1987
1988
1989
1989
1990
1991
1992
1993
1994
1994
1995
1996
1997
1998
1999
1999
2000
Control Sta-24
Indicator
Average Pre-op
Required LLD's


Trending Graph 2: Tritium in River Water-Station 11
pCi/liter - Vepco - North Anna
10000
1000
100
10
1
During the preoperational period, tritium was not detected in the samples analyzed.
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
Tritium
Required LLD's

C 5

expected. Naturally occurring potassium-40 was not detected in any control samples.. Potassium-40 was detected in two indicator samples with an average concentration of 0.005 pCi/m3 and a range of 0.005 to 0.006 pCi/m3. All other gamma emitters were below the detection limits. During the preoperational period gamma ray spectroscopy measured several fission products in numerous air particulate filters. All isotopes were attributed to atmospheric nuclear weapons testing conducted before the preoperational period. Among the isotopes measured were zirconium-95, ruthenium-103, ruthenium-106, cesium-137, cerium-141 and cerium-144.

The second quarter composites of air particulate filters from all twelve stations were analyzed for strontium-89 and 90. There was no detection of these fission products at any of the ten indicator stations nor at the control station.

2. Precipitation

A sample of rain water was collected monthly at station 01A, on site, 0.75 miles, 138 degrees SE and analyzed for gross beta activity. The results are presented in Table B-4. The average gross beta activity for 2000 in ten of the twelve samples was 3.9 pCi/liter with a range from 0 to 10 pCi/liter. Semi-annual composites were prepared and analyzed for gamma emitting isotopes and tritium. Beryllium-7 was not detected during the semi-annual composite sample for the first half of 2000. All other gamma emitters were below their detection limits. Tritium was not detected in the semi-annual composite samples. These results were comparable to or lower than those measured in 1986 through 1999. During the preoperational period gross beta activity in rain water was expressed in nCi per square meter of the collector surface, thus a direct comparison can not be made to the 2000 period. During the preoperational period, tritium was measured in over half of the few quarterly composites made. The tritium activity ranged from 100 to 330 pCi/liter.

3. Soil

Soil samples are collected every three years. Since they were collected in 1998, they were not collected during 2000.

B. Waterborne Exposure Pathway

1. Ground/Well Water

Water was sampled quarterly from the on site well at the metrology laboratory. These samples were analyzed for gamma radiation and for tritium. The results are presented in Table B-6. No gamma emitting isotopes were detected during 2000. The second quarter sample was analyzed for strontium-89 and strontium-90. There was no measured activity of these isotopes above the detection level. Tritium was not measured above the detection level. No gamma emitting isotopes were detected during the preoperational period. Tritium was measured in most of the samples during that period with concentrations between 80 and 370 pCi/liter.

2. River Water

A sample of water from the North Anna River was collected monthly at station 11, 5.8 miles downstream from the discharge lagoon, 128 degrees SSE. The results are presented in Table B-7. The samples were analyzed by gamma spectroscopy monthly. The samples were analyzed for tritium quarterly on a composite sample. The second quarter samples were analyzed in addition for strontium-89 and strontium-90.

Potassium-40 was detected in three of the twelve samples with an average concentration of 148 pCi/liter and a range of 7.7 to 385 pCi/liter[3]. All other gamma emitters were below their detection level. There was no measured activity of strontium-89 or strontium-90 above the detection limit. Tritium was measured in two samples with an average level of 3100 pCi/liter and a range of 1500 to 4700 pCi/liter. This is lower than the average level measured in 1999 of 3350 pCi/liter and a range of 3000 to 3800 pCi/liter. No river water samples were collected during the preoperational period.

3. Surface Water

Samples of surface water were collected monthly from two stations. Station 08 is at the discharge lagoon, 1.1 miles, 148 degrees SSE on Lake Anna. Station 09A is located 12.9 miles WNW. The samples were analyzed for iodine-131 by radiochemical separation. No iodine was detected in the 18 samples analyzed. The results are presented in Table B-8. The samples were also analyzed by gamma ray spectrometry. Naturally occurring potassium-40 was detected in one of the twelve samples with a concentration of 39.8 pCi/liter. All other gamma emitters were below their detection level.

A quarterly composite from each station was prepared and analyzed for tritium. The tritium activity at station 08 for the quarterly composites was at an average level of 3000 pCi/liter with a range of 1500 to 4500 pCi/liter. The tritium level had been increasing since the middle of 1978 when the average level was below 300 pCi/liter. However, during 2000 the results were within the same range as those measured in 1986 through 1999. During the preoperational period tritium was measured in several samples with concentrations between 90 and 250 pCi/liter. Tritium was not detected at station 09A.

C. Aquatic Exposure Pathway

1. Sediment/Silt

Sediment samples were collected during February and August from each of three locations and were analyzed by gamma spectrometry. The results are presented in Table B-9. One man-made and a number of naturally occurring radioisotopes were detected in these samples. Cesium-137 was detected in two samples with an average activity of 104 pCi/kg (dry weight) and a range from 38.8 to 205 pCi/kg (dry weight). The highest reading for cesium-137 was obtained from station 8 located 1.10 miles SSE.

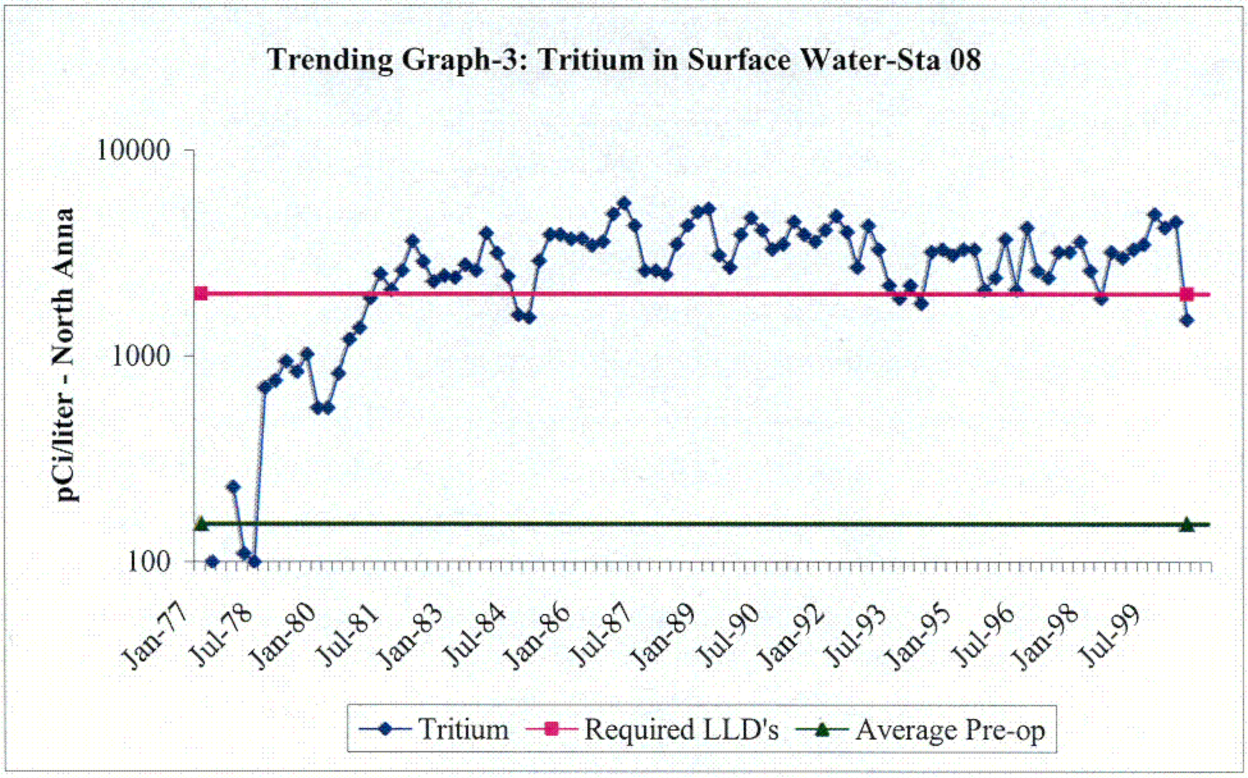
Naturally occurring potassium-40 was observed in all five of the six samples with an average activity of 10928 pCi/kg (dry weight) and a range from 3040 to 1470 pCi/kg (dry weight). Naturally occurring, thorium-228 was observed in all six samples with an average concentration of 932 pCi/kg (dry weight) and a range of 846 to 1100 pCi/kg (dry weight). Radium-226 was measured in four of the six samples with an average concentration of 1420 pCi/kg (dry weight) and a range of 399 to 1870 pCi/kg (dry weight). The August samples were analyzed for strontium-89 and strontium-90. There were no measurable amounts of strontium-89 or strontium-90 in aquatic sediment/silt.

During the preoperational period sediment samples were analyzed by gamma ray spectroscopy. Cesium-137 was measured in most of the samples with concentrations between 33 and 1210 pCi/kg (dry weight). Strontium-90 was measured in most of the samples with concentrations between 60 and 540 pCi/kg (dry weight). Strontium-89 was not measured. Potassium-40, radium-226, and thorium-228, all naturally occurring, were measured at background levels.

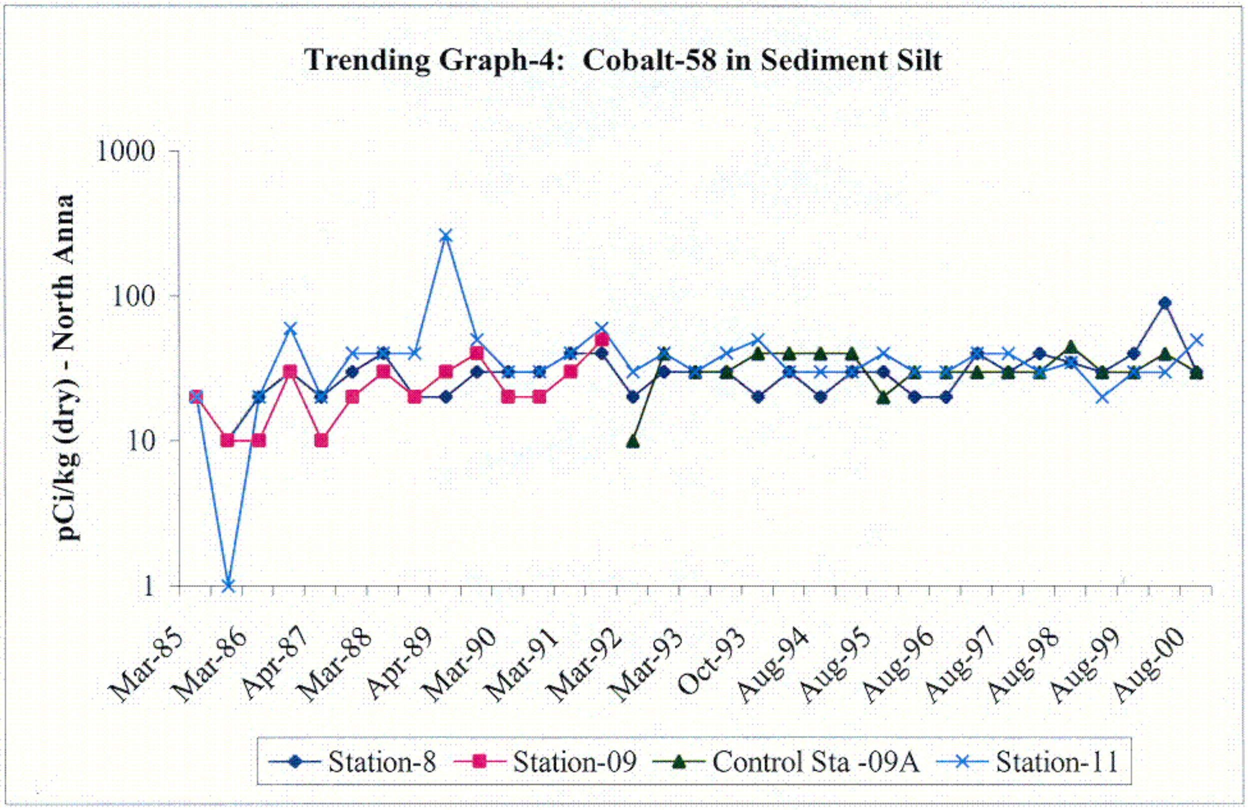
2. Shoreline Soil

A sample of shoreline sediment was collected in February and August from station 08. The samples were analyzed by gamma ray spectrometry. The results are presented in Table B-11. The naturally occurring nuclide potassium-40 was measured in both samples with an average activity of 1345 pCi/kg (dry weight) and a range of 1280 to 1410 pCi/kg (dry weight). Cosmogenic beryllium-7 was not measured during 2000. Thorium-228 was measured in both samples at an average of 251 pCi/kg (dry weight) and a range of 203 to 298 pCi/kg (dry weight). Radium-226 was measured in both samples with a concentration of 464 pCi/kg (dry weight) and a range of 313 to 615 pCi/kg (dry weight). Cesium-137, a fission product, was measured in one sample with a concentration of 167 pCi/kg (dry weight).

The August sample was analyzed for strontium-89 and strontium-90. There was no measured amount of strontium-89. Strontium-90 was measured at a concentration of 100 pCi/kg (dry weight).

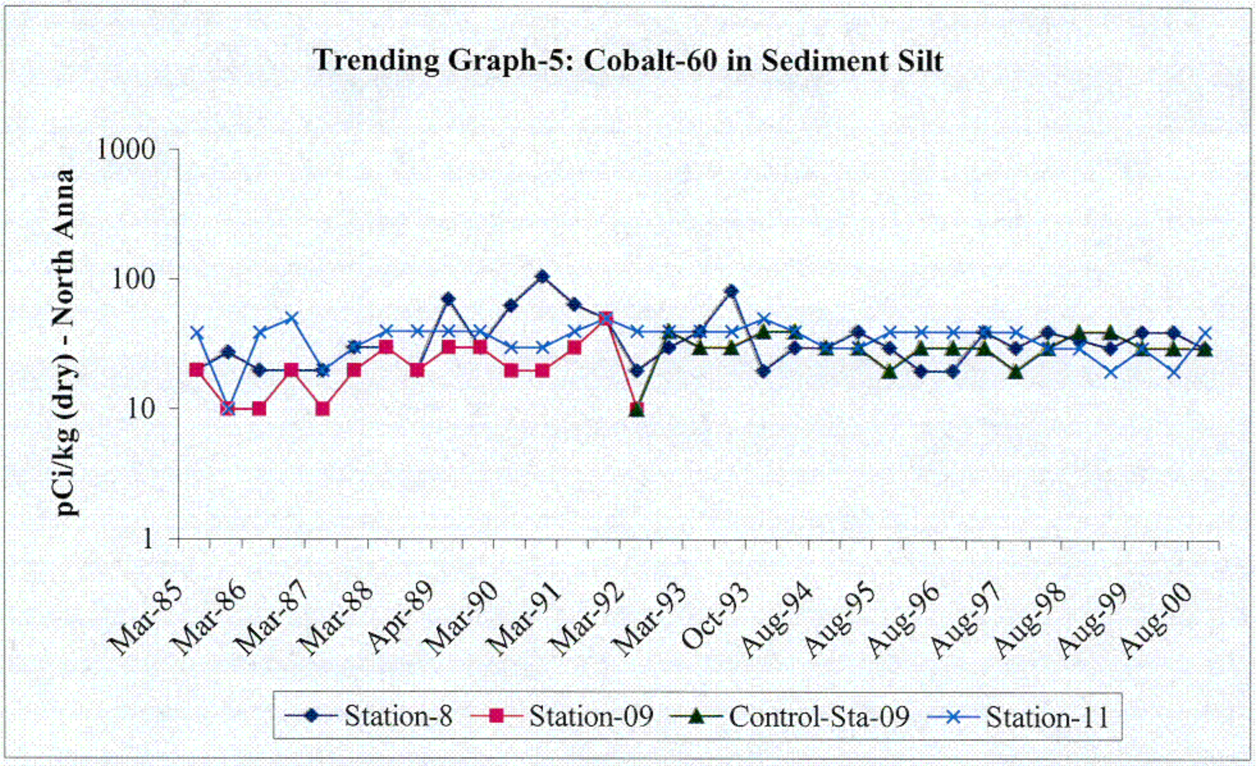


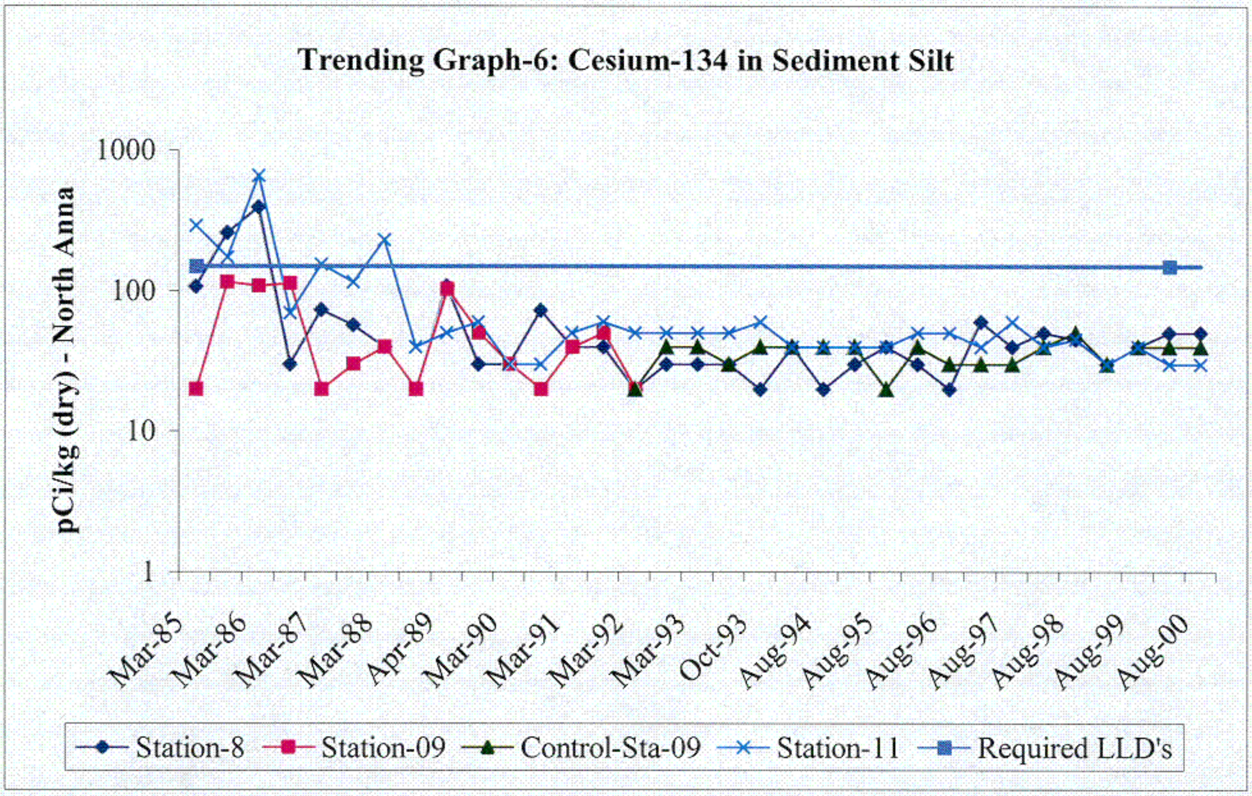
Trending Graph-3: Tritium in Surface Water-Sta 08
pCi/liter - North Anna
10000
1000
100
Jan-77
Jul-78
Jan-80
Jul-81
Jan-83
Jul-84
Jan-86
Jul-87
Jan-89
Jul-90
Jan-92
Jul-93
Jan-95
Jul-96
Jan-98
Jul-99
Tritium
Required LLD's
Average Pre-op



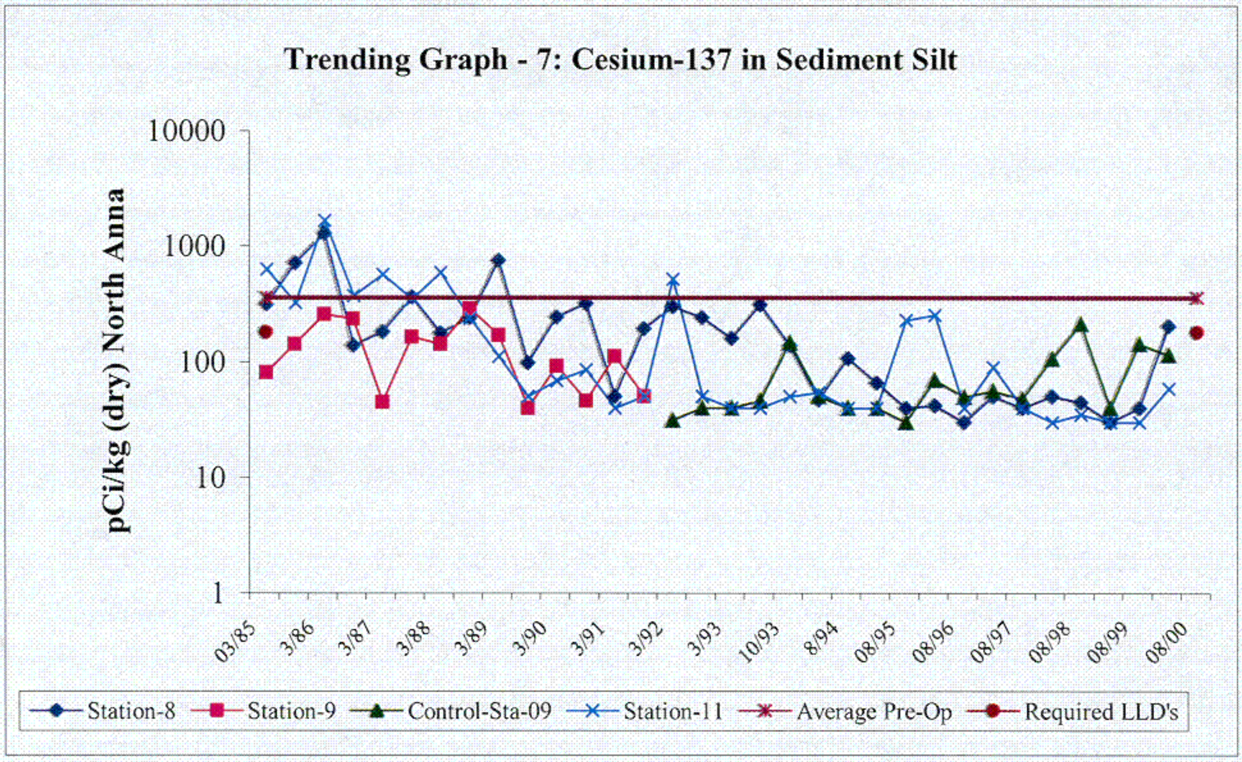
Trending Graph-4: Cobalt-58 in Sediment Silt
pCi/kg (dry) - North Anna
1000
100
10
1
Mar-85
Mar-86
Apr-87
Mar-88
Apr-89
Mar-90
Mar-91
Mar-92
Mar-93
Oct-93
Aug-94
Aug-95
Aug-96
Aug-97
Aug-98
Aug-99
Aug-00
Station-8
Station-09
Control Sta -09A
Station-11

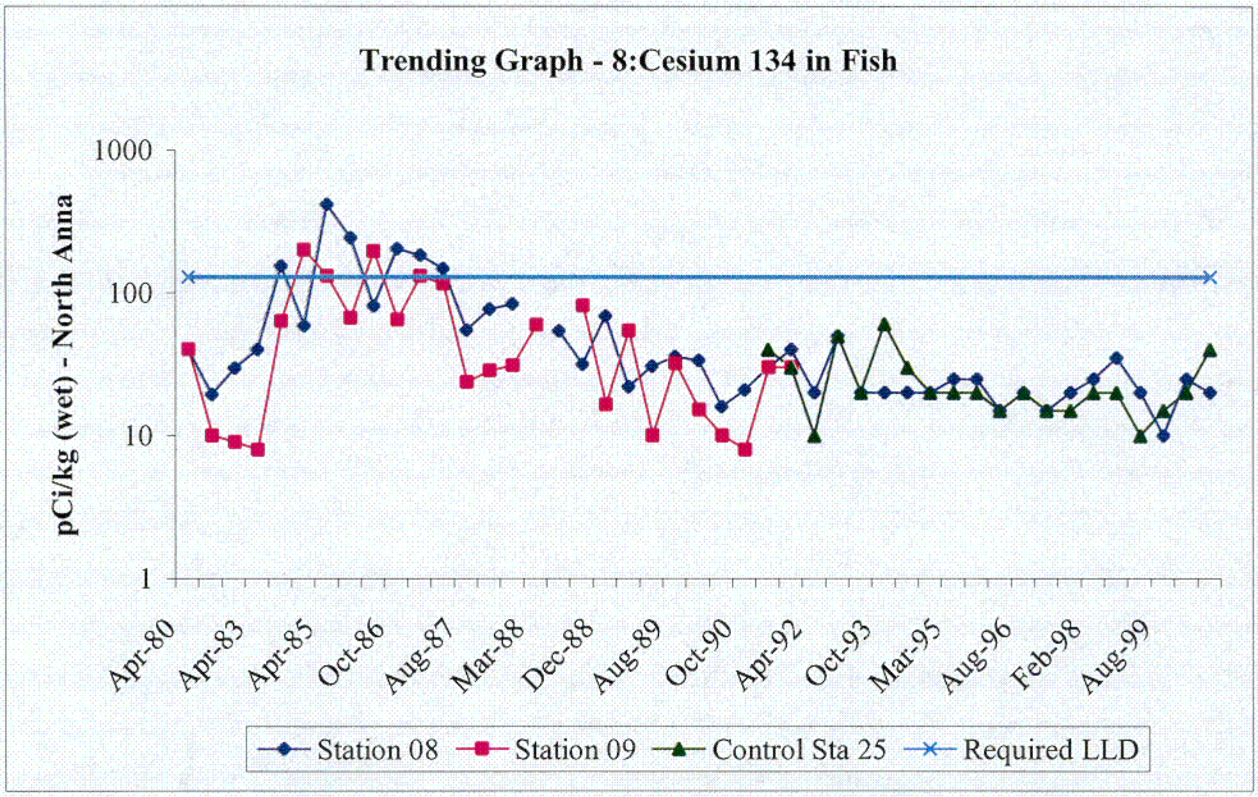
C-5B


Trending Graph-5: Cobalt-60 in Sediment Silt
pCi/kg (dry) - North Anna
1000
100
10
1
Mar-85
Mar-86
Mar-87
Mar-88
Apr-89
Mar-90
Mar-91
Mar-92
Mar-93
Oct-93
Aug-94
Aug-95
Aug-96
Aug-97
Aug-98
Aug-99
Aug-00
Station-8
Station-09
Control-Sta-09
Station-11


Trending Graph-6: Cesium-134 in Sediment Silt
pCi/kg (dry) - North Anna
1000
100
10
1
Mar-85
Mar-86
Mar-87
Mar-88
Apr-89
Mar-90
Mar-91
Mar-92
Mar-93
Oct-93
Aug-94
Aug-95
Aug-96
Aug-97
Aug-98
Aug-99
Aug-00
Station-8
Station-09
Control-Sta-09
Station-11
Required LLD's

C-6


Trending Graph - 7: Cesium-137 in Sediment Silt
pCi/kg (dry) North Anna
10000
1000
100
10
1
03/85
3/86
3/87
3/88
3/89
3/90
3/91
3/92
3/93
10/93
8/94
08/95
08/96
08/97
08/98
08/99
08/00
Station-8
Station-9
Control-Sta-09
Station-11
Average Pre-Op
Required LLD's


Trending Graph - 8:Cesium 134 in Fish
pCi/kg (wet) - North Anna
1000
100
10
1
Apr-80
Apr-83
Apr-85
Oct-86
Aug-87
Mar-88
Dec-88
Aug-89
Oct-90
Apr-92
Oct-93
Mar-95
Aug-96
Feb-98
Aug-99
Station 08
Station 09
Control Sta 25
Required LLD

c-1

D. Ingestion Exposure Pathway

1. Milk

The results of the iodine-131 analysis of milk samples are presented in Table B-12. A sample was collected monthly from two stations. A total of 24 samples were analyzed during 2000. There were no measurements of iodine-131 above the detection limits. The milk samples were also analyzed by gamma ray spectroscopy and the results are also presented in Table B-12. A total of 24 samples were analyzed. Naturally occurring potassium-40 was measured in all samples with an average of 1261 pCi/liter and a range of 1090 to 1410 pCi/liter. The fission product cesium-137 has been detected sporadically in recent years and the activity has been attributed to global fallout from past atmospheric weapons testing. However, cesium-137 was not detected at levels above LLD in any milk samples during 2000. All other gamma emitters were below their detection levels. A quarterly composite was prepared from each of the two collection stations and analyzed for strontium-89 and strontium-90. Strontium-89 was not detected at levels above LLD in any of the samples monitored. Strontium-90 was detected in the four samples monitored with an average level of 0.97 pCi/liter and a range of 0.75 to 1.2 pCi/liter. This is similar to activities determined in previous years and lower than the preoperational levels of 2.2 to 5.4 pCi/liter.

2. Fish

Aquatic biota can be sensitive indicators of radionuclide accumulation in the environment because of their ability to concentrate certain chemical elements which have radioactive isotopes. The results are presented in Table B-13. Eight samples of fish were collected during 2000. These samples were analyzed by gamma ray spectroscopy and the naturally occurring isotope potassium-40 was found in all samples at an average of 1157 pCi/kg (wet weight) with a range of 1120 to 2380 pCi/kg (wet weight). The fission product cesium-137 was measured in two of the eight samples with an average activity of 42.6 pCi/kg (wet weight) with a range of 34.1 to 51.1 pCi/kg (wet weight). During the preoperational period cesium-137 was measured in one-fourth of the fish samples collected with concentrations between 31 and 66 pCi/kg (wet weight). All other gamma emitters were below their detection levels.

3. Food/Vegetation

Thirty-five food samples were collected from five locations and analyzed by gamma spectrometry. The results are presented in Table B-14. Naturally occurring potassium-40 was monitored in all 35 samples with an average activity level of 11116 pCi/kg (wet weight) and a range of 7190 to 21300 pCi/kg (wet weight). Cosmogenic beryllium-7 was detected in 23 of the 35 samples with an average concentration of 933 pCi/kg (wet weight) and a range of 221 to 3540 pCi/kg (wet weight)..

Cesium-134, a fission product, was not detected at levels above LLD during 2000. Cesium-137 has been detected in some samples at low-levels in previous years and was detected in two samples at an average concentration of 98.8 pCi/kg (wet weight). Cesium-

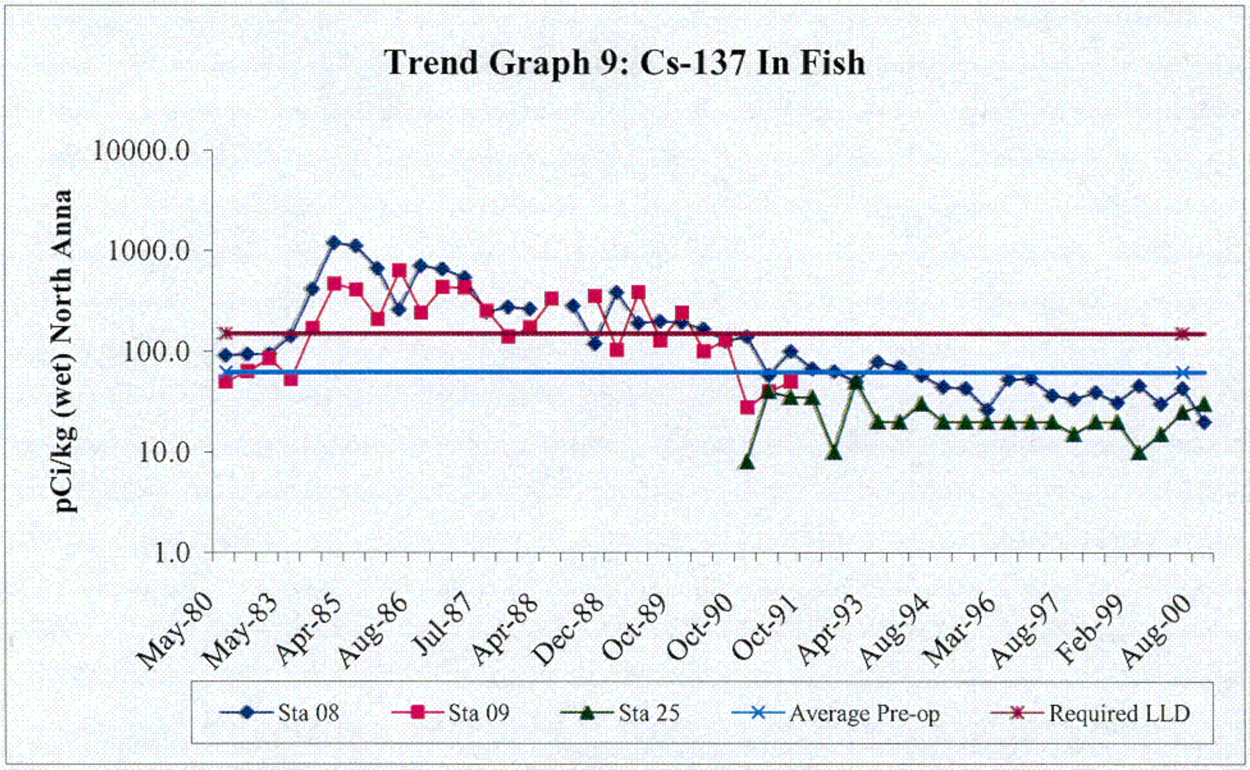
137 was measured in broadleaf garden vegetation during the preoperational period with concentrations between 53 and 98 pCi/kg (wet weight).

E. Direct Radiation Exposure Pathway

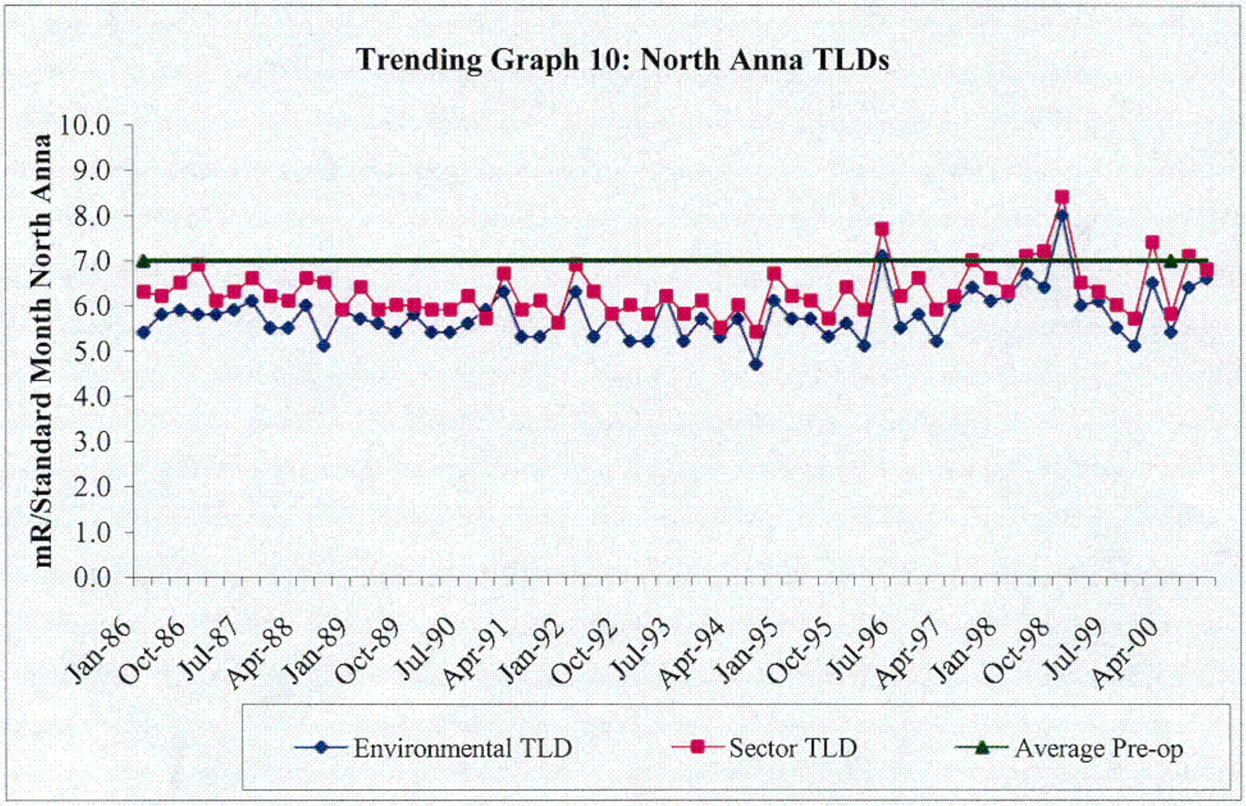
1. TLD Dosimeters

Thermoluminescent dosimeters (TLDs) determine environmental radiation doses and the results are presented in Table B-14. Individual measurements of external radiation levels in the environs of the North Anna site had an average dose of 5.5 mR/standard month with a range of 4.3 to 7.1 mR/standard month. This is comparable to the preoperational range. Station, No. 1, had an average reading of 8.2 mR/standard month with a range of 7.5 to 8.7 mR/standard month.

Sector TLDs are deployed quarterly at thirty-two locations in the environs of the North Anna site. Two badges are placed at each location. The results are presented in Table B-15. The average level of the 32 locations (two badges at each location) was 6.9 mR/standard month with a range of 3.9 to 11.1 mR/standard month. The eight control TLDs, collected quarterly from four locations, showed an average reading of 5.9 mR/standard month with a range of 3.9 to 7.9 mR/standard month. During the preoperational period (starting in 1977), when the calculation of the TLD dose included a correction for the in-transit dose, the doses were measured between 4.3 and 8.8 mR/standard month.



Trend Graph 9: Cs-137 In Fish
pCi/kg (wet) North Anna
10000.0
1000.0
100.0
10.0
1.0
May-80
May-83
Apr-85
Aug-86
Jul-87
Apr-88
Dec-88
Oct-89
Oct-90
Oct-91
Apr-93
Aug-94
Mar-96
Aug-97
Feb-99
Aug-00
Sta 08
Sta 09
Sta 25
Average Pre-op
Required LLD



Trending Graph 10: North Anna TLDs
mR/Standard Month North Anna
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Jan-86
Oct-86
Jul-87
Apr-88
Jan-89
Oct-89
Jul-90
Apr-91
Jan-92
Oct-92
Jul-93
Apr-94
Jan-95
Oct-95
Jul-96
Apr-97
Jan-98
Oct-98
Jul-99
Apr-00
Environmental TLD
Sector TLD
Average Pre-op

C-8

V. CONCLUSIONS

V. Conclusions

The results of the 2000 Radiological Environmental Monitoring Program for the North Anna Nuclear Power Station and ISFSI have been presented. The following sections discuss each pathway individually followed by a program summary.

Airborne Exposure Pathway

Air particulate gross beta concentrations of all the indicator locations for 2000 followed the gross beta concentrations at the control location. The gross beta concentrations were comparable to levels observed since 1982 except for a five week period in 1987 which was influenced by the Chernobyl accident. Gross beta concentrations in the preoperational period were highly variable, ranging from 0.0043 to 0.75 pCi/CuM, due to occasional atmospheric nuclear weapons tests. Gamma isotopic analysis of the particulate samples identified the gamma emitting isotopes as natural products (beryllium-7 and potassium-40). There was no detection above the LLD for fission products nor other man-made isotopes in the particulate media during 2000. Iodine-131 was not detected in the charcoal filters analyzed during 2000.

A precipitation sample was collected monthly during 2000 and analyzed for gross beta activity. All the gross beta activities were comparable to those measured in previous years. During the preoperational period the average gross beta activity was 0.92 pCi/liter. Semi-annual composites were analyzed for gamma emitting isotopes and tritium. All gamma emitters were below their detection limits. Tritium was not observed above the LLD during this reporting period in 1998. During the preoperational period the average tritium activity was 165 pCi/liter.

Waterborne Exposure Pathway

No man-made or natural isotopes were monitored in the surface water of Lake Anna except tritium. The average tritium activity during 2000 at the waste heat treatment facility was 3000 pCi/liter which is 13.2% of the reporting level for a water sample. In 1999 the tritium level was 3975 pCi/liter. The preoperational level was 150 pCi/liter and has risen since 1977, though it has remained relatively consistent since 1986.

River water collected from the North Anna River, 5.8 miles downstream of the site had an average tritium level of 3100 pCi/liter. The average tritium in 1999 had been 2600 pCi/liter. Naturally occurring potassium-40 wad measured in 3 out of 12 samples at an average concentration of 148 pCi/liter. No other gamma emitters were detected.

Ground water from the environmental well on site contained no gamma emitters. There were also no detection of tritium in ground/well water during 2000.

Aquatic Pathway

Sediment/silt samples provide a sensitive indicator of discharges from nuclear power stations. The sediment from North Anna environmental samples indicated that one man-made isotope was present. Cesium-137 was detected in two samples at the indicator location and in one sample at the control location. During the preoperational period, cesium-137 was measured in samples of aquatic sediment. Sediment contamination does not provide a direct dose pathway to man.

The samples of shoreline soil monitored downstream of the site contained no measurement of cesium-134. Cesium-137 was measured in both samples at an average level of 167 pCi/kg. Cesium-137 was not detected during 1999.

Ingestion Pathway

Iodine-131 was not detected in any of the twenty-four milk samples using the radiochemical separation method. Although cesium-137 has been detected occasionally in previous years and attributed to past atmospheric nuclear weapons testing there was no detection during 2000. Strontium-90 was measured in all four milk samples. Strontium-90 is attributed to past atmospheric nuclear weapons testing. No strontium-89 was detected in any of the milk samples. Naturally occurring potassium-40 was measured in all the milk samples at normal environmental levels.

Activity in fish and vegetation samples along with milk does present a direct dose pathway to man. Fish samples during 2000 showed the presence of one man-made isotope, cesium-137. This isotope was at an activity level somewhat higher than preoperational levels but statistically similar to levels in 1987 through 1999. Only cesium-137 was measured in preoperational environmental fish samples. Due to primary and secondary steam generator problems experienced at North Anna during 1984/1985, a build up in activity levels both in effluents and fish did occur. Repairs to the steam generators and better liquid waste processing have reduced these activity levels in effluents and thus decreased activity levels are now being observed in the fish. The average level of activity during 2000 of cesium-137 was 1.6% of the reporting level.

One vegetation sample contained cesium-137 at a level of 186 pCi/kg. Cesium-137 has been measured in the past and in preoperational samples.

Direct Exposure Pathway

The direct exposure pathway as measured in the environment of the North Anna site by thermoluminescent dosimetry has remained essentially the same since the preoperational period in 1977 at 6 milliroentgens per month or 0.2 milliroentgens per day. The average dose levels monitored have shown a normal fluctuation about these levels which are less than the estimated whole body dose due to natural terrestrial and cosmic radiation and the internal dose from natural radionuclides.

Program Conclusions

The results were as expected for normal environmental samples. Naturally occurring activity was observed in sample media in the expected activity ranges. Occasional samples of nearly all media showed the presence of man-made isotopes. These have been discussed individually in the text. Observed activities were at very low concentrations and had no significant dose consequence.

As a method of referencing the measured radionuclide concentrations in sample media to the dose consequence, the data may be compared to the Reporting Level Concentrations listed in the Offsite Dose Calculation Manual. These concentrations are based upon 25% of the annual dose commitment recommended by 10CFR50, Appendix I, to meet the criterion "As Low as is Reasonably Achievable". Based upon the evidence of the environmental monitoring program the station is operating within regulatory limits. Thus, no unusual radiological characteristics were observed in the environs of the North Anna Nuclear Power Station during 2000.

VI. REFERENCES

VI. References

1. Virginia Electric and Power Company, North Anna Power Station Technical Specifications, Units 1 and 2.

2. Virginia Electric and Power Company, Station Administrative Procedure, VPAP-2103, "Offsite Dose Calculation Manual".

3. Title 10 Code of Federal Regulation, Part 50 (10CFR50), "Domestic Licensing of Production and Utilization Facilities".

4. 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.

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

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

7. NUREG 0472, "Radiological Effluent Technical Specifications for PWRs", Rev. 3, March 1982.

8. "Technical Specifications for North Anna Independent Spent Fuel Storage Installation (ISFSI)"

APPENDIX A

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

ANNUAL SUMMARY TABLES – 2000

Medium or Pathway Sampled (Unit)	Analysis		LD*	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	
Air Iodine (pCi/m^3)	I-131	624	0.04	(0/561)(a,b) -	N/A		N/A	(0/49)(a,b) -	0
Airborne Particulates ($1E-03$ pCi/m^3)	Gross Beta	624	5	18.7(560-572)(a) (6.0-70)	23	0.93 mi SSE	20.0(52/52) (7.6-70)	19.4(51/52)(a) (7.1-41)	0
	Gamma	24							
	Be-7	24	10	61.0(21/22) (29.2-75.6)	24	22.0 mi NW	66.7(2/2) (66.0-67.4)	66.7(2/2) (66.0-67.4)	0
	K-40	24	10	5.43(2/22) (4.95-5.91)	07	7.30 mi SSE	5.91(1/2) -	(0/4) -	0
	Sr-89	12	3	(0/10) -	N/A		N/A	(0/2) -	0
	Sr-90	12	0.4	(0/10) -	N/A		N/A	(0/2) -	0
Ground Well Water (pCi/liter)	Gamma	4							
	K-40	4	60	(0/4) -	N/A		N/A	(0/0) -	0
	Tritium	3	2000	(0/3) -	N/A		N/A -	(0/0) -	0
	Sr-89	1	3	(0/1) -	N/A		N/A	(0/0) -	0
	Sr-90	1	0.4	(0/1) -	N/A		N/A	(0/0) -	0

* *LLD is the Lower Limit of Detection as defined and required in USNRC Branch Technical Position on an Acceptable Radiological Environmental Monitoring Program, Revision 1, November 1979.*
a) Sample was lost.
b) Samples not analyzed.
c) No precipitation for October.

Medium or Pathway Sampled (Unit)	Analysis Type	Analysis Total No.	LD*	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
River Water	Gamma	12							
(pCi/liter)	K-40	12	200	148(3/12) (7.7-385)	11	5.8 mi SSE	148(3/12) (7.7-385)	(0/0) -	0
	Tritium	2	2000	3100(2/2) (1500-4700)	11	5.8 mi. SSE	3100(2/2) (1500-4700)	(0/0) -	0
	Sr-89	1	3	(0/1) -	N/A		N/A	(0/0) -	0
	Sr-90	1	0.4	(0/1) -	N/A		N/A	(0/0) -	0
Precipitation (pCi/liter)	Monthly								
	Gross Beta	12	4	3.89(10/12) (0-10)	01A	0.2 mi. NE	3.89(10/12) (0-10)	(0/0) -	0
	Gamma (Semi-Annually	2		(0/2) -				(0/0) -	
	Tritium	1	2000	(0/1) -	N/A		N/A	(0/0) -	0
Surface Water (pCi/liter)	I-131	24	0.5	(0/12) -	N/A		N/A	(0/12) -	0
Regular Monthlies	Gamma	24							
	K-40	24	200	39.8(1/12)	08	1.0 mi SSE	39.8(1/12)	(0/12) -	0
	Tritium	4	2000	3000(2/2) (1500-4500)	08	1.10 mi SSE	3000(2/2) (1500-4500)	(0/2) -	0

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

a) *Sample was lost.*

b) *Samples not analyzed.*

c) *No precipitation for October.*

Medium or Pathway Sampled (Unit)	Analysis Type	Analysis Total No.	LD*	All Indicator Locations Mean Range	Location with Highest Mean Name	Distance Direction	Mean Range	Control Location Mean Range	Non-routine Reported Measurements
Surface Water (pCi/liter)	Sr-89	1		(0/1) -	N/A		N/A	(0/1) -	0
Regular Monthlies	Sr-90	1		(0/1) -	N/A		N/A	(0/1) -	0
Surface Water	Gamma	NA							
(pCi/liter) State Splits	K-40	NA							
	Tritium	NA							
Sediment Silt	Gamma	6							
(pCi/kg (dry))	Be-7	6		(0/4) -	NA		NA	227(1/2) (227)	0
	K-40	6	200	10460(4/4) (3040-14700)	11	5.8 mi SSE	13800(2/2) (12900-14700)	12800(1/2) (12800)	0
	Cs-137	6	194	132(2/4) (58.8-205)	08A	1.10 mi SSE	205(1/2) (205)	1720(1/2) (1720)	0
	Ra-226	6	100	1320(3/4) (399-1870)	08	1.10 mi SSE	1870(1/2) (1870)	1720(1/2) (1720)	0
	Th-228	6	30	975(2/4) (849-1100)	08	1.10 mi. SSE	1100(1/2) (1100)	846(1/2) (846)	0
	Sr-89 (Annually)	3	4.0	(0/0) -	N/A		N/A	(0/0) -	0
	Sr-90 (Annually)	3	0.8	(0/0) -	N/A		N/A	(0/0) -	0

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

a) *Sample was lost.*

b) *Samples not analyzed.*

c) *No precipitation for October.*

Medium or Pathway Sampled (Unit)	Analysis Type	Analysis Total No.	LD*	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
Soil (pCi/kg (dry))	Gamma	0							
	Be-7	0							
	K-40	0							
	Cs-134	0	100						
	Cs-137	0	180						
	Ra-226	0	100						
	Th-228	0	30						
	Sr-89 (Annually)	0	200						
	Sr-90 (Annually)	0	40						

Soil samples are collected every three years. Since they were collected in 1998, they were not collected during 2000.

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

a) Sample was lost.
b) Samples not analyzed.
c) No precipitation for October.

Medium or Pathway Sampled (Unit)	Analysis		LD*	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 Soil	Gamma	2							
(pCi/kg (dry))	Be-7	2		(0/2) -	N/A		N/A	(0/0) -	0
	K-40	2	200	1345(2/2) (1280-1410)	8	1.10 mi SSE	1345(2/2) (1280-1410)	(0/0) -	0
	Cs-137	2	40	167(1/2) (167)	8	1.10 mi SSE	167(1/2) (167)	(0/0) -	0
	Ra-226	2	100	464(2/2) (313-615)	8	1.10 mi SSE	464(2/2) (313-615)	(0/0) -	0
	Th-228	2	30	251(2/2) (203-298)	8	1.10 mi SSE	251(2/2) (203-298)	(0/0) -	0
	Sr-89 (Annually)	1	4.0	(0/1) -	N/A		N/A	(0/0) -	0
	Sr-90 (Annually)	1	0.8	100(1/1) (100)	8	1.10 mi SSE	100(1/1) (100)	(0/0) -	0
Milk (pCi/liter)	I-131	24	0.5	(0/24) -	N/A		N/A	(0/0) -	0
	Gamma	24							
	K-40	24	100	1336(23/24) (1010-1590)	12	8.3 mi. NW	1394(11/12) (1220-1590)	(0/0) -	0
	Sr-89 (Quarterly)	4	5	(0/4) -	N/A		N/A	(0/0) -	0
	Sr-90 (Quarterly)	4	0.8	0.97(4/4) (0.75-1.2)	12	8.3 mi NW	0.98(2/2) (0.75-1.2)	(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.*

Medium or Pathway Sampled (Unit)	Analysis		LD*	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	Gamma	8							
pCi/kg									
(wet)	K-40	8	200	1157(4/4) (1120-1730)	08	1.10 mi SSE	1157(4/4) (1120-1730)	1860(4/4) (1120-2380)	0
	Cs-137	8	40	42.6(2/4) (34.1-51.1)	08	1.10 mi. SSE	42.6(2/4) (34.1-51.1)	(0/4) -	0
Food Vegetation	Gamma Dose	35							
(pCi/kg (wet))	Be-7	35	-	1064(18/28) (221-3540)	21	1.00 mi WNW	1236(4/7) (506-2210)	614(5/7) (351-972)	0
	K-40	35	-	10796(27/28) (5390-21300)	23	0.93 mi SSE	12723(7/7) (7270-21300)	12350(7/7) (9750-17100)	0
	Cs-137	35	80	186(1/28) -	15	1.20 mi NE	186(1/7) -	11.2(1/7) -	0
	Th-228	35	-	(0/28) -			(0/7) -	(0/7) -	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.*

Medium or Pathway Sampled (Unit)	Analysis		LD*	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	
Direct Radiation (mR/std. month) (Regular TLDs)	Gamma Dose	48	0.2	6.24(44/44) (4.1-8.77)	01	0.2 mi. NE	8.20(4/4) (7.5-8.7)	5.8(4/4) (5.0-6.4)	0
Direct Radiation (mR/std. Month) (Annual TLDs)	Gamma Dose	12	0.2	5.47(11/11) (4.3-7.1)	01 23	0.2 mi. NE 0.93 mi. SSE	7.1(2/12) (7.1)	5.3(1/1) (5.3)	0
Direct Radiation (mR/std. Month) (Sector TLDs)	Gamma Dose	288	0.2	6.89(256/256) (4.9-11.1)	17/49	0.22 mi.S	9.9(8/8) (8.4-11.1)	5.86(32/32) (3.9-7.9)	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

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

North Anna Power Station, Louisa County, Virginia - 2000

pCi/m^3 ± 2 Sigma

Collection Date	01	02	03	04	05	05A	06	07	21	22	23	24
JANUARY												
12/29-01/06	< .007	< .007	< .007	< .007	< .005	< .01	< .01	< .01	< .01	< .007	< .006	< .005
01/06-01/12	< .009	< .009	< .009	< .009	< .006	< .008	< .009	< .008	< .008	< .006	< .01	< .01
01/12-01/19	< .008	< .008	< .008	< .008	< .006	< .008	< .008	< .008	< .008	< .006	< .01	< .01
01/19-01/27	< .01	< .01	< .01	< .01	< .009	< .01	< .01	< .01	< .01	< .008	< .02	< .02
01/27-02/02	< .02	< .02	< .02	< .02	< .009	< .009	< .009	< .009	< .01	< .01	< .01	< .01
FEBRUARY												
02/02-02/09	< .01	< .01	< .01	< .01	< .008	< .007	< .007	< .007	< .007	< .006	< .01	< .01
02/09-02/16	< .008	< .008	< .008	< .008	< .005	< .01	< .01	< .01	< .01	< .008	< .01	< .01
02/16-02/23	< .008	< .008	< .008	< .008	< .006	< .008	< .008	< .008	< .008	< .005	< .01	< .01
02/23-03/01	< .008	< .008	< .008	< .008	< .005	< .01	< .01	< .01	< .01	< .008	< .01	< .01
MARCH												
03/01-03/08	< .008	< .008	< .009	< .008	< .006	< .008	< .008	< .009	< .008	< .006	< .01	< .01
03/08-03/15	< .007	< .008	< .007	< .006	< .008	< .01	< .01	< .01	< .01	< .008	< .009	< .006
03/15-03/22	< .008	< .007	< .007	< .007	< .005	< .01	< .01	< .01	< .01	< .008	< .01	< .007
03/22-03/29	< .009	< .009	< .009	< .009	< .007	< .009	< .009	< .009	< .009	< .006	< .01	< .01
APRIL												
03/29-04/05	< .008	< .008	< .008	< .008	< .005	< .01	< .01	< .01	< .01	< .009	< .007	< .006
04/05-04/12	< .008	< .008	< .008	< .008	< .006	< .01	< .01	< .01	< .01	< .008	< .01	< .01
04/12-04/19	< .009	< .009	< .008	< .009	< .007	< .008	< .008	< .008	< .007	< .006	< .01	< .01
04/19-04/26	(a)	(a)	(a)	(a)	(a)	< .008	< .008	< .008	< .008	< .006	< .02	< .02
04/26-05/03	< .009	< .009	< .009	< .009	< .007	< .009	< .009	< .009	< .009	< .006	< .02	< .02
MAY												
05/03-05/10	< .007	< .007	< .007	< .007	< .005	< .007	< .007	< .008	< .007	< .004	< .006	< .01
05/10-05/17	< .009	< .009	< .009	< .009	< .006	< .02	< .02	< .02	< .02	< .01	< .005	< .007
05/17-05/23	< .01	< .01	< .01	< .008	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01
05/23-05/31	< .009	< .009	< .009	< .009	< .006	< .01	< .01	< .01	< .01	< .008	< .01	< .01
JUNE												
05/31-06/07	< .009	< .009	< .009	< .009	< .007	< .009	< .009	< .009	< .009	< .006	< .01	< .01
06/07-06/14	< .007	< .008	< .007	< .007	< .005	< .01	< .01	< .01	< .01	< .008	< .01	< .01
06/14-06/21	< .009	< .009	< .009	< .009	< .006	< .01	< .01	< .01	< .01	< .009	< .009	< .007
06/21-06/28	< .01	< .01	< .01	< .01	< .008	< .01	< .01	< .01	< .01	< .007	< .01	< .01

(a) The gamma spectral data was transcribed to magnetic tape. Due to a malfunction of this magnetic tape device, the data was irretrievable and the gamma data not reportable.

(b) The sample was not analyzed.

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

North Anna Power Station, Louisa County, Virginia - 2000

pCi/m^3 ± 2 Sigma

Collection Date	01	02	03	04	05	05A	06	07	21	22	23	24
JULY												
06/28-07/05	< .008	< .008	< .008	< .008	< .006	< .01	< .01	< .01	< .01	< .009	< .01	< .01
07/05-07/12	< .02	< .02	< .02	< .02	< .02	< .01	< .01	< .01	< .01	< .008	< .007	< .006
07/12-07/19	< .009	< .009	< .009	< .009	< .007	< .01	< .01	< .01	< .01	< .009	< .01	< .01
07/19-07/25	< .009	< .01	< .01	< .01	< .007	< .02	< .01	< .01	< .02	< .01	< .01	< (b)
07/25-08/02	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .007	< .02	< .01
AUGUST												
08/02-08/09	< .011	< .011	< .011	< .01118	< .007	< .014	< .014	< .014	< .014	< 0.01	< .009	< .01
08/09-08/16	< .01	< .01	< .01	< .01	< .009	< .02	< .02	< .02	< .02	< .01	< .01	< .009
08/16-08/23	< .02	< .02	< .02	< .02	< .02	< .02	< .02	< .02	< .02	< .01	< .02	< .02
08/23-08/30	< .006	< .006	< .006	< .006	< .006	< .007	< .007	< .007	< .007	< .008	< .01	< (b)
SEPTEMBER												
08/30-09/06	< .01	< .01	< .01	< .01	< .01	< .02	< .02	< .02	< .02	< .01	< .01	< .01
09/06-09/14	< .01	< .01	< .01	< .01	< .008	< .01	< .01	< .01	< .01	< .008	< .01	< .008
09/14-09/20	< .03	< .03	< .03	< .03	< .02	< .02	< .02	< .02	< .02	< .01	< .01	< .02
09/20-9/27	< .009	< .008	< .009	< .009	< .006	< .01	< .01	< .01	< .01	< .009	< .009	< .009
OCTOBER												
09/27-10/04	< .007	< .007	< .007	< .007	< .005	< .008	< .008	< .008	< .008	< .005	< .006	< 005
10/04-10/11	< .008	< .008	< .008	< .008	< .004	< .006	< .006	< .006	< .006	< .004	< .004	< .005
10/11-10/18	< .006	< .006	< .007	< .006	< .004	< .006	< .006	< .006	< .006	< .004	< .003	< .005
10/18-10/25	< .007	< .007	< .008	< .008	< .006	< .009	< .009	< .009	< .009	< .006	< .01	< .005
10/25-11/01	< .004	< .005	< .007	< .007	< .007	< .006	< .004	< .007	< .007	< .007	< .007	< .005
NOVEMBER												
11/01-11/08	< .008	< .008	< .008	< .009	< .005	< .008	< .008	< .008	< .008	< .006	< .02	< .01
11/08-11/15	< .01	< .01	< .01	< .01	< .007	< .01	< .01	< .01	< .01	< .007	< .01	< .01
11/15-1122	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
11/22-11/29	< .006	< .006	< .006	< .006	< .004	< .006	< .006	< .006	< .006	< .004	< .008	< .008
DECEMBER												
11/29-12/6	< .01	< .01	< .01	< .01	< .006	< .01	< .01	< .01	< .01	< .008	< .01	< .01
12/6-12/13	< .004	< .007	< .007	< .007	< .007	< .005	< .006	< .006	< .006	< .006	< .004	< .007
12/13-12/19	< .02	< .02	< .02	< .02	< .01	< .02	< .02	< .02	< .02	< .01	< .02	< .02
12/19-12/27	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01

(a) The gamma spectral data was transcribed to magnetic tape. Due to a malfunction of this magnetic tape device, the data was irretrievable and the gamma data not reportable.

(b) The sample was not analyzed.

TABLE B-2:CONCENTRATIONS OF GROSS BETA IN AIR PARTICULATES

North Anna Power Station, Louisa County, Virginia - 2000

1.0E-03 pCi/m^3 ± 2 Sigma

COLLECTION DATE	01	02	03	04	05	05A	06	07	21	22	23	24	AVERAGE ± 2 s.d.
JANUARY													
12/29-01/06	26 ± 2	25 ± 2	27 ± 2	29 ± 2	20 ± 2	27 ± 2	22 ± 2	29 ± 2	28 ± 2	24 ± 2	22 ± 2	26 ± 2	25 ± 6
01/06-01/12	18 ± 2	16 ± 2	19 ± 2	18 ± 2	19 ± 2	19 ± 2	18 ± 2	19 ± 2	19 ± 2	17 ± 2	18 ± 2	21 ± 2	18 ± 2
01/12-01/19	10 ± 1	15 ± 2	14 ± 2	16 ± 2	12 ± 1	13 ± 2	12 ± 1	15 ± 2	14 ± 2	10 ± 1	14 ± 2	14 ± 2	13 ± 4
01/19-01/27	21 ± 2	21 ± 2	25 ± 2	26 ± 2	26 ± 2	26 ± 2	20 ± 2	21 ± 2	27 ± 2	25 ± 2	25 ± 2	29 ± 2	24 ± 6
01/27-02/02	14 ± 2	17 ± 2	16 ± 2	21 ± 2	18 ± 2	19 ± 2	18 ± 2	17 ± 2	19 ± 2	16 ± 2	17 ± 2	17 ± 2	17 ± 4
FEBRUARY													
02/02-02/09	19 ± 2	20 ± 2	20 ± 2	23 ± 2	22 ± 2	22 ± 2	20 ± 2	24 ± 2	21 ± 2	21 ± 2	20 ± 2	24 ± 2	21 ± 3
02/09-02/16	21 ± 2	24 ± 2	23 ± 2	26 ± 2	24 ± 2	23 ± 2	23 ± 2	27 ± 2	29 ± 2	22 ± 2	25 ± 2	26 ± 2	24 ± 5
02/16-02/23	16 ± 2	17 ± 2	17 ± 2	18 ± 2	17 ± 2	18 ± 2	15 ± 2	20 ± 2	21 ± 2	18 ± 2	20 ± 2	17 ± 2	18 ± 3
02/23-03/01	13 ± 2	14 ± 2	15 ± 2	14 ± 2	14 ± 2	14 ± 2	13 ± 2	16 ± 2	15 ± 2	14 ± 2	14 ± 2	15 ± 2	14 ± 2
MARCH													
03/01-03/08	16 ± 2	15 ± 2	18 ± 2	19 ± 2	21 ± 2	18 ± 2	17 ± 2	22 ± 2	18 ± 2	14 ± 2	19 ± 2	19 ± 2	18 ± 5
03/08-03/15	18 ± 2	19 ± 2	17 ± 2	20 ± 2	21 ± 2	19 ± 2	17 ± 2	22 ± 2	18 ± 2	16 ± 2	18 ± 2	17 ± 2	19 ± 4
03/15-03/22	10 ± 2	11 ± 1	10 ± 1	10 ± 1	10 ± 1	12 ± 2	10 ± 1	11 ± 1	13 ± 2	9 ± 1.4	10 ± 1	11 ± 1	11 ± 2
03/22-03/29	11 ± 2	12 ± 2	10 ± 1	12 ± 2	11 ± 2	13 ± 2	10 ± 1	13 ± 2	12 ± 2	10 ± 1	12 ± 2	11 ± 1	11 ± 2
Quarter Avg. ± 2 s.d.	**16 ±10**	**17 ± 9**	**18 ± 11**	**19 ± 11**	**18 ± 10**	**19 ± 10**	**17 ± 9**	**20 ± 11**	**20 ± 11**	**17 ± 10**	**18 ± 9**	**19 ± 12**	**18 ± 10**

(a) Sample not analyzed.

TABLE B-2: CONCENTRATIONS OF GROSS BETA IN AIR PARTICULATES

North Anna Power Station, Louisa County, Virginia - 2000

1.0E-03 pCi/m^3 ± 2 Sigma

COLLECTION DATE	01	02	03	04	05	05A	06	07	21	22	23	24	AVERAGE ± 2 s.d.
APRIL													
03/29-04/05	14 ± 2	15 ± 2	15 ± 2	15 ± 2	15 ± 2	13 ± 2	14 ± 2	16 ± 2	14 ± 2	13 ± 2	13 ± 2	12 ± 2	14 ± 2
04/05-04/12	16 ± 2	17 ± 2	17 ± 2	17 ± 2	14 ± 2	15 ± 2	14 ± 2	16 ± 2	14 ± 2	13 ± 2	15 ± 2	16 ± 2	15 ± 3
04/12-04/19	8 ± 1	8 ± 1	9 ± 1	9 ± 1	9 ± 1	9 ± 1	8 ± 1	10 ± 1	10 ± 1	9 ± 1	8 ± 1	9 ± 1	9 ± 1
04/19-04/26	7 ± 1	8 ± 1	8 ± 1	7 ± 1	7 ± 1	8 ± 1	7 ± 1	9 ± 1	7 ± 1	6 ± 1	8 ± 1	7 ± 1	7 ± 2
04/26-05/03	14 ± 2	15 ± 2	15 ± 2	15 ± 2	13 ± 2	15 ± 2	14 ± 2	17 ± 2	15 ± 2	13 ± 2	14 ± 2	15 ± 2	15 ± 2
MAY													
05/03-05/10	21 ± 2	21 ± 2	20 ± 2	20 ± 2	19 ± 2	20 ± 2	18 ± 2	21 ± 2	22 ± 2	19 ± 2	19 ± 2	21 ± 2	20 ± 2
05/10-05/17	16 ± 2	17 ± 2	16 ± 2	15 ± 2	18 ± 2	18 ± 2	14 ± 2	21 ± 2	18 ± 2	16 ± 2	16 ± 2	18 ± 2	17 ± 4
05/17-05/23	15 ± 2	15 ± 2	13 ± 2	15 ± 2	13 ± 2	14 ± 2	12 ± 2	10 ± 2	12 ± 2	14 ± 2	14 ± 2	14 ± 2	13 ± 3
05/23-05/31	14 ± 2	14 ± 2	14 ± 2	14 ± 2	14 ± 2	13 ± 1	15 ± 2	13 ± 1	14 ± 2	15 ± 2	13 ± 1	12 ± 1	14 ± 2
JUNE													
05/31-06/07	11 ± 1	14 ± 2	12 ± 1	13 ± 2	13 ± 2	14 ± 2	12 ± 1	13 ± 2	11 ± 1	13 ± 2	13 ± 2	14 ± 2	13 ± 2
06/07-06/14	21 ± 2	21 ± 2	23 ± 2	21 ± 2	21 ± 2	24 ± 2	18 ± 2	19 ± 2	21 ± 2	21 ± 2	20 ± 2	23 ± 2	21 ± 3
06/14-06/21	10 ± 1	9 ± 1	11 ± 1	10 ± 1	10 ± 1	11 ± 1	9 ± 1.4	10 ± 1	9 ± 1	10 ± 1	11 ± 1	11 ± 1	10 ± 2
06/21-06/28	22 ± 2	21 ± 2	20 ± 2	21 ± 2	17 ± 2	21 ± 2	19 ± 2	21 ± 2	17 ± 2	20 ± 2	20 ± 2	20 ± 2	20 ± 3
Quarter Avg. ± 2 s.d.	**15 ± 10**	**15 ± 9**	**15 ± 9**	**15 ±9**	**14 ± 8**	**15 ± 9**	**13 ± 8**	**15 ± 9**	**14 ± 9**	**14 ± 9**	**14 ± 8**	**15 ± 9**	**14 ± 9**

(a) Sample not analyzed.

TABLE B-2: CONCENTRATIONS OF GROSS BETA IN AIR PARTICULATES

North Anna Nuclear Power Station, Louisa County, Virginia- 2000

1.0E-03 pCi/m^3 ± 2 Sigma

COLLECTION DATE	01	02	03	04	05	05A	06	07	21	22	23	24	AVERAGE ± 2 s.d.
JULY													
06/28-07/05	18 ± 2	17 ± 2	16 ± 2	17 ± 2	15 ± 2	18 ± 2	17 ± 2	16 ± 2	16 ± 2	17 ± 2	15 ± 2	15 ± 2	16 ± 2
07/05-07/12	19 ± 2	18 ± 2	16 ± 2	18 ± 2	16 ± 2	17 ± 2	14 ± 2	15 ± 2	15 ± 2	16 ± 2	15 ± 2	15 ± 2	16 ± 3
07/12-07/19	15 ± 2	15 ± 2	17 ± 2	18 ± 2	15 ± 2	14 ± 2	14 ± 2	16 ± 2	14 ± 2	13 ± 2	15 ± 2	14 ± 2	15 ± 3
07/19-07/25	18 ± 2	18 ± 2	19 ± 2	19 ± 2	17 ± 2	18 ± 2	18 ± 2	15 ± 2	18 ± 2	16 ± 2	16 ± 2	16 ± 2	17 ± 3
07/25-08/02	13 ± 1	11 ± 1	14 ± 1	14 ± 1	11 ± 1	12 ± 1	10 ± 1	11 ± 1	13 ± 1	12 ± 1	12 ± 1	12 ± 1	12 ± 2
AUGUST													
08/02-08/09	22 ± 2	22 ± 2	23 ± 2	23 ± 2	18 ± 2	22 ± 2	19 ± 2	23 ± 2	21 ± 2	22 ± 2	24 ± 2	23 ± 2	22 ± 4
08/09-08/16	19 ± 2	18 ± 2	19 ± 2	20 ± 2	17 ± 2	18 ± 2	15 ± 2	16 ± 2	20 ± 2	18 ± 2	19 ± 2	19 ± 2	18 ± 3
08/16-08/23	14 ± 2	16 ± 2	18 ± 2	17 ± 2	15 ± 2	16 ± 2	< 1.0(a)	15 ± 2	19 ± 2	17 ± 2	16 ± 2	18 ± 2	16 ± 3
08/23-08/30	28 ± 2	25 ± 2	24 ± 2	26 ± 2	23 ± 2	22 ± 2	22 ± 2	23 ± 2	24 ± 2	24 ± 2	23 ± 2	31 ± 2	25 ± 5
SEPTEMBER													
08/30-09/06	13 ± 2	12 ± 2	12 ± 2	13 ± 2	12 ± 2	13 ± 2	12 ± 2	11 ± 2	8.6 ± 1.5	13 ± 2	14 ± 2	12 ± 2	12 ± 3
09/06-09/14	19 ± 2	17 ± 2	19 ± 2	17 ± 2	17 ± 2	19 ± 2	15 ± 1	18 ± 2	17 ± 2	19 ± 2	18 ± 2	18 ± 2	18 ± 2
09/14-09/20	16 ± 2	13 ± 2	16 ± 2	13 ± 2	14 ± 2	14 ± 2	13 ± 2	13 ± 2	14 ± 2	15 ± 2	16 ± 2	13 ± 2	14 ± 3
09/20-09/27	14 ± 2	13 ± 2	12 ± 2	13 ± 2	12 ± 2	11 ± 1	11 ± 1	10 ± 1	13 ± 2	12 ± 2	13 ± 2	12 ± 2	12 ± 2
Quarter Avg. ±2 s.d.	**18± 9**	**16 ± 8**	**17 ± 7**	**17 ± 8**	**16 ± 6**	**16 ± 7**	**15 ± 7**	**16 ± 8**	**16 ± 8**	**16 ± 7**	**17 ± 7**	**17 ± 11**	**16 ± 8**

(a) Sample not analyzed.

TABLE B-2: CONCENTRATIONS OF GROSS BETA IN AIR PARTICULATES

North Anna Nuclear Power Station, Louisa County, Virginia- 2000

1.0E-03 pCi/m^3 ± 2 Sigma

COLLECTION DATE	01	02	03	04	05	05A	06	07	21	22	23	24	AVERAGE ± 2 s.d.
OCTOBER													
09/27-10/04	20 ± 2	21 ± 2	20 ± 2	20 ± 2	19 ± 2	19 ± 2	22 ± 2	19 ± 2	19 ± 2	20± 2	22 ± 2	19 ± 2	20 ± 2
10/04-10/11	22 ± 2	20 ± 2	22 ± 2	21 ± 2	21 ± 2	21 ± 2	20 ± 2	25 ± 2	18 ± 2	18 ± 2	23 ± 2	24 ± 2	21 ± 4
10/11-10/18	39 ± 3	38 ± 3	41 ± 3	38 ± 3	41 ± 3	37 ± 2	36 ± 2	34 ± 2	34 ± 2	39 ± 2	42 ± 3	40 ± 3	38 ± 5
10/18-10/25	42 ± 3	39 ± 3	41 ± 3	42 ± 3	41 ± 3	37 ± 2	31 ± 2	31 ± 2	39 ± 3	41 ± 3	44 ± 3	41 ± 3	39 ± 8
10/25-11/01	28 ± 2	27 ± 2	27 ± 2	27 ± 2	28 ± 2	26 ± 2	19 ± 2	21 ± 2	26 ± 2	25 ± 2	28 ± 2	28 ± 2	26 ± 6
NOVEMBER													
11/01-11/08	29 ± 2	25 ± 2	29 ± 2	32 ± 3	30 ± 2	27 ± 2	27 ± 2	26 ± 2	24 ± 2	29 ± 2	70 ± 5	29 ± 3	31 ± 25
11/08-11/15	23 ± 2	23 ± 2	23 ± 2	25 ± 2	22 ± 2	25 ± 2	19 ± 2	20 ± 2	22± 2	20 ± 2	22 ± 2	24 ± 2	22 ± 4
11/15-11/22	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
11/22-11/29	19 ± 2	20 ± 2	20 ± 2	21 ± 2	20 ± 2	20 ± 2	18 ± 2	18 ± 2	19 ± 2	20 ± 2	21 ± 2	21 ± 2	20 ± 2
DECEMBER													
11/29-12/06	18 ± 2	16 ± 2	20 ± 2	19 ± 2	18 ± 2	19 ± 2	17 ± 2	17 ± 2	18 ± 2	17 ± 2	19 ± 2	19 ± 2	18 ± 3
12/06-12/13	32 ± 2	28 ± 2	33 ± 2	30 ± 2	27 ± 2	28 ± 2	27 ± 2	27 ± 2	30 ± 2	27 ± 2	29 ± 2	27 ± 2	29 ± 4
12/13-12/19	23 ± 2	23 ± 2	27 ± 2	29 ± 2	22 ± 2	25 ± 2	24 ± 2	21 ± 2	23 ± 2	25 ± 2	28 ± 2	28 ± 2	25 ± 5
12/19-12/27	31 ± 2	28 ± 2	36 ± 2	31 ± 2	28 ± 2	30 ± 2	33 ± 2	30 ± 2	28 ± 2	30 ± 2	37 ± 2	31 ± 2	31 ± 6
Quarter Avg. ± 2 s.d.	**27 ± 16**	**26 ± 14**	**28 ± 16**	**28 ± 15**	**26 ± 16**	**26 ± 12**	**24 ± 13**	**24 ± 11**	**25 ± 13**	**26 ± 16**	**32 ± 29**	**28 ± 14**	**27 ± 16**
Annual Avg. ± 2 s.d.	**19 ± 14**	**19 ± 13**	**19 ± 15**	**20 ± 14**	**18 ± 14**	**19 ± 13**	**17 ± 12**	**18 ± 12**	**19 ± 13**	**18 ± 14**	**20 ± 21**	**19 ± 15**	**19 ± 14**

(a) Sample not analyzed.

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

North Anna Power Station, Louisa County, Virginia - 2000

1.0 E-03 pCi/m^3 ± 2 Sigma

Station	Nuclide*	First Quarter 12/29-03/29	Second Quarter 03/29-06/28	Third Quarter	Fourth Quarter	Average
STA-01	Sr-89	(a)	< 4			
	Sr-90	(a)	< 0.5			
	Be-7	58.8 ± 5.9	68.6 ± 6.9			63.7 ± 13.9
	K-40	< 8	< 4			
	Co-60	< 0.3	< 0.3			
	Ru-103	< 0.4	< 0.4			
	Cs-134	< 0.3	< 0.2			
	Cs-137	< 0.3	< 0.2			
	Th-228	< 0.4	< 0.4			
STA-02	Sr-89	(a)	< 4			
	Sr-90	(a)	< 0.4			
	Be-7	61.5 ± 6.1	58.9 ± 5.9			60.2 ± 3.7
	K-40	< 10	< 4			
	Co-60	< 0.4	< 0.2			
	Ru-103	< 0.5	< 0.3			
	Cs-134	< 0.3	< 0.2			
	Cs-137	< 0.3	< 0.2			
	Th-228	< 0.4	< 0.4			
STA-03	Sr-89	(a)	< 4			
	Sr-90	(a)	< 0.5			
	Be-7	69.5 ± 6.9	56.4 ± 5.6			63.0 ± 18.5
	K-40	< 4	< 10			
	Co-60	< 0.2	< 0.3			
	Ru-103	< 0.4	< 0.4			
	Cs-134	< 0.3	< 0.3			
	Cs-137	< 0.2	< 0.3			
	Th-228	< 0.4	< 0.4			
STA-04	Sr-89	(a)	< 2			
	Sr-90	(a)	< 0.3			
	Be-7	64.9 ± 6.5	61.5 ± 6.2			63.02 ± 4.8
	K-40	4.95 ± 2.14	< 5			
	Co-60	< 0.3	< 0.3			
	Ru-103	< 0.4	< 0.4			
	Cs-134	< 0.2	< 0.2			
	Cs-137	< 0.2	< 0.3			
	Th-228	< 0.4	< 0.4			

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

(a) Strontium-89/90 analyses performed only on second quarter samples.

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

North Anna Power Station, Louisa County, Virginia - 2000

1.0 E-03 pCi/m^3 ± 2 Sigma

Station	Nuclide*	First Quarter 12/29-03/29	Second Quarter 03/29-06/28	Third Quarter	Fourth Quarter	Average
STA-05	Sr-89	(a)	< 6			
	Sr-90	(a)	< 0.8			
	Be-7	68.5 ± 6.9	58.2 ± 5.8			63.4 ± 14.6
	K-40	< 5	< 5			
	Co-60	< 0.3	< 0.2			
	Ru-103	< 0.4	< 0.3			
	Cs-134	< 0.3	< 0.2			
	Cs-137	< 0.3	< 0.2			
	Th-228	< 0.4	< 0.3			
STA-05A	Sr-89	(a)	< 3			
	Sr-90	(a)	< 0.5			
	Be-7	65.6 ± 6.6	51.2 ± 5.1			58.4 ± 20.4
	K-40	< 4	< 7			
	Co-60	< 0.2	< 0.2			
	Ru-103	< 0.4	< 0.4			
	Cs-134	< 0.2	< 0.2			
	Cs-137	< 0.2	< 0.2			
	Th-228	< 0.5	< 0.3			
STA-06	Sr-89	(a)	< 3			
	Sr-90	(a)	< 0.4			
	Be-7	57.3 ± 5.7	29.2 ±3.7			43.3 ± 39.7
	K-40	< 5	< 9			
	Co-60	< 0.3	< 0.4			
	Ru-103	< 0.4	< 0.5			
	Cs-134	< 0.3	< 0.3			
	Cs-137	< 0.3	< 0.3			
	Th-228	< 0.4	< 0.4			
STA-07	Sr-89	(a)	< 2			
	Sr-90	(a)	< 0.4			
	Be-7	74.6 ± 7.5	56.4 ±5.6			65.5 ± 25.7
	K-40	< 6	5.91 ±1.69			
	Co-60	< 0.3	< 0.3			
	Ru-103	< 0.4	< 0.4			
	Cs-134	< 0.3	< 0.2			
	Cs-137	< 0.2	< 0.2			
	Th-228	< 0.3	< 0.3			

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

(a) Strontium-89/90 analyses performed only on second quarter samples.

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

North Anna Power Station, Louisa County, Virginia - 2000

1.0 E-03 pCi/m^3 ± 2 Sigma

Station	Nuclide*	First Quarter 12/29-03/29	Second Quarter 03/29-06/28	Third Quarter	Fourth Quarter	Average
STA-21	Sr-89	(a)	< 10			
	Sr-90	(a)	< 0.8			
	Be-7	75.6 ± 7.6	56.8 ± 4.17			66.2 ± 26.6
	K-40	< 10	< 3			
	Co-60	< 0.4	< 0.2			
	Ru-103	< 0.6	< 0.3			
	Cs-134	< 0.4	< 0.2			
	Cs-137	< 0.4	< 0.2			
	Th-228	< 0.5	< 0.3			
STA-22	Sr-89	(a)	< 20			
	Sr-90	(a)	< 4			
	Be-7	64.0 ± 6.4	49.0 ± 3.92			56.5 ± 21.2
	K-40	< 5	< 9			
	Co-60	< 0.3	< 0.3			
	Ru-103	< 0.5	< 0.4			
	Cs-134	< 0.4	< 0.3			
	Cs-137	< 0.4	< 0.3			
	Th-228	< 0.5	< 0.4			
STA-23	Sr-89	(a)	< 6			
	Sr-90	(a)	< 1			
	Be-7	74.2± 7.4	< 2			
	K-40	< 6	< 1			
	Co-60	< 0.3	< 0.1			
	Ru-103	< 0.4	< 0.3			
	Cs-134	< 0.3	< 0.2			
	Cs-137	< 0.3	< 0.1			
	Th-228	< 0.5	< 0.5			
STA-24	Sr-89	(a)	(b)			
	Sr-90	(a)	(b)			
	Be-7	67.4 ± 6.7	66.0 ± 4.66			66.7 ± 2.0
	K-40	< 8	< 8			
	Co-60	< 0.3	< 0.3			
	Ru-103	< 0.4	< 0.4			
	Cs-134	< 0.3	< 0.3			
	Cs-137	< 0.3	< 0.3			
	Th-228	< 0.4	< 0.4			

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

(a) Strontium-89/90 analyses performed only on second quarter samples.

TABLE B-4: GROSS BETA, TRITIUM AND GAMMA EMITTER CONCENTRATIONS IN PRECIPITATION*

Station 01A -- (On Site)

North Anna Power Station, Louisa County, Virginia - 2000

pCi/l ± 2 Sigma Page 1 of 1

Collection Dates	Gross Beta	Rainfall (inches)
12/29/99-01/27/00	5.0 ± 0.8	2.10
01/27/00-02/23/00	2.2 ± 0.5	2.15
02/23/00-03/29/00	4.0 ± 0.7	3.67
03/29/00-04/26/00	1.8 ± 0.6	5.45
04/26/00-05/31/00	2.7 ± 0.7	3.71
05/31/00-06/28/00	3.1 ± 0.7	3.17
06/28/00-07/25/00	10.0 ± 1.0	2.35
07/25/00-08/30/00	4.5 ± 1.1	3.74
08/30/00-09/27/00	5.2 ± 0.8	4.6
9/27/00-10/25/00	(a)	(a)
10/25/00-11/29/00	< 3	1.61
11/29/00-12/27/00	4.3 ± 1.7	2.13
Average ± 2 s.d.	3.89 ± 5.1	

SEMI-ANNUAL PRECIPITATION COMPOSITES

12/29/99 – 06/28/00	06/28/00 – 12/27/00
Be-7 = < 10	Be-7 = < 300
H-3 = < 200	H-3 =

(a) No precipitation for October.

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TABLE B-5 CONCENTRATIONS OF GAMMA EMITTERS* IN SOIL

North Anna Power Station, Louisa County, Virginia - 2000

pCi/kg ± 2 Sigma

STATION	COLL DATES	Sr-89	Sr-90	Be-7	K-40	Cs-134	Cs-137	Ra-226	Th-228

Soil samples are collected every three years. Since they were collected in 1998, they were not collected during 2000.

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

North Anna Power Station, Louisa County, Virginia - 2000

pCi/l ± 2 Sigma Page 1 of 1

Collection Dates	Sr-89	Sr-90	H-3	Be-7	K-40	I-131	Ba-140	Th-228
STATION 01A								
03/29/00	(a)	(a)	< 100	< 30	< 50	< 7 (b)	< 5	< 6
06/28/00	< 0.9	< 0.8	< 100	< 30	< 50	< 10 (b)	< 9	< 6
09/27/00	(a)	(a)		< 200	< 75	< 900000	< 30000	< 8
12/28/00	(a)	(a)	< 100	< 40	< 80	< 40	< 50	< 7
Average ± 2 sd.								

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

(a) Strontium-89/90 analyses performed only on second quarter sample.

(b) I-131 results by Gamma. More sensitive method by radiochemistry not requested.

TABLE B-7: GAMMA EMITTER, STRONTIUM, TRITIUM, AND IODINE CONCENTRATIONS IN RIVER WATER*

North Anna Power Station, Louisa County, Virginia - 2000

pCi/l ± 2 Sigma Page 1 of 1

Collection Dates Dates	Sr-89	Sr-90	H-3	Be-7	K-40	I-131	Cs-137	Ba-140	Ra-226	Th-228
STATION - 11										
01/13/00	(a)	(a)	4700 ± 200	< 30	< 60 <	< 0.5	< 3	< 7	< 50	< 5
02/15/00	(a)	(a)	(b)	< 30	< 60	< 0.2	< 3	< 5	< 50	< 5
03/15/00	(a)	(a)	(b)	< 30	< 50	< 0.3	< 4	< 6	< 70	< 6
04/17/00	< 4	<0.6	1500 ± 100	< 30	< 60	< 0.4	< 2	< 10	< 40	< 4
05/11/00	(a)	(a)	(b)	< 20	52.3 ± 13.7	< 0.3	< 2	< 10	< 40	< 3
06/15/00	(a)	(a)	(b)	< 30	< 30	< 0.6	< 2	< 9	< 50	< 4
07/12/00	(a)	(a)		< 40	385 ± 38	< 0.8	< 3	< 10	< 60	< 5
08/15/00	(a)	(a)	(b)	< 30	< 80	< 0.4	< 3	< 9	< 60	< 6
09/15/00	(a)	(a)	(b)	< 40	< 80	< 0.8	< 3	< 10	< 60	< 5
10/16/00	(a)	(a)		< 40	< 60	< 0.1	< 3	< 40	< 100	< 300
11/16/00	(a)	(a)	(b)	< 20	< 40	< 1.0	< 3	< 8	< 80	< 10
12/18/00	(a)	(a)	(b)	< 50	7.71 ± 31.5	< 1.0	< 4	< 200	< 9	< 8
Average ± 2 sd			**3100 ± 4525**		**148 ± 412**					

(a) Strontium-89/90 analyses performed only on second quarter sample.

(b) Tritium analysis performed on quarterly composite.

TABLE B-8: GAMMA EMITTER, STRONTIUM AND TRITIUM CONCENTRATIONS IN SURFACE WATER*

North Anna Power Station, Louisa County, Virginia - 2000

pCi/l ± 2 Sigma

Collection Dates	Sr-89	Sr-90	H-3	Be-7	K-40	I-131**	Cs-137	Ba-140	Ra-226	Th-228
STATION - 08										
01/13	(a)	(a)	4500 ± 200	< 30	< 50	< 0.4	< 3	< 7	< 70	< 6
02/15	(a)	(a)	(b)	< 30	< 50	< 0.2	< 3	< 5	< 80	< 6
03/15	(a)	(a)	(b)	< 30	< 50	< 0.4	< 3	< 3	< 70	< 6
04/17	< 4	< 0.6	1500 ± 100	< 30	< 30	< 0.3	< 2	< 10	< 40	< 4
05/11	(a)	(a)	(b)	< 20	< 20	< 0.6	< 1	< 10	< 30	< 3
06/15	(a)	(a)	(b)	< 30	39.8 ± 21.9	< 0.6	< 3	< 10	< 60	< 5
07/12	a)	(a)		< 30	< 30	< 0.6	< 3	< 7	< 70	< 6
08/15	(a)	(a)	(b)	< 30	< 40	< 0.4	< 3	< 8	< 70	< 6
09/15	(a)	(a)	(b)	< 40	< 80	< 0.6	< 3	< 10	< 60	< 5
10/16	(a)	(a)		< 60	< 100	< 0.8	< 5	< 60	< 120	< 600
11/16	(a)	(a)	(b)	< 30	< 50	< 0.8	< 3	< 10	< 90	< 10
12/18	(a)	(a)	(b)	< 40	< 50	< 0.8	< 5	< 100	< 6	< 100
Average ± 2 sd			**3000±4243**							
STATION - 09A										
01/13	(a)	(a)	< 200	< 20	< 40	< 0.3	< 3	< 6	< 60	< 6
02/15	(a)	(a)	(b)	< 20	< 40	< 0.2	< 3	< 5	< 60	< 5
03/15	(a)	(a)	(b)	< 30	< 60	< 0.3	< 4	< 5	< 60	< 5
04/17	< 2	< 0.9	< 200	< 30	< 30	< 0.3	< 2	< 10	< 50	< 4
05/11	(a)	(a)	(b)	< 20	< 40	< 0.3	< 1	< 10	< 30	< 2
06/15	(a)	(a)	(b)	< 40	< 100	< 0.6	< 4	< 10	< 70	< 6
07/12	(a)	(a)		< 40	< 90	< 0.6	< 4	< 9	< 70	< 5
08/15	(a)	(a)	(b)	< 30	< 40	< 0.4	< 2	< 6	< 60	< 5
09/15	(a)	(a)	(b)	< 40	< 80	< 0.7	< 3	< 10	< 60	< 5
10/16	(a)	(a)		< 40	< 80	< 0.9	< 4	< 60	< 100	< 300
11/16	(a)	(a)	(b)	< 30	< 50	< 1	< 3	< 10	< 100	< 10
12/18	(a)	(a)	(b)	< 50	< 50	< 0.9	< 3	< 100	11.4 ± 2.6	< 8
Average ± 2 sd										

(a) Strontium-89/90 analyses performed only on second quarter sample.
(b) Tritium analysis performed on quarterly composite.

TABLE B-9: GAMMA EMITTER AND STRONTIUM CONCENTRATIONS IN SEDIMENT SILT*

North Anna Power Station, Louisa County, Virginia - 2000

pCi/kg ± 2 Sigma Page 1 of 1

Nuclide	STA-08 02/21 (b)	STA-09A 02/21	STA-11 02/21	STA-08 08/07	STA-09A 08/07	STA-11 08/07	Average ± 2 s.d.
Sr-89	(a)	(a)	(a)				
Sr-90	(a)	(a)	(a)				
Be-7	< 1000	< 400	< 300	< 250	227 ± 119	< 457	
K-40	11200 ± 1100	12800 ± 1300	12900 ± 1300	3040 ± 362	< 405	14700 ± 950	10900 ± 9160
Mn-54	< 40	< 30	< 20	< 20	< 30	< 50	
Co-58	< 90	< 40	< 30	< 30	< 30	< 50	
Co-60	< 40	< 30	< 20	< 30	< 30	< 40	
Cs-134	< 50	< 40	< 30	< 20	< 28	< 40	
Cs-137	205 ± 39	114 ± 38	58.8 ± 15.3	< 30	38.8 ± 15.9	< 50	104 ± 149
Ra-226	1870 ± 530	1720 ± 570	1690 ± 70	399 ± 28.2	< 80	< 110	1420 ± 1370
Th-228	1100 ± 110	846 ± 85	849 ± 85	< 40	< 50	< 70	932 ± 292

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

(a) Strontium 89/90 analyses performed annually.

(b) Europium-152 was measured at 2250 ± 260 pCi/kg.

TABLE B-10: GAMMA EMITTER AND STRONTIUM CONCENTRATIONS IN SHORELINE SOIL*

Nuclide	Station-08 02/21/00	Station-08 08/07/00	Average ± 2 Sigma
Sr-89	(a)	< 2000	
Sr-90	(a)	100 ± 60	
Be-7	< 200	< 330	
K-40	1280 ± 210	1410 ± 315	1345 ± 185
Mn-54	< 20	< 30.8	
Co-58	< 20	< 33.0	
Co-60	< 20	< 42.9	
Cs-134	< 20	< 32.6	
Cs-137	< 20	167 ± 23.6	
Ra-226	615 ± 256	313 ± 22.7	464 ± 427
Th-228	298 ± 32	203 ± 21.3	251 ± 134

* All gamma emitters other than those listed were <LLD.
(a) Strontium 89/90 analyses performed annually.

TABLE B-11: GAMMA EMITTER AND STRONTIUM CONCENTRATIONS IN MILK*

North Anna Power Station, Louisa County, Virginia - 2000

pCi/l ± 2 Sigma

MONTH	NUCLIDE	STATION-12	STATION-13
JANUARY	Sr-89	(a)	(a)
	Sr-90	(a)	(a)
	K-40	1360 ± 140	1420 ± 140
	Cs-137	< 4	< 5
	I-131	< 0.3	< 0.2
FEBRUARY	Sr-89	(a)	(a)
	Sr-90	(a)	(a)
	K-40	1580 ± 160	1250 ± 120
	Cs-137	< 4	< 5
	I-131	< 0.3	< 0.3
MARCH	Sr-89	< 3	< 2
	Sr-90	1.2 ± 0.3	0.82 ± 0.25
	K-40	1370 ± 140	1250 ± 120
	Cs-137	< 4	< 4
	I-131	< 0.3	< 0.2
APRIL	Sr-89	(a)	(a)
	Sr-90	(a)	(a)
	K-40	1220 ± 120	1400 ± 140
	Cs-137	< 4	< 5
	I-131	< 0.3	< 0.3
MAY	Sr-89	(a)	(a)
	Sr-90	(a)	(a)
	K-40	1590 ± 160	1310 ± 130
	Cs-137	< 3	< 4
	I-131	< 0.2	< 0.3
JUNE	Sr-89	< 2	< 2
	Sr-90	0.75 ± 0.23	1.1 ± 0.2
	K-40	1370 ± 140	1340 ± 130
	Cs-137	< 4	< 3
	I-131	< 0.5	< 0.4

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

(a) Strontium 89/90 analyses performed quarterly.

(b) The gamma library did not contain K-40.

TABLE B-11: GAMMA EMITTER AND STRONTIUM CONCENTRATIONS IN MILK*

North Anna Power Station, Louisa County, Virginia - 2000

pCi/l ± 2 Sigma

MONTH	NUCLIDE	STATION-12	STATION-13
JULY	Sr-89	(a)	(a)
	Sr-90	(a)	(a)
	K-40	1270± 130	1260 ± 130
	Cs-137	< 4	< 3
	I-131	< 0.3	< 0.3
AUGUST	Sr-89	(a)	(a)
	Sr-90	(a)	(a)
	K-40	1420 ± 84	1310 ± 93
	Cs-137	< 4	< 5
	I-131	< 0.3	< 0.4
SEPTEMBER	Sr-89		
	Sr-90		
	K-40	1430 ± 127	1010 ± 69
	Cs-137	< 6	< 4
	I-131	< 0.6	< 0.4
OCTOBER	Sr-89	(a)	(a)
	Sr-90	(a)	(a)
	K-40	(b)	1240 ± 110
	Cs-137	< 4	< 2
	I-131	< 0.6	< 0.7
NOVEMBER	Sr-89	(a)	(a)
	SR-90	(a)	(a)
	K-40	1390 ± 140	1310 ± 110
	Cs-137	< 5	< 2
	I-131	< 0.6	< 0.5
DECEMBER	Sr-89		
	Sr-90		
	K-40	1340 ± 53	1280 ± 57
	Cs-137	< 5	< 4
	I-131	< 0.6	< 0.9
Average ± 2 s.d.	**Sr-89**		
	Sr-90	**0.98 ±0.63**	**0.96 ± 0.40**
	K-40	**1395 ± 224**	**1282 ± 206**
	Cs-137		
	I-131		

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

(a) Strontium 89/90 analyses performed quarterly.

(b) The gamma library did not contain K-40.

TABLE B-12: GAMMA EMITTER CONCENTRATIONS IN FISH*

North Anna Power Station, Louisa County, Virginia - 2000

pCi/kg ± 2 Sigma

Collection Date	Station	Sample Type	K-40	Co-58	Cs-134	Cs-137
02/24	08	Fish (a)	1730 ± 270	< 30	< 30	51.1 ± 20.6
02/22	25	Fish (a)	1880 ± 230	< 20	< 20	< 20
02/24	08	Catfish (b)	1630 ± 210	< 20	< 20	34.1 ± 16.8
02/23	25	Catfish (b)	1120 ± 200	< 30	< 20	< 30
08/10	08	Fish (a)	1670 ± 217	< 20	< 20	< 20
08/09	25	Fish (a)	2380 ± 330	< 30	< 20	< 30
08/10	08	Catfish (b)	1120 ± 203	< 20	< 20	< 20
08/09	25	Catfish (b)	2060 ± 306	< 38	< 20	< 30
Avg. ± 2 s.d.	**08**		**1157 ± 1813**			**42.6 ± 24.0**
	25		**1860 ± 1070**			**-**

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

(a) Non-bottom dwelling species of gamefish.

(b) Bottom dwelling species of fish.

TABLE B-13: GAMMA EMITTER CONCENTRATIONS IN FOOD/VEGETATION*

North Anna Power Station, Louisa County, Virginia –2000

pCi/kg ± 2 Sigma

Collection Date	Be-7	K-40	I-131	Ru-103	Cs-134	Cs-137	Ra-226	Th-228
STATION 14								
04/19	1290 ± 130	5930 ± 590	< 50	< 9	< 8	< 8	< 100	< 10
05/17	627 ± 172	7270 ± 730	< 30	< 30	< 20	< 20	< 300	< 30
06/21	584 ± 180	7191 ± 720	< 100 (a)	< 30	< 20	< 20	< 400	< 30
07/25	1270 ± 200	12300 ± 1200	< 50	< 30	< 30	< 20	< 400	< 30
08/16	2170 ± 260	10300 ± 1000	< 60	< 40	< 30	< 30	< 500	< 50
09/20	< 2040	11600 ± 530	< 10	< 590	< 20	< 20	< 550	< 30
10/18(b)	< 300	< 200	< 300	< 30	< 20	< 20	< 400	< 90
STATION 15								
04/19	983 ± 98	6840 ± 680	< 50	< 10	< 10	< 10	< 200	< 10
05/17	337 ± 124	7970 ± 800	< 20	< 20	< 10	< 10	< 200	< 20
06/21	283 ± 120	9420 ± 940	< 400 (a)	< 20	< 10	< 10	< 200	< 20
07/25	933 ± 107	13300 ± 570	< 40	< 27	< 19	186 ± 16.6	< 47	< 30
08/16	3540 ± 540	11100 ± 1100	< 50	< 80	< 60	< 60	< 1000	< 100
09/20	< 700	8140 ± 250	< 9	< 200	< 8	< 7	< 100	< 20
10/18(b)	< 400	13100 ± 800	< 300	< 40	< 30	< 20	< 400	< 100
STATION 16								
04/19	429 ± 52	10300 ± 1000	< 60	< 8	< 7	< 6	< 100	< 10
05/17	907 ± 203	11100 ± 1100	< 20	< 30	< 20	< 20	< 400	< 40
06/21	409 ± 138	9750 ± 980	< 90 (a)	< 20	< 20	< 20	< 200	< 20
07/25	351 ± 66.7	10600 ± 440	< 50	< 18	< 13	11.2 ± 8.5	< 30	< 30
08/16	972 ± 172	17100 ± 1700	< 60	< 20	< 20	< 20	< 300	< 30
09/20	< 3200	12800 ± 600	< 10	< 980	< 40	< 30	< 700	< 60
10/18(b)	< 400	14800 ± 900	< 270	< 40	< 30	< 30	< 500	< 100
STATION 21								
04/19	< 200	7360 ± 740	< 50	< 20	< 10	< 10	< 200	< 20
05/17	506 ± 101	6910 ± 690	< 20	< 20	< 10	< 10	< 200	< 20
06/21	< 80	7690 ± 770	< 5	< 8	< 10	< 10	< 200	< 20
07/25	1590 ± 280	13200 ± 1300	< 40	< 40	< 30	< 30	< 500	< 50
08/16	2210 ± 220	18600 ± 1900	< 70	< 30	< 30	< 20	< 400	< 40
09/20	< 2850	13400 ± 570	< 10	< 850	< 40	< 30	< 60	< 40
10/18(b)	637 ± 232	10800 ± 600	< 400	< 40	< 30	< 20	< 500	< 100

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

(a) More sensitive I-131 method by radiochemistry not requested by customer nor ordered by lab. Specs not met for I-131.

(b) Vegetation samples were not subbed in a timely manner. Some detection levels were not met.

TABLE B-13: GAMMA EMITTER CONCENTRATIONS IN FOOD/VEGETATION*

North Anna Power Station, Louisa County, Virginia –2000

pCi/kg ± 2 Sigma

Collection Date	Be-7	K-40	I-131	Ru-103	Cs-134	Cs-137	Ra-226	Th-228
STATION 23								
04/19	857 ± 86	7270 ± 730	< 50	< 10	< 8	< 8	< 100	< 10
05/17	661 ± 111	7800 ± 780	< 30	< 20	< 10	< 10	< 200	< 20
06/21	221 ± 93	9420 ± 940	< 80 (a)	< 20	< 10	< 10	< 200	< 20
07/25	< 500	7470 ± 750	< 50	< 70	< 50	< 50	< 1000	< 90
08/16	< 400	21300 ± 2100	< 50	< 50	< 30	< 40	< 700	< 60
09/20	< 4400	21300 ± 830	< 10	< 1300	< 60	< 40	< 800	< 100
10/18(b)	457 ± 232	14500 ± 800	< 300	< 40	< 30	< 30	< 500	< 100
Average ± 2 s.d.	**966±1570**	**11116±8038**				**98.8±247**		

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

(a) More sensitive I-131 method by radiochemistry not requested by customer nor ordered by lab. Specs not met for I-131.

(b) Vegetation samples were not subbed in a timely manner. Some detection levels were not met.

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

North Anna Power Station, Louisa County, Virginia - 2000
mR/Std. Month (30.4 days) ± 2 Sigma Page 1 of 1

Station Number	First Qtr 01/06/00 03/29/00	Second Qtr 03/29/00 07/05/00	Third Qtr 07/05/00 09/28/00	Fourth Qtr 09/28/00 01/11/01	Quarterly Average	Annual TLD
01	8.7 ± 0.5	7.5 ± 0.4	8.1 ± 0.7	8.5 ± 0.4	8.2 ± 1.1	7.1 ± 0.8
02	5.5 ± 0.2	4.1 ± 0.2	5.3 ± 0.1	5.3 ± 0.1	5.1 ± 1.3	4.3 ± 0.5
03	5.8 ± 0.5	4.1 ± 0.3	4.9 ± 0.2	5.1 ± 0.2	5.0 ± 1.4	4.3 ± 0.3
04	5.2 ± 0.6	4.3 ± 0.5	5.0 ± 0.5	5.1 ± 0.4	4.9 ± 0.8	4.5 ± 0.4
05	6.6 ± 0.4	5.3 ± 0.4	6.6 ± 0.6	6.7 ± 0.2	6.3 ± 1.3	5.7 ± 0.3
05A	6.0 ± 0.1	4.7 ± 0.1	5.2 ± 0.8	5.9 ± 0.3	5.5 ± 1.2	5.1 ± 0.3
06	7.3 ± 0.1	6.8 ± 0.5	7.9 ± 0.8	7.8 ± 0.5	7.5 ± 1.0	6.3 ± 0.7
07	6.3 ± 1.2	4.8 ± 0.4	6.0 ± 0.4	6.2 ± 0.3	5.8 ± 1.4	5.0 ± 0.1
21	6.6 ± 0.9	4.9 ± 0.3	5.9 ± 0.2	6.0 ± 0.3	5.9 ± 1.4	4.7 ± 0.3
22	6.9 ± 0.8	6.3 ± 1.0	7.5 ± 0.6	7.3 ± 0.5	7.0 ± 1.1	6.2 ± 0.4
23	7.1 ± 1.3	6.6 ± 0.3	8.4 ± 1.4	8.4 ± 0.4	7.6 ± 1.8	7.1 ± 0.2
24	6.0 ± 0.4	5.0 ± 0.1	5.8 ± 0.6	6.4 ± 0.4	5.8 ± 1.2	5.3 ± 0.5
Average ± 2 s.d.	**6.5 ± 1.9**	**5.4 ± 2.3**	**6.4 ± 2.6**	**6.6 ± 2.4**	**6.2 ± 2.2**	**5.5 ± 2.0**

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

North Anna Power Station, Louisa County, Virginia - 2000
mR/Std. Month (30.4 days) ± 2 Sigma Page 1 of 2

Station Number	First Qtr. 01/06-03/29	Second Qtr. 03/29-07/05	Third Qtr. 07/05-09/28	Fourth Qtr. 09/28-01/11/01	Average ± 2 s.d.
N-1	7.6 ± 0.5	5.9 ± 0.6	7.2 ± 0.5	6.7 ± 0.9	6.9 ± 1.5
N-2	5.7 ± 0.3	4.3 ± 0.8	5.2 ± 0.5	5.3 ± 0.3	5.1 ± 1.2
NNE-3	10.1 ± 0.6	7.8 ± 1.2	9.6 ± 0.5	9.5 ± 0.4	9.3 ± 2.0
NNE-4	6.8 ± 0.2	5.3 ± 1.0	6.7 ± 0.7	6.5 ± 0.3	6.3 ± 1.4
NE-5	8.6 ± 1.0	7.0 ± 0.4	8.1 ± 0.3	7.9 ± 0.5	7.9 ± 1.3
NE-6	6.5 ± 0.4	5.0 ± 0.9	6.2 ± 0.6	5.9 ± 0.5	5.9 ± 1.3
ENE-7	7.9 ± 0.6	5.9 ± 0.8	7.3 ± 0.2	7.1 ± 0.4	7.1 ± 1.7
ENE-8	5.4 ± 0.4	4.1 ± 0.2	5.7 ± 0.4	5.5 ± 0.0	5.2 ± 1.5
E-9	7.9 ± 0.4	6.6 ± 0.4	8.1 ± 0.4	7.6 ± 0.3	7.6 ± 1.3
E-10	6.9 ± 0.5	5.5 ± 0.4	7.1 ± 0.7	6.7 ± 0.3	6.6 ± 1.4
ESE-11	7.1 ± 0.6	5.6 ± 0.5	6.6 ± 0.4	6.7 ± 0.5	6.5 ± 1.3
ESE-12	7.9 ± 0.3	6.2 ± 0.4	7.5 ± 0.5	7.2 ± 0.8	7.2 ±1.5
SE-13	7.1 ± 0.4	5.9 ± 0.4	6.8 ± 0.1	6.5 ± 0.4	6.6 ± 1.0
SE-14	9.6 ± 0.2	7.9 ± 1.3	9.3 ± 0.5	9.0 ± 0.8	9.0 ± 1.5
SSE-15	8.2 ± 0.6	6.4 ± 0.4	8.1 ± 0.4	7.4 ± 0.3	7.5 ± 1.7
SSE-16	6.5 ± 0.3	4.7 ± 0.4	5.9 ± 0.2	5.6 ± 0.4	5.7 ±1.5
S-17	10.2 ± 0.2	8.5 ± 0.7	10.3 ± 0.2	9.8 ± 0.5	9.7 ± 1.7
S-18	5.9 ± 0.3	4.3 ± 0.3	5.2 ± 0.3	4.7 ± 0.1	5.0 ± 1.4
SSW-19	8.8 ± 0.9	7.8 ± 0.1	9.3 ± 1.1	8.7 ± 0.7	8.7 ± 1.2
SSW-20	5.6 ± 0.7	4.0 ± 0.5	5.0 ± 0.2	4.7 ± 0.2	4.8 ± 1.3
SW-21	6.6 ± 0.5	5.4 ± 0.2	6.7 ± 1.0	5.9 ± 0.5	6.2 ± 1.2
SW-22	7.3 ± 0.2	5.8 ± 1.0	7.1 ± 0.4	6.8 ± 0.4	6.8 ± 1.3
WSW-23	8.7 ± 0.3	7.3 ± 0.4	8.4 ± 0.4	7.6 ± 0.2	8.0 ±1.3
WSW-24	7.6 ± 0.2	6.1 ± 0.6	7.1 ± 0.5	6.9 ± 0.4	6.9 ± 1.2
W-25	9.6 ± 0.3	8.0 ± 1.3	8.8 ± 0.4	8.1 ± 0.4	8.6 ± 1.5
W-26	6.3 ± 0.3	4.5 ± 0.6	5.7 ± 0.4	5.5 ± 0.2	5.5 ± 1.5
WNW-27	6.1 ± 0.6	4.8 ± 0.5	6.0 ± 0.3	5.6 ± 0.4	5.6 ± 1.2
WNW-28	6.8 ± 1.0	4.9 ± 0.4	6.0 ± 0.2	5.6 ± 0.3	5.8 ± 1.6
NW-29	9.9 ± 0.6	7.8 ± 0.3	9.7 ± 0.5	8.8 ± 0.3	9.1 ± 1.9
NW-30	6.1 ± 0.4	4.6 ± 0.3	5.3 ± 0.3	5.3 ± 0.2	5.3 ± 1.2
NNW-31	6.8 ± 0.2	5.2 ± 0.3	6.2 ± 0.5	6.0 ± 0.1	6.1 ± 1.3
NNW-32	7.6 ± 0.8	5.3 ± 0.4	6.7 ± 0.3	6.3 ± 0.7	6.5 ± 1.9
N-33	8.3 ± 1.1	6.2 ± 0.2	7.0 ± 0.3	7.2 ± 0.4	7.2 ± 1.7
N-34	5.9 ± 0.6	4.3 ± 0.5	5.2 ± 0.2	5.4 ± 0.2	5.2 ± 1.3
NNE-35	10.6 ± 0.7	8.0 ± 0.9	9.4 ± 0.9	9.7 ± 0.9	9.4 ± 2.2
NNE-36	7.5 ± 0.2	5.8 ± 0.3	6.9 ± 0.2	6.7 ± 0.3	6.7 ± 1.4
NE-37	9.0 ± 0.5	7.0 ± 0.5	8.2 ± 0.2	7.9 ± 0.6	8.0 ± 1.7
NE-38	6.7 ± 0.4	5.1 ± 1.2	6.3 ± 0.2	6.0 ± 0.3	6.0 ± 1.4

TABLE B-15: DIRECT RADIATION MEASUREMENTS

SECTOR QUARTERLY TLD RESULTS

North Anna Power Station, Louisa County, Virginia - 2000
mR/Std. Month (30.4 days) ± 2 Sigma Page 2 of 2

Station Number	First Qtr 01/06-03/29	Second Qtr 03/29-07/05	Third Qtr 07/05-09/28	Fourth Qtr 09/28-01/11/01	Average ± 2 S.d.
ENE-39	7.7 ± 0.6	6.5 ± 0.7	7.5 ± 1.1	7.5 ± 0.1	7.3 ± 1.1
ENE-40	5.7 ± 0.3	3.9 ± 0.3	5.9 ± 0.2	5.6 ± 0.5	5.3 ± 1.9
E-41	8.0 ± 0.5	6.5 ± 0.3	7.9 ± 0.4	8.0 ± 0.4	7.6 ± 1.5
E-42	7.2 ± 0.4	5.8 ± 0.3	7.0 ± 0.1	7.0 ± 0.6	6.0 ± 2.9
ESE-43	7.4 ± 0.7	5.5 ± 0.7	6.7 ± 0.9	6.8 ± 0.5	6.6 ± 1.6
ESE-44	7.9 ± 0.4	6.1 ± 1.1	7.7 ± 0.3	7.5 ± 0.3	7.3 ± 1.6
SE-45	7.7 ± 0.2	6.2 ± 0.3	6.8 ± 0.5	6.8 ± 0.3	6.9 ± 1.2
SE-46	9.4 ± 0.9	7.5 ± 1.2	9.8 ± 0.6	9.0 ± 0.4	8.9 ± 2.0
SSE-47	8.6 ± 0.7	6.4 ± 0.4	8.3 ± 0.6	7.5 ± 0.4	7.7 ± 2.0
SSE-48	6.6 ± 0.8	5.0 ± 0.4	6.3 ± 0.9	5.9 ± 0.4	6.0 ± 1.4
S-49	10.2 ± 0.3	8.4 ± 1.4	11.1 ± 0.9	9.8 ± 0.9	9.9 ± 2.2
S-50	5.4 ± 0.3	4.2 ± 0.3	5.4 ± 0.5	4.9 ± 0.1	5.0 ± 1.1
SSW-51	9.2 ± 1.4	7.6 ± 0.5	9.6 ±0.3	9.3 ± 0.5	8.9 ± 1.8
SSW-52	5.8 ± 0.2	4.0 ± 0.5	5.5 ± 0.2	5.0 ± 0.4	5.1 ± 1.6
SW-53	7.1 ± 0.6	5.3 ± 0.4	6.8 ± 0.7	6.1 ± 0.5	6.3 ± 1.6
SW-54	7.4 ± 0.3	6.1 ± 0.6	7.8 ± 0.5	7.2 ± 0.3	7.1 ± 1.5
WSW-55	8.6 ± 0.6	6.9 ± 0.8	8.6 ± 0.7	7.8 ± 0.3	8.0 ± 1.6
WSW-56	8.0 ± 1.4	6.4 ± 0.5	7.9 ± 1.0	7.0 ± 0.2	7.3 ± 1.5
W-57	9.3 ± 0.2	7.6 ± 0.5	9.5 ± 1.2	8.5 ± 0.4	8.7 ± 1.7
W-58	6.7 ± 0.6	4.7 ± 0.4	5.8 ± 0.3	5.2 ± 0.2	5.6 ± 1.7
WNW-59	6.4 ± 0.3	5.0 ± 0.1	5.5 ± 0.7	5.6 ± 0.2	5.6 ± 1.2
WNW-60	6.9 ± 1.2	4.8 ± 0.6	6.3 ± 0.1	5.8 ± 0.2	6.0 ± 1.8
NW-61	9.7 ± 1.1	7.9 ± 0.6	9.2 ± 0.4	8.5 ± 0.7	8.8 ± 1.6
NW-62	5.9 ± 0.4	4.7 ± 0.1	5.6 ± 0.3	5.2 ± 0.3	5.4 ± 1.0
NNW-63	7.0 ± 0.4	5.3 ± 0.3	6.5 ± 0.5	6.2 ± 0.1	6.3 ± 1.4
NNW-64	6.9 ± 0.6	5.4 ± 0.4	6.4 ± 0.8	6.3 ± 0.4	6.3 ± 1.2
C-1	6.4 ± 1.1	4.9 ± 0.5	6.1 ± 0.1	6.2 ± 1.0	5.7 ± 1.4
C-2	5.9 ± 0.7	5.1 ± 0.3	6.0 ± 0.1	5.9 ± 0.1	5.7 ± 0.8
C-3	6.3 ± 0.1	5.1 ± 0.2	6.0 ± 0.2	6.0 ± 0.3	5.9 ± 1.0
C-4	6.8 ± 0.9	5.1 ± 0.2	5.9 ± 0.5	6.0 ± 0.3	6.0 ± 1.4
C-5	5.3 ± 0.1	3.9 ± 0.4	5.1 ± 0.5	5.2 ± 0.5	4.9 ± 1.3
C-6	5.4 ± 0.3	4.0 ± 0.2	5.3 ± 0.5	4.8 ± 0.2	4.9 ± 1.3
C-7	7.4 ± 0.3	5.7 ± 0.5	7.9 ± 0.5	6.9 ± 0.4	7.0 ± 1.9
C-8	7.5 ± 0.5	5.9 ± 0.2	7.7 ± 0.7	6.9 ± 0.6	7.0 ± 1.6
Average	**7.4 ± 2.7**	**5.8 ± 2.5**	**7.1 ± 3.0**	**6.8 ± 2.7**	**6.8 ± 2.7**

APPENDIX C
LAND USE CENSUS - 2000

DOMINION VIRGINIA POWER NORTH ANNA POWER STATION Annual Radiological Environmental Land Use Census Data for 2000 August 1 - September 8						
Sector	Nearest Resident kM	Nearest Site Boundary kM	Milch * Cow kM	Meat Animal kM	Milch * Goat kM	Veg. Garden 500 Sq. ft. kM
N	2.4	1.4		3.5		2.4
NNE	1.4	1.4		2.3		2.5
NE	1.5	1.3		2.3		1.5
ENE	3.4	1.3		4.0		3.4
E	2.1	1.3		5.7		2.1
ESE	2.7	1.4		NONE		5.6
SE	2.3	1.4		2.3		2.3
SSE	1.6	1.5		4.5		4.1
S	1.7	1.5		NONE		1.5
SSW	1.9	1.6		3.1		4.6
SW	5.0	1.7		NONE		5.0
WSW	2.7	1.8		2.7		2.7
W	2.4	1.7		7.1		8.0
WNW	1.8	1.6		6.5		3.5
NW	1.7	1.6		NONE		1.9
NNW	1.6	1.4		3.2		1.9
* Note: No milch cow or goats within a 5 mile radius of North Anna Power Station						
kM = kilometer						

DOMINION VIRGINIA POWER NORTH ANNA POWER STATION Annual Radiological Environmental Land Use Census Data for 2000 August 1 - September 8						
Sector	Nearest Resident M	Nearest Site Boundary M	Milch * Cow M	Meat Animal M	Milch * Goat M	Veg. Garden 500 Sq. Ft. M
N	1.5	0.9		2.2		1.5
NNE	0.9	0.9		1.5		1.5
NE	0.9	0.8		1.4		0.9
ENE	2.1	0.8		2.5		2.1
E	1.3	0.8		3.5		1.3
ESE	1.7	0.9		NONE		3.5
SE	1.4	0.9		1.4		1.4
SSE	1.0	0.9		2.8		2.6
S	1.1	0.9		NONE		1.0
SSW	1.2	1.0		2.0		2.9
SW	3.1	1.1		NONE		3.1
WSW	1.7	1.1		1.7		1.7
W	1.5	1.1		4.4		5.0
WNW	1.1	1.0		4.1		2.2
NW	1.0	1.0		NONE		1.2
NNW	1.0	0.9		2.0		1.2
* Note: No milch cow or goats within a 5 mile radius of North Anna Power Station						
M = mile						

DOMINION VIRGINIA POWER
NORTH ANNA POWER STATION
COMPARISON OF THE 2000 TO THE 1999 LAND USE CENSUS

I. No changes were observed in the nearest resident.

II. No changes were observed in the nearest site boundary distances.

III. No changes were observed in the nearest milk cow/goat status.

IV. The following change was observed in the nearest vegetable garden as compared to the previous year:

a.	Sector South	2.1 kM to 1.5 kM.
b.	Sector N	3.2 kM to 2.4 kM
c.	Sector ESE	5.3 kM to 5.6 kM
d.	Sector SSE	1.6 kM to 4.1 kM

V. The following change was observed in the nearest meat animal status as compared to the previous year:

a.	Sector South	1.5 miles to deletion of the meat animal.

APPENDIX D
SYNOPSIS OF ANALYTICAL PROCEDURES

ANALYTICAL PROCEDURES SYNOPSIS

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

ANALYSIS TITLE

GROSS BETA ANALYSIS OF SAMPLES

Air Particulates

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

Calculations of the result, 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^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)

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 the 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 which allow for the change in effective 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 counting time of 50 minutes and upon representative values of counting efficiency and background of 0.2 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.

ANALYSIS OF SAMPLES FOR TRITIUM
(Liquid Scintillation)

Water

Ten millimeters 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 result, the two sigma error and the lower limit detection (LLD) in pCi/l:

RESULT	=	$(N-B)/(2.22\ V\ E)$
TWO SIGMA ERROR	=	$2(N + B)/\bullet t)^{1/2}/ (2.22\ V\ E)$
LLD	=	$4.66\ (B/\bullet t)^{1/2}/ (2.22\ V\ E)$

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

Milk

Stable strontium carrier is added to 1 liter of sample and the sample is first evaporated, then ashed in a muffle furnace. The ash is dissolved and strontium is precipitated as phosphate, then is dissolved and precipitated as $SrNO_3$ 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 ingrowth. Yttrium is then precipitated as hydroxide, dissolved and then re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchette and is counted in a low level beta counter to infer Sr-90 activity. Strontium-89 is determined by precipitating $SrCO_3$ 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 ingrowth. Yttrium is then precipitated as hydroxide, dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchette and is counted in a low level beta counter to infer Sr-90 activity. Strontium-89 is determined by precipitating $SrCO_3$ 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 $Sr(NO_3)$ using fuming (90%) nitric acid. An iron (ferric hydroxide) scavenge is performed, followed by addition of stable yttrium carrier and a minimum of 5 days period for yttrium ingrowth. Yttrium is then precipitated as hydroxide, dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchette and is counted in a low level beta counter to infer strontium-90 activity. Strontium-89 activity is determined by precipitating $SrCO_3$ from the sample after yttrium separation. This precipitate is counted 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 ingrowth. Yttrium is then precipitated as hydroxide, dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchette and is counted in a low level beta counter to infer strontium-90 activity. Strontium-89 activity is determined by precipitating $SrCO_3$ from the sample after yttrium separation. This precipitate is counted on a nylon planchette and is covered with 80 mg/cm^2 aluminum absorber for low level beta counting.

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

RESULT Sr-89	=	$(N/Dt-B_C-B_A)/(2.22\ V\ Y_S\ DF_{SR\text{-}89}E_{SR\text{-}89})$
TWO SIGMA ERROR Sr-89	=	$2(N/Dt+B_C+B_A)/\bullet t)^{1/2}/(2.22\ V\ Y_SDF_{SR\text{-}89}E_{SR\text{-}89})$
LLD Sr-89	=	$4.66(B_C+B_A)/\ \bullet t)^{1/2}/(2.22\ V\ Y_SDF_{SR\text{-}89}E_{SR\text{-}89})$
RESULT Sr-90	=	$(N/\bullet t-B)/(2.22\ V\ Y_1\ Y_2\ DF\ IF\ E)$
TWO SIGMA ERROR Sr-90	=	$2(N/\bullet t+B)\ /\bullet t)^{1/2}/(2.22\ V\ Y_1\ Y_2\ DF\ E\ IF)$
LLD Sr-90	=	$4.66(B/\bullet t)^{1/2}/(2.22\ V\ Y_1\ Y_2\ IF\ DF\ E)$

Where:	N	=	total counts from sample
	$\bullet t$	=	counting time for sample (min)
	B_C	=	background rate of counter (cpm) using absorber Configuration.
	2.22	=	dpm /pCi
	V	=	volume or weight of sample analyzed
	B_A	=	background addition from Sr-90 and ingrowth of Y-90
	B_C	=	$0.016(K) + (K)\ E_Y/_{abs})(IG_{Y\text{-}90})$
	Y_S	=	chemical yield of strontium
	$DF_{SR\text{-}89}$	=	decay factor from the mid collection date to the counting date for SR-89
	K	=	$(N\bullet t-B_C)_{Y\text{-}90})/E_{Y\text{-}90}\ IF_{Y\text{-}90}\ DF_{Y\text{-}90}Y_1)$
	$DF_{Y\text{-}90}$	=	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
	$IF_{Y\text{-}90}$	=	ingrowth factor for Y-90 from scavenge to time to milking time
	$IG_{Y\text{-}90}$	=	the ingrowth factor for Y-90 into the strontium mount from the "milk" time to the mid count time

0.016	=	the efficiency of measuring SR-90 through a No. 6 absorber
$EY/_{abs}$	=	the efficiency of counting Y-90 through a No. 6 absorber
B	=	background rate of counter (cpm)
Y_1	=	chemical yield of yttrium
Y_2	=	chemical yield of strontium
DF	=	decay factor of yttrium from the radiochemical milking time to the mid count time
E	=	efficiency of the counter for Y-90
IF	=	ingrowth factor for Y-90 from scavenge time to the radiochemical 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) in pCi/l:

RESULT	=	$(N/\bullet t-B)/(2.22\ V\ Y\ DF)$
TWO SIGMA ERROR	=	$2((N/\bullet t+B)\ /\bullet t)^{1/2}/(2.22\ E\ V\ Y\ DF)$
LLD	=	$4.66(B/\bullet t)^{1/2}/(2.22\ E\ V\ Y\ DF)$

Where	N	=	total counts from sample
	•t	=	counting time for sample (min)
	B	=	background rate of counter
	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
	M_S	=	mass of $Ph1_2$ on the standard mount, mg
	M	=	mass of PDI_2 on the sample mount, mg

GAMMA SPECTROMETRY OF SAMPLES

Milk and Water

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

Dried Solids Other Than Soil and Sediments

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

Fish

As much as possible (up to the total sample) of the edible portion of the sample is loaded into a tared Marinelli and weighed. The sample is then counted for approximately 100 minutes with a shield Ge(Li) detector coupled to a mini-computer-based data acquisition system which performs pulse height analysis.

Soil and Sediments

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

Charcoal Cartridges (Air Iodine)

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

Air Particulate

The thirteen airborne particulate filters for a quarterly composite for each field station are aligned one in front of another and then counted for at least six hours with a shielded Ge(Li)detector coupled to a min-computer-based data acquisition system which performs pulse height analysis.

A mini-computer software programs defines peaks by certain changes I 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.

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 peak.
	t	=	length of time in minutes the sample was counted
	2.22	=	dpm/pCi
	E	=	detector efficiency for energy of interest and geometry of sample
	V	=	sample aliquot size (liters, cubic meters, kilograms, or grams)
	F	=	fractional gamma abundance (specific for each emitted gamma)
	DF	=	decay factor from the mid-collection date to the counting date

ENVIRONMENTAL DOSIMETRY

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

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

In June of 2000, clients were notified that TBE would no longer a provider of environmental TLD service.

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

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

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

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

APPENDIX E

INTERLABORATORY COMPARISON PROGRAM

INTERLABORATORY COMPARISION PROGRAM

The US Environmental Protection Agency (EPA) discontinued their Interlaboratory Comparison Program in December 1998. Since the EPA is no longer involved in the program, there are no "approved" laboratories for Intercomparison Studies; however, Teledyne Brown Engineering participates in the Analytics, Inc. and Environmental Resource Associates (ERA) programs to the fullest extent possible. That is, we participate in the program for all radioactive isotopes prepared and at the maximum frequency of availability.

The National Institute of Standards and Technology (NIST) is the approval authority for laboratory providers participating in Intercomparison Study Programs; however, at this time, there are no approved laboratories for environmental and/or radiochemical isotope analyses.

Trending graphs are provided in this section for the EPA Program and for Analytics when there were at least two data points to plot.

ANALYTICS CROSS CHECK COMPARISON PROGRAM 2000

Sample Date	Media	Nuclide	Teledyne Brown Engineering Result (a)	Analytics Result	Ratio (b)
03/20/00	Milk	I-131	18 ± 1	20 ± 1	0.90
		Cr-51	381 ± 38	387 ± 19	0.98
		Cs-134	132 ± 13	143 ± 7	0.92
		Cs-137	128 ± 13	114 ± 6	1.12
		Co-58	89 ± 9	79 ± 4	1.13
		Mn-54	195 ± 20	176 ± 9	1.11
		Fe-59	161 ± 16	144 ± 7	1.12
		Zn-65	171 ± 17	165 ± 8	1.04
		CO-60	179 ± 18	176 ± 9	1.02
03/20/00	Milk	Sr-89	13 ± 3	25 ± 1	0.52(c)
		Sr-90	16 ± 1	19 ± 1	0.84
06/19/00	Air Filter	Ce-141	143 ± 8	132 ± 7	1.08
		Cr-51	229 ± 17	198 ± 10	1.16
		Cs-134	74 ± 4	81 ± 4	0.91
		Cs-137	143 ± 8	115 ± 6	1.24
		Co-58	89 ± 5	77 ± 4	1.16
		Mn-54	102 ± 6	84 ± 4	1.21
		Fe-59	98 ± 6	75 ± 4	1.31
		Zn-65	188 ± 11	139 ± 7	1.35
		Co-60	113 ± 7	104 ± 5	1.09
06/19/00	Cartridge	I-131	106 ± 6	88 ± 4	1.20
06/19/00	Air Filter	Sr-90	88 ± 5	96 ± 5	0.92
06/19/00	Air Filter	Gross Alpha	103 ± 6	93 ± 5	1.11
		Gross Beta	210 ± 6	193 ± 10	1.09
09/18/00	Milk	I-131	97 ± 10	87 ± 4	1.11
		Ce-141	83 ± 8	77 ± 4	1.08
		Cr-51	323 ± 40	304 ± 15	1.06
		Cs-134	98 ± 10	102 ± 5	0.96
		Cs-137	117 ± 12	107 ± 5	1.09
		Co-58	64 ± 6	60 ± 3	1.07
		Mn-54	99 ± 10	88 ± 4	1.13
		Fe-59	132 ± 13	119 ± 6	1.11
		Zn-65	218 ± 22	196 ± 10	1.11
		Co-60	209 ± 21	197 ± 10	1.06

ANALYTICS CROSS CHECK COMPARISON PROGRAM 2000 (cont.)

Sample Date	Media	Nuclide	Teledyne Brown Engineering Result (a)	Analytics Result	Ratio (b)
09/18/00	Milk	Sr-89	14 ± 1	15 ± 1	0.93
		Sr-90	18 ± 1	14 ± 1	1.29
09/18/00	Milk	Sr-89	77 ± 8	90 ± 5	0.86
		Sr-90	58 ± 1	59 ± 3	0.98
09/18/00	Milk	I-131	83 ± 8	84 ± 4	0.99
		Ce-141	470 ± 47	460 ± 23	1.02
		Cr-51	266 ± 35	256 ± 13	1.04
		Cs-134	150 ± 15	150 ± 8	1.00
		Cs-137	155 ± 15	138 ± 7	1.12
		Co-58	53 ± 5	47 ± 2	1.12
		Mn-54	191 ± 19	171 ± 9	1.12
		Fe-59	115 ± 12	99 ± 5	1.16
		Zn-65	237 ± 24	208 ± 10	1.14
		Co-60	133 ± 13	125 ± 6	1.06
09/18/00	Milk	Fe-55	140 ± 60	99 ± 5	1.41
		Sr-89	65 ± 7	74 ± 4	0.88
		Sr-90	35 ± 1	37 ± 2	0.90
09/18/00	Air Filter	Ce-141	90 ± 9	110 ± 6	0.82
		Cr-51	92 ± 25	133 ± 7	0.69
		Cs-134	48 ± 5	74 ± 4	0.64
		Cs-137	107 ± 11	126 ± 6	0.85
		Co58	27 ± 4	34 ± 2	0.80
		Mn-54	42 ± 4	52 ± 3	0.80
		Fe-59	24 ± 8	31 ± 2	0.77
		Zn-65	65 ± 9	77 ± 4	0.84
		Co-60	112 ± 11	142 ± 7	0.79

Footnotes:

(a) Teledyne Results - counting error is two standard deviations. Units are pCi/liter for water and milk. For gamma results, if two standard deviations are less than 10%, then a 10% error is reported. Units are total pCi for air particulate filters.

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

(c) Caused by incorrect rinsing of the strontium extraction column. Additional training was conducted and was documented in the analyst's training file. Subsequent tests on two milk samples spiked with Sr-89 produced correct results.

ERA* STATISTICAL SUMMARY
PROFICIENCY TESTING (PT) PROGRAM – 2000

DATE	NUCLIDE	ERA Known Value (pCi/l)(a)	TBE Result (b) (pCi/l)	Expected Dev. Known (c) (pCi/l)	Control Limits (d) (pCi/l)	Warning Limits (e) (pCi/l)	Performance Evaluation (f)
2/10/00	Gr-A	58.4	83.6	14.6	33.3-83.5	41.5-75.3	NA (g)
2/10/00	Gr-B	16.8	15.4	5.00	38.1-25.5	3.1-22.6	A
2/24/00	U(NAT)	6.07	5.77	3.00	0.870-11.3	2.61-9.53	A
2/24/00	Ra-226	8.26	7.20	1.24	6.11-10.4	6.83-9.69	A
2/24/00	Ra-228	2.25	2.37	0.56	1.28-3.22	1.60-2.90	A
2/24/00	Gr-A	25.4	14.0	6.35	14.5-36.3	18-132.7	NA
2/24/00	Gr-B	42.1	34.0	5.00	33.4-50.8	36.3-47.9	CE
2/25/00	Ba-133	98.2	91.7	9.82	81.5-115	86.9-110	A
2/25/00	Co-60	99.6	101	5.00	90.9-108	93.8-105	A
2/25/00	Cs-134	49.2	48.0	5.00	40.5-57.9	43.3-55.0	A
2/25/00	Cs-137	209	76.3	10.4	191-227	197-221	NA
2/26/00	Sr-89	16.4	15.7	5.00	7.70-25.1	10.6-22.2	A
2/26/00	Sr-90	28.9	29.0	5.00	20.2-37.6	23.1-34.7	A
2/26/00	Co-60	64.4	68.3	5.00	55.7-73.1	58.6-70.2	A
2/26/00	Cs-134	12.3	12.0	5.00	3.60-21.1	6.53-18.1	A
2/26/00	Cs-137	72.2	76.3	5.00	63.5-80.9	66.4-78.0	A
3/01/00	H-3	23800	22300	12380	21100-26500	21000-26500	A

ERA* STATISTICAL SUMMARY
PROFICIENCY TESTING (PT) PROGRAM - 2000

DATE	NUCLIDE	ERA Known Value (pCi/l)(a)	TBE Result (b) (pCi/l)	Expected Dev. Known (c) (pCi/l)	Control Limits (d) (pCi/l)	Warning Limits (e) (pCi/l)	Performance Evaluation (f)
5/18/00	Sr-89	22.5	18.3	5.00	13.8-31.2	16.7-28.3	A
5/18/00	Sr-90	9.6	8.33	5.00	0.9-18.3	3.83-15.4	A
5/23/00	I-131	19.9	2.03	3.00	14.7-25.1	16.4-23.4	NA
9/1/00	Ra-226	13.0	9.70	1.15	7.41-18.6	9.25-16.8	A
9/1/00	U (NAT)	63.4	57.0	4.44	52.6-74.2	56.1-70.7	A
9/1/00	Ra-228	2.83	2.99	6.34	2.21-3.77	2.47-3.51	A
9/1/00	Ra-228	13.0	10.0	3.25	7.41-16.8	9.25-16.8	A
9/1/00	Sr-90	26.2	28.6	1.40	17.5-34.9	20.4-32.0	A
9/1/00	Gr-A	7.17	6.90	1.11	DL-15.9	1.40-12.9	A
9/1/00	Gr-B	87.5	88.8	9.76	70.2-105	76.0-99.0	A
9/1/00	H-3	8320	8740	174	6910-9730	7360-9280	A

Footnotes:

* All ERA samples are water.

(a) 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.

(b) Average $\pm$ 1 sigma.

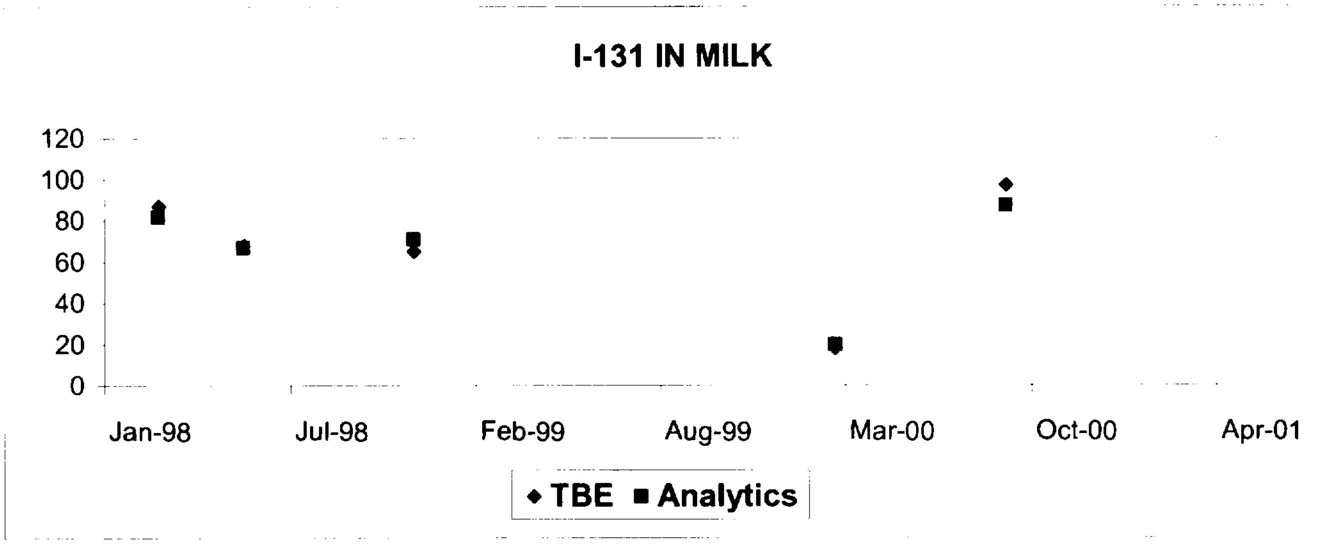
(c) Established per the guidelines contained in the EPA's National Standards for Water Proficiency Testing Criteria Document, December 1998, as applicable.

(d) Established per the guidelines contained in the EPA's National Standards for Water Proficiency Testing Criteria Document, December 1998, as applicable.

(e) Established per the guidelines contained in the EPA's National Standards for Water Proficiency Testing Criteria Document, December 1998, as applicable.

(f) 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 Limit.

(g) For Westwood, NJ results outside control limits, an investigation was not instituted. After the relocation to Knoxville, TN, it has been determined that the vast majority of outlying results were caused by analyst error or equipment failure. These possibilities were eliminated by the relocation.


I-131 IN MILK
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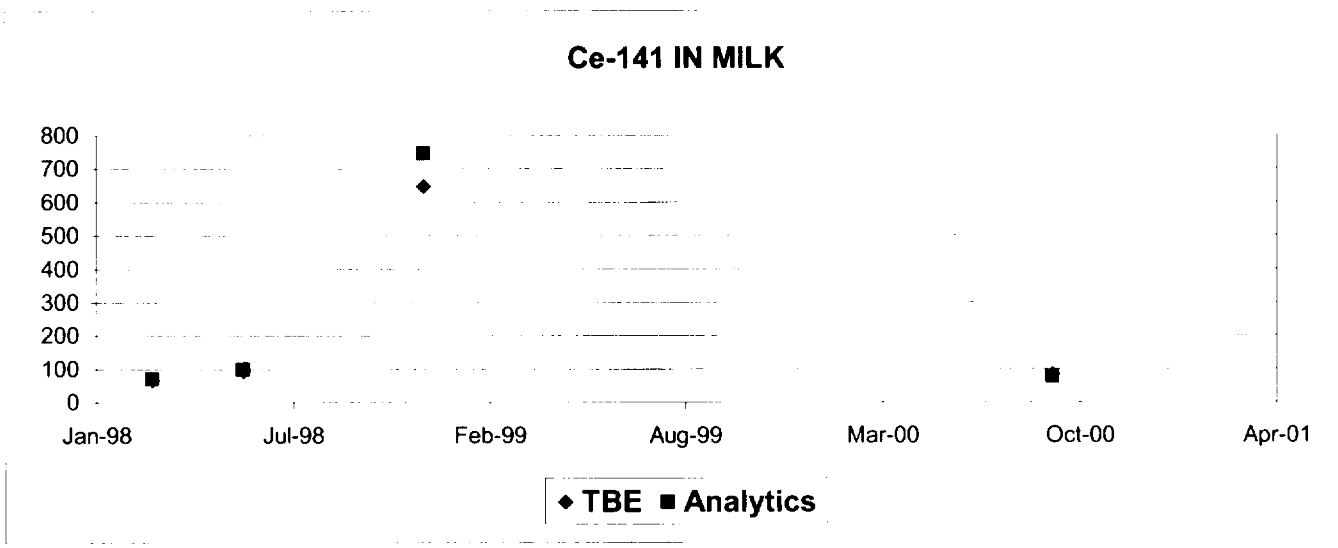
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
TBE
Analytics


Ce-141 IN MILK
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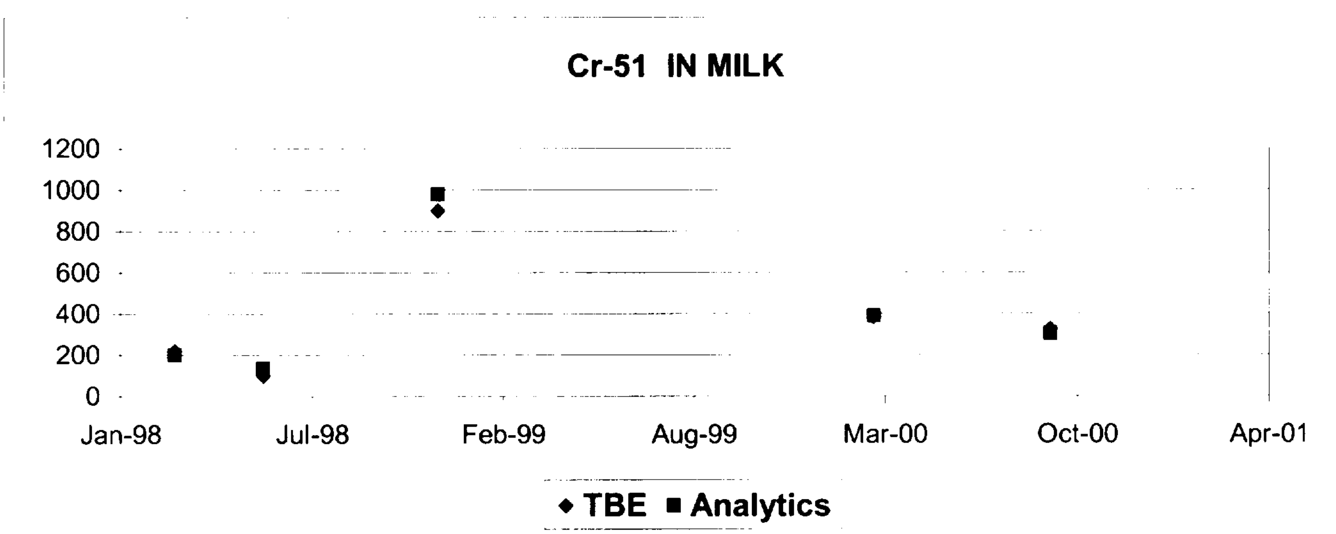
Mar-00
Oct-00
Apr-01
TBE
Analytics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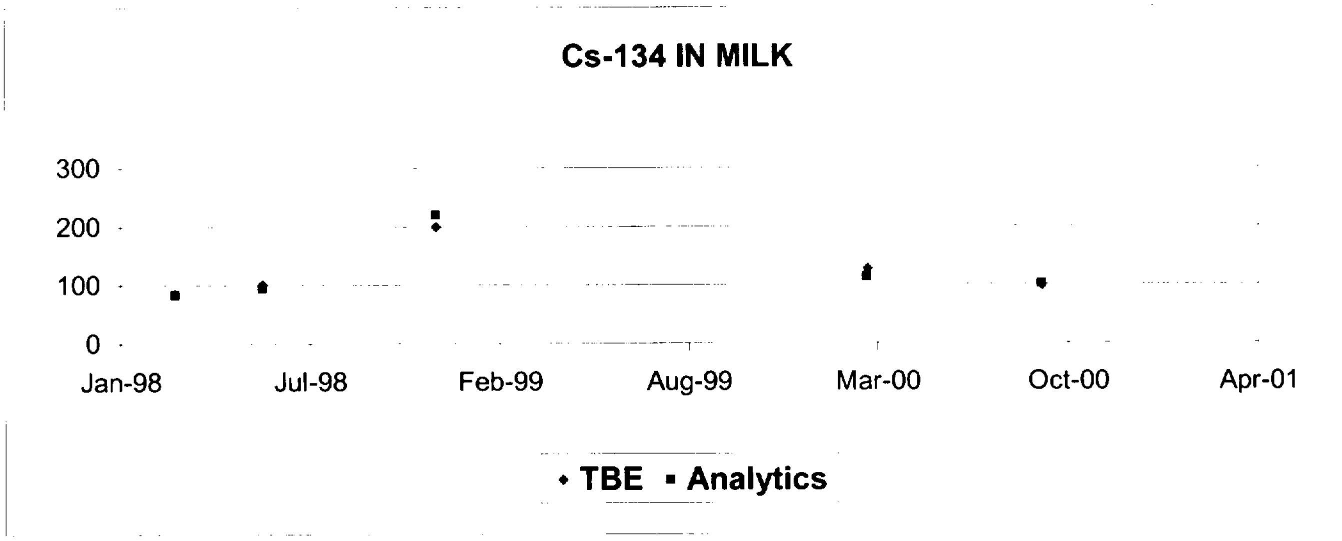
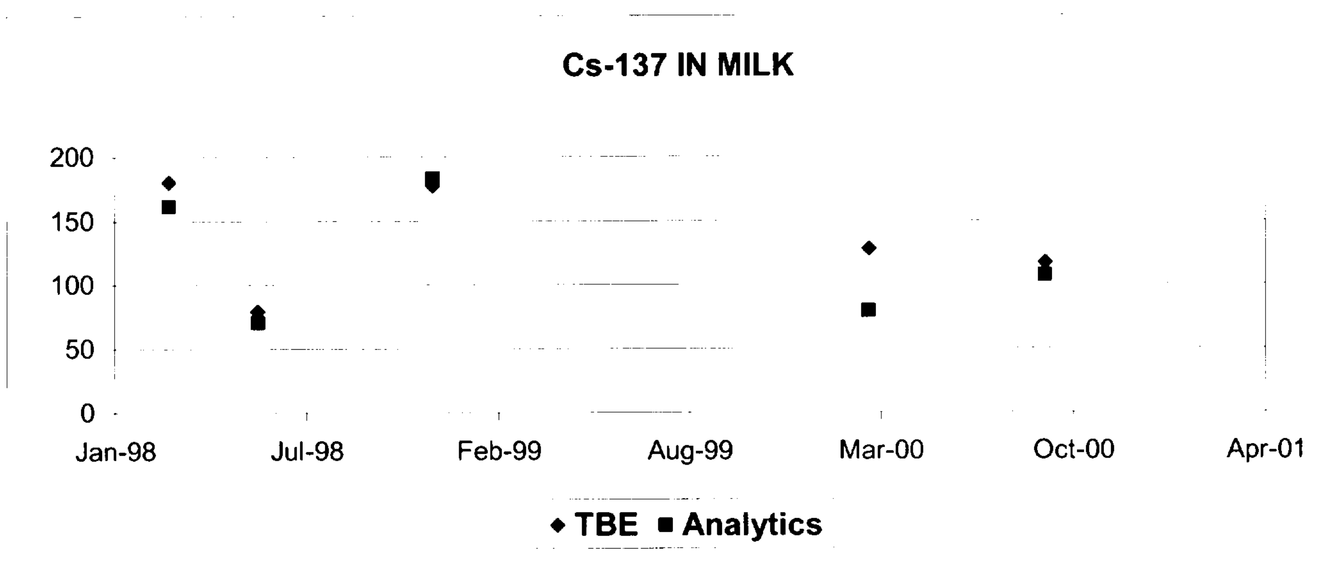
Apr-01
TBE
Analytics



Cs-134 IN MILK
300
200
100
0
Jan-98
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
TBE
Analytics



Cs-137 IN MILK
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150
100
50
0
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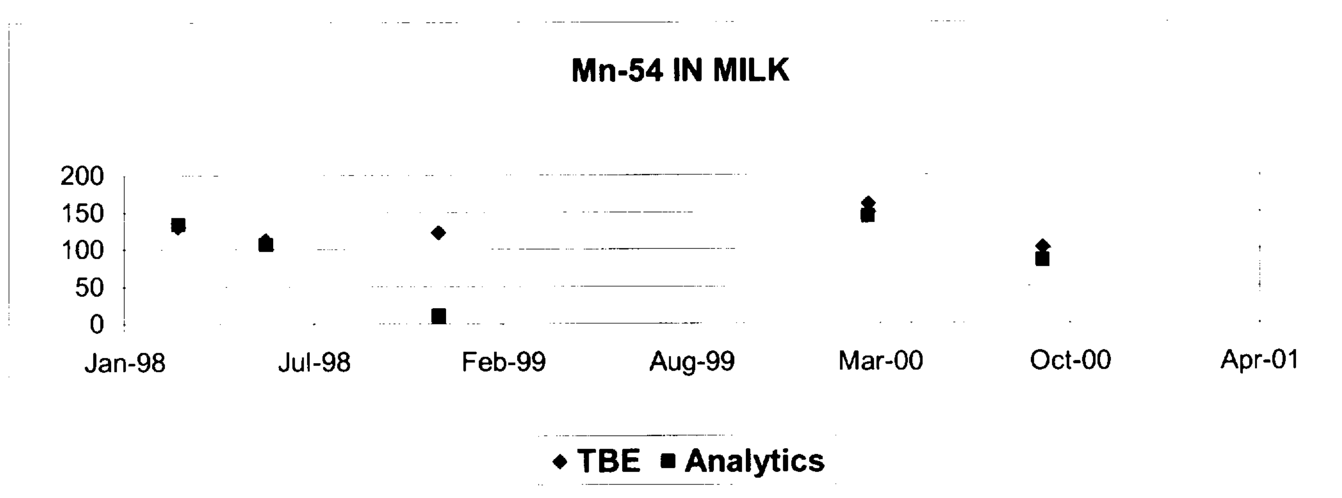
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
TBE
Analytics



Mn-54 IN MILK
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150
100
50
0
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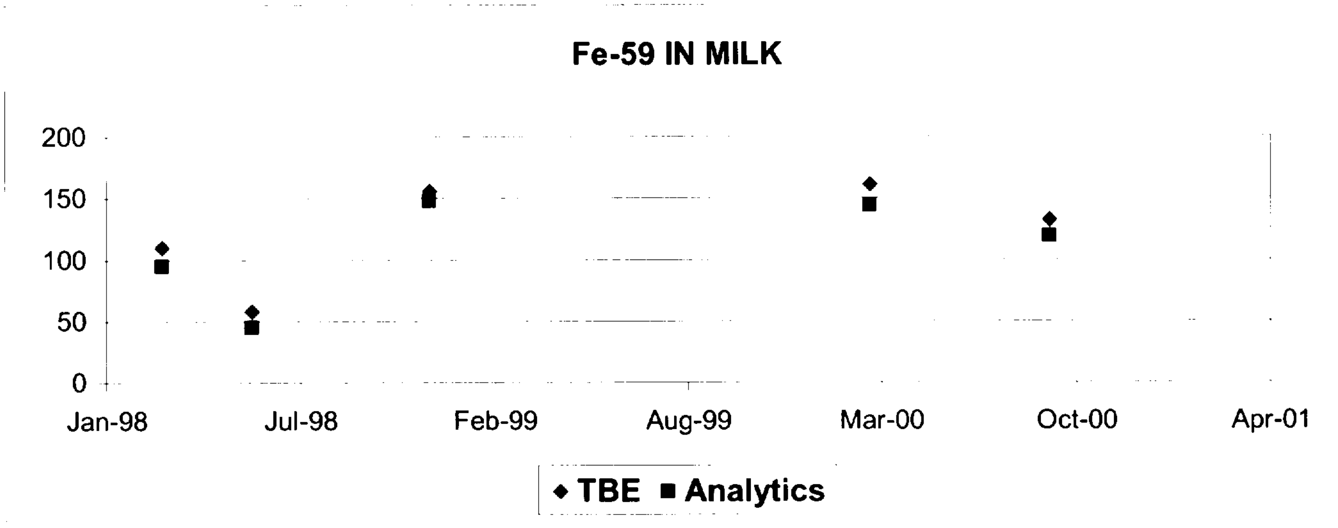
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
TBE
Analytics


Fe-59 IN MILK
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150
100
50
0
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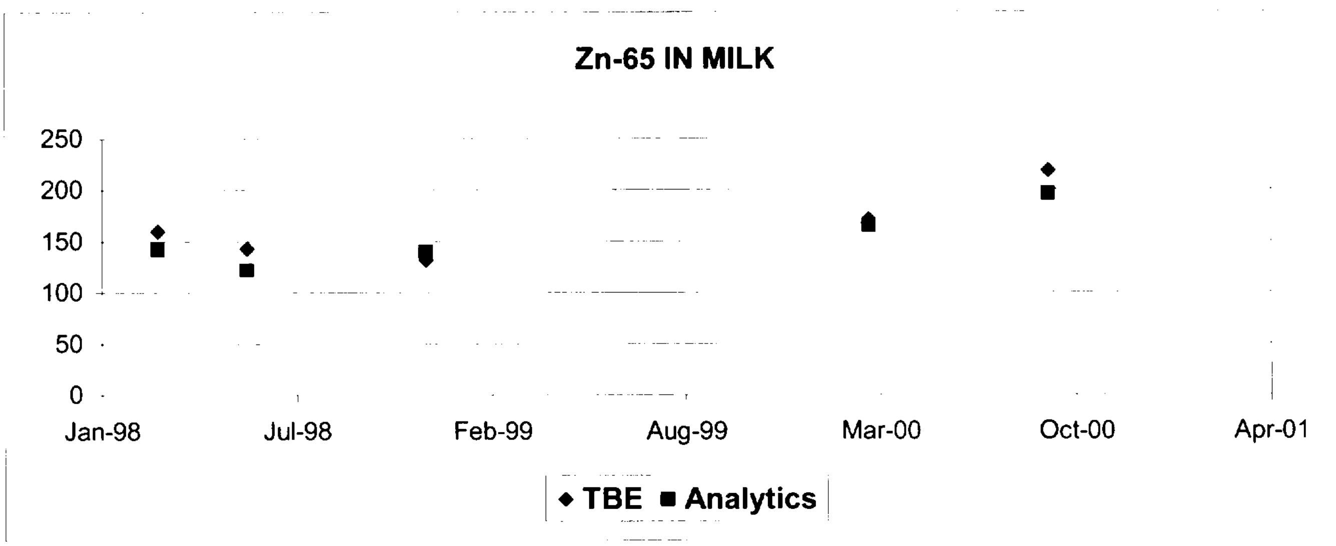
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
TBE
Analytics


Zn-65 IN MILK
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200
150
100
50
0
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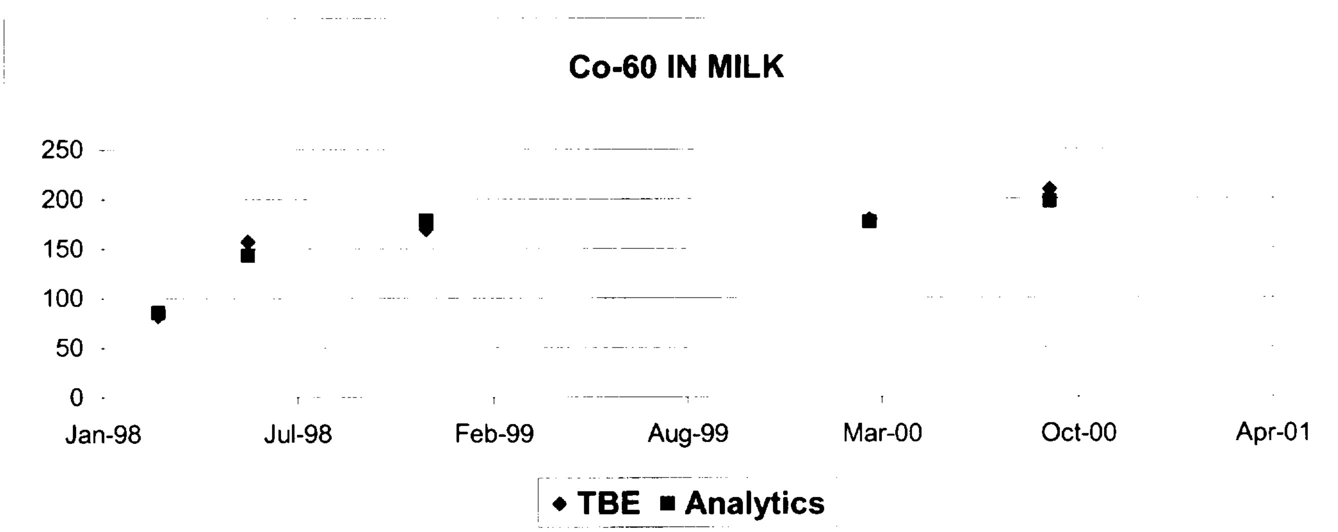
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
TBE
Analytics


Co-60 IN MILK
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200
150
100
50
0
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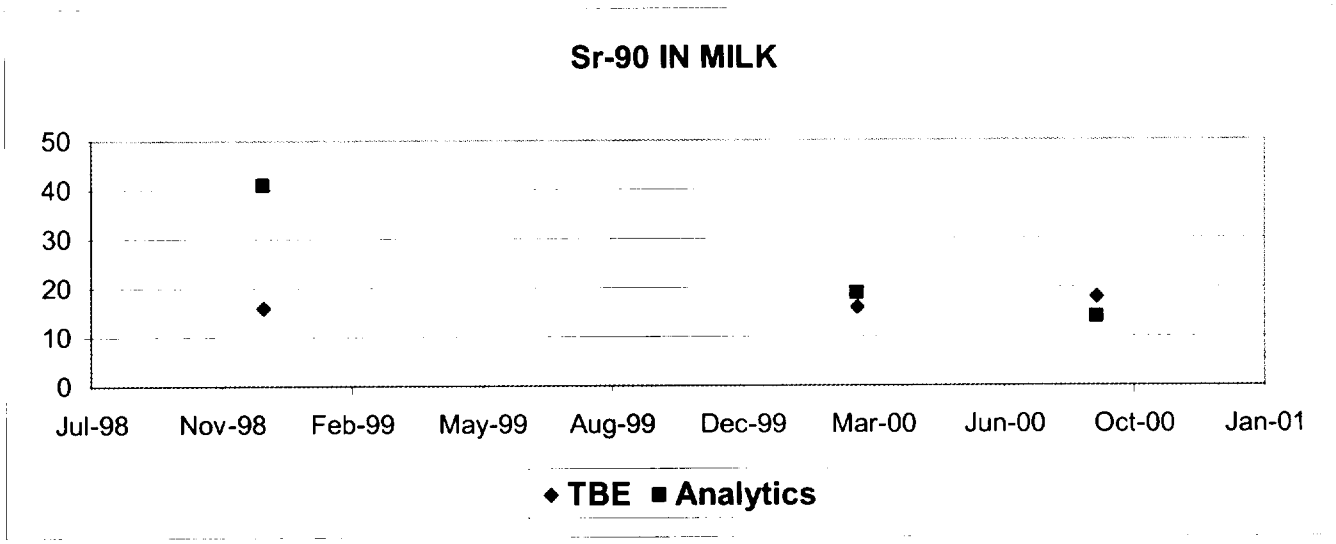
Jul-98
Feb-99
Aug-99
Mar-00
Oct-00
Apr-01
TBE
Analytics


Sr-90 IN MILK
50
40
30
20
10
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Dec-99
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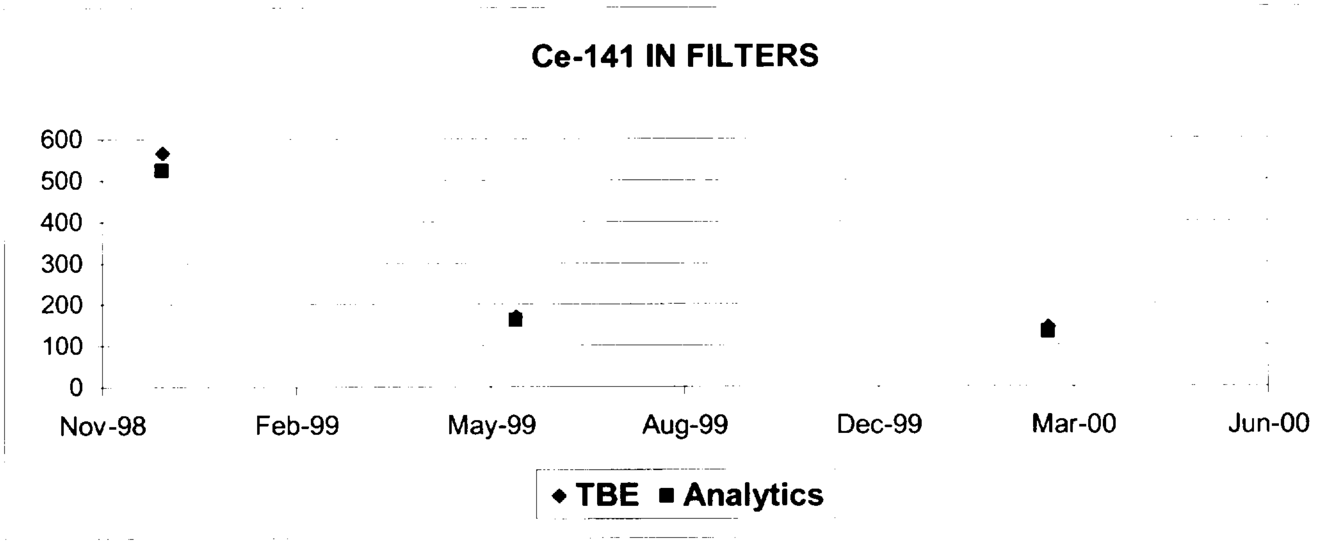
Jun-00
Oct-00
Jan-01
TBE
Analytics


Ce-141 IN FILTERS
600
500
400
300
200
100
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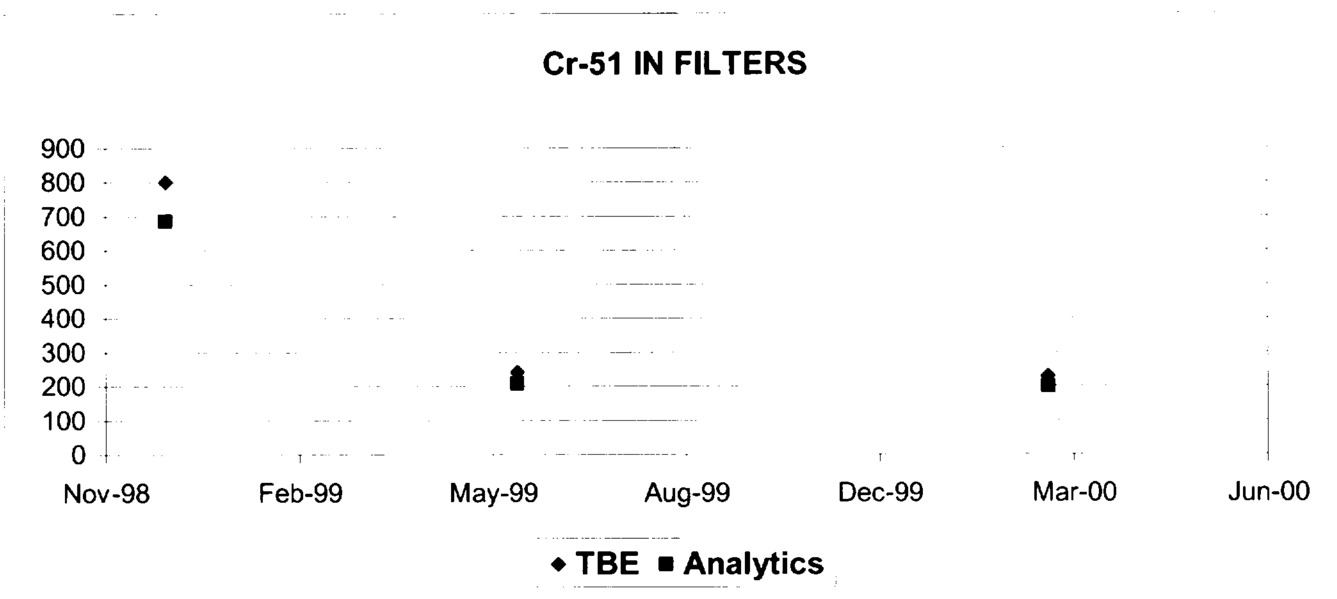
Feb-99
May-99
Aug-99
Dec-99
Mar-00
Jun-00
TBE
Analytics


Cr-51 IN FILTERS
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800
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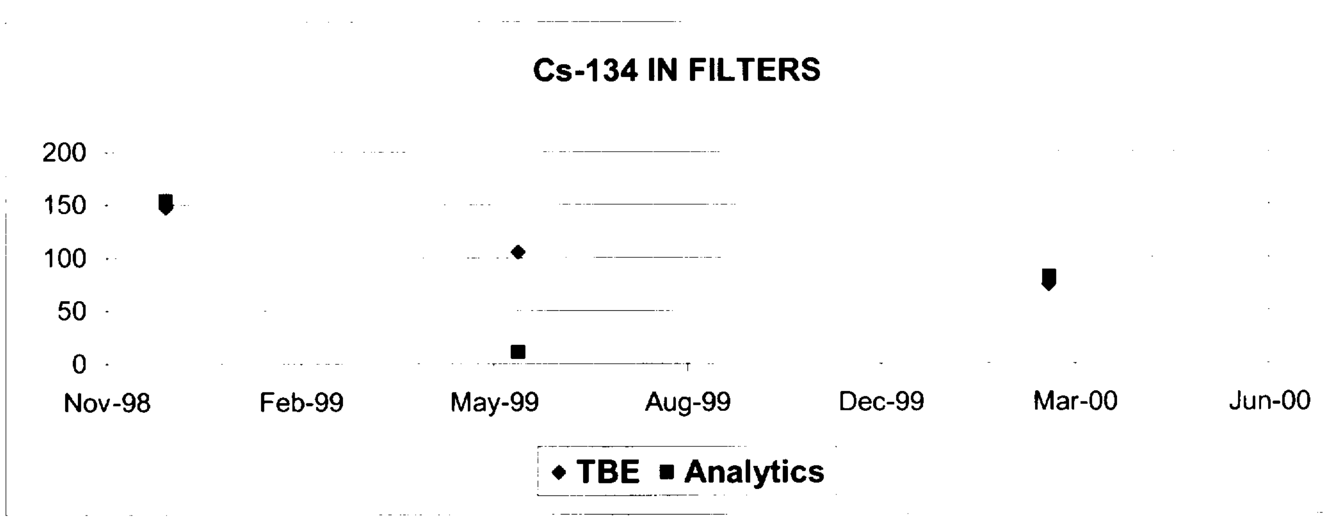
Jun-00
TBE
Analytics


Cs-134 IN FILTERS
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150
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0
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Feb-99
May-99
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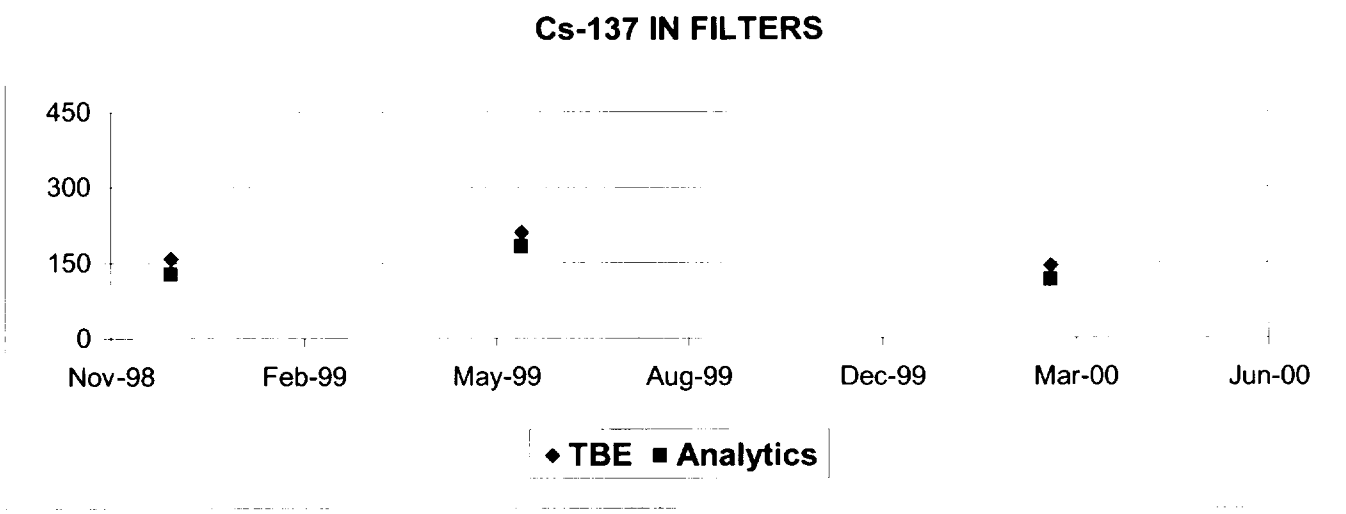
Dec-99
Mar-00
Jun-00
TBE
Analytics


Cs-137 IN FILTERS
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300
150
0
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Feb-99
May-99
Aug-99
Dec-99
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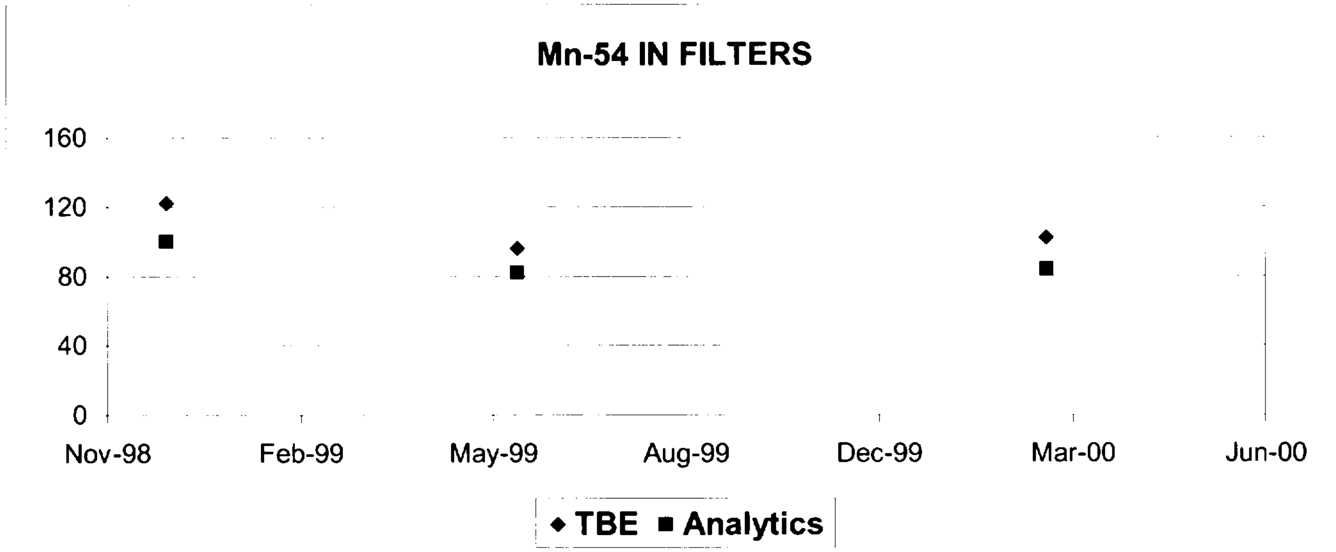
Jun-00
TBE
Analytics


Mn-54 IN FILTERS
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80
40
0
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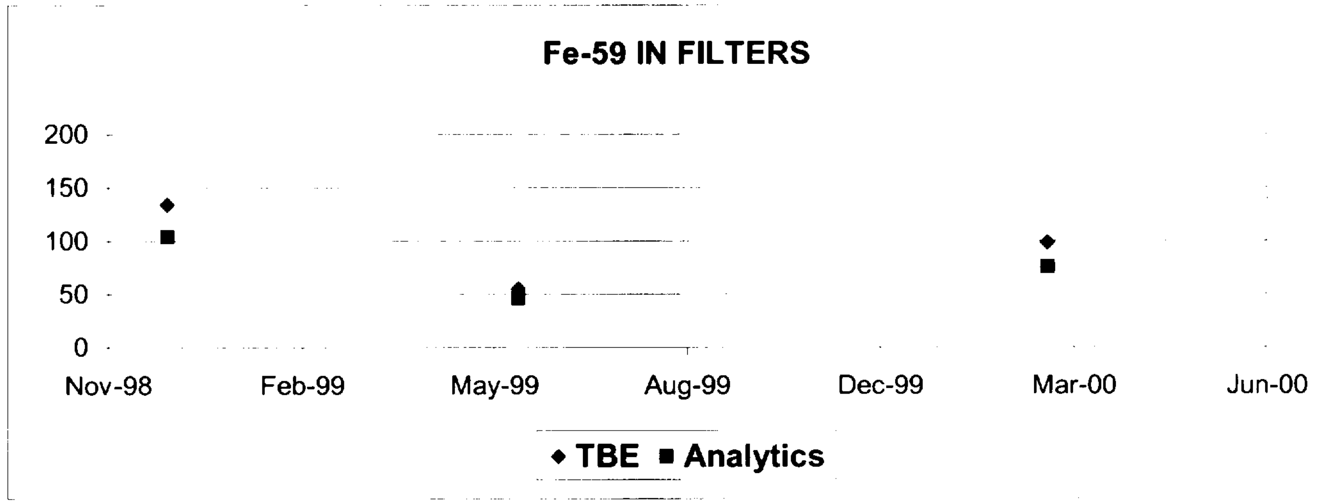
May-99
Aug-99
Dec-99
Mar-00
Jun-00
TBE
Analytics


Fe-59 IN FILTERS
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100
50
0
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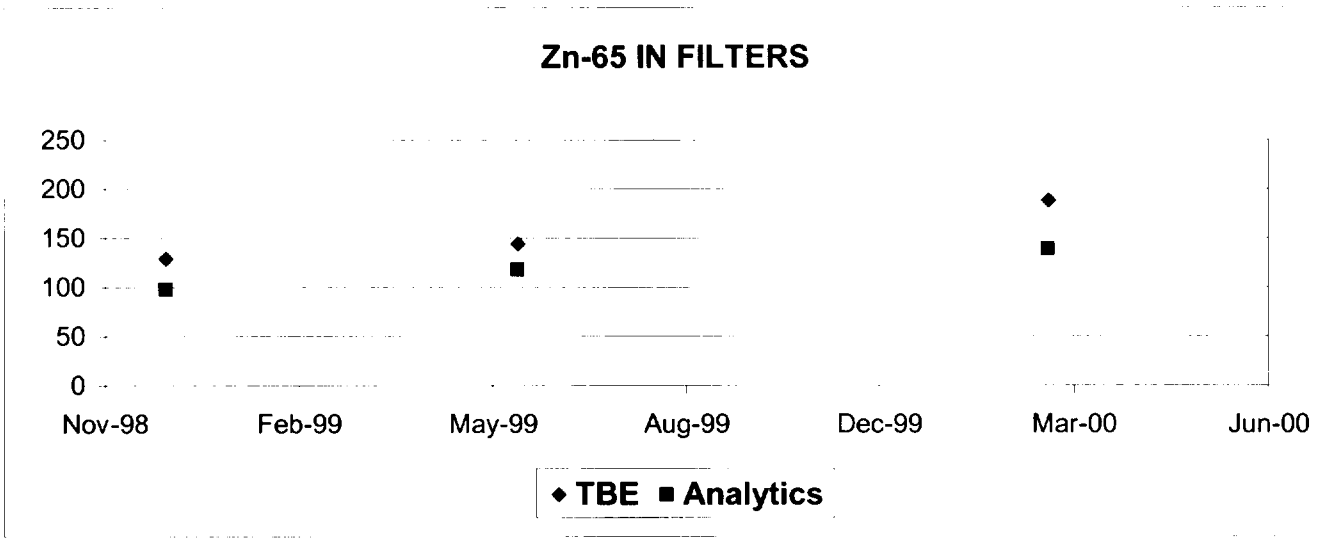
Dec-99
Mar-00
Jun-00
TBE
Analytics


Zn-65 IN FILTERS
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200
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May-99
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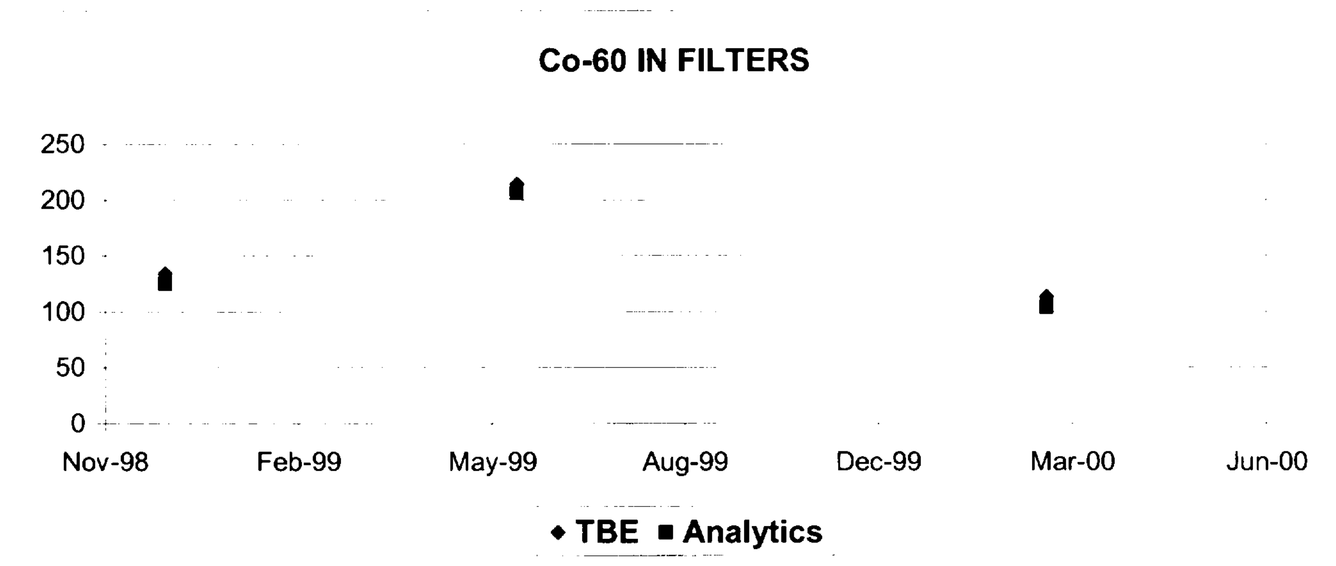
Dec-99
Mar-00
Jun-00
TBE
Analytics


Co-60 IN FILTERS
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200
150
100
50
0
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Feb-99
May-99
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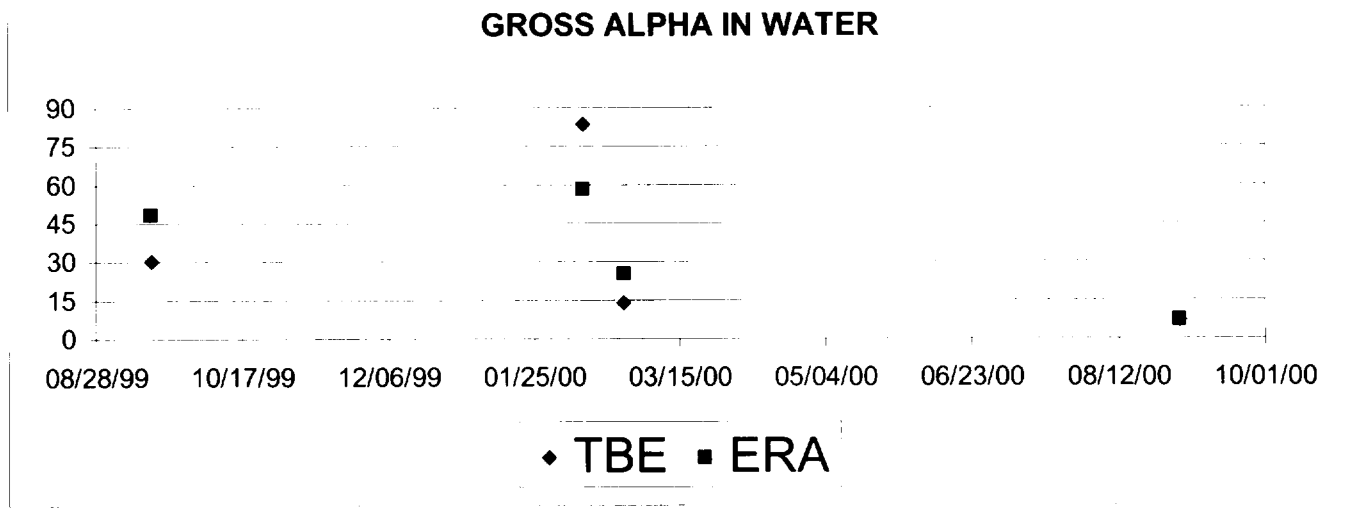
Dec-99
Mar-00
Jun-00
TBE
Analytics


GROSS ALPHA IN WATER
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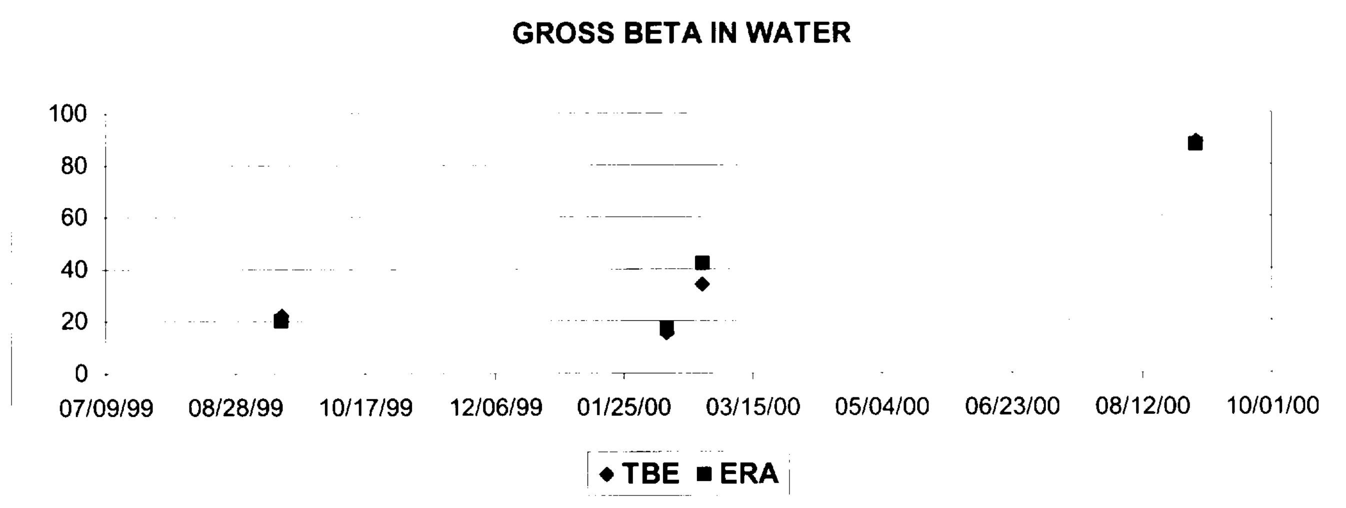
75
60
45
30
15
0
08/28/99
10/17/99
12/06/99
01/25/00
03/15/00
05/04/00
06/23/00
08/12/00
10/01/00
TBE
ERA


GROSS BETA IN WATER
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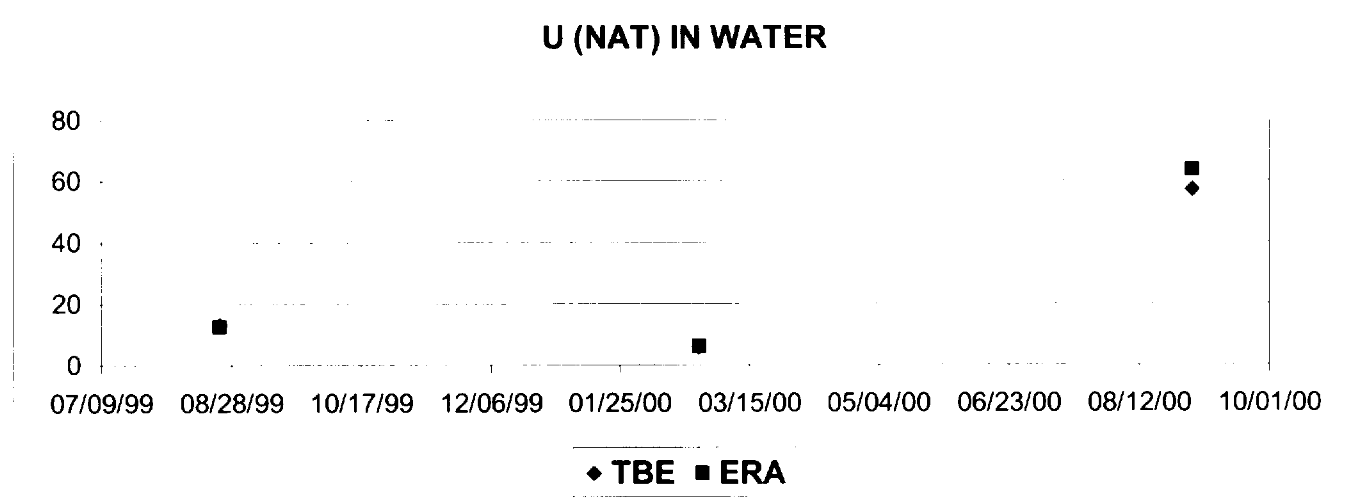
80
60
40
20
0
07/09/99
08/28/99
10/17/99
12/06/99
01/25/00
03/15/00
05/04/00
06/23/00
08/12/00
10/01/00
TBE
ERA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60
40
20
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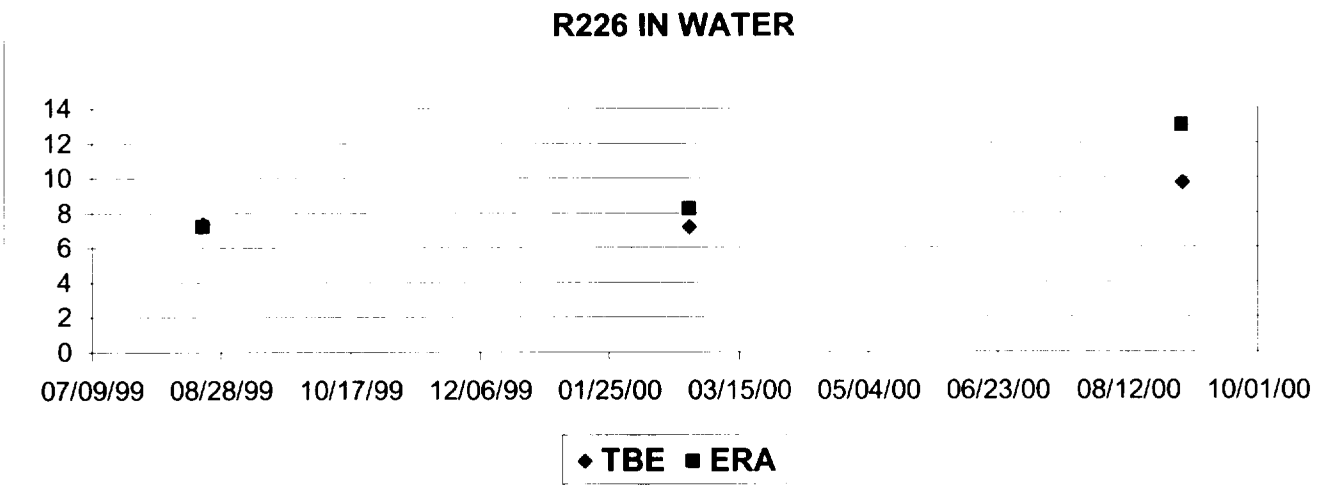
07/09/99
08/28/99
10/17/99
12/06/99
01/25/00
03/15/00
05/04/00
06/23/00
08/12/00
10/01/00
TBE
ERA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0
07/09/99
08/28/99
10/17/99
12/06/99
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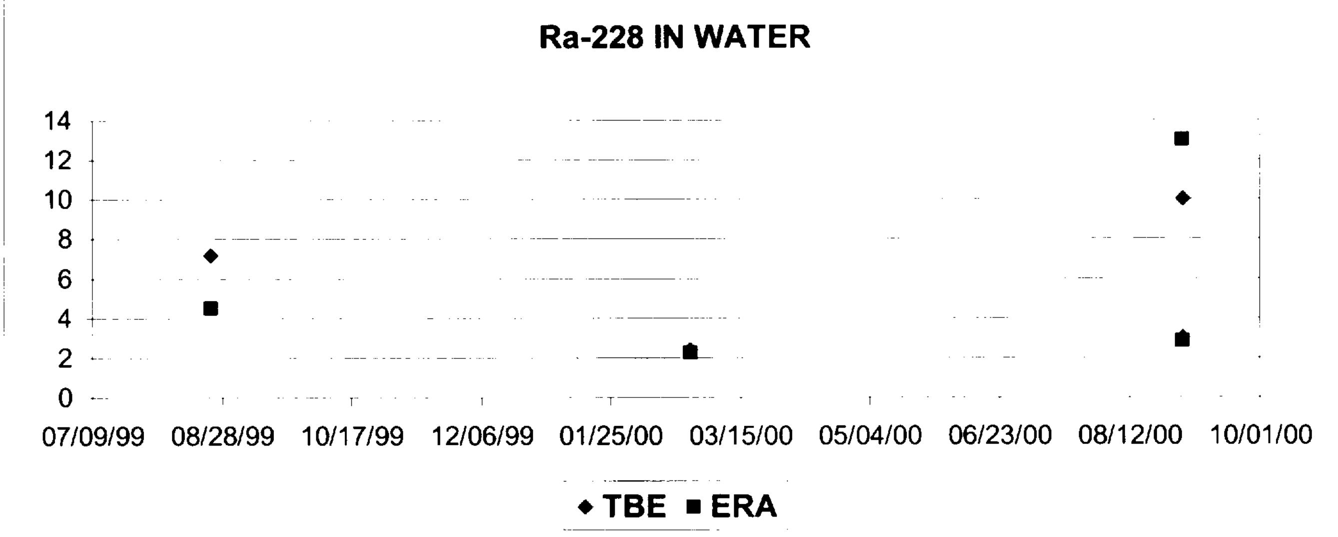
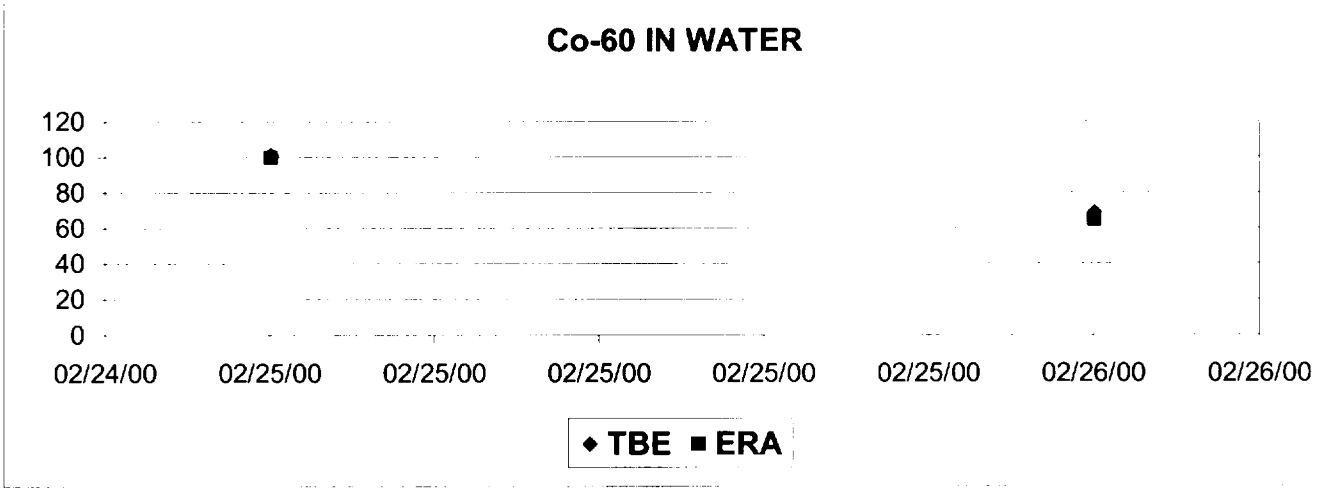
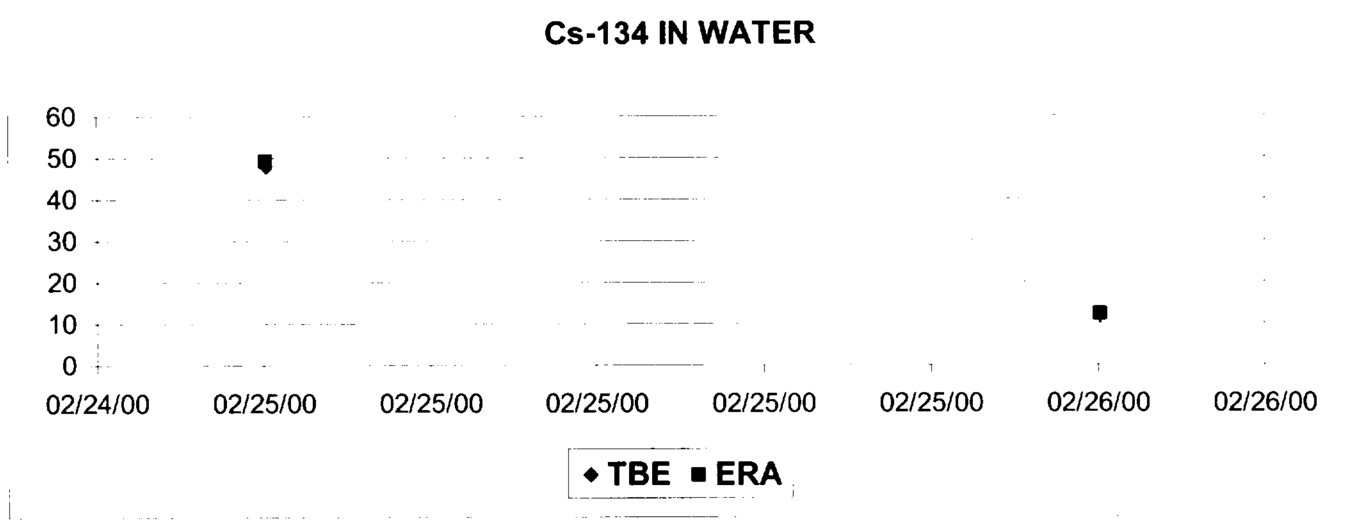
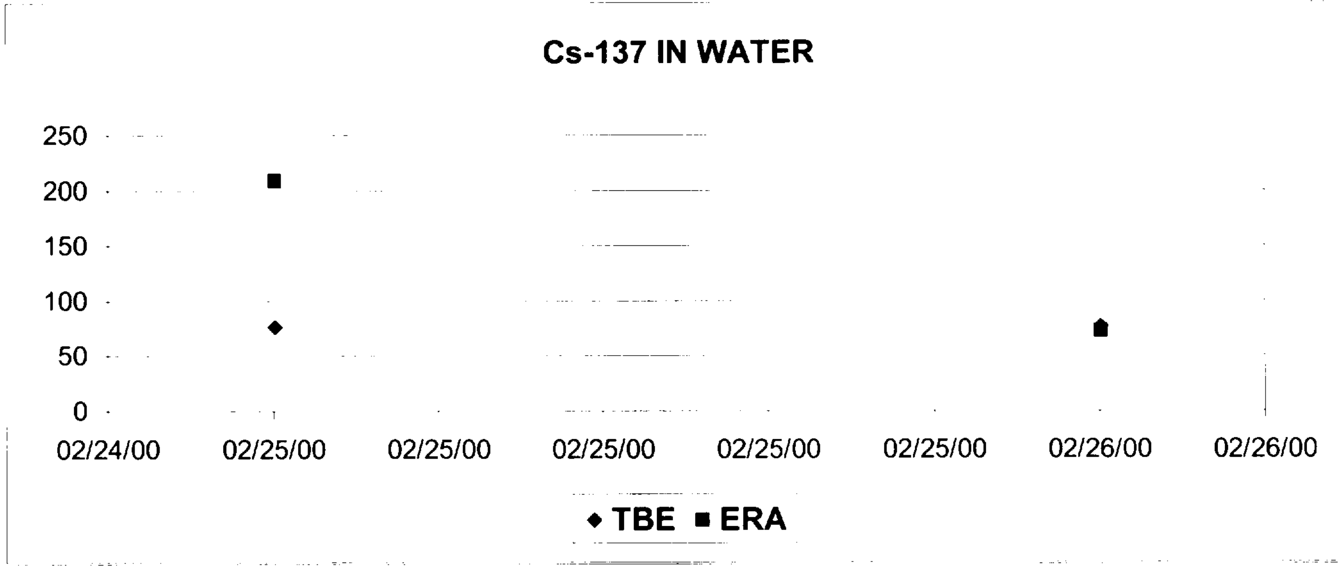
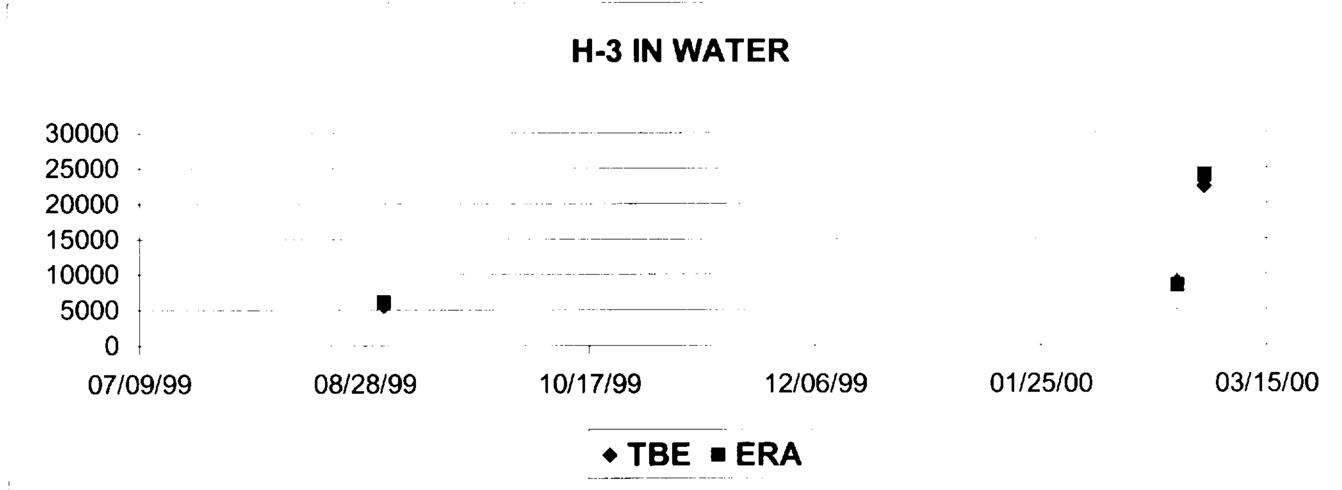
05/04/00
06/23/00
08/12/00
10/01/00
TBE
ERA

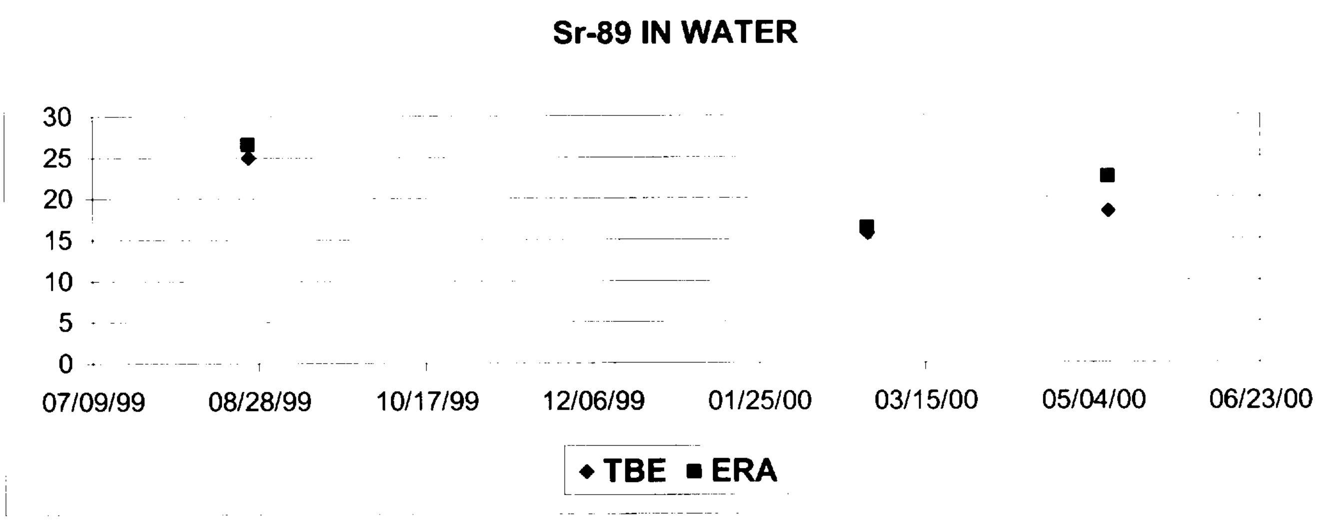

Ra-228 IN WATER
14
12
10
8
6
4
2
0
07/09/99
08/28/99
10/17/99
12/06/99
01/25/00
03/15/00
05/04/00
06/23/00
08/12/00
10/01/00
TBE
ERA

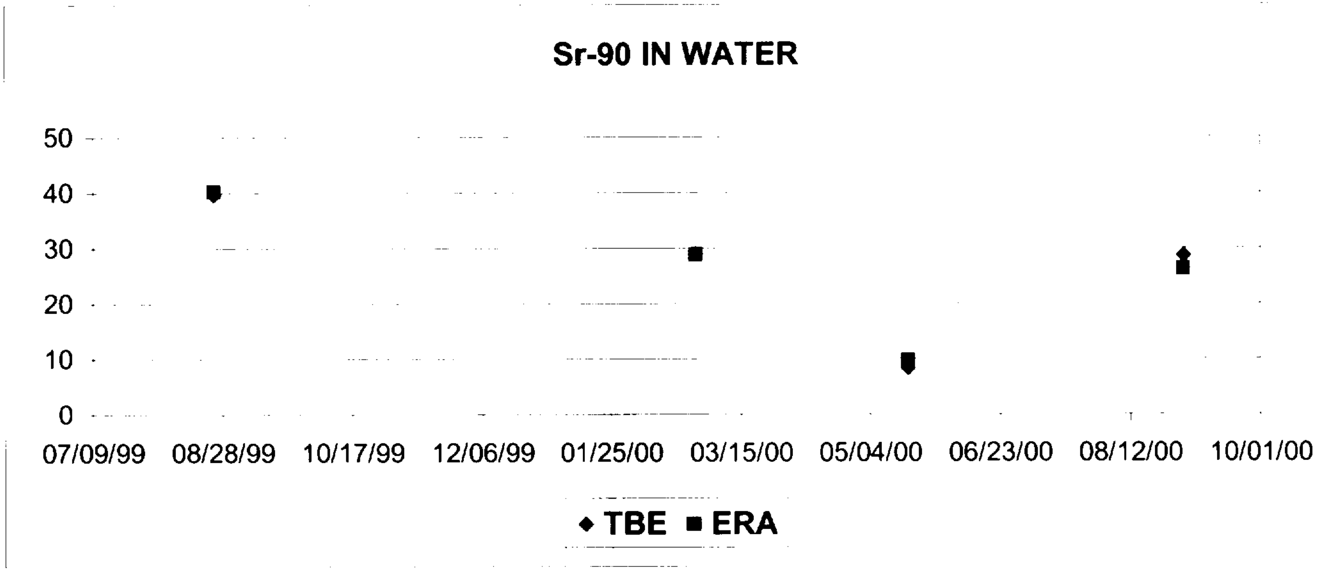

Co-60 IN WATER
120
100
80
60
40
20
0
02/24/00
02/25/00
02/25/00
02/25/00
02/25/00
02/25/00
02/26/00
02/26/00
TBE
ERA


Cs-134 IN WATER
60
50
40
30
20
10
0
02/24/00
02/25/00
02/25/00
02/25/00
02/25/00
02/25/00
02/26/00
02/26/00
TBE
ERA


Cs-137 IN WATER
250
200
150
100
50
0
02/24/00
02/25/00
02/25/00
02/25/00
02/25/00
02/25/00
02/26/00
02/26/00
TBE
ERA


H-3 IN WATER
30000
25000
20000
15000
10000
5000
0
07/09/99
08/28/99
10/17/99
12/06/99
01/25/00
03/15/00
TBE
ERA


Sr-89 IN WATER
30
25
20
15
10
5
0
07/09/99
08/28/99
10/17/99
12/06/99
01/25/00
03/15/00
05/04/00
06/23/00
TBE
ERA


Sr-90 IN WATER
50
40
30
20
10
0
07/09/99
08/28/99
10/17/99
12/06/99
01/25/00
03/15/00
05/04/00
06/23/00
08/12/00
10/01/00
TBE
ERA