VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

April 25, 2002

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

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License Nos. NPF-4
NPF-7
SNM-2507

Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION UNITS 1 AND 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 Anna Independent Spent Fuel Storage Installation Technical Specification 5.5.2.b, 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, 2001 through December 31, 2001.

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: None

A E25

cc: U. S. Nuclear Regulatory Commission
Region II
Sam Nunn 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℠

North Anna Power Station

2001 Annual Radiological Environmental Operating Report

DOMINION VIRGINIA POWER
NORTH ANNA POWER STATION

Radiological Environmental Monitoring Program

January 1, 2001 to December 31, 2001

ANNUAL REPORT

Prepared by

DOMINION VIRGINIA POWER

and

TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

Annual Radiological Environmental Operating Report

North Anna Power Station

January 1, 2001 to December 31, 2001

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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 2001 North Anna Nuclear Power Station Radiological Environmental Monitoring Program (REMP). Radioactivity levels from January 1 through December 31, 2001 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 as a "pre-operational baseline." Analysis results from the indicator samples are compared to both current control sample values and the pre-operational baseline to determine if changes in radioactivity levels are attributable to station operations, other causes such as the Chernobyl accident, or natural variation.

Teledyne Brown Engineering Environmental Services 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 in percent of 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 2001 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 2001.

- The waterborne exposure pathway 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 2001 was 3825 pCi/liter which was 19.13% of the reporting level for a water sample. The 2000 tritium level was 2850 pCi/liter. The preoperational level was 150 pCi/liter and has risen since 1978, though it has remained relatively consistent since 1986. 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 3450 pCi/liter. The average tritium level in 2000 was 3025 pCi/liter. Naturally occurring thorium-228 was measured in one out of twelve samples at an average concentration of 5.73 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 both of the two samples at 177 pCi/kg (dry).

- The ingestion exposure pathway includes milk, fish, and food/vegetation samples. Iodine-131 was not detected in any 2001 milk samples. Although cesium-137 has been detected in the past, it was not detected in 2001 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 2001 contained cesium-137 at a slightly lower activity than preoperational levels. Steam generator repairs and better liquid waste processing 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 but have shown a slight decline in 2001 reflecting a change in the TLD design.

During 2001, 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 2001 would be approximately 0.32 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 2001 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, 2001 through December 31, 2001 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 Environmental Services 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 2001 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

II. SAMPLING AND ANALYSIS PROGRAM

A. Sampling Program

1. Table 1 summarizes the sampling program for environmental monitoring stations for North Anna Power Station during 2001. The relative location of these stations is shown.

2. For routine TLD measurements, two dosimeters made of CaF and LiF 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 Environmental Services 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 - 2001

RADIOLOGICAL SAMPLING STATION

DISTANCE AND DIRECTION FROM UNIT NO. 1

Sample Media	Location	Station	Distance Miles	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	
	"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	

Table 1

(Page 2 of 4)

NORTH ANNA POWER STATION - 2001

RADIOLOGICAL SAMPLING STATION

DISTANCE AND DIRECTION FROM UNIT NO. 1

Sample Media	Location	Station	Distance Miles	Direction	Degrees	Collection Frequency	Remarks
Environmental Thermoluminescent Dosimetry (TLD)	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	0.60	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
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

Table 1

(Page 3 of 4)

NORTH ANNA POWER STATION - 2001

RADIOLOGICAL SAMPLING STATION

DISTANCE AND DIRECTION FROM UNIT NO. 1

Sample Media	Location	Station	Distance Miles	Direction	Degrees	Collection Frequency	Remarks
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

(Page 4 of 4)

NORTH ANNA POWER STATION - 2001

RADIOLOGICAL SAMPLING STATION

DISTANCE AND DIRECTION FROM UNIT NO. 1

Sample Media	Location	Station	Distance Miles	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	16.50	NW	312°	Semi-Annually	Control
Food Products (Broadleaf or at harvest Vegetation)	Bel Aire Plantation *	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	
	Historic Lane	26**	1.15	S	172°	Monthly if available or at harvest	

* Food Products station 14 was moved from Route 713 to Bel Aire Plantation during 4th Quarter of 2001.

** Food Products station 26 replaced 21 during 4th Quarter of 2001.

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

Map Designation	Environmental Station Identification	Map Designation	Environmental Station Identification
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-5/6	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 (d)	21/53	SW-21/53
9A	09A-Water sample, Sediment (d)	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-4/36
25 (c)	25-Fish	10/42	10/42
26 (e)	26-Vegetation		
30/62	NW-30/62		

(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.

(e) Food Products station 26 replaced station 21 during 4th Quarter of 2001.

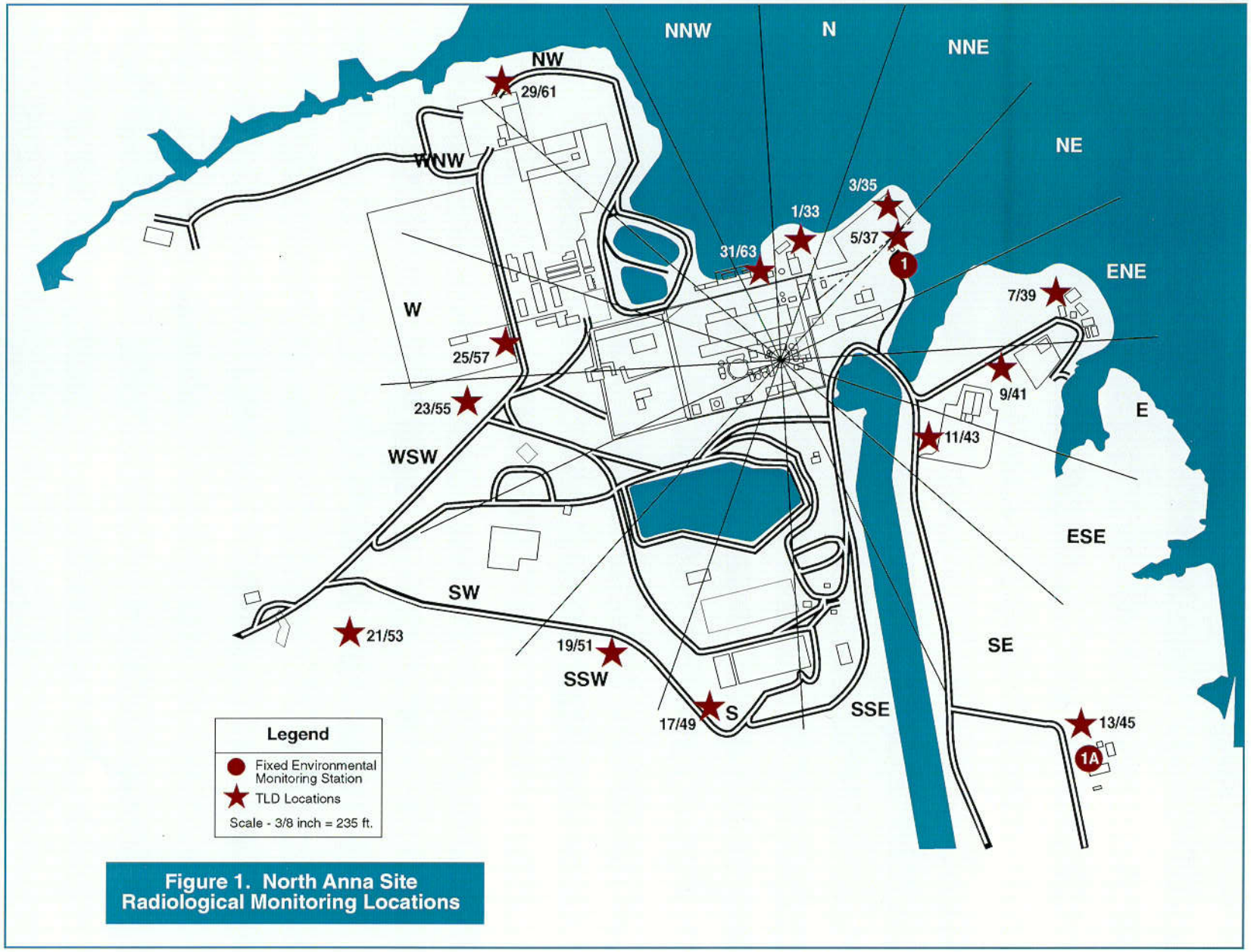

Figure 1. North Anna Site Radiological Monitoring Locations

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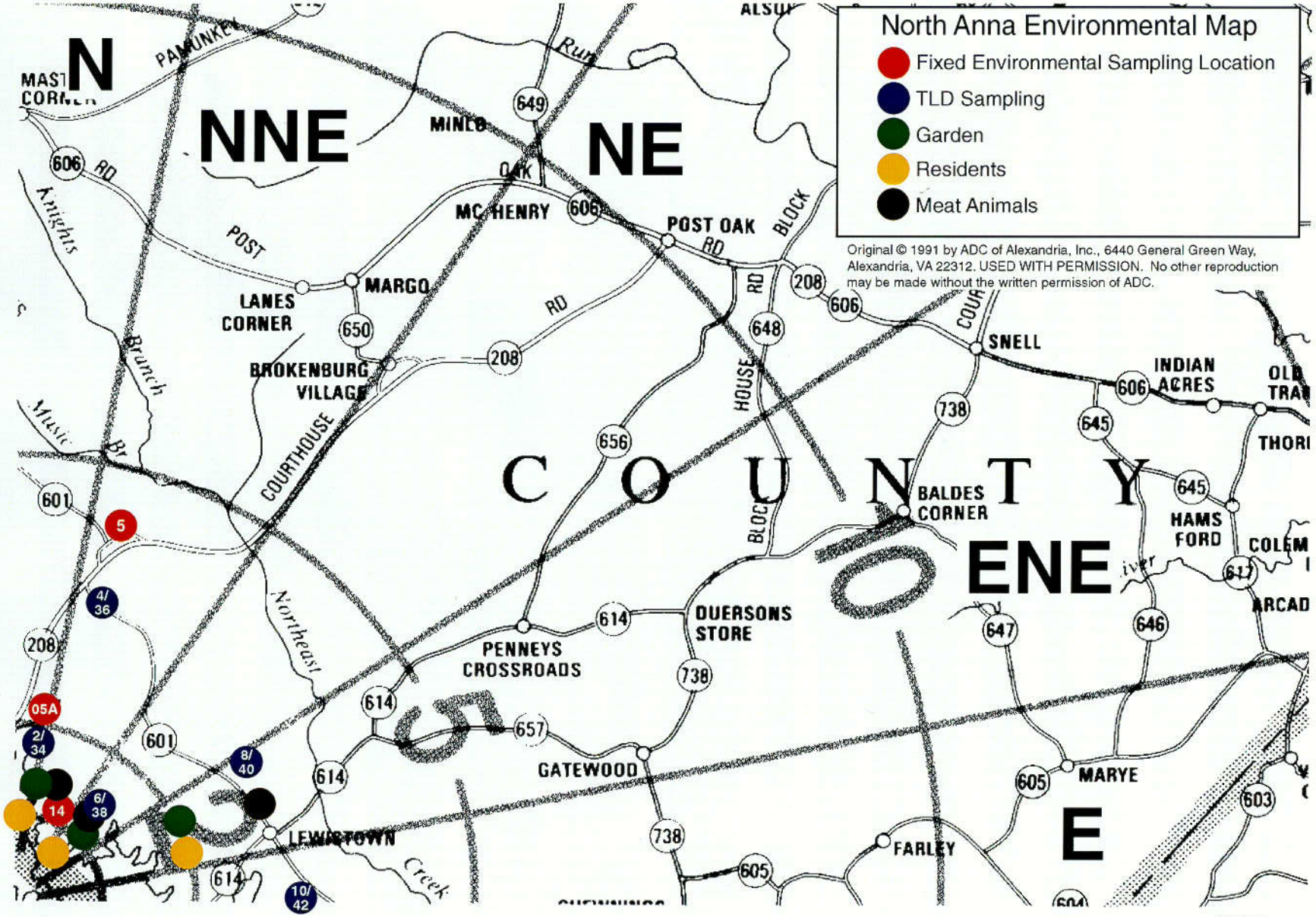
North Anna Environmental Map
Fixed Environmental Sampling Location
TLD Sampling
Garden
Residents
Meat Animals
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N
NNE
NE
ENE
E
COUNTY
LOUISA
MINERAL
OAK
MC HENRY
POST OAK
BLOCK
HOUSE
SNELL
INDIAN ACRES
THORI
BALDES CORNER
HAMS FORD
COLEM
ARCAD
DUERSONS STORE
PENNEYS CROSSROADS
GATEWOOD
MARYE
FARLEY
LEWISTOWN
LANES CORNER
MARGO
BROKENBURG VILLAGE
COURTHOUSE
Northeast
Branch
Creek
606
RD
649
650
208
656
648
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645
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5
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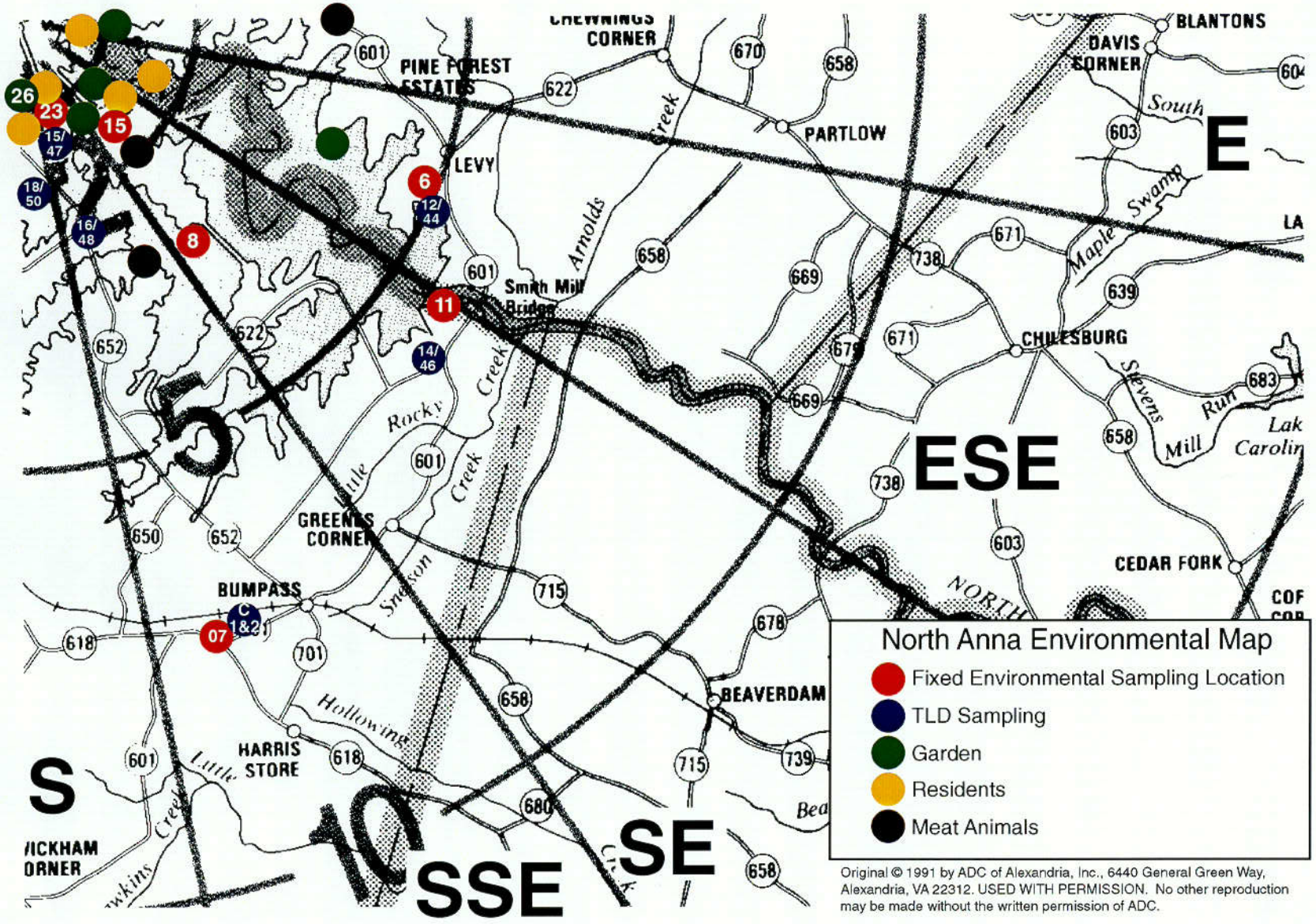
C02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Fixed Environmental Sampling Location
TLD Sampling
Garden
Residents
Meat Animals
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CB3282C
PINE FOREST ESTATES
CHEWNINGS CORNER
PARTLOW
DAVIS CORNER
BLANTONS
LEVY
Smith Mill Bridge
CHILESBURG
GREENES CORNER
BUMPASS
HARRIS STORE
BEAVERDAM
CEDAR FORK
Rocky Creek
Little Creek
Arnolds Creek
Hollowing
Snelson
South Anna
Maple Swamp
Stevens Mill Run
ESE
SSE
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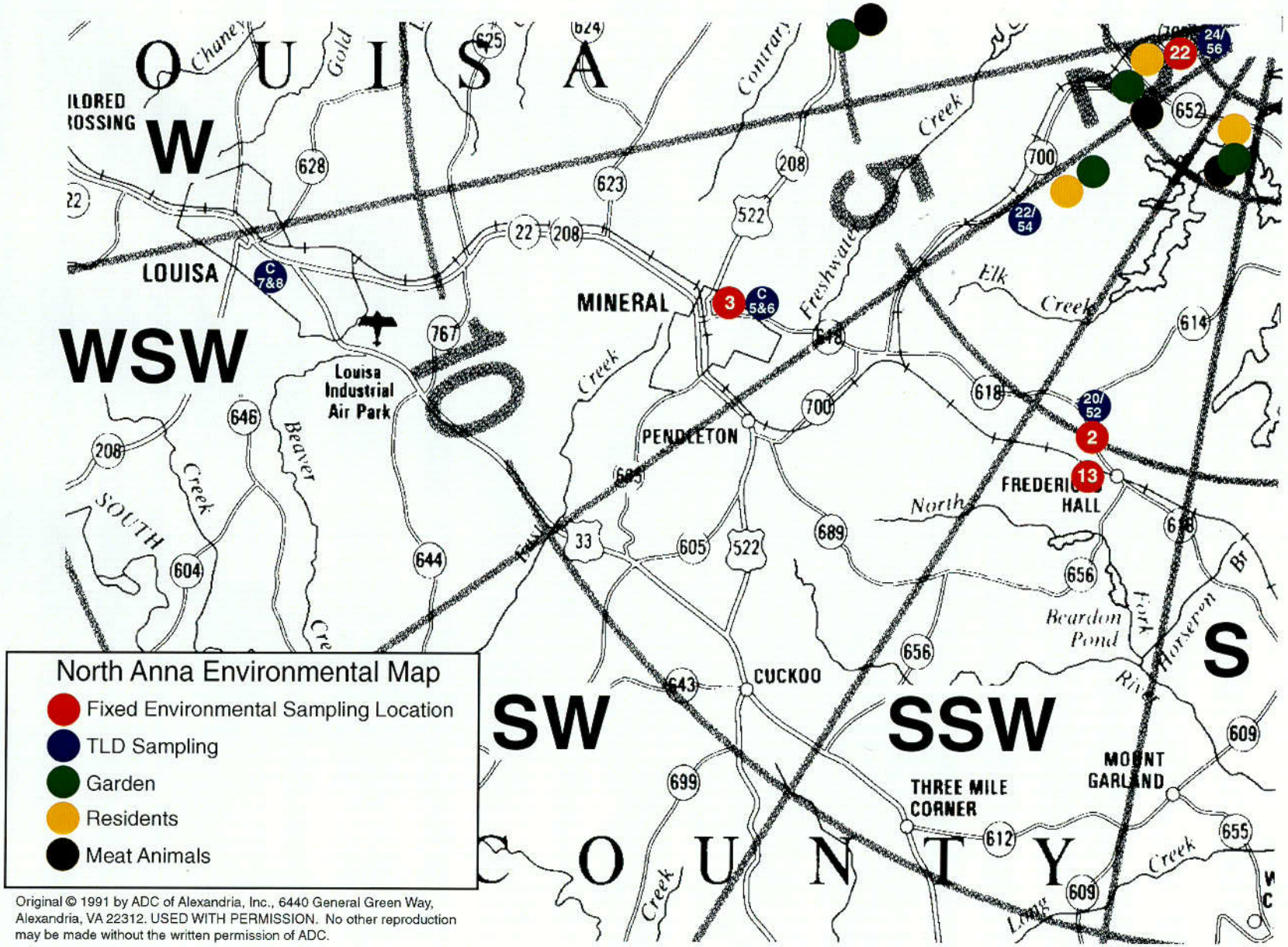
C03


North Anna Environmental Map
Fixed Environmental Sampling Location
TLD Sampling
Garden
Residents
Meat Animals
LOUISA
MINERAL
PENDLETON
CUCKOO
THREE MILE CORNER
MOUNT GARLAND
FREDERICKS HALL
Louisa Industrial Air Park
WSW
SW
SSW
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COUNTY
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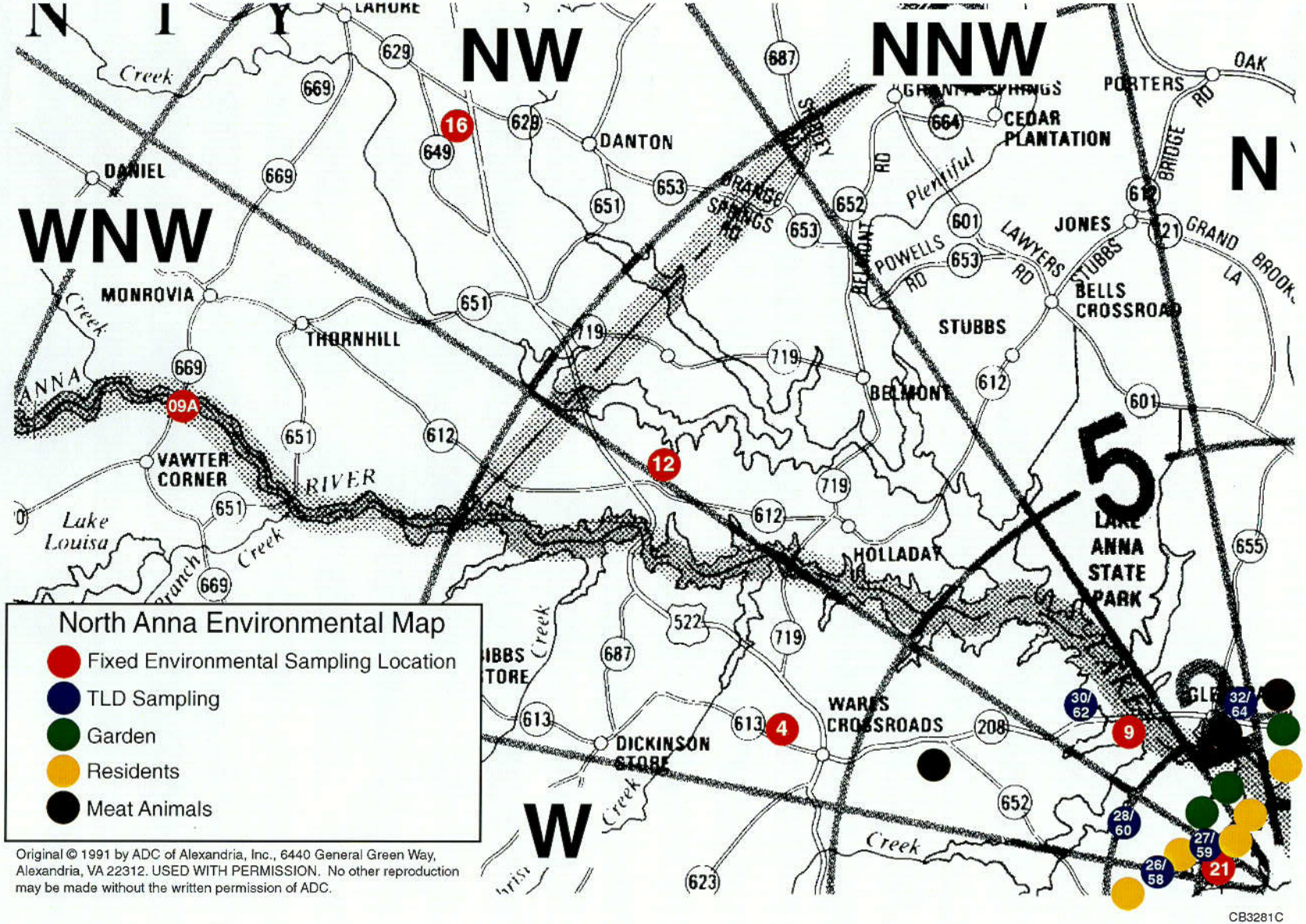
C04



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B. Analysis Program

1. Table 2 summarizes the analysis program conducted by Teledyne Brown Engineering Environmental Services for North Anna Power Station during 2001. 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 4)

NORTH ANNA POWER STATION

SAMPLE ANALYSIS PROGRAM

SAMPLE MEDIA	FREQUENCY	ANALYSIS	LLD*	REPORT UNITS
Thermoluminescent Dosimetry (TLD) (84 Routine Station TLDs)	Quarterly	Gamma Dose	2mR ± 2mR	mR/std. Month
12 Station TLDs	Annually	Gamma Dose	2mR ± 2mR	mR/std. Month
Airborne Radioiodine	Weekly	I-131	0.07	pCi/m3
Airborne Particulate	Weekly	Gross Beta	0.01	pCi/m3
	Quarterly (a)	Gamma Isotopic		pCi/m3
		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)	

* LLDs 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 Environmental Services 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 LLDs for strontium-89/90. LLDs are those achieved by Teledyne Brown Engineering Environmental Services.

Table 2

(Page 2 of 4)

NORTH ANNA POWER STATION

SAMPLE ANALYSIS PROGRAM

SAMPLE MEDIA	FREQUENCY	ANALYSIS	LLD*	REPORT UNITS
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	Quarterly	Gamma Isotopic		pCi/L
(Well Water)		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)	

* LLDs 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 Environmental Services 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 LLDs for strontium-89/90. LLDs are those achieved by Teledyne Brown Engineering Environmental Services.

Table 2

(Page 3 of 4)

NORTH ANNA POWER STATION

SAMPLE ANALYSIS PROGRAM

SAMPLE MEDIA	FREQUENCY	ANALYSIS	LLD*	REPORT UNITS
Precipitation	Monthly	Gross Beta	10	pCi/L
	Semi-Annual Composite	Gamma Isotopic	10	pCi/L
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)	
		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	

* LLDs 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 Environmental Services 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 LLDs for strontium-89/90. LLDs are those achieved by Teledyne Brown Engineering Environmental Services.

Table 2

(Page 4 of 4)

NORTH ANNA POWER STATION

SAMPLE ANALYSIS PROGRAM

SAMPLE MEDIA	FREQUENCY	ANALYSIS	LLD*	REPORT UNITS
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)

III. PROGRAM EXCEPTIONS

REMP Exceptions for Scheduled
Sampling And Analysis During 2001 - North Anna

Location	Description	Date of Sample	Reason(s) for Loss/Exception
All Stations	Vegetation	01/17/01	Seasonal unavailability.
All Stations	Vegetation	02/21/01	Seasonal unavailability.
All Stations	Vegetation	03/21/01	Seasonal unavailability.
NNE-36, NW-62	TLD	04/05/01	Lost in service.
Sta 15, 21,23	Vegetation	04/19/01	Due to small sample size, the Cs-134 LLD was missed.
Sta 15	Vegetation	04/19/01	Due to small sample size, the Cs-137 LLD was missed.
Qtr Sta 06, ESE-12, ESE-44	TLD	07/12/01	Lost in service. Replacement Annual TLD placed in service.
Sta 14	Vegetation	07/19/01	Due to small sample size, the Cs-134 and Cs 137 LLDs were missed.
Sta 16	Vegetation	07/19/01	Due to small sample size, the Cs-134 LLD was missed.
Sta 15	Vegetation	08/27/01	Due to small sample size, the Cs-134 and Cs 137 LLDs were missed.
All Stations	Vegetation	10/17/01	Seasonal unavailability.
All Station	Vegetation	11/21/01	Season unavailability.
Sta 14, Sta 21, Sta 26	Vegetation	11/01/01	Station 14 changed, station 21 deleted, station 26 added.
All Stations	Vegetation	12/01/01	Seasonal unavailability.

IV. SUMMARY AND DISCUSSION OF 2001 ANALYTICAL RESULTS

IV. Summary And Discussion of 2001 Analytical Results

Data from the radiological analyses of environmental media collected during 2001 are tabulated and discussed below. The procedures and specifications followed in the laboratory for these analyses are as required in the Teledyne Brown Engineering Environmental Services Quality Assurance manual and are explained in the Teledyne Brown Engineering Environmental Services 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 Environmental Services's analytical methods meet the Lower Limit of Detection (LLD) requirements given in table 2 of the USNRC Branch Technical Position, Radiological Monitoring Acceptable Program (November 1979, Revision 1) and the ODCM.

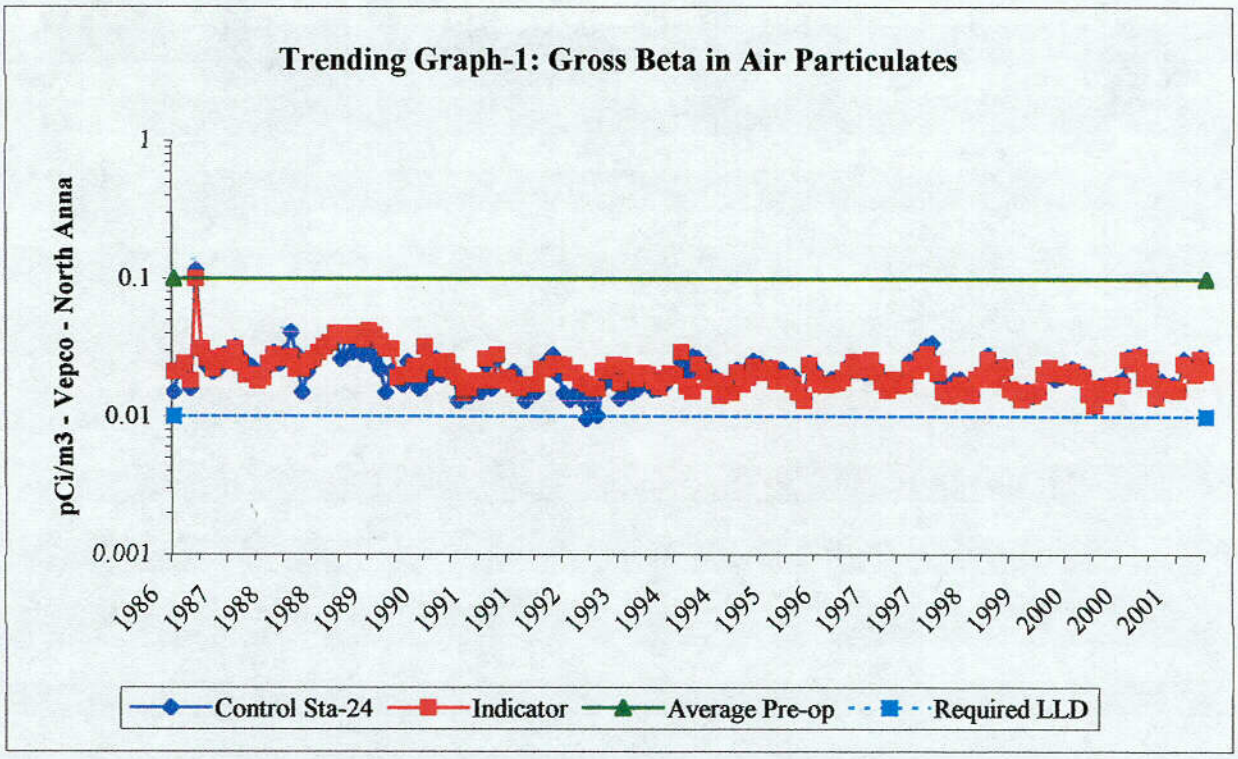
The following is a discussion and summary of the results of the environmental measurements taken during the 2001 reporting period.

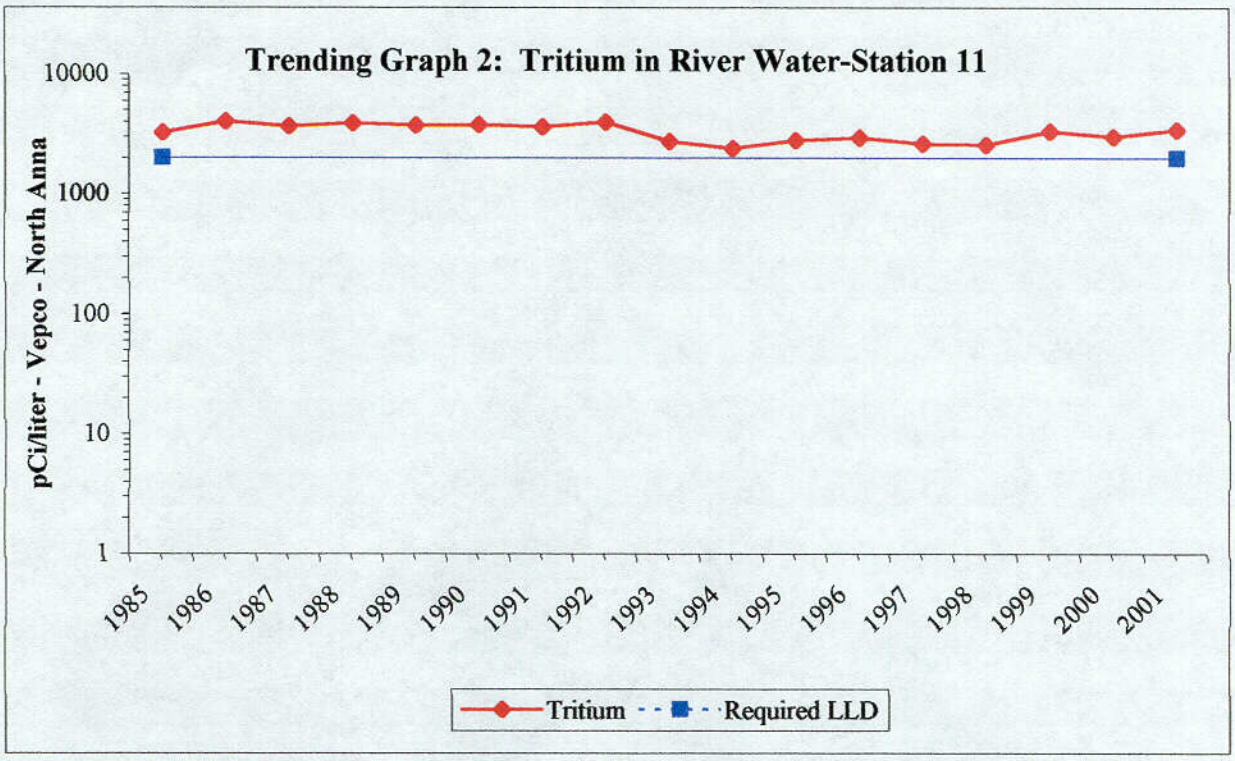
A. Airborne Exposure Pathway

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-two control samples with an average concentration of 0.020 pCi/m^3 and a range of 0.009 to 0.041 pCi/m^3. The average measurement for the indicator locations was 0.019 pCi/m^3 with a range of 0.007 to 0.047 pCi/m^3. The results of the gross beta activities are presented in Table B-2. The gross beta activities for 2001 were comparable to levels measured in the 1982-2001 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 44 of the 44 composite samples. The average measurement for the control location was 0.081 pCi/m^3 with a range of 0.028 to 0.149 pCi/m^3. The indicator locations had an average concentration of 0.086 pCi/m^3 and a range of 0.021 to 0.667





During the properational period, tritium was not detected in the sample analyzed.

C06

pCi/m^3. During the preoperational period, beryllium-7 was measured at comparable levels, as would be expected. Naturally occurring potassium-40 was not detected in any control samples. Potassium-40 was detected in one indicator sample with a concentration of 0.108 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, tritium, and gamma emitters. The results are presented in Table B-4. The average gross beta activity for 2001 in ten of the twelve samples was 6.5 pCi/liter with a range from 2.9 to 16 pCi/liter. Semi-annual composites were prepared and analyzed for gamma emitting isotopes and tritium. Beryllium-7 was not detected in the semi-annual composite samples for 2001. All other gamma emitters were below their detection limits. Tritium was detected one of the two semi-annual composite samples with a concentration of 170 pCi/liter. These results were comparable to or lower than those measured in 1986 through 2001. 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 2001 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, which are collected every three years from twelve stations, were collected in July and analyzed by gamma ray spectroscopy. The results are presented in Table B-5. Naturally occurring potassium-40 was detected in all eleven indicator stations with an average concentration of 13765 pCi/kg (dry) and a range of 6570 to 29400 pCi/kg (dry). The control location had a concentration of 4610 pCi/kg (dry). The terrestrial nuclide radium-226 was measured in seven of the eleven indicator stations, with an average concentration of 1540 pCi/kg (dry) and a range of 538 to 2820 pCi/kg (dry). The control location had a concentration of 1150 pCi/kg (dry). Thorium-228 was detected in all eleven indicator stations with an average activity of 1251 pCi/kg (dry) and a range of 852 to 2260 pCi/kg (dry). The control location had a concentration of 1290 pCi/kg (dry). The fission product cesium-137 was detected in ten of the eleven indicator stations with an average activity of 334 pCi/kg (dry) and a range of 58 to 876 pCi/kg (dry). The control location had a concentration of 527 pCi/kg (dry). The cesium-137 is attributed to past atmospheric nuclear weapons testing. U-235 was also detected in seven of eleven

indicator stations with an average activity of 117 pCi/kg (dry) and a range of 82 to 161 pCi/kg (dry). The control location had a concentration of 125 pCi/kg (dry).

The twelve soil samples were analyzed for strontium-89 and strontium-90. Strontium-89 was not detected. Strontium-90 was detected in two of eleven indicator stations with an average concentration of 145 pCi/kg (dry) and a range of 130 to 160 pCi/kg (dry). The control location had a concentration of 240 pCi/kg (dry). This was most likely due to fallout from past nuclear weapons testing.

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 2001. 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 detected in one sample with a concentration of 120 pCi/liter. No gamma emitting isotopes were detected during the preoperational period.

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 SE. 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.

Thorium-228 was detected in one of the twelve samples with a concentration of 6 pCi/liter. 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 all four samples with an average concentration of 3450 pCi/liter and a range of 3100 to 4000 pCi/liter. This is higher than the average level measured in 2000 of 3025 pCi/liter and a range of 1500 to 4700 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. One of twelve indicator samples had a concentration of 0.8 pCi/liter. One of twelve control samples had a concentration of 1.4 pCi/liter. The results are presented in Table B-8. The samples were also analyzed by gamma ray spectrometry. Naturally occurring

thorium-228 was detected in one of the 12 control samples with a concentration of 7 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 3825 pCi/liter with a range of 3400 to 4400 pCi/liter. The tritium level had been increasing since the middle of 1978 when the average level was below 300 pCi/liter. However, during 2001 the results were within the same range as those measured in 1986 through 2000. During the preoperational period tritium was measured in several samples with concentrations between 90 and 250 pCi/liter.

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. Two man-made and a number of naturally occurring radioisotopes were detected in these samples. Cesium-137 was detected in three of the six samples with an average activity of 61 pCi/kg (dry weight) and a range of 15.6 to 136 pCi/kg (dry weight). The highest reading for cesium-137 was obtained from station 09A located 12.90 miles WNW.

Naturally occurring potassium-40 was observed in all of the six samples with an average activity of 9087 pCi/kg (dry weight) and a range of 2430 to 14600 pCi/kg (dry weight). Naturally occurring thorium-228 was observed in all six samples with an average concentration of 779 pCi/kg (dry weight) and a range of 282 to 1160 pCi/kg (dry weight). Radium-226 was measured in all six samples with an average concentration of 567 pCi/kg (dry weight) and a range of 163 to 855 pCi/kg (dry weight). U-235 was measurred in the three August samples at an average concentration of 34 pCi/kg (dry weight) and a range of 19.9 to 47.3 pCi/kg (dry weight). The August samples were analyzed for strontium-89 and strontium-90. There was no measurable amount of strontium-89 in aquatic sediment/silt. Strontium-90 was measured in one indicator sample with a concentration of 32 pCi/kg (dry weight).

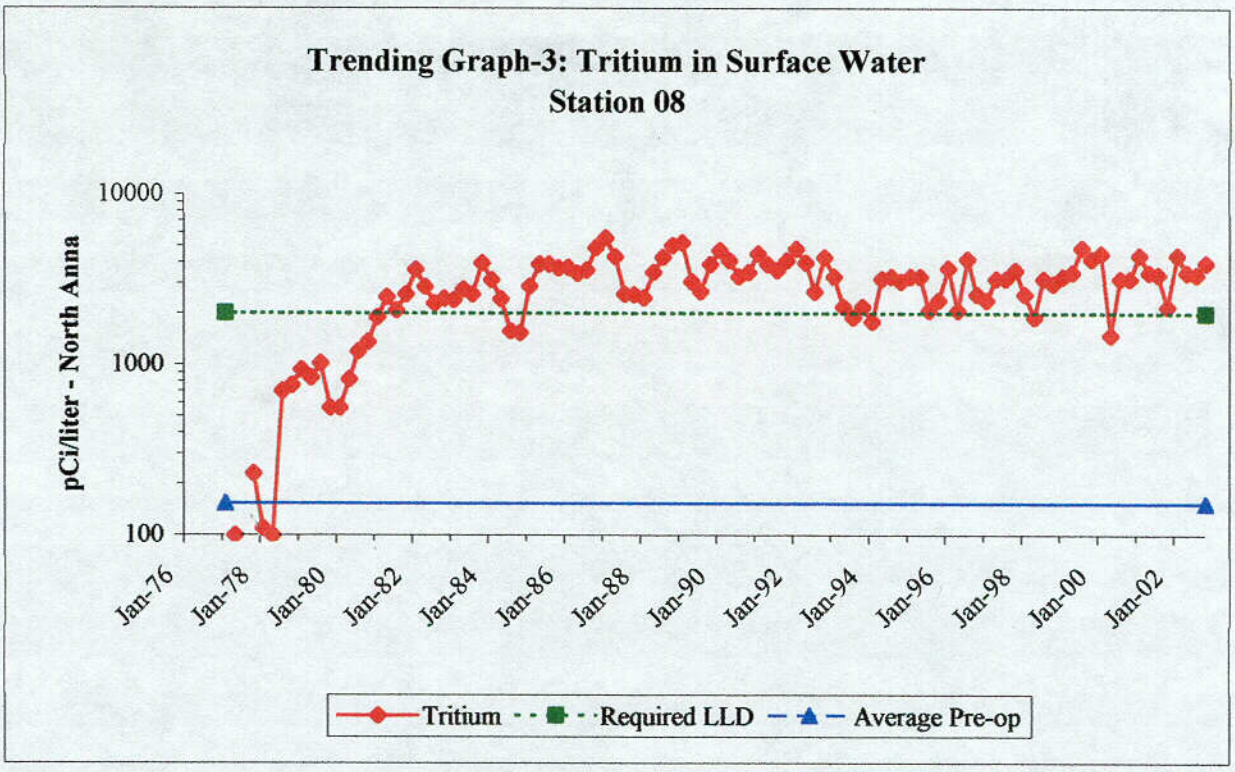
During the preoperational period sediment samples were analyzed by gamma ray spectroscopy. Cesium-137 was measured in most of the samples with concentrations between 33 and 1210 pCi/kg (dry weight). Strontium-90 was measured in most of the samples with concentrations between 60 and 540 pCi/kg (dry weight).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

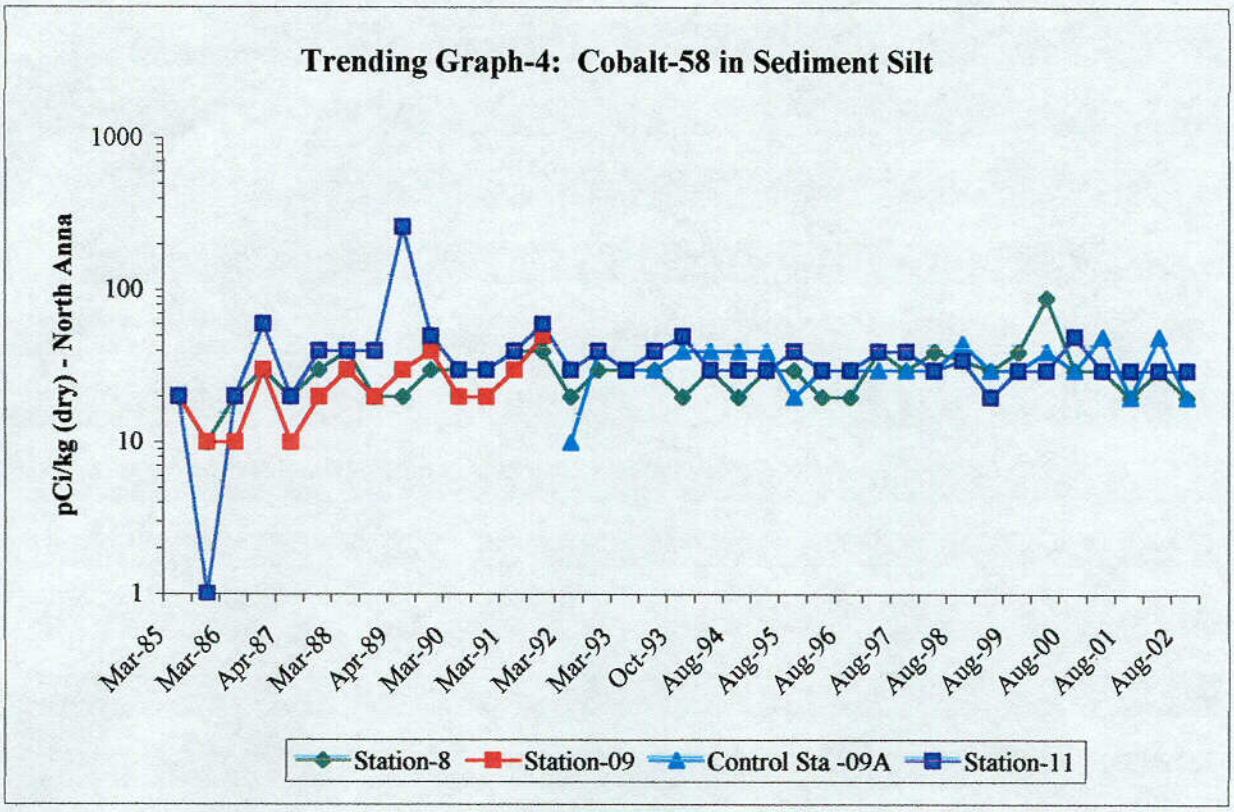
2. Shoreline Soil

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-10. The naturally occurring nuclide potassium-40 was measured in both samples with an average activity of 1820 pCi/kg (dry weight) and a range of 1610 to 2030 pCi/kg (dry weight). Cosmogenic beryllium-7 was not measured during 2001. Thorium-228 was measured in both samples at an average of 329 pCi/kg (dry weight) and a range of 232 to 426 pCi/kg (dry weight). Radium-226 was measured in both samples with a concentration of 407 pCi/kg (dry weight) and a range of 310 to 503 pCi/kg (dry weight). Cesium-137, a fission product, was measured in both samples with a concentration of 177 pCi/kg (dry weight) and a range of 99.9 to 255 pCi/kg (dry weight).

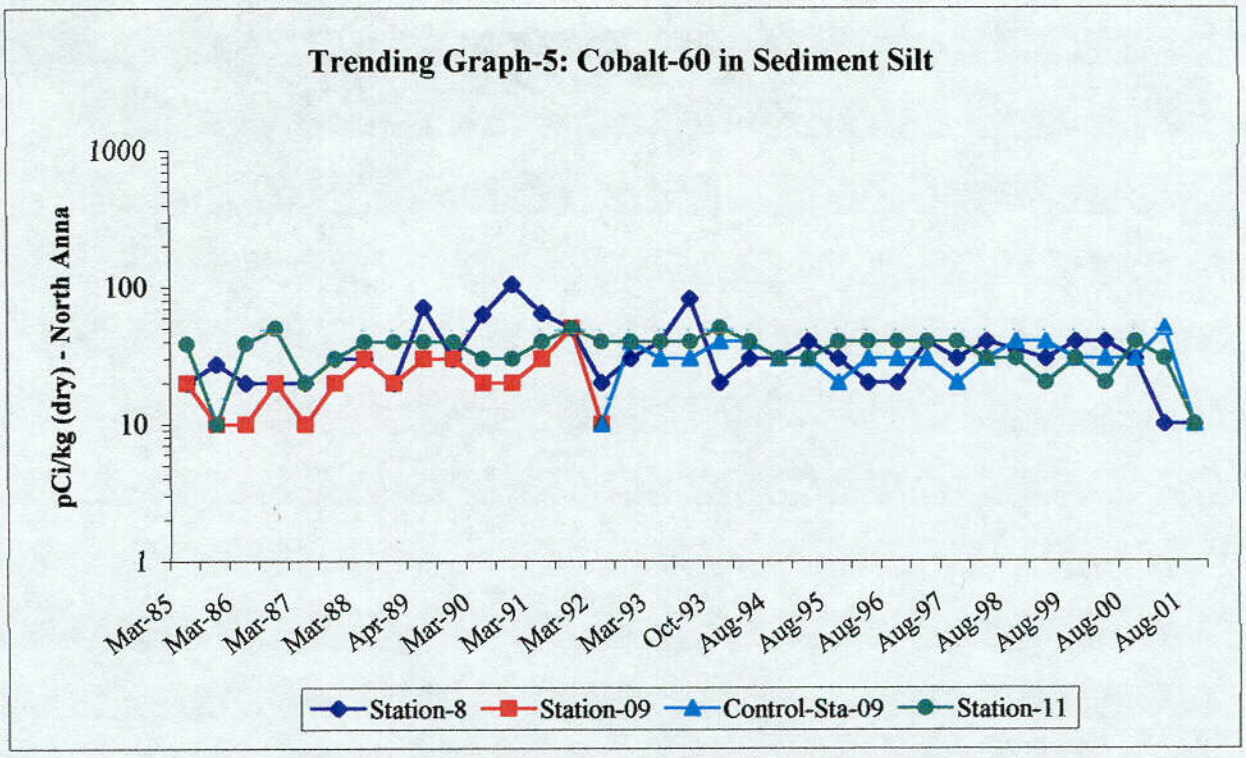
The August sample was analyzed for strontium-89 and strontium-90. There was no measured amount of strontium-89. Strontium-90 was measured at a concentration of 48 pCi/kg (dry weight).



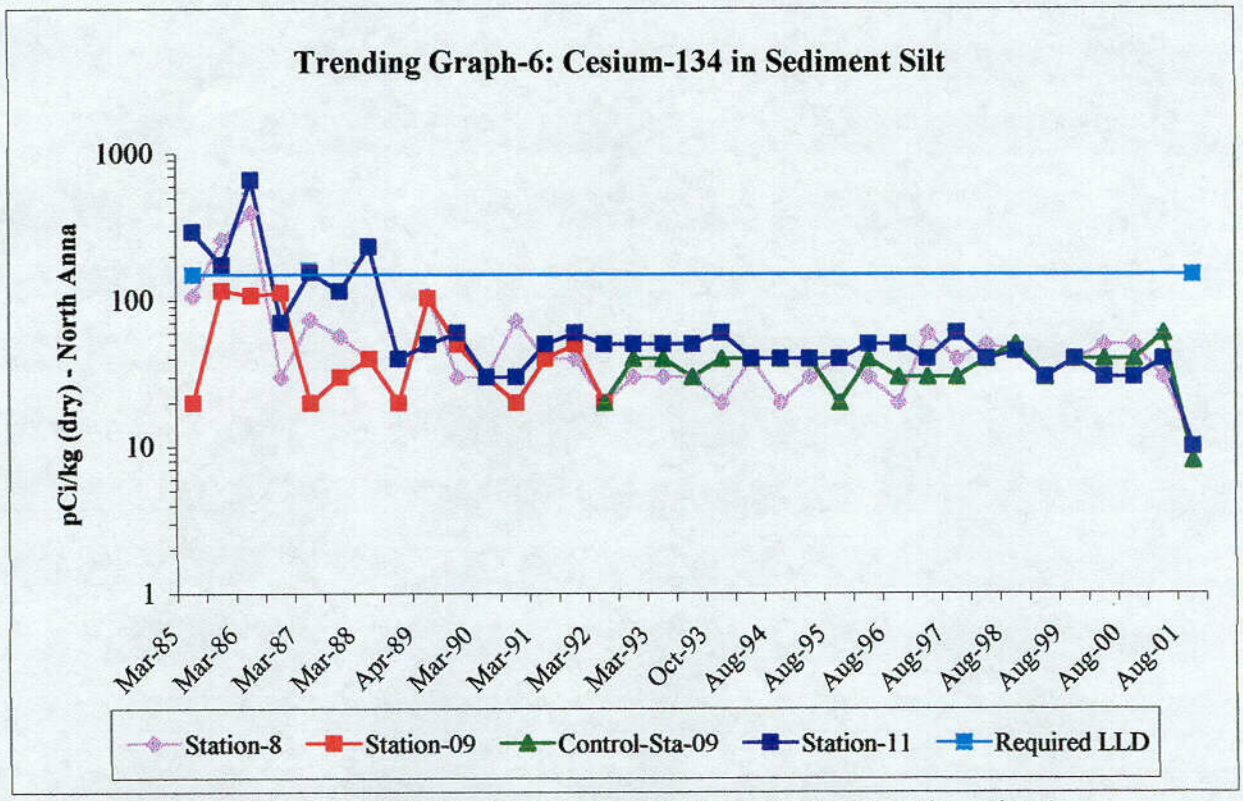


During the properational period, cobalt-58 was not detected in the samples analyzed.

C07

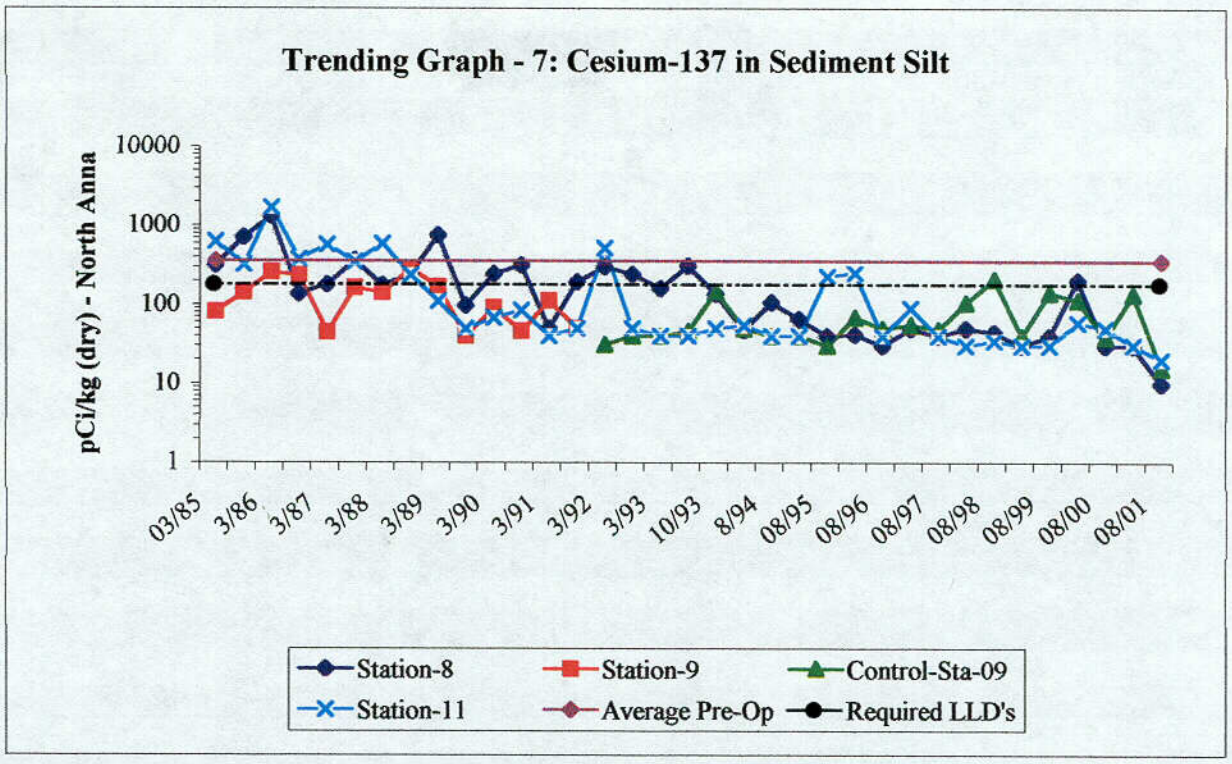


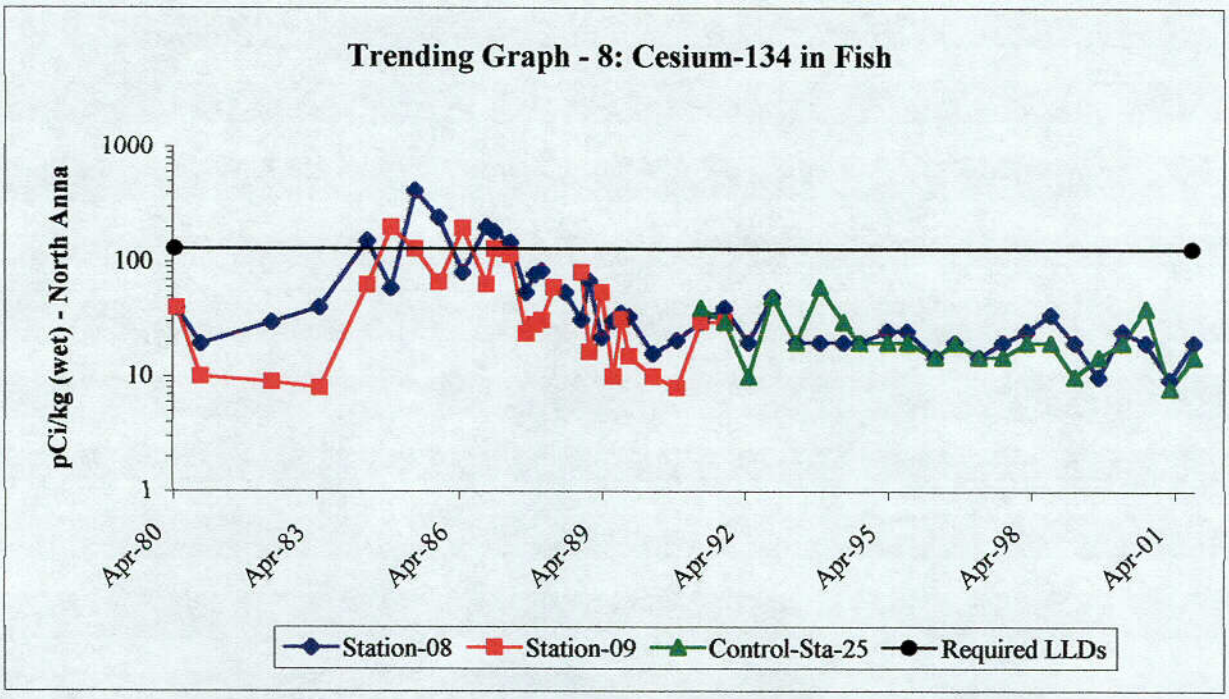
During the properational period, cobalt-60 was not detected in the sample analyzed.



During the properational period, Cesium-134 was not detected in the samples analyzed.

C08





During the preoperational period, cesium-134 was not detected in the samples analyzed.
Station 25 replaced station 09.

C09

D. Ingestion Exposure Pathway

1. Milk

The results of the iodine-131 analysis of milk samples are presented in Table B-11. A sample was collected monthly from two stations. A total of 24 samples were analyzed during 2001. 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-11. A total of 24 samples were analyzed. Naturally occurring potassium-40 was measured in all samples with an average of 1269 pCi/liter and a range of 655 to 1530 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 2001. 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 eight samples monitored with an average level of 1.02 pCi/liter and a range of 0.52 to 1.5 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-12. Eight samples of fish were collected during 2001. These samples were analyzed by gamma ray spectroscopy and the naturally occurring isotope potassium-40 was found in all samples at an average of 1653 pCi/kg (wet weight) with a range of 1310 to 2080 pCi/kg (wet weight). The fission product cesium-137 was measured in two of the eight samples with an average activity of 24.5 pCi/kg (wet weight) with a range of 23.5 to 25.5 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 food samples were collected from five locations and analyzed by gamma spectrometry. The results are presented in Table B-13. Naturally occurring potassium-40 was monitored in all 30 samples with an average activity level of 22480 pCi/kg (wet weight) and a range of 7760 to 37300 pCi/kg (wet weight). Cosmogenic beryllium-7 was detected in 28 of the 30 samples with an average concentration of 1828 pCi/kg (wet weight) and a range of 159 to 4950 pCi/kg (wet weight).

Cesium-134, a fission product, was not detected at levels above LLD during 2001. Cesium-137 has been detected in some samples at low-levels in previous years and was

detected in one sample at a concentration of 47.9 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).

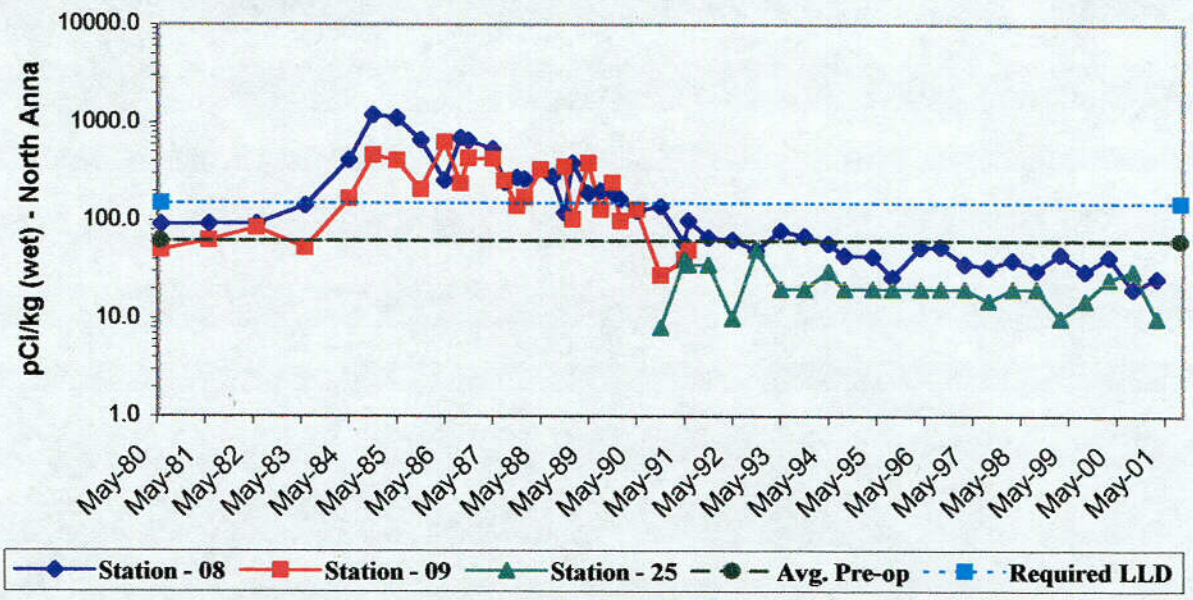
E. Direct Radiation Exposure Pathway

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 3.3 mR/standard month with a range of 1.3 to 6.0 mR/standard month. This is comparable to the preoperational range. Station No. 1, had an average reading of 5.0 mR/standard month with a range of 3.8 to 6.0 mR/standard month.

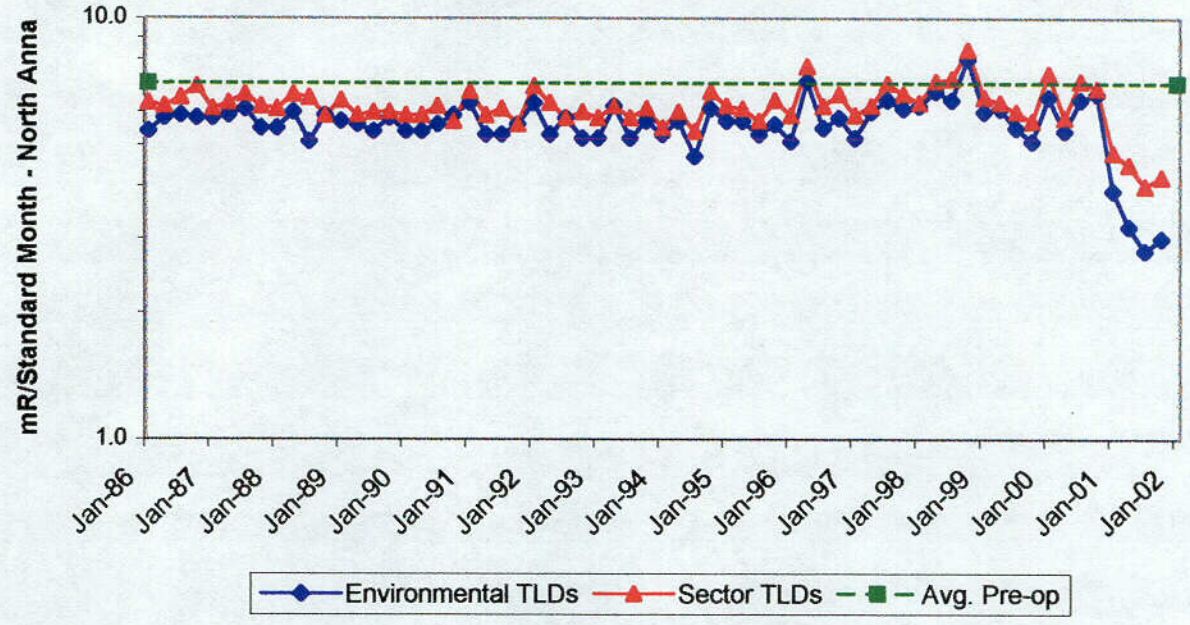
Sector TLDs are deployed quarterly at thirty-two locations in the environs of the North Anna site. Two badges are placed at each location. The results are presented in Table B-15. The average level of the 32 locations (two badges at each location) was 4.4 mR/standard month with a range of 0.7 to 17.4 mR/standard month. The eight control TLDs, collected quarterly from four locations, showed an average reading of 2.9 mR/standard month with a range of 1.1 to 5.5 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.

Trending Graph-9: Cesium-137 in Fish



Station 25 replaced station 09.

Trending Graph-10: Environmental Radiation - TLDs



C10

V. CONCLUSIONS

V. Conclusions

The results of the 2001 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 2001 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 2001. Iodine-131 was not detected in the charcoal filters analyzed during 2001.

A precipitation sample was collected monthly during 2001 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 detected in one sample at 170 pCi/liter. During the preoperational period the average tritium activity was 165 pCi/liter.

Waterborne Exposure Pathway

One naturally occurring isotope, potassium-40 and two man-made isotopes were monitored in the surface water of Lake Anna. Iodine-131 was detected in one sample at 0.8 pCi/liter. The average tritium activity during 2001 at the waste heat treatment facility was 3825 pCi/liter, which is 19.13% of the reporting level for a water sample. In 2000 the tritium level was 2850 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 3450 pCi/liter. The average tritium in 2000 had been 3025 pCi/liter. Naturally occurring thorium-228 was detected 1 out of 12 samples at a concentration of 6 pCi/liter. No other gamma emitters were detected.

Ground water from the environmental well on site contained no gamma emitters. There was no detection of tritium in ground/well water during 2001.

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. Strontium-90 was detected in one sample at the indicator location. 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 all two samples at a level of 177 pCi/kg. Cesium-137 was detected during 2000 at a level of 167 pCi/kg.

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 2001. Strontium-90 was measured in all eight composite 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 2001 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 2000. 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 2001 of cesium-137 was 1.3% of the reporting level.

One vegetation sample contained cesium-137 at an average level of 47.9 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 2001.

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-2103N, "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)"

VII. APPENDICES

APPENDIX A

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

ANNUAL SUMMARY TABLES – 2001

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

North Anna Nuclear Power Station, Louisa County, Virginia - 2001
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Medium or Pathway Sampled (Unit)	Analysis Type	Analysis Total No.	LLD*	All Indicator Locations Mean Range	Location with Highest Mean Name	Location with Highest Mean Distance Direction	Location with Highest Mean Mean Range	Control Location Mean Range	Non-Routine Reported Measure-ments
Air Iodine (pCi/m^3)	I-131	624	0.04	-(0/572) -	N/A		N/A	-(0/52) -	0
Air Particulate ($1E^{-03}$ pCi/m^3)	Gross Beta	624	5	7 (6.6-47)	5A N	3.20 mi.	20.5(52/52) (8.7-47)	20.3(52/52) (8.8-41)	0
	Gamma	48							
	Be-7	48	10	86.3(44/44) (21.4-667)	5A N	3.20 mi.	209(4/4) (24.1-667)	80.7(4/4) (27.5-149)	0
	K-40	48	10	108(1/44) -	5A N	3.20 mi.	108(1/44) -	-(0/4) -	0
	Sr-89	12	3	-(0/11) -	N/A		N/A	-(0/1) -	0
	Sr-90	12	12	-(0/11) -	N/A		N/A	-(0/1) -	0
Ground Well Water (pCi/liter)	Gamma	4							
	K-40	4	60	-(0/4) -	N/A		N/A	-(0/0) -	0
	Tritium	4	2000	120(1/4) -	01A SE	0.75 mi.	120(1/4)	-(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

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Medium or Pathway Sampled (Unit)	Analysis Type	Analysis Total No.	LLD*	All Indicator Locations Mean Range	Location with Highest Mean Name	Location with Highest Mean Distance Direction	Location with Highest Mean Mean Range	Control Location Mean Range	Non-Routine Reported Measure-ments
River Water	Gamma	12							
(pCi/liter)	K-40	12	200	-(0/12) -	N/A		N/A	-(0/0) -	0
	Th-228	12		5.73(1/12) -	11 SE	5.80 mi.	5.73(1/12) -	-(0/0) -	
	H-3	4	2000	3450(4/4) (3100-4000)	11 SE	5.80 mi.	3450(4/4) (3100-4000)	-(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	6.54(10/12) (2.9-16.0)	01A SE	0.75 mi.	6.54(10/12) (2.9-16.0)	-(0/0) -	0
	Gamma (Semi-Annually)	2		-(0/2) -	N/A		N/A	-(0/0) -	0
	Tritium	2	2000	170(1/2) -	01A SE	0.75 mi.	170(1/2) -	-(0/0) -	0
Surface Water	I-131	24	0.5	0.83(1/12) -	09A WNW	12.90 mi.	1.40(1/12) -	1.40(1/12) -	0
(pCi/liter)	Gamma	24							
Regular Monthlies	K-40	24	200	-(0/12) -	N/A		N/A	-(0/12) -	0
	Th-228	24		-(0/12) -	09A WNW	12.90 mi.	7.0(1/12) -	7.0(1/12) -	7.0(1/12) -

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Medium or Pathway Sampled (Unit)	Analysis Type	Analysis Total No.	LLD*	All Indicator Locations Mean Range	Location with Highest Mean Name	Location with Highest Mean Distance Direction	Location with Highest Mean Mean Range	Control Location Mean Range	Non-Routine Reported Measurements
Surface Water (pCi/liter) Regular Monthlies	Tritium	8	2000	3825(4/4) (3400-4400)	08 SSE	1.10 mi.	3825(4/4) (3400-4400)	-(0/4) -	0
	Sr-89	1		(0/1) -	N/A		N/A	(0/1) -	0
	Sr-90	1		(0/1) -	N/A		N/A	(0/1) -	0
Surface Water (pCi/liter) State Splits	Gamma	N/A							
	K-40	N/A							
	Tritium	N/A							
Sediment Silt (pCi/kg (dry))	Gamma	6							
	Be7	6		-(0/4) -	N/A		N/A	-(0/2) -	0
	K-40	6	200	6353(3/4) (2030-14600)	11 SSE	5.80 mi.	14600(1/2) -	13200(1/2) -	0
	Cs-137	6	194	65.4(2/4) (30.9-99.9	09A WNW	12.90 mi.	136(1/2) -	136(1/2) -	0
	Ra-226	6	100	396(3/4) (163-715)	09A WNW	12.90 mi.	855(1/2) -	855(1/2) -	0
	Th-228	6	30	623(3/4) (282-1160)	11 SSE	5.80 mi.	1160(1/2) -	1150(1/2) -	0
	U-235	6		40.9(2/4) (34.4-47.3)	11 SSE	5.80 mi.	47.3(1/2) -	19.9(1/2) -	0

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Medium or Pathway Sampled (Unit)	Analysis Type	Analysis Total No.	LLD*	All Indicator Locations Mean Range	Location with Highest Mean Name	Location with Highest Mean Distance Direction	Location with Highest Mean Mean Range	Control Location Mean Range	Non-Routine Reported Measurements
Sediment Silt (pCi/kg (dry))	Sr-89 (Annually)	3	4.0	-(0/0) -	N/A		N/A	-(0/0) -	0
	Sr-90 (Annually)	3	0.8	32.0(1/2) -	08 SSE	1.10 mi.	32.0(1/2) -	-(0/1) -	0
Soil (pCi/kg (dry))	Gamma	12							
	Be-7	12		-(0/11) -	NA		NA	-(0/1) -	0
	K-40	12		13765(11/11) (6570-29400)	23 SSE	0.93 mi.	29400(1/1) -	4610(1/1) -	0
	Cs-134	12	100	-(0/11) -	NA		NA	-(0/1) -	0
	Cs-137	12	180	334(10/11) (58-876)	05A N	3.20 mi.	876(1/1) -	527(1/1) -	0
	Ra-226	12	100	1540(7/11) (538-2820)	05 NNE	4.20 mi.	2820(1/1) -	1150(1/1) -	0
	Th-228	12	30	1251(11/11) (852-2260)	06 ESE	4.70 mi.	2260(1/1) -	1290(1/1) -	0
	U-235	12		117(7/11) (82-158)	23 SSE	0.93 mi.	158(1/1) -	125(1/1) -	
	Sr-89	12	200	-(0/11) -	NA		NA	-(0/1) -	0
	Sr-90	12	40	145(2/11) (130-160)	24 NW	22.0 mi.	240(1/1) -	240(1/1) -	0

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Medium or Pathway Sampled (Unit)	Analysis Type	Analysis Total No.	LLD*	All Indicator Locations Mean Range	Location with Highest Mean Name	Location with Highest Mean Distance Direction	Location with Highest Mean Mean Range	Control Location Mean Range	Non-Routine Reported Measurements
Shoreline Soil	Gamma	2							
(pCi/kg (dry))	Be-7	2		-(0/2) -	N/A		N/A	-(0/0) -	0
	K-40	2	200	1820(2/2) (1610-2030)	08 SSE	1.10 mi.	1820(2/2) (1610-2030)	-(0/0) -	0
	Cs-137	2	40	177(2/2) (99.9-255)	08 SSE	1.10 mi.	177(2/2) (99.9-255)	-(0/0) -	0
	Ra-226	2	100	407(2/2) (310-503)	08 SSE	1.10 mi.	407(2/2) (310-503)	-(0/0) -	0
	Th-228	2	30	329(2/2) (232-426)	08 SSE	1.10 mi.	329(2/2) (232-426)	(0/0) -	0
	Sr-89 (Annually)	1	4.0	-(0/1) -	N/A		N/A	-(0/0) -	0
	Sr-90 (Annually)	1	0.8	48(1/1) -	08 SSE	1.10 mi.	48(1/1) -	-(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	1269(24/24) (655-1530)	13 SSW	5.60 mi.	1278(12/12) (1070-1530)	-(0/0) -	0
	Sr-89 (Quarterly)	8	5	-(0/8) -	N/A		N/A	-(0/0) -	0
	SR-90 (Quarterly)	8	0.8	1.02(8/8) (0.52-1.50)	13 SSW	5.60 mi.	1.04(4/4) (0.52-1.50)	-(0/0) -	0

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Medium or Pathway Sampled (Unit)	Analysis Type	Analysis Total No.	LLD*	All Indicator Locations Mean Range	Location with Highest Mean Name	Location with Highest Mean Distance Direction	Location with Highest Mean Mean Range	Control Location Mean Range	Non-Routine Reported Measurements
Fish (pCi/kg (wet))	Gamma	8							
	K-40	8	200	1525(4/4) (1310-1860)	25 NW	16.5 mi.	1780(4/4) (1530-2080)	1780(4/4) (1530-2080)	0
	Cs-137	8	40	25.5(1/4) -	08 SSE	1.10 mi.	25.5(1/4) -	23.5(1/4) -	0
Food Vegetation (pCi/kg (wet))	Gamma	35							
	Be-7	30		1981(23/24) (159-4950)	14 NE	1.20 mi.	3039(6/6) (306-4950)	1123(5/6) (197-1520)	0
	K-40	30		22528(24/24) (7760-37300)	14 NE	1.20 mi.	25000(6/6) (11600-33000)	22290(6/6) (8940-29900)	0
	Cs-137	30	80	47.9(1/24) -	21 WNW	1.00 mi.	47.9(1/24) -	-(0/6) -	0
	Ra-226	30		834(4/24) (156-1300)	14 NE	1.20 mi.	1056(2/6) (811-1300)	-(0/6) -	
	Th-228	30		234(5/24) (57.8-643)	21 WNW	1.00 mi.	643(1/6) -	73.6(2/6) (55.0-92.1)	0
	I-131	30		52.0(1/24) -	23 SSE	0.93 MI.	52.0(1/24) -	-(0/6) -	
Direct Radiation (mR/std. Month) (Regular TLDs)	Gamma Dose	47	0.2	3.29(43/43) (1.3-6.0)	01 NE	0.20 mi.	5.0(4/4) (3.8-6.0)	2.88(4/4) (1.5-4.2)	0
Direct Radiation (mR/std. Month) (Annual TLDs)	Gamma Dose	12	0.2	2.77(11/11) (1.7-4.7)	01 NE	0.20 mi.	4.7(1/1)	2.7(1/1)	0

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Medium or Pathway Sampled (Unit)	Analysis Type	Analysis Total No.	LLD*	All Indicator Locations Mean Range	Location with Highest Mean Name	Location with Highest Mean Distance Direction	Location with Highest Mean Mean Range	Control Location Mean Range	Non-Routine Reported Measure-ments
Direct Radiation (mR/std. Month) (Sector TLDs)	Gamma Dose	284	0.2	4.43(252/252) (0.7-17.4)	SSW-19/51 SSW	0.42 mi.	11.3(8/8) (8.2-17.4)	2.85(32/32) (1.1-5.5)	0

APPENDIX B
DATA TABLES

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

North Anna Power Station, Louisa County, Virginia - 2001

pCi/m^3 ± 2 Sigma

Collection Date	STATIONS 01	02	03	04	05	05A	06	07	21	22	23	24
JANUARY												
12/27 - 01/03	< 0.009	< 0.007	< 0.009	< 0.009	< 0.009	< 0.009	< 0.005	< 0.009	< 0.009	< 0.009	< 0.009	< 0.006
01/03 - 01/10	< 0.012	< 0.013	< 0.013	< 0.013	< 0.007	< 0.013	< 0.013	< 0.013	< 0.013	< 0.005	< 0.011	< 0.011
01/10 - 01/17	< 0.015	< 0.015	< 0.015	< 0.015	< 0.009	< 0.016	< 0.016	< 0.016	< 0.016	< 0.011	< 0.019	< 0.019
01/17 - 01/24	< 0.015	< 0.015	< 0.015	< 0.015	< 0.009	< 0.015	< 0.015	< 0.015	< 0.016	< 0.011	< 0.020	< 0.020
01/24 - 02/01	< 0.015	< 0.015	< 0.009	< 0.018	< 0.018	< 0.018	< 0.010	< 0.012	< 0.010	< 0.012	< 0.013	< 0.011
FEBRUARY												
02/01 - 02/07	< 0.019	< 0.019	< 0.011	< 0.025	< 0.025	< 0.014	< 0.013	< 0.017	< 0.015	< 0.014	< 0.016	< 0.013
02/07 - 02/15	< 0.019	< 0.019	< 0.019	< 0.024	< 0.024	< 0.024	< 0.014	< 0.011	< 0.013	< 0.010	< 0.012	< 0.017
02/15 - 02/22	< 0.021	< 0.022	< 0.021	< 0.019	< 0.019	< 0.019	< 0.016	< 0.012	< 0.032	< 0.033	< 0.032	< 0.024
02/22 - 03/02	< 0.041	< 0.041	< 0.024	< 0.044	< 0.044	< 0.024	< 0.040	< 0.030	< 0.031	< 0.038	< 0.038	< 0.029
MARCH												
03/02 - 03/07	< 0.027	< 0.027	< 0.017	< 0.032	< 0.033	< 0.023	< 0.021	< 0.016	< 0.019	< 0.015	< 0.017	< 0.019
03/07 - 03/14	< 0.018	< 0.018	< 0.013	< 0.022	< 0.022	< 0.018	< 0.009	< 0.009	< 0.026	< 0.026	< 0.024	< 0.020
03/14 - 03/22	< 0.008	< 0.009	< 0.008	< 0.006	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.004	< 0.006	< 0.006
03/22 - 03/28	< 0.020	< 0.020	< 0.012	< 0.021	< 0.021	< 0.012	< 0.013	< 0.016	< 0.012	< 0.014	< 0.014	< 0.011
APRIL												
03/28 - 04/04	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013	< 0.009	< 0.008	< 0.025	< 0.008	< 0.008	< 0.011
04/04 - 04/11	< 0.014	< 0.014	< 0.009	< 0.014	< 0.013	< 0.009	< 0.010	< 0.004	< 0.011	< 0.009	< 0.020	< 0.016
04/11 - 04/19	< 0.020	< 0.020	< 0.013	< 0.015	< 0.003	< 0.003	< 0.003	< 0.004	< 0.004	< 0.005	< 0.005	< 0.004
04/19 - 04/25	< 0.021	< 0.022	< 0.013	< 0.026	< 0.026	< 0.014	< 0.015	< 0.019	< 0.016	< 0.018	< 0.010	< 0.011
04/25 - 05/02	< 0.012	< 0.012	< 0.007	< 0.012	< 0.012	< 0.009	< 0.009	< 0.007	< 0.009	< 0.008	< 0.008	< 0.010
MAY												
05/02 - 05/08	< 0.020	< 0.020	< 0.012	< 0.024	< 0.024	< 0.013	< 0.013	< 0.019	< 0.016	< 0.017	< 0.019	< 0.015
05/08 - 05/16	< 0.022	< 0.022	< 0.014	< 0.018	< 0.018	< 0.013	< 0.015	< 0.010	< 0.015	< 0.013	< 0.014	< 0.015
05/16 - 05/23	< 0.016	< 0.016	< 0.016	< 0.016	< 0.026	< 0.025	< 0.009	< 0.012	< 0.010	< 0.008	< 0.014	< 0.013
05/23 - 05/30	< 0.016	< 0.016	< 0.011	< 0.021	< 0.021	< 0.012	< 0.012	< 0.022	< 0.012	< 0.014	< 0.011	< 0.012
JUNE												
05/30 - 06/06	< 0.012	< 0.012	< 0.014	< 0.011	< 0.015	< 0.015	< 0.013	< 0.017	< 0.028	< 0.029	< 0.027	< 0.020
06/06 - 06/13	< 0.024	< 0.024	< 0.015	< 0.024	< 0.024	< 0.017	< 0.017	< 0.015	< 0.015	< 0.032	< 0.016	< 0.021
06/13 - 06/20	< 0.018	< 0.018	< 0.013	< 0.021	< 0.021	< 0.012	< 0.014	< 0.021	< 0.015	< 0.016	< 0.016	< 0.012
06/20 - 06/27	< 0.029	< 0.029	< 0.029	< 0.037	< 0.037	< 0.029	< 0.050	< 0.050	< 0.040	< 0.041	< 0.040	< 0.031

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

North Anna Power Station, Louisa County, Virginia - 2001

pCi/m^3 ± 2 Sigma

Collection Date	STATIONS 01	02	03	04	05	05A	06	07	21	22	23	24
JULY												
06/27 - 07/05	< 0.020	< 0.020	< 0.011	< 0.023	< 0.023	< 0.015	< 0.029	< 0.029	< 0.029	< 0.029	< 0.019	< 0.013
07/05 - 07/12	< 0.023	< 0.024	< 0.014	< 0.031	< 0.031	< 0.017	< 0.019	< 0.015	< 0.020	< 0.020	< 0.012	< 0.020
07/12 - 07/19	< 0.020	< 0.020	< 0.011	< 0.016	< 0.016	< 0.011	< 0.013	< 0.010	< 0.008	< 0.009	< 0.014	< 0.016
07/19 - 07/26	< 0.026	< 0.026	< 0.026	< 0.026	< 0.014	< 0.021	< 0.021	< 0.021	< 0.021	< 0.011	< 0.013	< 0.014
07/26 - 08/01	< 0.021	< 0.021	< 0.021	< 0.020	< 0.013	< 0.019	< 0.019	< 0.019	< 0.019	< 0.013	< 0.024	< 0.024
AUGUST												
08/01 - 08/08	< 0.031	< 0.031	< 0.031	< 0.032	< 0.031	< 0.031	< 0.031	< 0.031	< 0.025	< 0.025	< 0.026	< 0.025
08/08 - 08/15	< 0.023	< 0.023	< 0.023	< 0.023	< 0.026	< 0.026	< 0.026	< 0.026	< 0.021	< 0.035	< 0.022	< 0.022
08/15 - 08/23	< 0.008	< 0.008	< 0.008	< 0.007	< 0.007	< 0.007	< 0.009	< 0.009	< 0.009	< 0.011	< 0.010	< 0.010
08/23 - 08/29	< 0.009	< 0.010	< 0.010	< 0.010	< 0.009	< 0.009	< 0.009	< 0.008	< 0.011	< 0.010	< 0.011	< 0.010
SEPTEMBER												
08/29 - 09/05	< 0.011	< 0.011	< 0.011	< 0.011	< 0.009	< 0.009	< 0.009	< 0.009	< 0.012	< 0.012	< 0.012	< 0.012
09/05 - 09/12	< 0.016	< 0.016	< 0.016	< 0.014	< 0.014	< 0.014	< 0.012	< 0.012	< 0.012	< 0.013	< 0.013	< 0.013
09/12 - 09/20	< 0.015	< 0.015	< 0.015	< 0.015	< 0.009	< 0.010	< 0.010	< 0.008	< 0.010	< 0.010	< 0.009	< 0.010
09/20 - 09/26	< 0.017	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.014	< 0.014	< 0.014	< 0.014
OCTOBER												
09/26 - 10/03	< 0.006	< 0.006	< 0.006	< 0.006	< 0.004	< 0.009	< 0.010	< 0.012	< 0.011	< 0.012	< 0.011	< 0.009
10/03 - 10/10	< 0.016	< 0.015	< 0.015	< 0.015	< 0.016	< 0.016	< 0.016	< 0.015	< 0.021	< 0.021	< 0.011	< 0.010
10/10 - 10/17	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.016	< 0.014	< 0.014	< 0.014	< 0.011	< 0.011	< 0.011
10/17 - 10/24	< 0.024	< 0.025	< 0.024	< 0.024	< 0.019	< 0.019	< 0.019	< 0.019	< 0.024	< 0.023	< 0.024	< 0.023
10/24 - 10/31	< 0.017	< 0.014	< 0.010	< 0.023	< 0.023	< 0.023	< 0.023	< 0.012	< 0.016	< 0.016	< 0.016	< 0.016
NOVEMBER												
10/31 - 11/07	< 0.018	< 0.018	< 0.018	< 0.018	< 0.022	< 0.017	< 0.022	< 0.022	< 0.022	< 0.014	< 0.024	< 0.024
11/07 - 11/14	< 0.021	< 0.023	< 0.021	< 0.021	< 0.015	< 0.018	< 0.018	< 0.020	< 0.018	< 0.013	< 0.029	< 0.032
11/14 - 11/21	< 0.023	< 0.023	< 0.025	< 0.023	< 0.023	< 0.024	< 0.023	< 0.022	< 0.030	< 0.027	< 0.028	< 0.030
11/21 - 11/28	< 0.028	< 0.028	< 0.028	< 0.028	< 0.021	< 0.021	< 0.021	< 0.021	< 0.022	< 0.022	< 0.022	< 0.022
DECEMBER												
11/28 - 12/05	< 0.040	< 0.040	< 0.040	< 0.040	< 0.038	< 0.038	< 0.038	< 0.038	< 0.032	< 0.043	< 0.033	< 0.032
12/05 - 12/12	< 0.018	< 0.019	< 0.019	< 0.015	< 0.019	< 0.011	< 0.016	< 0.016	< 0.016	< 0.016	< 0.009	< 0.014
12/12 - 12/19	< 0.026	< 0.026	< 0.025	< 0.026	< 0.020	< 0.020	< 0.020	< 0.020	< 0.027	< 0.027	< 0.028	< 0.027
12/19 - 12/27	< 0.045	< 0.013	< 0.013	< 0.013	< 0.030	< 0.030	< 0.030	< 0.030	< 0.036	< 0.036	< 0.036	< 0.036

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

North Anna Power Station, Louisa County, Virginia - 2001

$1.0E^{-03}$ pCi/m^3 ± 2 Sigma

COLLECTION DATE	01	02	03	04	05	05A	06	07	21	22	23	24	AVERAGE ± 2 s.d.
JANUARY													
12/27/01 - 01/03/01	20 ± 2	16 ± 2	18 ± 2	21 ± 2	16 ± 2	18 ± 2	18 ± 2	17 ± 2	21 ± 2	17 ± 2	19 ± 2	18 ± 2	18 ± 3
01/03/01 - 01/10/01	19 ± 2	19 ± 2	19 ± 2	19 ± 2	15 ± 2	19 ± 2	17 ± 2	18 ± 2	20 ± 2	19 ± 2	19 ± 2	19 ± 2	19 ± 3
01/10/01 - 01/17/01	19 ± 2	19 ± 2	19 ± 2	20 ± 2	19 ± 2	18 ± 2	17 ± 2	17 ± 2	17 ± 2	19 ± 2	19 ± 2	19 ± 2	19 ± 2
01/17/01 - 01/24/01	20 ± 2	20 ± 2	19 ± 2	21 ± 2	21 ± 2	21 ± 2	20 ± 2	19 ± 2	21 ± 2	21 ± 2	22 ± 2	24 ± 2	21 ± 3
01/24/01 - 02/01/01	22 ± 2	20 ± 2	21 ± 2	22 ± 2	21 ± 2	21 ± 2	21 ± 2	19 ± 2	22 ± 2	20 ± 2	21 ± 2	20 ± 2	21 ± 2
FEBRUARY													
02/01/01 - 02/07/01	25 ± 2	21 ± 2	20 ± 2	28 ± 2	26 ± 2	25 ± 2	22 ± 2	24 ± 2	25 ± 2	23 ± 2	26 ± 2	23 ± 2	24 ± 5
02/07/01 - 02/15/01	17 ± 2	15 ± 2	16 ± 2	18 ± 2	18 ± 2	18 ± 2	17 ± 2	17 ± 2	17 ± 2	17 ± 2	19 ± 2	17 ± 2	17 ± 2
02/15/01 - 02/22/01	24 ± 2	22 ± 2	25 ± 2	26 ± 2	27 ± 2	25 ± 2	25 ± 2	23 ± 2	24 ± 2	23 ± 2	26 ± 2	26 ± 2	25 ± 3
02/22/01 - 03/02/01	20 ± 2	18 ± 2	21 ± 2	22 ± 2	22 ± 2	21 ± 2	19 ± 2	21 ± 2	19 ± 2	19 ± 2	22 ± 2	21 ± 2	20 ± 3
MARCH													
03/02/01 - 03/07/01	14 ± 2	15 ± 2	14 ± 2	15 ± 2	15 ± 2	16 ± 2	13 ± 2	15 ± 2	15 ± 2	15 ± 2	15 ± 2	13 ± 2	15 ± 2
03/07/01 - 03/14/01	13 ± 2	12 ± 2	12 ± 2	14 ± 2	13 ± 2	12 ± 2	12 ± 2	13 ± 2	14 ± 2	13 ± 2	14 ± 2	13 ± 2	13 ± 2
03/14/01 - 03/22/01	9 ± 2	9 ± 2	8 ± 1	9 ± 2	8 ± 1	9 ± 1	8 ± 1	7 ± 1	10 ± 2	8 ± 1	8 ± 1	9 ± 2	8 ± 1
03/22/01 - 03/28/01	20 ± 2	18 ± 2	20 ± 2	21 ± 2	19 ± 2	18 ± 2	18 ± 2	20 ± 2	21 ± 2	18 ± 2	19 ± 2	20 ± 2	19 ± 2
Quarter Avg. ± 2 s.d.	**19 ± 8.9**	**17 ± 7.5**	**18 ± 9**	**20 ± 10**	**18 ± 10**	**19 ± 9**	**17 ± 9**	**18 ± 9**	**19 ± 8**	**18 ± 8**	**19 ± 10**	**19 ± 10**	**18 ± 9**

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

North Anna Power Station, Louisa County, Virginia - 2001

$1.0E^{-03}$ pCi/m^3 ± 2 Sigma

COLLECTION DATE	01	02	03	04	05	05A	06	07	21	22	23	24	AVERAGE ± 2 s.d.
APRIL													
03/28/01 - 04/04/01	11 ± 2	9 ± 1	10 ± 1	10 ± 1	11 ± 1	11 ± 2	10 ± 1	10 ± 1	13 ± 3	11 ± 1	12 ± 2	13 ± 2	11 ± 3
04/04/01 - 04/11/01	20 ± 2	18 ± 2	20 ± 2	19 ± 2	20 ± 2	18 ± 2	17 ± 2	19 ± 2	18 ± 2	18 ± 2	20 ± 2	20 ± 2	19 ± 2
04/11/01 - 04/19/01	16 ± 2	12 ± 2	15 ± 2	14 ± 2	14 ± 2	14 ± 2	14 ± 2	14 ± 2	15 ± 2	14 ± 2	10 ± 2	15 ± 2	14 ± 3
04/19/01 - 04/25/01	19 ± 2	22 ± 2	21 ± 2	21 ± 2	19 ± 2	22 ± 2	18 ± 2	20 ± 2	18 ± 2	19 ± 2	21 ± 2	23 ± 2	20 ± 3
04/25/01 - 05/02/01	20 ± 2	22 ± 2	21 ± 2	23 ± 2	20 ± 2	22 ± 2	20 ± 2	18 ± 2	19 ± 2	21 ± 2	22 ± 2	20 ± 2	21 ± 3
MAY													
05/02/01 - 05/08/01	23 ± 2	24 ± 2	21 ± 2	23 ± 2	26 ± 2	21 ± 2	18 ± 2	21 ± 2	22 ± 2	20 ± 2	23 ± 2	24 ± 2	22 ± 4
05/08/01 - 05/16/01	19 ± 2	19 ± 2	18 ± 2	16 ± 2	15 ± 2	22 ± 2	17 ± 2	17 ± 2	17 ± 2	19 ± 2	19 ± 2	20 ± 2	18 ± 4
05/16/01 - 05/23/01	9 ± 2	7 ± 2	10 ± 2	9 ± 2	9 ± 2	12 ± 2	8 ± 2	8 ± 2	7 ± 2	9 ± 2	8 ± 2	9 ± 2	9 ± 3
05/23/01 - 05/30/01	15 ± 2	13 ± 2	14 ± 2	15 ± 2	13 ± 2	16 ± 2	15 ± 2	14 ± 2	13 ± 2	13 ± 2	15 ± 2	13 ± 2	14 ± 2
JUNE													
05/30/01 - 06/06/01	12 ± 2	10 ± 1	10 ± 1	12 ± 2	11 ± 2	10 ± 1	9 ± 1	12 ± 2	10 ± 1	10 ± 1	11 ± 1	11 ± 2	11 ± 2
06/06/01 - 06/13/01	20 ± 2	19 ± 2	18 ± 2	18 ± 2	18 ± 2	21 ± 2	17 ± 2	20 ± 2	17 ± 2	17 ± 2	19 ± 2	20 ± 2	19 ± 3
06/13/01 - 06/20/01	18 ± 2	17 ± 2	18 ± 2	19 ± 2	17 ± 2	18 ± 2	17 ± 2	18 ± 2	17 ± 2	17 ± 2	19 ± 2	21 ± 2	18 ± 2
06/20/01 - 06/27/01	19 ± 2	17 ± 2	18 ± 2	18 ± 2	18 ± 2	20 ± 2	18 ± 2	18 ± 2	15 ± 2	19 ± 2	18 ± 2	17 ± 2	18 ± 2
Quarter Avg. ± 2 s.d.	**17 ± 8.2**	**16 ± 11**	**16 ± 9**	**17 ± 9**	**16 ± 9**	**17 ± 9**	**15 ± 8**	**16 ± 8**	**15 ± 8**	**16 ± 8**	**17 ± 10**	**17 ± 9**	**16 ± 9**

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

North Anna Power Station, Louisa County, Virginia - 2001

$1.0E^{-03}$ pCi/m^3 ± 2 Sigma

COLLECTION DATE	01	02	03	04	05	05A	06	07	21	22	23	24	AVERAGE ± 2 s.d.
JULY													
06/27/01 - 07/05/01	18 ± 2	14 ± 1	17 ± 2	17 ± 2	14 ± 2	18 ± 2	15 ± 2	16 ± 2	16 ± 2	16 ± 2	17 ± 2	16 ± 2	16 ± 3
07/05/01 - 07/12/01	18 ± 2	17 ± 2	23 ± 2	19 ± 2	18 ± 2	19 ± 2	18 ± 2	17 ± 2	20 ± 2	20 ± 2	20 ± 2	21 ± 2	19 ± 3
07/12/01 - 07/19/01	18 ± 2	18 ± 2	20 ± 2	20 ± 2	18 ± 2	20 ± 2	17 ± 2	14 ± 2	17 ± 2	18 ± 2	20 ± 2	19 ± 2	18 ± 4
07/19/01 - 07/26/01	12 ± 2	12 ± 2	14 ± 2	14 ± 2	14 ± 2	15 ± 2	12 ± 2	13 ± 2	13 ± 2	13 ± 2	13 ± 2	14 ± 2	13 ± 2
07/26/01 - 08/01/01	11 ± 2	10 ± 2	11 ± 2	11 ± 2	11 ± 2	11 ± 2	11 ± 2	11 ± 2	10 ± 2	12 ± 2	11 ± 2	10 ± 2	11 ± 1
AUGUST													
08/01/01 - 08/08/01	25 ± 2	23 ± 2	24 ± 2	25 ± 2	24 ± 2	23 ± 2	22 ± 2	23 ± 2	22 ± 2	24 ± 2	23 ± 2	27 ± 2	24 ± 3
08/08/01 - 08/15/01	22 ± 2	21 ± 2	26 ± 2	25 ± 2	21 ± 2	24 ± 2	21 ± 2	21 ± 2	19 ± 2	39 ± 3	23 ± 2	25 ± 2	24 ± 10
08/15/01 - 08/23/01	22 ± 2	20 ± 2	26 ± 2	25 ± 2	23 ± 2	25 ± 2	22 ± 2	24 ± 2	24 ± 2	22 ± 2	25 ± 2	24 ± 2	24 ± 3
08/23/01 - 08/29/01	27 ± 2	23 ± 2	27 ± 2	27 ± 2	26 ± 2	26 ± 2	26 ± 2	23 ± 2	23 ± 2	26 ± 2	24 ± 2	28 ± 2	26 ± 4
SEPTEMBER													
08/29/01 - 09/05/01	22 ± 2	20 ± 2	22 ± 2	22 ± 2	20 ± 2	26 ± 2	22 ± 2	20 ± 2	21 ± 2	23 ± 2	23 ± 2	23 ± 2	22 ± 3
09/05/01 - 09/12/01	18 ± 2	17 ± 2	20 ± 2	18 ± 2	17 ± 2	19 ± 2	15 ± 2	17 ± 2	18 ± 2	18 ± 2	19 ± 2	19 ± 2	18 ± 3
09/12/01 - 09/20/01	26 ± 2	24 ± 2	25 ± 2	25 ± 2	24 ± 2	26 ± 2	24 ± 2	22 ± 2	22 ± 2	24 ± 2	24 ± 2	26 ± 2	24 ± 3
09/20/01 - 09/26/01	24 ± 2	21 ± 2	26 ± 2	26 ± 2	25 ± 2	26 ± 2	25 ± 2	21 ± 2	25 ± 2	25 ± 2	24 ± 2	27 ± 2	25 ± 4
Quarter Avg. ± 2 s.d.	**20 ± 10**	**18 ± 8.7**	**22 ± 10**	**21 ± 10**	**20 ± 10**	**21 ± 10**	**19 ± 10**	**19 ± 8**	**19 ± 9**	**22 ± 14**	**20 ± 9**	**21 ± 11**	**20 ± 10**

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

North Anna Power Station, Louisa County, Virginia - 2001

$1.0E^{-03}$ pCi/m^3 ± 2 Sigma

COLLECTION DATE	01	02	03	04	05	05A	06	07	21	22	23	24	AVERAGE ± 2 s.d.
OCTOBER													
09/26 - 10/03	19 ± 2	19 ± 2	17 ± 2	21 ± 2	19 ± 2	19 ± 2	18 ± 2	17 ± 2	16 ± 2	18 ± 2	18 ± 2	20 ± 2	18 ± 3
10/03 - 10/10	25 ± 2	25 ± 2	31 ± 2	30 ± 2	27 ± 2	31 ± 2	25 ± 2	26 ± 2	27 ± 2	29 ± 2	26 ± 2	27 ± 2	27 ± 5
10/10 - 10/17	15 ± 2	13 ± 2	14 ± 2	15 ± 2	16 ± 2	17 ± 2	14 ± 2	13 ± 2	14 ± 2	16 ± 2	15 ± 2	17 ± 2	15 ± 3
10/17 - 10/24	23 ± 2	24 ± 2	26 ± 2	27 ± 2	23 ± 2	26 ± 2	25 ± 2	24 ± 2	24 ± 2	28 ± 2	24 ± 2	26 ± 2	25 ± 3
10/24 - 10/31	19 ± 2	14 ± 2	16 ± 2	17 ± 2	16 ± 2	16 ± 2	16 ± 2	16 ± 2	17 ± 2	11 ± 2	15 ± 2	17 ± 2	16 ± 4
NOVEMBER													
10/31 - 11/07	23 ± 2	24 ± 2	24 ± 2	25 ± 2	25 ± 2	24 ± 2	24 ± 2	23 ± 2	21 ± 2	18 ± 2	23 ± 2	23 ± 2	23 ± 4
11/07 - 11/14	23 ± 2	22 ± 2	23 ± 2	22 ± 2	21 ± 2	24 ± 2	23 ± 2	26 ± 2	21 ± 2	15 ± 2	23 ± 2	23 ± 2	22 ± 5
11/14 - 11/21	41 ± 3	36 ± 3	41 ± 3	36 ± 3	40 ± 3	47 ± 3	39 ± 3	40 ± 3	36 ± 3	26 ± 2	39 ± 3	41 ± 3	39 ± 10
11/21 - 11/28	24 ± 2	23 ± 2	22 ± 2	23 ± 2	22 ± 2	23 ± 2	22 ± 2	22 ± 2	23 ± 2	17 ± 2	22 ± 2	22 ± 2	22 ± 3
DECEMBER													
11/28 - 12/05	24 ± 2	24 ± 2	24 ± 2	28 ± 2	24 ± 2	27 ± 2	26 ± 2	24 ± 2	23 ± 2	24 ± 2	26 ± 2	28 ± 2	25 ± 3
12/05 - 12/12	19 ± 2	20 ± 2	23 ± 2	23 ± 2	20 ± 2	24 ± 2	19 ± 2	23 ± 2	21 ± 2	20 ± 2	24 ± 2	23 ± 2	22 ± 4
12/12 - 12/19	20 ± 2	19 ± 2	22 ± 2	20 ± 2	17 ± 2	19 ± 2	18 ± 2	19 ± 2	19 ± 2	18 ± 2	19 ± 2	21 ± 2	19 ± 3
12/19 - 12/27	22 ± 4	19 ± 2	20 ± 2	20 ± 2	19 ± 2	23 ± 2	19 ± 2	22 ± 2	19 ± 2	18 ± 2	21 ± 2	21 ± 2	20 ± 3
Quarter Avg. ± 2 s.d.	**23 ± 12**	**22 ± 11**	**23 ± 14**	**24 ± 11**	**22 ± 13**	**25 ± 16**	**22 ± 13**	**23 ± 13**	**22 ± 11**	**20 ± 11**	**23 ± 12**	**24 ± 12**	**23 ± 12**

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

North Anna Power Station, Louisa County, Virginia - 2001

1.0 E^{-03} pCi/m^3 ± 2 Sigma

Station	Nuclide	First Quarter 12/27-3/28	Second Quarter 03/28-06/27	Third Quarter 06/27-09/26	Fourth Quarter 09/26-12/27	Average
STA-01	Sr-89	(a)	< 0.7	(a)	(a)	
	Sr-90	(a)	< 0.2	(a)	(a)	
	Be-7	28.2 ± 1.9	74.7 ± 3.9	135 ± 7.2	62.0 ± 3.90	75.0 ± 89.1
	K-40	< 3	< 3	< 3	< 5	
	Co-60	< 0.2	< 0.2	< 0.2	< 0.3	
	Ru-103	< 0.2	< 0.3	< 1	< 0.6	
	Cs-134	< 0.2	< 0.2	< 0.2	< 0.3	
	Cs-137	< 0.2	< 0.2	< 0.2	< 0.3	
	Th-228	< 0.2	< 0.3	< 1	< 2	
STA-02	Sr-89	(a)	< 0.7	(a)	(a)	
	Sr-90	(a)	< 0.2	(a)	(a)	
	Be-7	24.3 ± 1.8	73.4 ± 4.3	101 ± 6.1	62.0 ± 3.8	65.2 ± 63.6
	K-40	< 4	< 5	< 3	< 3	
	Co-60	< 0.2	< 0.3	< 0.2	< 0.2	
	Ru-103	< 0.2	< 0.4	< 0.9	< 0.4	
	Cs-134	< 0.2	< 0.4	< 0.2	< 0.3	
	Cs-137	< 0.2	< 0.3	< 0.2	< 0.2	
	Th-228	< 0.3	< 0.4	< 0.2	< 2	
STA-03	Sr-89	(a)	< 0.8	(a)	(a)	
	Sr-90	(a)	< 0.2	(a)	(a)	
	Be-7	25.8 ± 1.8	79.3 ± 4.5	152 ± 8.1	62.2 ± 4.4	79.8 ± 106
	K-40	< 6	< 5	< 3	< 6	
	Co-60	< 0.2	< 0.2	< 0.2	< 0.3	
	Ru-103	< 0.2	< 0.3	< 0.8	< 0.6	
	Cs-134	< 0.2	< 0.2	< 0.2	< 0.4	
	Cs-137	< 0.2	< 0.2	< 0.2	< 0.3	
	Th-228	< 0.2	< 0.3	< 0.2	< 2	
STA-04	Sr-89	(a)	< 0.9	(a)	(a)	
	Sr-90	(a)	< 0.2	(a)	(a)	
	Be-7	27.9 ± 1.8	72.1 ± 3.9	157 ± 7.8	65.5 ± 3.8	80.6 ± 109
	K-40	< 5	< 4	< 3	< 4	
	Co-60	< 0.3	< 0.2	< 0.1	< 0.2	
	Ru-103	< 0.2	< 0.2	< 0.5	< 0.3	
	Cs-134	< 0.1	< 0.2	< 0.1	< 0.2	
	Cs-137	< 0.2	< 0.2	< 0.1	< 0.2	
	Th-228	< 0.2	< 0.2	< 1	< 1	

* 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 - 2001

1.0 E^{-03} pCi/m^3 ± 2 Sigma

Station	Nuclide	First Quarter 12/27-3/28	Second Quarter 03/28-06/27	Third Quarter 06/27-09/26	Fourth Quarter 09/26-12/27	Average
STA-05	Sr-89	(a)	< 0.8	(a)	(a)	
	Sr-90	(a)	< 0.3	(a)	(a)	
	Be-7	24.5 ± 1.8	76.4 ± 4.3	134 ± 6.8	65.2 ± 4.9	75.0 ± 90.4
	K-40	< 4	< 5	< 3	< 5	
	Co-60	< 0.2	< 0.3	< 0.1	< 0.4	
	Ru-103	< 0.2	< 0.3	< 0.6	< 0.7	
	Cs-134	< 0.2	< 0.2	< 0.1	< 0.4	
	Cs-137	< 0.2	< 0.2	< 0.1	< 0.4	
	Th-228	< 0.2	< 0.3	< 1	< 3	
STA-05A	Sr-89	(a)	< 0.8	(a)	(a)	
	Sr-90	(a)	< 0.2	(a)	(a)	
	Be-7	24.1 ± 1.9	79.2 ± 4.7	667 ± 32.4	64.5 ± 5.13	209.0 ± 613
	K-40	< 5	< 3	108 ± 7.6	< 6	108.0 ± 7.6
	Co-60	< 0.2	< 0.4	< 0.5	< 0.4	
	Ru-103	< 0.2	< 0.6	< 3	< 0.7	
	Cs-134	< 0.2	< 0.4	< 0.5	< 0.4	
	Cs-137	< 0.2	< 0.3	< 0.5	< 0.4	
	Th-228	< 0.3	< 0.5	< 0.8	< 3	
STA-06	Sr-89	(a)	< 0.8	(a)	(a)	
	Sr-90	(a)	< 0.2	(a)	(a)	
	Be-7	21.4 ± 1.5	68.2 ± 3.8	131 ± 6.5	60.3 ± 5.4	70.2 ± 90.8
	K-40	< 4	< 2	< 2	< 8	
	Co-60	< 0.2	< 0.3	< 0.2	< 0.5	
	Ru-103	< 0.2	< 0.4	< 0.5	< 0.9	
	Cs-134	< 0.2	< 0.2	< 0.1	< 0.6	
	Cs-137	< 0.2	< 0.3	< 0.1	< 0.5	
	Th-228	< 0.2	< 0.3	< 0.1	< 3	
STA-07	Sr-89	(a)	< 0.8	(a)	(a)	
	Sr-90	(a)	< 0.3	(a)	(a)	
	Be-7	24.1 ± 1.8	75.7 ± 4.2	130 ± 6.7	64.7 ± 5.0	73.6 ± 87
	K-40	< 5	< 4	< 3	< 7	
	Co-60	< 0.3	< 0.2	< 0.1	< 0.5	
	Ru-103	< 0.3	< 0.2	< 0.6	< 0.9	
	Cs-134	< 0.2	< 0.2	< 0.1	< 0.5	
	Cs-137	< 0.2	< 0.2	< 0.1	< 0.4	
	Th-228	< 0.2	< 0.2	< 0.2	< 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 - 2001

1.0 E^{-03} pCi/m^3 ± 2 Sigma

Station	Nuclide	First Quarter 12/27-3/28	Second Quarter 03/28-06/27	Third Quarter 06/27-09/26	Fourth Quarter 09/26-12/27	Average
STA-21	Sr-89	(a)	< 0.8	(a)	(a)	
	Sr-90	(a)	< 0.2	(a)	(a)	
	Be-7	25.9 ± 2.0	72.1 ± 4.1	128 ± 6.8	57.6 ± 5.1	70.9 ± 85.4
	K-40	< 3	< 4	< 4	< 7	
	Co-60	< 0.3	< 0.2	< 0.1	< 0.5	
	Ru-103	< 0.4	< 0.3	< 0.7	< 1	
	Cs-134	< 0.3	< 0.2	< 0.1	< 0.5	
	Cs-137	< 0.3	< 0.2	< 0.1	< 0.4	
	Th-228	< 0.4	< 0.2	< 1	< 3	
STA-22	Sr-89	(a)	< 0.9	(a)	(a)	
	Sr-90	(a)	< 0.2	(a)	(a)	
	Be-7	24.6 ± 2.0	71.2 ± 4.0	141 ± 7.0	55.9 ± 3.5	73.2 ± 98.4
	K-40	< 3	< 5	< 2	< 3	
	Co-60	< 0.4	< 0.2	< 0.1	< 0.2	
	Ru-103	< 0.5	< 0.3	< 0.6	< 0.3	
	Cs-134	< 0.4	< 0.2	< 0.1	< 0.2	
	Cs-137	< 0.3	< 0.2	< 0.1	< 0.2	
	Th-228	< 0.6	< 0.4	< 1	< 1	
STA-23	Sr-89	(a)	< 0.8	(a)	(a)	
	Sr-90	(a)	< 0.2	(a)	(a)	
	Be-7	25.2 ± 2.5	71.9 ± 3.9	146 ± 7.5	66.8 ± 5.1	77.5 ± 100
	K-40	< 3	< 4	< 4	< 5	
	Co-60	< 0.3	< 0.3	< 0.2	< 0.3	
	Ru-103	< 0.4	< 0.2	< 0.7	< 0.5	
	Cs-134	< 0.3	< 0.1	< 0.1	< 0.2	
	Cs-137	< 0.3	< 0.2	< 0.1	< 0.3	
	Th-228	< 0.4	< 0.2	< 0.2	< 2	
STA-24	Sr-89	(a)	< 0.8	(a)	(a)	
	Sr-90	(a)	< 0.2	(a)	(a)	
	Be-7	27.5 ± 1.9	79.1 ± 4.4	149 ± 7.4	67.0 ± 5.4	80.7 ± 101
	K-40	< 2	< 4	< 3	< 5	
	Co-60	< 0.3	< 0.2	< 0.2	< 0.3	
	Ru-103	< 0.4	< 0.3	< 0.7	< 0.5	
	Cs-134	< 0.3	< 0.2	< 0.2	< 0.3	
	Cs-137	< 0.3	< 0.2	< 0.1	< 0.3	
	Th-228	< 0.4	< 0.4	< 2	< 2	

* 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 - 2001

pCi/L ± 2 Sigma

Collection Dates	Gross Beta	Rainfall (inches)
12/27/00 - 02/01/01	2.9 ± 1.8	2.71
02/01/01 - 03/02/01	< 4	1.69
03/02/01 - 03/28/01	3.8 ± 0.7	2.77
03/28/01 - 04/25/01	4.3 ± 1.5	2.19
04/25/01 - 05/30/01	11.0 ± 2.0	4.84
05/30/01 - 06/27/01	8.3 ± 1.6	3.94
06/27/01 - 07/26/01	16.0 ± 3.0	0.90
07/26/01 - 08/29/01	4.2 ± 1.2	4.62
08/29/01 - 09/26/01	4.4 ± 0.8	1.04
09/26/01 - 10/31/01	< 7	0.64
10/31/01 - 11/28/01	6.3 ± 2.0	0.53
11/28/01 - 12/27/01	4.2 ± 1.3	2.25
Average ± 2 s.d.	**6.54 ± 8.27**	

SEMI-ANNUAL PRECIPITATION COMPOSITES

12/27/00 - 06/27/01		06/27/01 - 12/27/01	
Be-7	< 80	Be-7	< 140
H-3	< 100	H-3	170 ± 70
Average ± 2 s.d.			**170 ± 70**

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

*TABLE B-5: CONCENTRATIONS OF GAMMA EMITTERS * IN SOIL*

North Anna Power Station, Louisa Conty, Virginia - 2001

pCi/kg ± 2 Sigma

STATION	COLLECTION DATE	Sr-89	Sr-90	Be-7	K-40	Cs-134	Cs-137	Ra-226	Th-228	U-235
01	07/19/01	< 300	< 100	< 200	21000 ± 730	< 20	< 20	1140 ± 557	1130 ± 34	82 ± 30
02	07/19/01	< 300	< 100	< 200	7750 ± 401	< 20	58 ± 10	< 600	1070 ± 38	< 40
03	07/19/01	< 400	< 100	< 300	13700 ± 620	< 20	229 ± 16	< 700	1180 ± 40	128 ± 16
04	07/19/01	< 400	< 200	< 300	6570 ± 381	< 20	681 ± 31	< 600	867 ± 33	< 40
05	07/19/01	< 300	< 100	< 300	10600 ± 500	< 20	166 ± 14	2820 ± 293	1070 ± 40	161 ± 18
05A	07/19/01	< 400	< 100	< 400	11000 ± 590	< 30	876 ± 43	2000 ± 332	859 ± 39	114 ± 19
06	07/19/01	< 300	160 ± 90	< 300	10200 ± 480	< 20	213 ± 16	1470 ± 39	2260 ± 68	89 ± 18
07	07/19/01	< 400	< 200	< 300	10800 ± 520	< 20	217 ± 18	< 800	1140 ± 44	< 40
21	07/19/01	< 800	< 200	< 300	12800 ± 500	< 30	451 ± 21	538 ± 23	852 ± 34	< 30
22	07/19/01	< 400	< 100	< 300	17600 ± 690	< 50	210 ± 19	1260 ± 41	1470 ± 52	87 ± 18
23	07/19/01	< 300	130 ± 80	< 500	29400 ± 1070	< 60	237 ± 22	1550 ± 48	1860 ± 63	158 ± 31
24	07/19/01	< 400	240 ± 130	< 300	4610 ± 325	< 40	527 ± 26	1150 ± 39	1290 ± 50	125 ± 17
Average ± 2 s.d.			**177 ± 114**		**13003 ± 13703**		**351 ± 502**	**1491 ± 1359**	**1254 ± 852**	**118 ± 62**

* All other gamma emitters were <LLD.

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

North Anna Power Station, Louisa County, Virginia - 2001

pCi/L ± 2 Sigma

Collection Dates	Sr-89	Sr-90	H-3	Be-7	K-40	I-131	Ba-140	Th-228
STATION 01A								
03/28/01	(a)	(a)	< 300	< 50	< 90	< 15	< 10	< 10
06/27/01	< 0.9	< 1	< 100	< 50	< 90	< 20	< 10	< 10
09/26/01	(a)	(a)	< 100	< 35	< 80	< 7	< 7	< 6
01/10/02	(a)	(a)	120 ± 50	< 40	< 90	< 8	< 8	< 40
Average ± 2 s.d.			**120 ± 50**					

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

North Anna Power Station, Louisa County, Virginia - 2001

pCi/L ± 2 Sigma

Collection Date	Sr-89	Sr-90	H-3	Be-7	K-40	I-131	Cs-137	Ba-140	Ra-226	Th-228
STATION 11										
01/16/01	(a)	(a)	4000 ± 200	< 50	< 140	< 1	< 6	< 40	< 10	< 8
02/14/01	(a)	(a)	(b)	< 70	< 100	< 0.6	< 6	< 40	< 100	< 10
03/13/01	(a)	(a)	(b)	< 30	< 60	< 0.6	< 4	< 20	< 120	< 9
04/12/01	< 4.0	< 0.3	3400 ± 100	< 60	< 150	< 0.8	< 6	< 20	< 160	< 10
05/15/01	(a)	(a)	(b)	< 30	< 70	< 0.5	< 4	< 9	< 100	5.73 ± 5.5
06/14/01	(a)	(a)	(b)	< 30	< 50	< 0.2	< 4	< 9	< 60	< 8
07/17/01	(a)	(a)	3300 ± 100	< 50	< 90	< 0.7	< 6	< 10	< 100	< 10
08/13/01	(a)	(a)	(b)	< 40	< 90	< 0.5	< 4	< 10	< 140	< 6
09/13/01	(a)	(a)	(b)	< 30	< 80	< 0.4	< 4	< 6	< 130	< 5
10/15/01	(a)	(a)	3100 ± 100	< 40	< 80	< 0.6	< 4	< 9	< 140	< 7
11/12/01	(a)	(a)	(b)	< 40	< 70	< 0.5	< 4	< 8	< 110	< 6
12/10/01	(a)	(a)	(b)	< 40	< 70	< 0.5	< 5	< 8	< 80	< 10
Average ± 2 s.d.			**3450 ± 775**							**5.73 ± 5.5**

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

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

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

North Anna Power Station, Louisa County, Virginia - 2001

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										
01/16	(a)	(a)	4400 ± 200	< 40	< 70	< 1	< 4	< 30	< 9	< 6
02/14	(a)	(a)	(b)	< 40	< 80	< 0.5	< 7	< 30	< 10	< 9
03/13	(a)	(a)	(b)	< 50	< 90	< 0.5	< 5	< 30	< 130	< 9
04/12	< 3	< 0.3	3500 ± 100	< 40	< 80	< 0.5	< 5	< 20	< 110	< 6
05/15	(a)	(a)	(b)	< 40	< 90	< 0.6	< 6	< 9	< 120	< 9
06/14	(a)	(a)	(b)	< 30	< 80	< 0.1	< 4	< 10	< 100	< 8
07/17	(a)	(a)	3400 ± 100	< 50	< 80	0.83 ± 0.33 (c)	< 6	< 10	< 80	< 10
08/13	(a)	(a)	(b)	< 40	< 80	< 0.7	< 4	< 10	< 150	< 10
09/13	(a)	(a)	(b)	< 20	< 50	< 0.5	< 4	< 10	< 70	< 4
10/15	(a)	(a)	4000 ± 100	< 50	< 130	< 0.7	< 5	< 10	< 170	< 6.8
11/12	(a)	(a)	(b)	< 50	< 80	< 0.5	< 5	< 10	< 90	< 7.8
12/10	(a)	(a)	(b)	< 40	< 60	< 0.4	< 5	< 8.8	< 130	< 8.2
Average ± 2 s.d.			**3825 ± 929**			**0.83 ± 0.33**				
STATION - 09A										
01/16	(a)	(a)	< 100	< 40	< 80	< 1	< 4	< 30	< 10	< 7
02/14	(a)	(a)	(b)	< 50	< 90	< 0.5	< 6	< 30	< 110	< 10
03/13	(a)	(a)	(b)	< 30	< 80	< 0.7	< 4	< 20	< 100	< 6
04/12	< 3	< 0.3	< 100	< 40	< 80	< 0.6	< 4	< 10	< 120	7.0 ± 2.9
05/15	(a)	(a)	(b)	< 30	< 60	< 0.5	< 3	< 8	< 70	< 5
06/14	(a)	(a)	(b)	< 30	< 60	< 0.2	< 4	< 8	< 60	< 4
07/17	(a)	(a)	< 100	< 60	< 110	1.4 ± 0.5 (c)	< 7	< 10	< 200	< 10
08/13	(a)	(a)	(b)	< 30	< 80	< 0.5	< 3	< 8	< 120	< 5
09/13	(a)	(a)	(b)	< 30	< 70	< 0.4	< 3	< 5	< 90	< 5
10/15	(a)	(a)	< 100	< 30	< 60	< 0.5	< 4	< 8	< 90	< 4.9
11/12	(a)	(a)	(b)	< 50	< 70	< 0.4	< 5	< 10	< 80	< 6.1
12/10	(a)	(a)	(b)	< 50	< 70	< 0.5	< 5	< 9	< 90	< 10
Average ± 2 s.d.						**1.4 ± 0.5**				**7.0 ± 2.9**

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

** I-131 by radiochemistry.

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

(b) Tritium analyses performed on quarterly composite.

(c) The reported iodine levels detected in station 8 and station 9A on 07/17/01 are very close to the MDA and based on no detectable activity prior to nor afterwards, are most likely false positives.

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

North Anna Power Station, Louisa County, Virginia - 2001

pCi/kg ± 2 Sigma

Nuclide	STA-08 2/19	STA-09A 2/19	STA-11 2/19	STA-08 08/06	STA-09A 08/06	STA-11 08/06	Average
Sr-89	(a)	(a)	(a)	< 100	< 200	< 200	
Sr-90	(a)	(a)	(a)	32.0 ± 12.0	< 50	< 50	
Be-7	< 260	< 270	< 300	< 260	< 160	< 290	
K-40	2430 ± 205	13200 ± 650	14600 ± 510	6740 ± 290	7690 ± 273	9860 ± 351	9087 ± 8930
Mn-54	< 30	< 50	< 10	< 10	< 9	< 10	
Co-58	< 30	< 50	< 30	< 20	< 20	< 30	
Co-60	< 10	< 50	< 30	< 10	< 10	< 10	
Cs-134	< 30	< 60	< 40	< 10	< 8	< 10	
Cs-137	< 30	136 ± 32	30.9 ± 7.1	< 10	15.6 ± 4.1	< 20	61 ± 131
Ra-226	163 ± 19	855 ± 40	715 ± 23	550 ± 15	421 ± 12	697 ± 18	567 ± 495
Th-228	282 ± 20	1150 ± 66	1160 ± 39	790 ± 24	310 ± 12	983 ± 31	779 ± 796
U-235	< 170	< 330	< 220	34.4 ± 7.9	19.9 ± 5.8	47.3 ± 10.2	33.9 ± 27.4

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

(a) Strontium 89/90 analyses performed annually.

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

North Anna Power Station, Louisa County, Virginia - 2001

pCi/kg ± 2 Sigma

Nuclide	Station-08 02/19/01	Station-08 08/06/01	Average ± 2 sigma
Sr-89	(a)	< 30	
Sr-90	(a)	48.0 ± 17.0	
Be-7	< 350	< 290	
K-40	2030 ± 236	1610 ± 158	1820 ± 594
Mn-54	< 10	< 10	
Co-58	< 40	< 20	
Co-60	< 40	< 10	
Cs-134	< 40	< 10	
Cs-137	99.9 ± 11.9	255 ± 14	177 ± 219
Ra-226	310 ± 20	503 ± 17	407 ± 273
Th-228	426 ± 31	232 ± 13	329 ± 274

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

(a) Strontium 89/90 analyses performed annually.

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

North Anna Power Station, Louisa County, Virginia - 2001

pCi/L ± 2 Sigma

MONTH	NUCLIDE	STATION-12	STATION-13
JANUARY	Sr-89	(a)	(a)
	Sr-90	(a)	(a)
	K-40	1260 ± 88	1170 ± 74
	Cs-137	< 6	< 5
	I-131	< 1	< 1
FEBRUARY	Sr-89	(a)	(a)
	Sr-90	(a)	(a)
	K-40	1360 ± 75	1340 ± 89
	Cs-137	< 3	< 4
	I-131	< 0.3	< 0.2
MARCH	Sr-89	< 2	< 2
	Sr-90	0.71 ± 0.28	0.52 ± 0.22
	K-40	655 ± 38	1270 ± 82
	Cs-137	< 4	< 6
	I-131	< 0.3	< 0.4
APRIL	Sr-89	(a)	(a)
	Sr-90	(a)	(a)
	K-40	1340 ± 92	1250 ± 69
	Cs-137	< 5	< 3
	I-131	< 0.4	< 0.5
MAY	Sr-89	(a)	(a)
	Sr-90	(a)	(a)
	K-40	1260 ± 87	1530 ± 75
	Cs-137	< 6	< 3
	I-131	< 0.4	< 0.4
JUNE	Sr-89	< 2	< 2
	Sr-90	0.70 ± 0.21	0.93 ± 0.22
	K-40	1460 ± 97	1070 ± 74
	Cs-137	< 8	< 6
	I-131	< 0.3	< 0.2

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

(a) Strontium-89/90 analyses performed on the last monthly sample of each quarter.

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

North Anna Power Station, Louisa County, Virginia - 2001

pCi/L ± 2 Sigma

MONTH	NUCLIDE	STATION-12	STATION-13
JULY	Sr-89	(a)	(a)
	Sr-90	(a)	(a)
	K-40	1310 ± 86	1360 ± 88
	Cs-137	< 5	< 5
	I-131	< 0.5	< 0.7
AUGUST	Sr-89	(a)	(a)
	Sr-90	(a)	(a)
	K-40	1310 ± 61	1340 ± 70
	Cs-137	< 4	< 5
	I-131	< 0.8	< 0.8
SEPTEMBER	Sr-89	< 1	< 2
	Sr-90	1.4 ± 0.2	1.5 ± 0.2
	K-40	1240 ± 89	1270 ± 68
	Cs-137	< 6	< 4
	I-131	< 0.4	< 0.6
OCTOBER	Sr-89	(a)	(a)
	Sr-90	(a)	(a)
	K-40	1260 ± 76	1160 ± 74
	Cs-137	< 4	< 4
	I-131	< 0.5	< 0.4
NOVEMBER	Sr-89	(a)	(a)
	Sr-90	(a)	(a)
	K-40	1300 ± 70	1250 ± 73
	Cs-137	< 4	< 4
	I-131	< 0.4	< 0.4
DECEMBER	Sr-89	< 3	< 2
	Sr-90	1.2 ± 0.3	1.2 ± 0.2
	K-40	1360 ± 69	1320 ± 83
	Cs-137	< 3	< 5
	I-131	< 0.6	< 0.7
Average ± 2 s.d.	**Sr-89**		
	Sr-90	**1.0 ± 0.71**	**1.0 ± 0.83**
	K-40	**1260 ± 400**	**1278 ± 234**
	Cs-137		
	I-131		

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

(a) Strontium-89/90 analyses performed on the last monthly sample of each quarter.

TABLE B-12: GAMMA EMITTER CONCENTRATIONS IN FISH*

North Anna Power Station, Louisa County, Virginia - 2001

pCi/kg ± 2 Sigma

Collection Date	Station	Sample Type	K-40	Co-58	Cs-134	Cs-137
02/20	08	Fish (a)	1540 ± 106	< 9	< 9	< 10
02/20	25	Fish (a)	1530 ± 100	< 9	< 8	23.5 ± 3.7
02/20	08	Catfish (b)	1860 ± 149	< 10	< 10	25.5 ± 4.6
02/20	25	Catfish (b)	1700 ± 106	< 8	< 8	< 10
08/09	08	Fish (a)	1310 ± 241	< 20	< 20	< 30
08/06	25	Fish (a)	1810 ± 261	< 20	< 20	< 20
08/09	08	Catfish (b)	1390 ± 374	< 30	< 20	< 30
08/07	25	Catfish (b)	2080 ± 228	< 20	< 10	< 20
Average ± 2 s.d.	**08**		**1525 ± 486**			**25.5 ± 4.6**
	25		**1780 ± 462**			**23.5 ± 3.7**

* 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 AND VEGETATION*

North Anna Power Station, Louisa County, Virginia - 2001

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	2360 ± 409	25100 ± 1090	< 60	< 80	< 70 (a)	< 70	< 110	203 ± 37.0
05/16	663 ± 100	16400 ± 620	< 20	< 40	< 30	< 30	< 460	< 60
06/20	549 ± 101	29600 ± 1090	< 40	< 30	< 20	< 20	< 630	< 30
07/19	< 930	29400 ± 1340	52.0 ± 23.0	< 80	< 50	< 60	< 1400	83.3 ± 32.0
08/27	1580 ± 155	19700 ± 820	< 20	< 30	< 30	< 40	< 770	< 40
09/20	1310 ± 130	14900 ± 610	< 20	< 30	< 30	< 40	< 750	< 50
Average ± 2 s.d.	**1828 ± 5758**	**22480 ± 14904**	**52.0 ± 23.0**			**47.9 ± 12.0**	**834 ± 989**	**188 ± 418**

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

(a) Due to small sample size, the LLD was missed.

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

North Anna Power Station, Louisa County, Virginia - 2001

Std. Month (30.4 days) ± 2 Sigma

Station Number	First Qtr 01/11/01 04/05/01	Second Qtr 04/05/01 07/12/01	Third Qtr 07/12/01 10/03/01	Fourth Qtr 10/03/01 01/08/01	Quarterly Average	Annual TLD 01/11/01 01/08/02
01	6.0	6.0	4.1	3.8	5.0 ± 2.4	4.7
02	2.7	2.7	1.6	2.6	2.4 ± 1.1	1.9
03	2.4	2.6	1.7	1.3	2.0 ± 1.2	1.8
04	2.5	3.4	2.7	1.8	2.6 ± 1.3	2.2
05	3.9	2.8	3.5	4.1	3.6 ± 1.1	2.9
05A	2.9	1.7	2.4	1.7	2.2 ± 1.2	2.1
06	5.1	*	4.0	3.5	4.2 ± 1.6	1.7
07	3.3	2.3	2.7	3.4	2.9 ± 1.0	2.5
21	3.8	2.5	1.7	3.0	2.7 ± 1.8	2.6
22	4.8	3.5	4.4	3.4	4.0 ± 1.4	3.6
23	5.5	4.9	3.3	5.4	4.8 ± 2.0	4.5
24	4.2	3.4	1.5	2.4	2.9 ± 2.3	2.7
Average ± 2 s.d.	**3.9 ± 2.4**	**3.2 ± 2.5**	**2.8 ± 2.1**	**3.0 ± 2.3**	**3.3 ± 2.0**	**2.8 ± 2.0**

* Refer to Section III, "REMP Exceptions for Scheduled Sampling and Analysis During 2001"

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

North Anna Power Station, Louisa County, Virginia - 2001

mR/Std. Month (30.4 days) ± 2 Sigma

Station Number	First Qtr 01/11 - 04/05	Second Qtr 04/05 - 07/12	Third Qtr 07/12 - 10/03	Fourth Qtr 10/03 - 01/08	Average ± 2 s.d.
N-1	5.0	4.3	4.9	4.6	4.7 ± 0.6
N-2	3.0	2.8	3.5	2.9	3.0 ± 0.7
NNE-3	7.5	8.1	6.7	7.0	7.3 ± 1.2
NNE-4	4.6	4.2	4.1	4.4	4.3 ± 0.4
NE-5	6.0	5.8	5.9	5.7	5.9 ± 0.2
NE-6	3.8	4.1	3.7	3.8	3.8 ± 0.3
ENE-7	4.8	3.1	6.1	4.9	4.7 ± 2.5
ENE-8	3.1	3.2	2.7	3.2	3.1 ± 0.5
E-9	5.2	4.6	4.6	5.7	5.0 ± 1.1
E-10	5.0	4.5	4.5	5.0	4.7 ± 0.6
ESE-11	4.3	3.1	3.6	4.1	3.8 ± 1.1
ESE-12	5.2	*	4.0	4.6	4.6 ± 1.2
SE-13	4.6	4.5	3.3	4.1	4.1 ± 1.2
SE-14	7.3	5.4	6.4	6.3	6.4 ± 1.5
SSE-15	5.0	3.8	5.6	4.8	4.8 ± 1.5
SSE-16	3.5	4.0	2.6	3.5	3.4 ± 1.1
S-17	8.2	7.8	6.7	7.2	7.5 ± 1.3
S-18	2.7	1.7	1.1	2.4	2.0 ± 1.5
SSW-19	9.1	9.0	8.1	10.1	9.1 ± 1.6
SSW-20	2.5	2.3	1.7	1.4	2.0 ± 1.0
SW-21	4.4	3.4	3.4	2.8	3.5 ± 1.3
SW-22	4.7	4.5	4.0	4.8	4.5 ± 0.8
WSW-23	5.5	4.3	5.0	3.6	4.6 ± 1.7
WSW-24	5.0	5.1	5.6	2.7	4.6 ± 2.5
W-25	6.3	6.1	6.4	4.4	5.8 ± 1.9
W-26	3.0	2.4	2.1	1.6	2.3 ± 1.1
WNW-27	3.7	2.2	2.6	2.2	2.7 ± 1.5
WNW-28	3.4	3.3	3.0	1.9	2.9 ± 1.3
NW-29	6.9	6.9	5.8	6.5	6.5 ± 1.0
NW-30	2.9	3.4	0.7	1.5	2.1 ± 2.5
NNW-31	4.3	4.0	3.0	2.5	3.4 ± 1.7
NNW-32	4.1	4.2	3.0	2.8	3.5 ± 1.5
N-33	5.2	5.5	4.2	3.2	4.5 ± 2.1
N-34	3.5	2.9	2.0	2.6	2.8 ± 1.2
NNE-35	7.8	7.4	4.6	4.9	6.2 ± 3.3
NNE-36	*	3.1	3.9	2.7	3.3 ± 1.3
NE-37	5.5	6.5	3.5	4.0	4.9 ± 2.8
NE-38	3.5	4.2	3.2	1.9	3.2 ± 2.0
ENE-39	5.1	5.0	4.0	3.6	4.4 ± 1.5
ENE-40	3.3	3.8	2.7	2.1	3.0 ± 1.5
E-41	5.3	5.4	4.5	4.0	4.8 ± 1.4

* Refer to Section III, "REMP Exceptions for Scheduled Sampling and Analysis During 2001"

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

North Anna Power Station, Louisa County, Virginia - 2001

mR/Std. Month (30.4 days) ± 2 Sigma

Station Number	First Qtr 01/11 - 04/05	Second Qtr 04/05 - 07/12	Third Qtr 07/12 - 10/03	Fourth Qtr 10/03 - 01/08	Average ± 2 s.d.
E-42	4.7	6.2	5.0	3.1	4.8 ± 2.6
ESE-43	4.2	4.7	3.8	4.2	4.2 ± 0.8
ESE-44	5.1	*	4.0	3.1	4.1 ± 2.0
SE-45	4.3	4.8	3.6	4.7	4.3 ± 1.1
SE-46	7.1	7.1	6.2	5.2	6.4 ± 1.9
SSE-47	5.2	5.2	5.6	3.7	4.9 ± 1.6
SSE-48	3.3	3.4	1.8	3.2	2.9 ± 1.5
S-49	7.6	7.7	5.6	8.1	7.3 ± 2.3
S-50	2.8	2.7	1.7	2.5	2.4 ± 1.0
SSW-51	9.2	10.5	8.2	17.4	11.3 ± 8.3
SSW-52	2.6	2.7	2.0	2.7	2.5 ± 0.6
SW-53	4.5	4.0	3.9	4.5	4.2 ± 0.6
SW-54	4.8	3.5	2.9	4.5	3.9 ± 1.8
WSW-55	5.7	5.9	5.6	5.0	5.5 ± 0.8
WSW-56	4.7	4.6	4.5	4.7	4.6 ± 0.3
W-57	6.5	6.0	5.9	6.2	6.2 ± 0.5
W-58	3.4	3.3	2.0	2.9	2.9 ± 1.2
WNW-59	3.5	4.3	3.0	2.4	3.3 ± 1.6
WNW-60	3.7	3.6	2.6	3.2	3.3 ± 1.0
NW-61	6.2	6.1	6.0	7.0	6.3 ± 1.0
NW-62	*	3.0	2.4	2.6	2.6 ± 0.6
NNW-63	3.5	3.7	3.7	3.7	3.6 ± 0.1
NNW-64	3.3	3.8	2.4	4.0	3.4 ± 1.5
C-1	3.3	2.2	1.8	3.1	2.6 ± 1.5
C-2	3.3	3.7	2.7	2.9	3.2 ± 0.9
C-3	3.5	2.4	2.0	2.2	2.5 ± 1.3
C-4	3.8	2.3	1.5	3.3	2.7 ± 2.1
C-5	2.5	2.0	2.1	2.5	2.3 ± 0.5
C-6	2.5	1.7	1.7	1.1	1.8 ± 1.1
C-7	4.3	3.1	3.7	4.1	3.8 ± 1.1
C-8	5.5	3.1	3.4	4.0	4.0 ± 2.1
Average	**4.8 ± 3.2**	**4.5 ± 3.6**	**4.0 ± 3.4**	**4.2 ± 4.4**	**4.4 ± 3.4**

* Refer to Section III, "REMP Exceptions for Scheduled Sampling and Analysis During 2001"

APPENDIX C

LAND USE CENSUS - 2001

DOMINION VIRGINIA POWER
NORTH ANNA POWER STATION
COMPARISON OF THE 2001 TO THE 2000 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 N	1.5 mi. to 1.8 mi.
b.	Sector NNE	1.5 mi. to 1.6 mi.
c.	Sector SSE	2.6 mi. to 1.3 mi.
d.	Sector S	1.0 mi. to 1.2 mi.
e.	Sector SSW	2.9 mi. to 1.6 mi.
f.	Sector WSW	1.7 mi. to 2.0 mi.
g.	Sector WNW	2.2 to None
h.	Sector NW	1.2 mi. to 1.1 mi.

V. No changes were observed in the nearest meat animal status.

DOMINION VIRGINIA POWER
NORTH ANNA POWER STATION
Annual Radiological Environmental Land Use Census Data for 2001
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		2.9
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		2.1
S	1.7	1.5		NONE		1.9
SSW	1.9	1.6		3.1		2.6
SW	5.0	1.7		NONE		5.0
WSW	2.7	1.8		2.7		3.2
W	2.4	1.7		7.1		8.0
WNW	1.8	1.6		6.5		NONE
NW	1.7	1.6		NONE		1.8
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 2001
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		1.8
NNE	0.9	0.9		1.5		1.6
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		1.3
S	1.1	0.9		NONE		1.2
SSW	1.2	1.0		2.0		1.6
SW	3.1	1.1		NONE		3.1
WSW	1.7	1.1		1.7		2.0
W	1.5	1.1		4.4		5.0
WNW	1.1	1.0		4.1		NONE
NW	1.0	1.0		NONE		1.1
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

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 Environmental Services and include those recommended by the USNRC Branch Technical Position, Rev. 1, November 1979.

GROSS BETA ANALYSIS OF SAMPLES

Air Particulates

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

Calculations of the 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		=	$2(N + B)/(\Delta t)^{1/2}/ (2.22\ V\ E)$
LLD		=	$4.66\ (B/\Delta t)^{1/2}/ (2.22\ V\ E)$
where:	N	=	the gross cpm of the sample
	B	=	the background of the detector in cpm
	2.22	=	conversion factor changing dpm to pCi
	V	=	volume of the sample in ml
	E	=	efficiency of the detector
	Δt	=	counting time for the sample

ANALYSIS OF SAMPLES FOR STRONTIUM-89 AND -90

Water

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

Milk

Stable strontium carrier is added to 1 liter of sample and the sample is first evaporated, then ashed in a muffle furnace. The ash is dissolved and strontium is precipitated as phosphate, then is dissolved and precipitated as $SrNO_3$ 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 $(SrNO_3)_2$ 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 = $(N/\Delta t - B_C - B_A)/(2.22\ V\ Y_S\ DF_{Sr\text{-}89} E_{Sr\text{-}89})$

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

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

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

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

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

Where:

N	=	total counts from sample
Δt	=	counting time for sample (min)
B_C	=	background rate of counter (cpm) using absorber Configuration.
2.22	=	dpm /pCi
V	=	volume or weight of sample analyzed
B_A	=	background addition from Sr-90 and ingrowth of Y-90
B_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	=	$(N\Delta t - B_C)_{Y\text{-}90}/(E_{Y\text{-}90}\ IF_{Y\text{-}90}\ DF_{Y\text{-}90} Y_1)$
$DF_{Y\text{-}90}$	=	the decay factor for Y-90 from the "milk" time to the mid count time
$E_{Y\text{-}90}$	=	efficiency of the counter for Y-90

$IF_{Y\text{-}90}$	=	ingrowth factor for Y-90 from scavenge to time to milkingtime
$IG_{Y\text{-}90}$	=	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 = $(N/\Delta t - B)/(2.22\ V\ Y\ DF)$

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

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

Where	N	=	total counts from sample
	Δt	=	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 PdI_2 on the standard mount, mg
	M	=	mass of PdI_2 on the sample mount, mg

GAMMA SPECTROMETRY OF SAMPLES

Milk and Water

A 1.0 liter Marinelli beaker is filled with a representative aliquot of the sample. The sample is then counted for approximately 1000 minutes with a shielded high purity germanium (HPGe) detector coupled to a personal computer (PC)-based data acquisition system 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 HPGe detector coupled to a PC-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 HPGe detector coupled to a PC-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 HPGe detector coupled to a PC-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 HPGe detector and up to four on the side of the HPGe detector. Each HPGe detector is calibrated for both positions. The detection limit for 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 Particulates

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

A PC software program defines peaks by certain changes in the slope of the spectrum. The program also compares the energy of each peak with a library of peaks for isotope identification and then performs the radioactivity calculation using the appropriate fractional gamma ray abundance, half life, detector efficiency, and net counts in the peak region.

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

ICN Worldwide Dosimetry Services (ICN) uses a Harshaw/Bicron NE 210 thermoluminescent dosimeter (TLD). The TLD is composed of 2 CaF and 2 LiF sensitive elements. These materials have a high light output, negligible thermally induced fading and, and negligible self-dosing. The energy response curve and all other features satisfy NRC Reg. Guide 4.13. Transit doses are accounted are accounted for by using separate TLD's.

A Harshaw/Bicron NE 8800 Automatic TLD Reader processes the TLD's at ICN after each filed exposure. The 8800 reader heats each element by passing hot Nitrogen gas over the sensitive element causing the TLD to emit light. The reader records the light output. The ICN Environmental Algorithm and members of the ICN Technical staff evaluate and investigate any irregularities before reporting to the client. The average and 2-sigma error are calculated for each station in the following manner:

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

Where:

E_{mon} = Element Average/Month
R_i = Element Result
N = Number of Elements
D = Total days in field

APPENDIX E

INTERLABORATORY COMPARISON PROGRAM

INTERLABORATORY COMPARISION PROGRAM

A review of the 1999 Interlaboratory Comparison Program verified that Teledyne Brown Engineering (TBE) did not perform iodine-131, strontium-89, strontium-90, or gamma analyses on milk samples. TBE presumed, erroneously, that we were meeting client contract requirements. The 2001 Interlaboratory Comparison Program includes all contractually required analyses with the exception of I-131 in water, strontium-89 and strontium-90 in milk as described below. These has been included in the TBE blanket purchase order for Analytics and Environmental Resource Associates (ERA) for the year 2002.

The US Environmental Protection Agency (EPA) discontinued their Interlaboratory Comparison Program in December 1998. However, on May 1, 2001, accreditation was granted to Environmental Resource Associates' RadCheM Proficiency Testing Program to complete the process of replacing the USEPA EMSL-LV Nuclear Radiation Assessment Division program. Although TBE Environmental Services participated in the EPA program, there was a lapse in time between the period of the closure of the EPA program and the commencement of the ERA program. We have objective evidence that TBE participates in these commercial ICP programs as well as documentation that we are continuing to do so. For the year 2001 and forward, the determinations in TBE's ICP program are equivalent to or exceed the NRC requirements. This has been verified for all the Nuclear Utility clients. However, in order to ensure this information has been communicated to all the utilities, a copy of this letter is being included in all 2001 annual reports for all utility clients.

The U.S. Department of Energy (DOE) Environmental Measurement Laboratory (EML) provides a comprehensive and extensive intercomparison/performance evaluation program. TBE participates in this program twice annually. The program offers an extensive and industry accepted matrix and radionuclide representation. The results supporting our first quarter 2001 strontium-89, strontium-90, and iodine-131 in water was obtained from the EML program based on the receipt schedule of the samples as compared to the start up of the TBE Knoxville laboratory in early 2001.

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 Analytics, ERA, and DOE/EML Program when there were at least two data points to plot.

Exceptions 2001

During 2001, several Interlaboratory Comparison Program (ICP) analyses were not performed as required by the ODCM. This omission was found during the last half of 2001. The omitted analyses occurred during the first half of 2001 while TBE facilities were in transition to the Knoxville, TN facility. The omissions follow.

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

To prevent recurrence, Dominion initiated internal commitment tracking by Radiological Protection Department to verify status and compliance by TBE on a quarterly basis. This tracking identified the above omission. TBE now has blanket purchase orders with Analytics and ERA to eliminate the recurrence of this anomaly.

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

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

All footnotes for this chart appear on page 3 of 3.

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

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

All footnotes for this chart appear on page 3 of 3.

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

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

(a) Teledyne Brown Engineering reported result.

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

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

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

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

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

(a) Teledyne Brown Engineerin reported result.

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

(c) Ratio of Teledyne Brown Engineering to DOE/EML results.

(d) DOE/EML evaluation: A=acceptable, W=acceptable with warning, N=not acceptable.

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

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

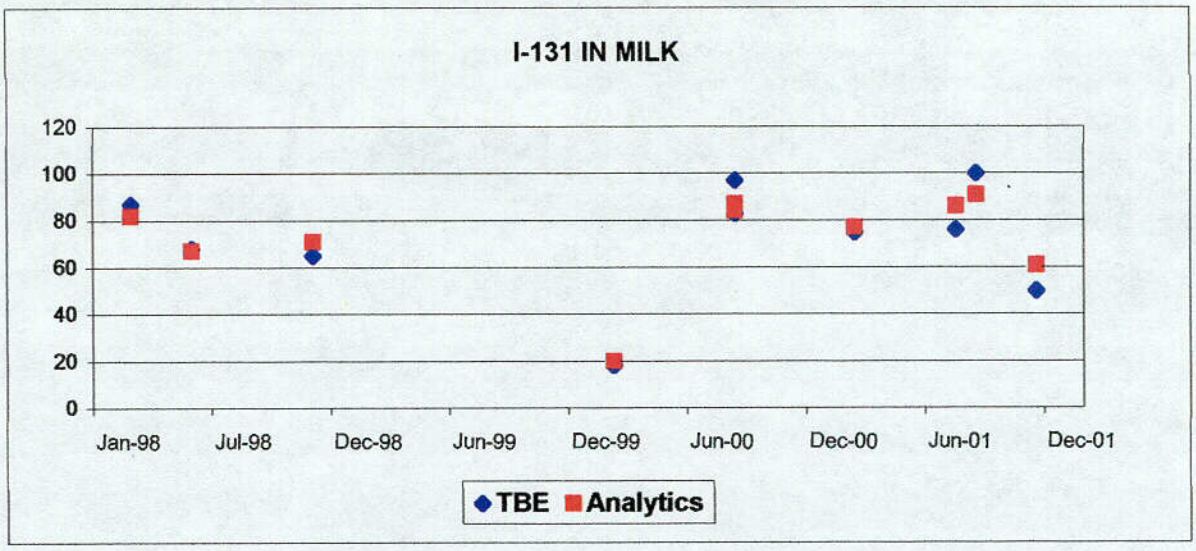
* *All ERA samples are water.*

(a) Teledyne Brown Engineering reported result.

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

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

(d) ERA evaluation: A=acceptable. Reported result falls within the Warning Limits. NA=not acceptable. Reported result falls outside of the Control Limits. CE=check for Error. Reported result falls within the Control Limits and outside of the Warning Limit.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Dec-00
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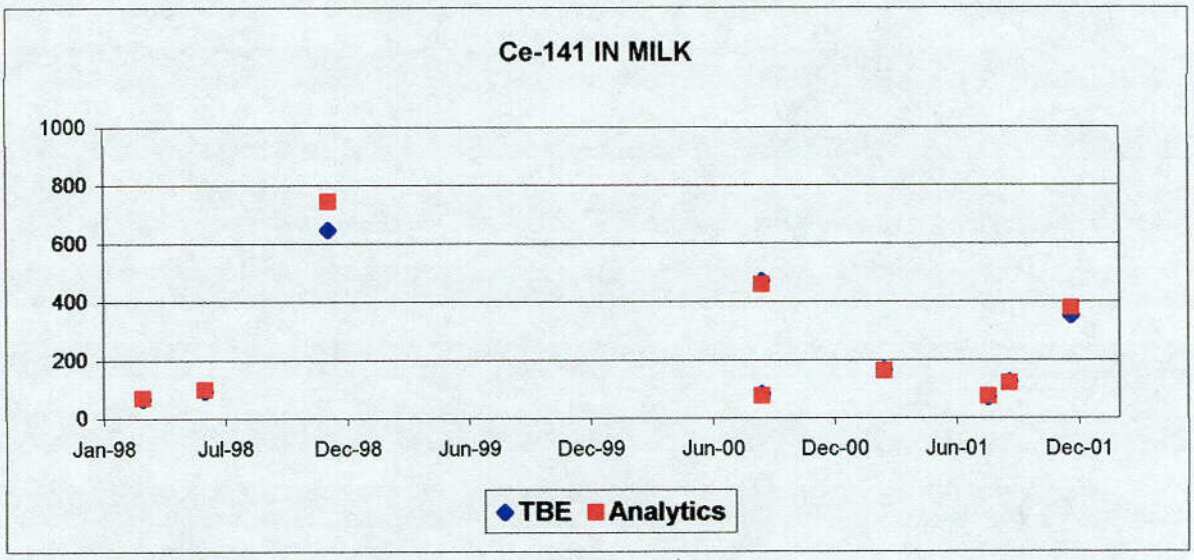
Dec-01
TBE
Analytics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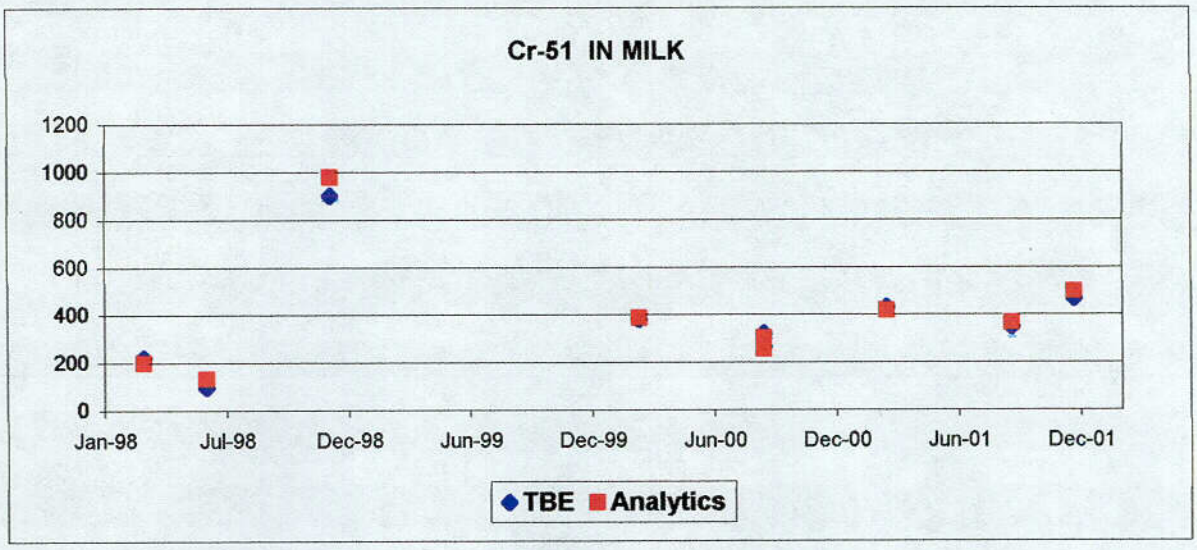
Dec-01
TBE
Analytics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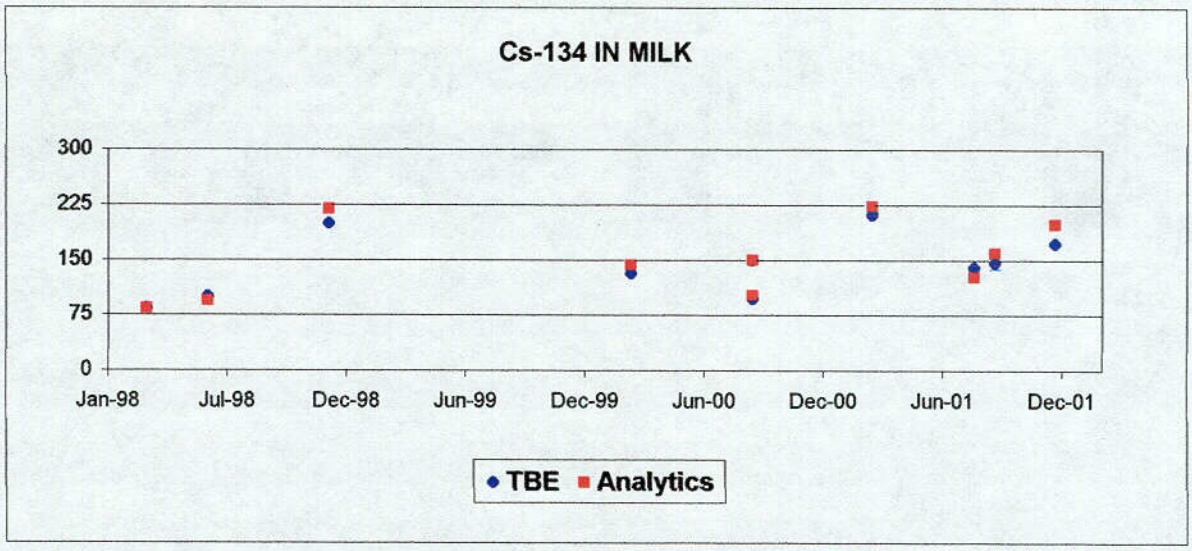
Dec-01
TBE
Analytics

C11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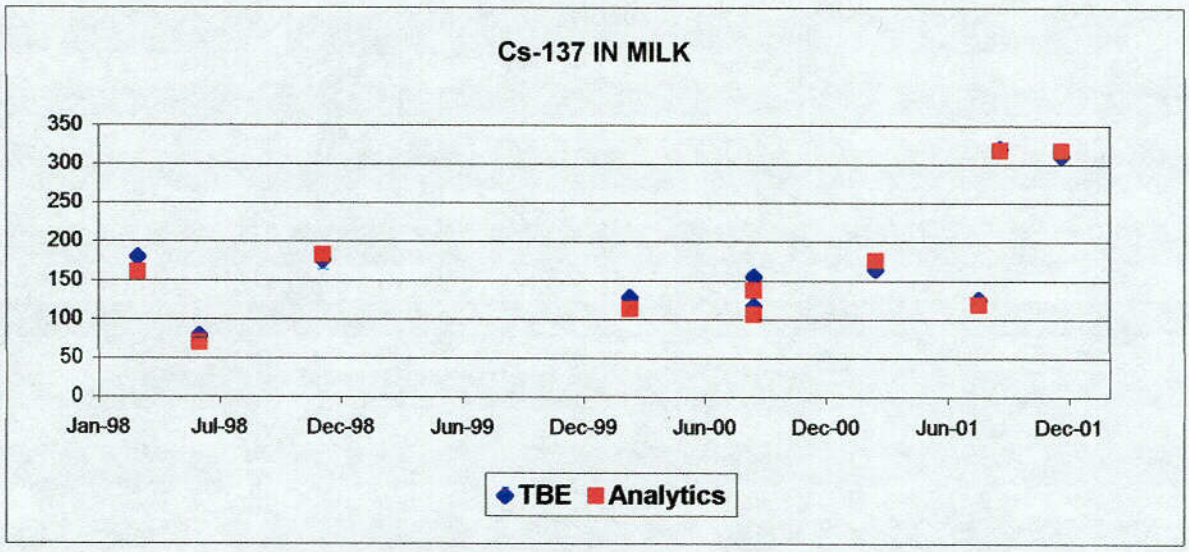
TBE
Analytics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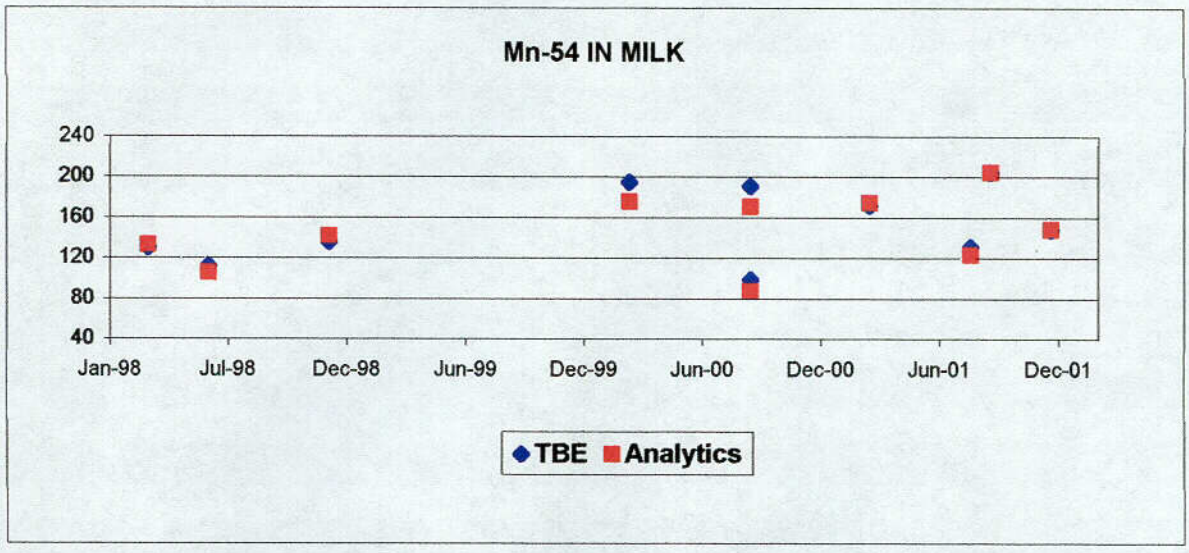
TBE
Analytics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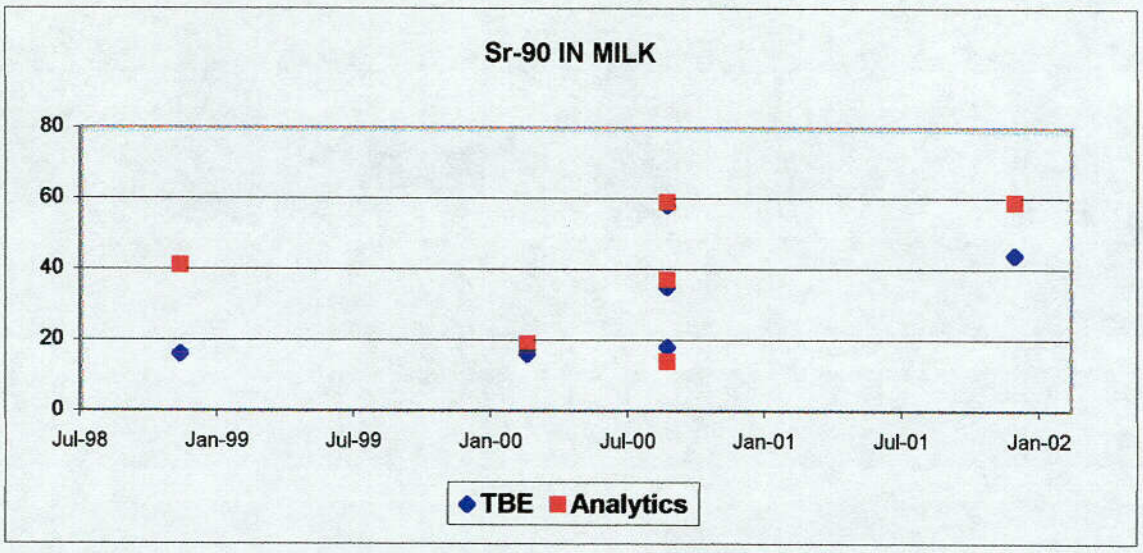
Jun-01
Dec-01
TBE
Analytics

C12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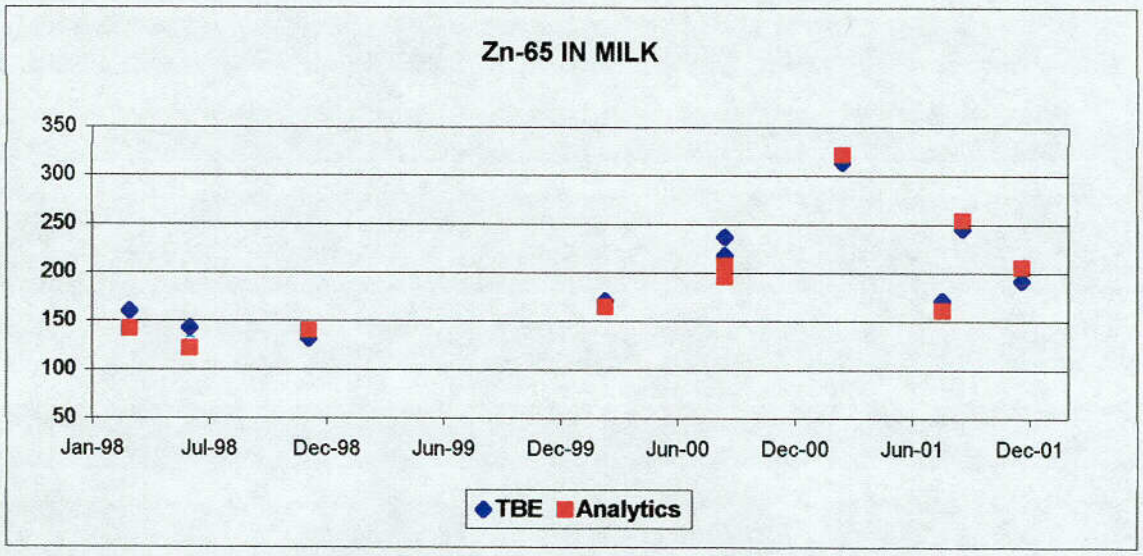
TBE
Analytics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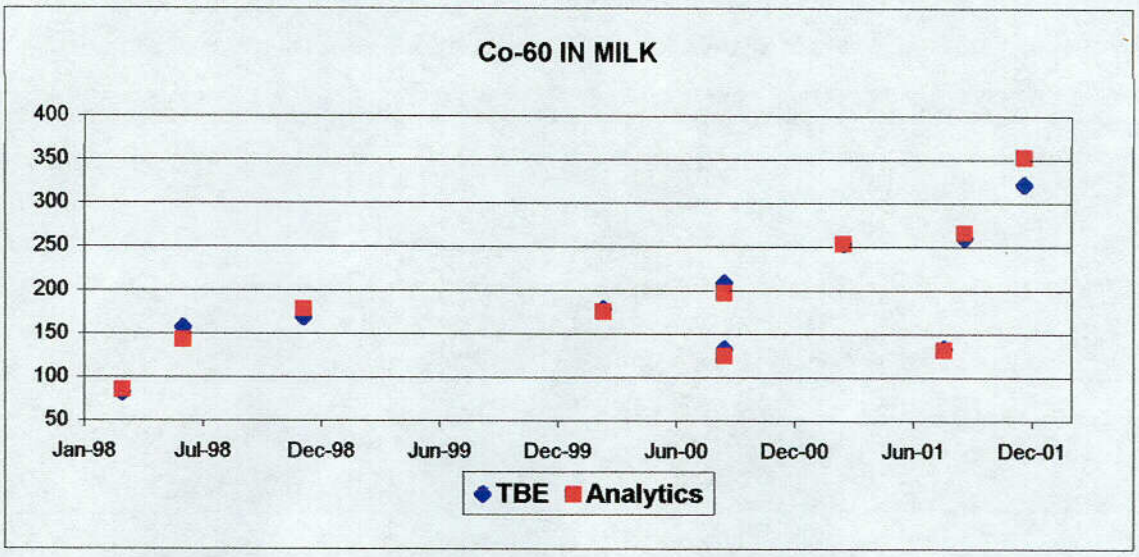
Dec-01
TBE
Analytics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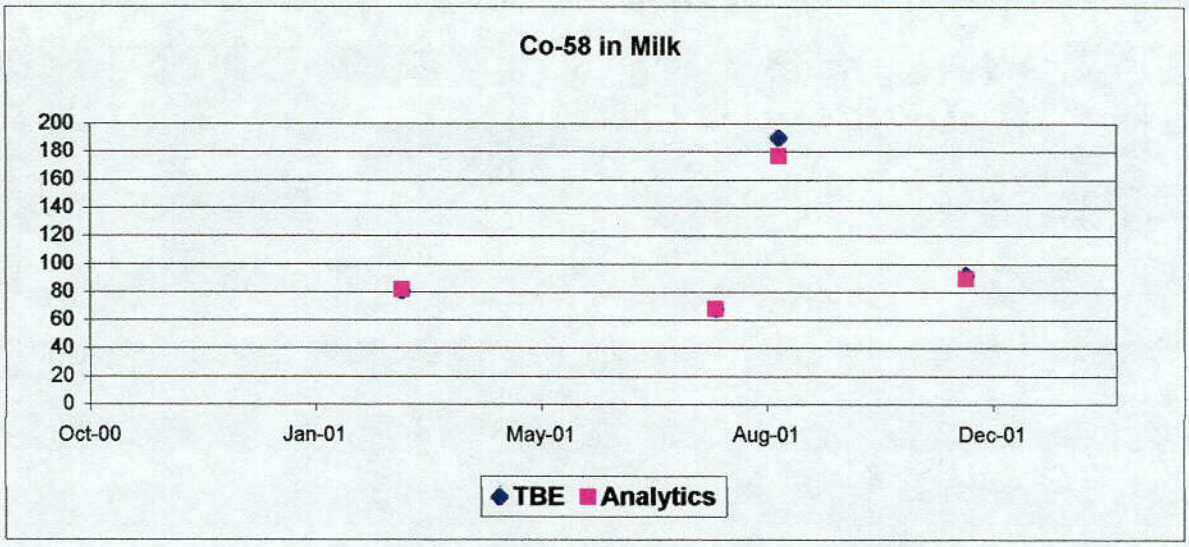
Dec-01
TBE
Analytics

C13


Co-58 in Milk
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20
0
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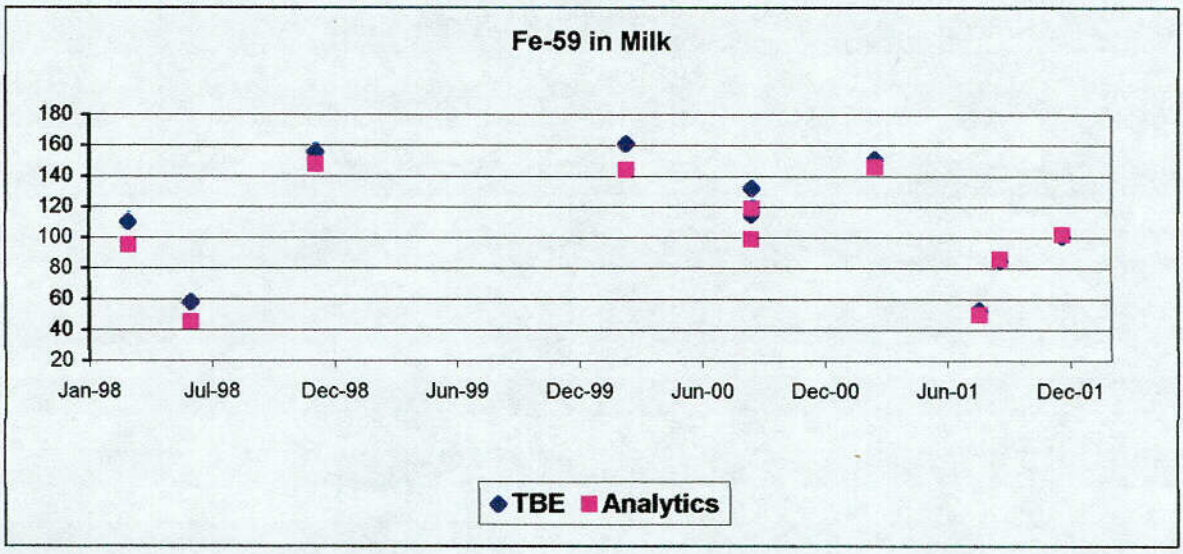
Jan-01
May-01
Aug-01
Dec-01
TBE
Analytics


Fe-59 in Milk
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100
80
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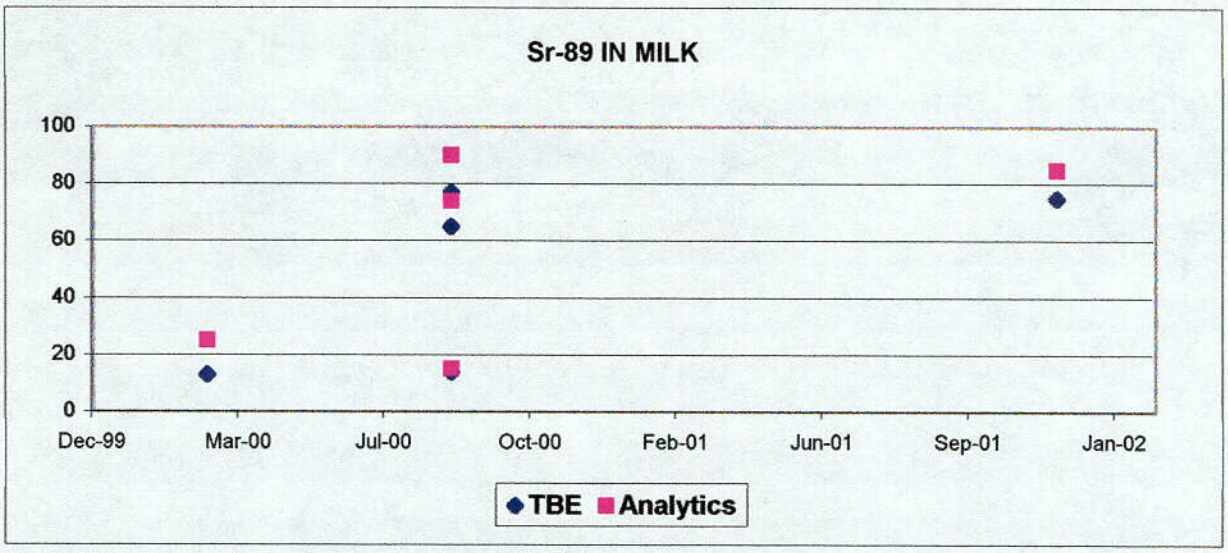
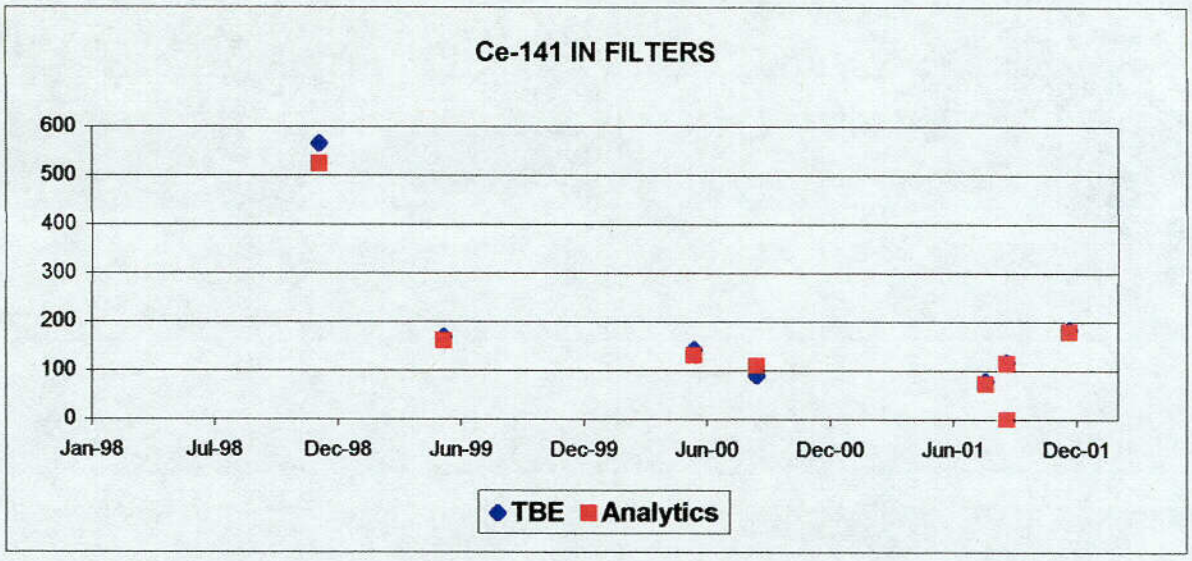
20
Jan-98
Jul-98
Dec-98
Jun-99
Dec-99
Jun-00
Dec-00
Jun-01
Dec-01
TBE
Analytics

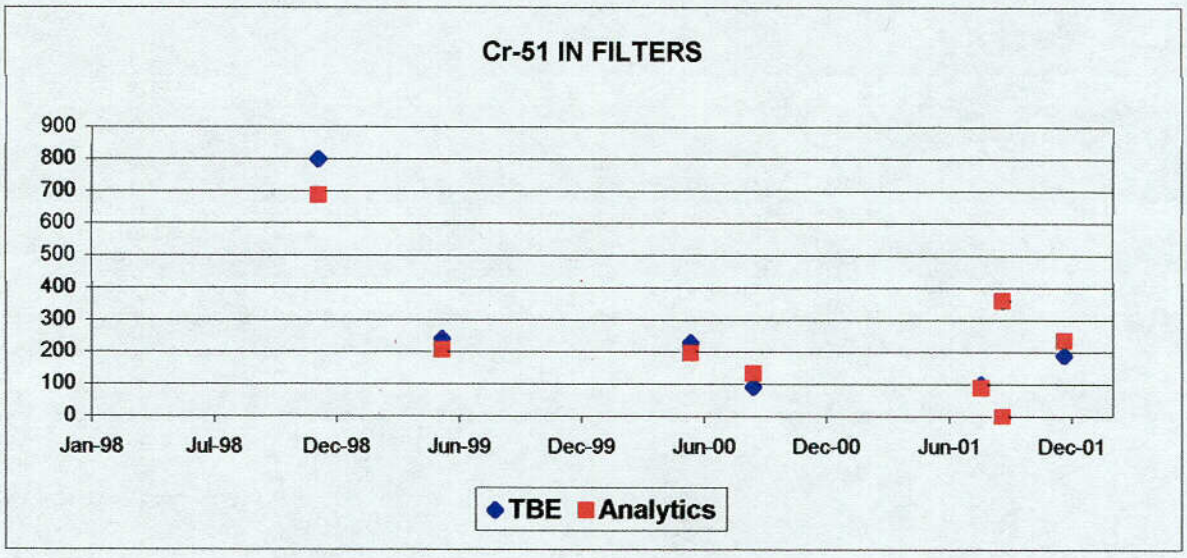
C14

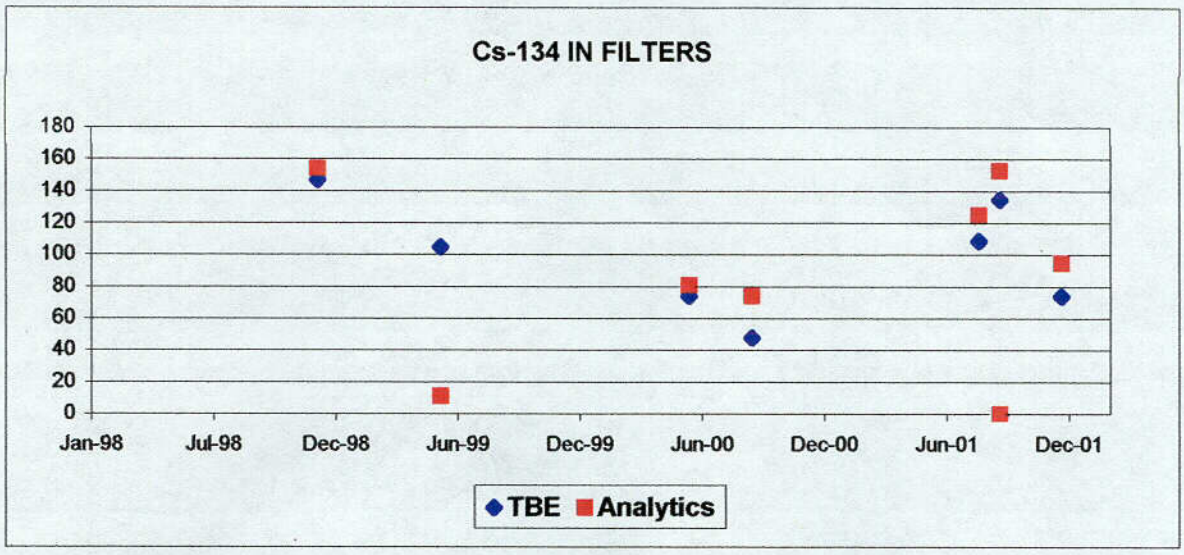


March, 2000 - Incorrect rinsing of extraction column resulted in low results.

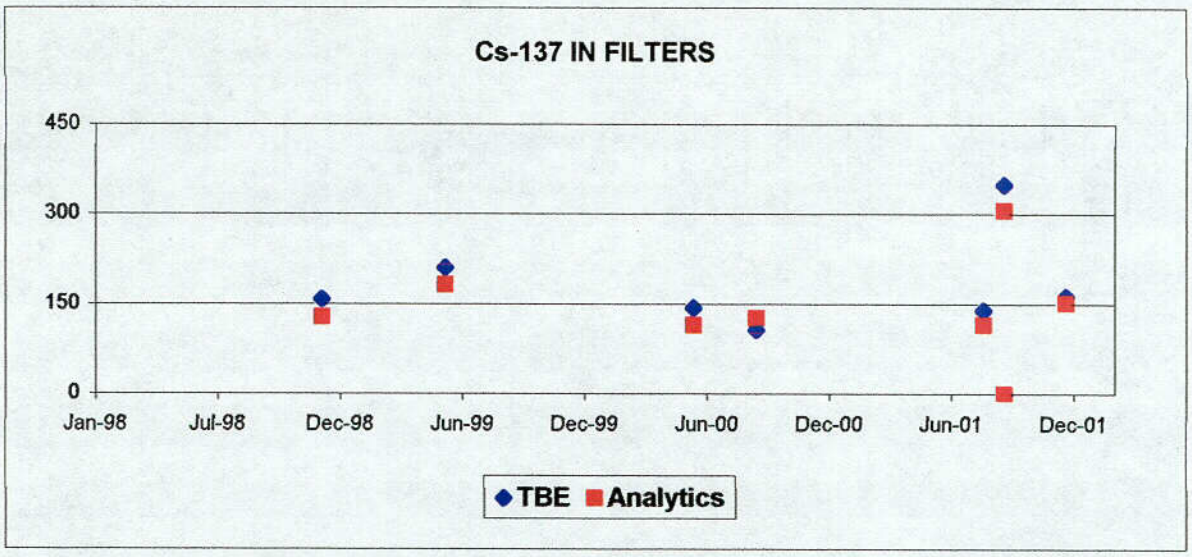
C15

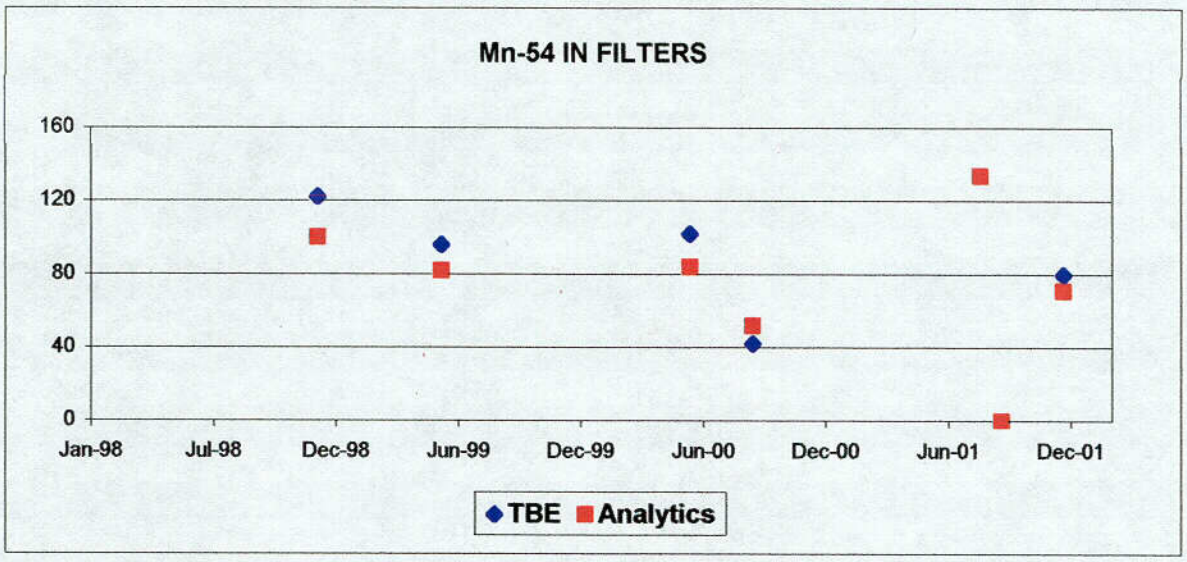

Ce-141 IN FILTERS
600
500
400
300
200
100
0
Jan-98
Jul-98
Dec-98
Jun-99
Dec-99
Jun-00
Dec-00
Jun-01
Dec-01
TBE
Analytics

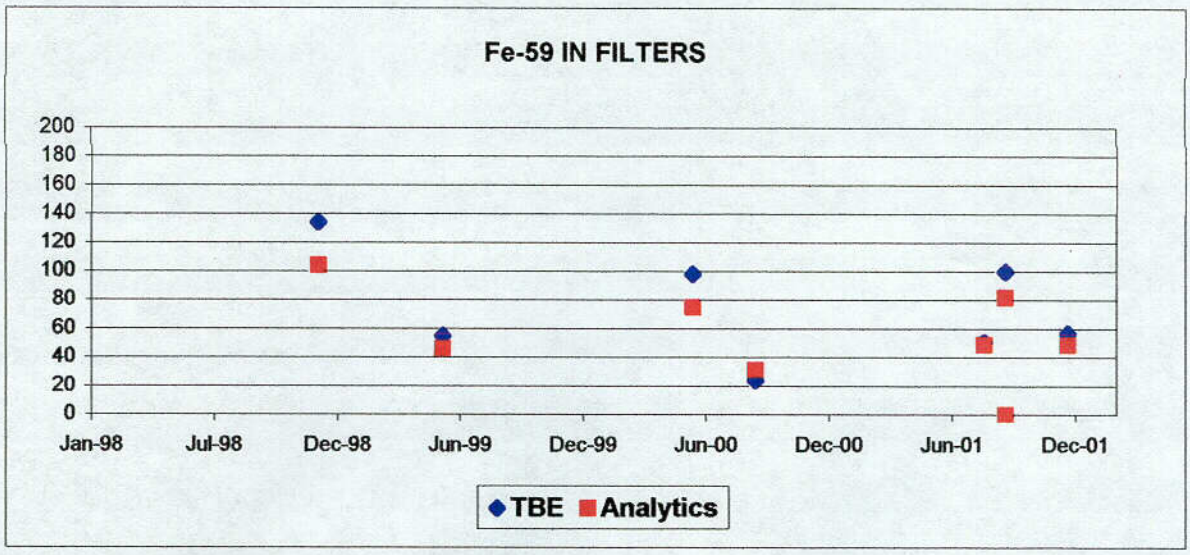

Cr-51 IN FILTERS
900
800
700
600
500
400
300
200
100
0
Jan-98
Jul-98
Dec-98
Jun-99
Dec-99
Jun-00
Dec-00
Jun-01
Dec-01
TBE
Analytics


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

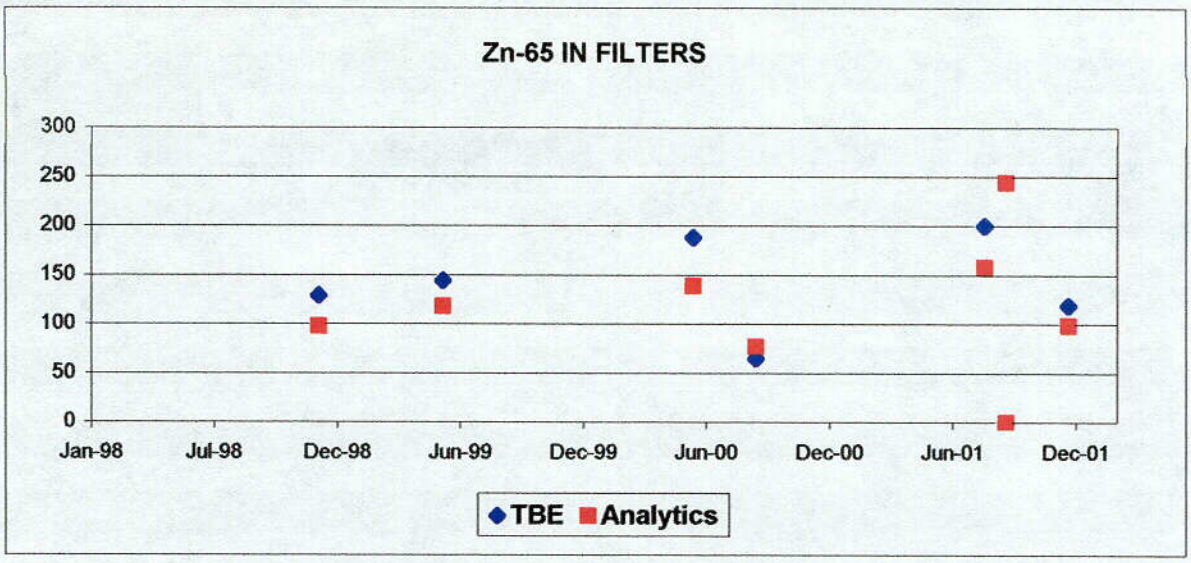
C16

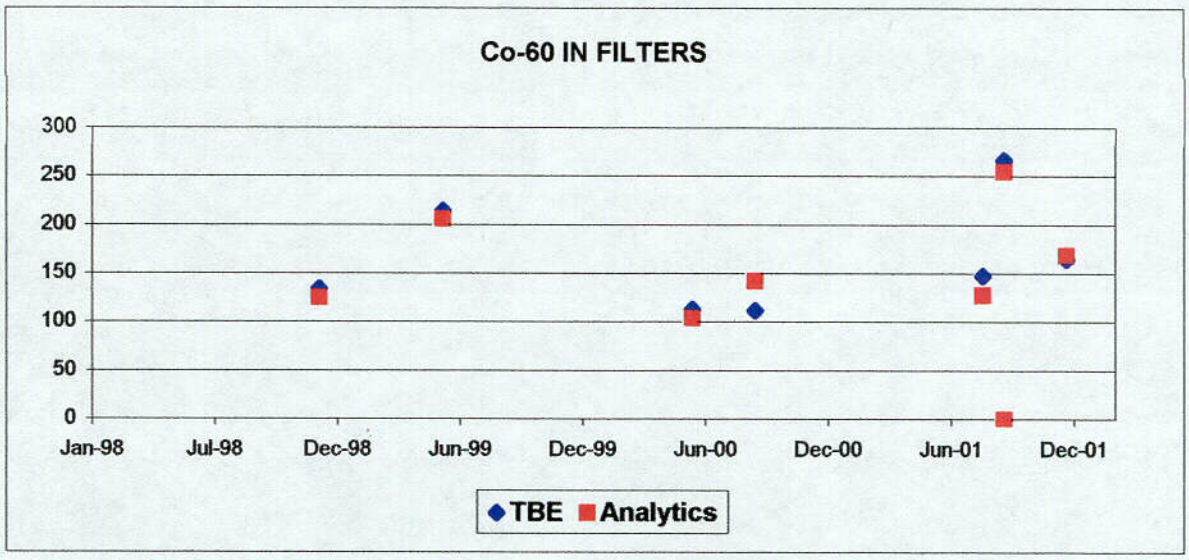

Cs-137 IN FILTERS
450
300
150
0
Jan-98
Jul-98
Dec-98
Jun-99
Dec-99
Jun-00
Dec-00
Jun-01
Dec-01
TBE
Analytics

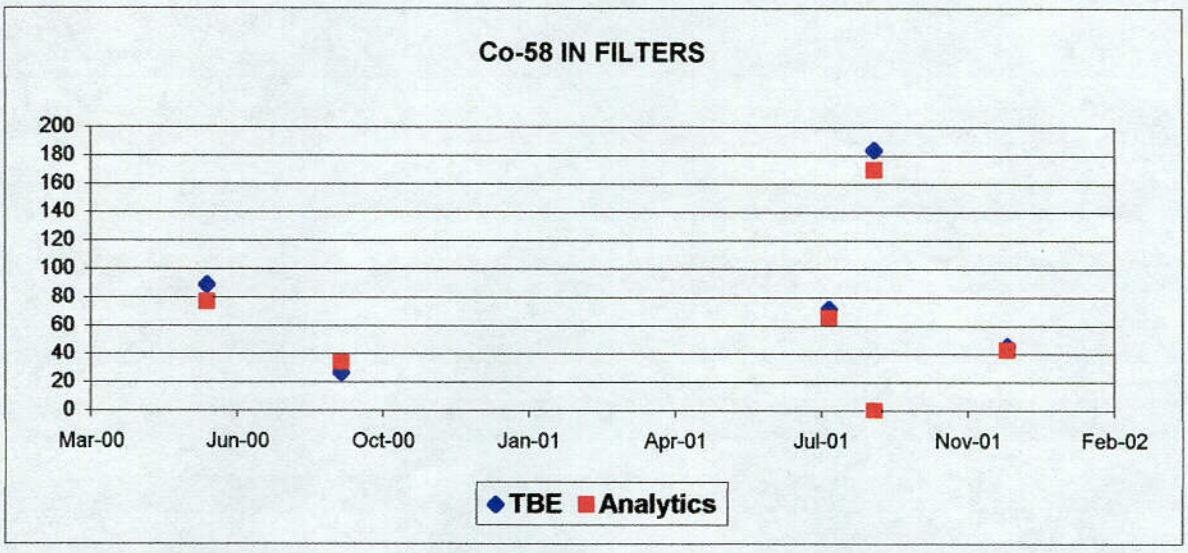

Mn-54 IN FILTERS
160
120
80
40
0
Jan-98
Jul-98
Dec-98
Jun-99
Dec-99
Jun-00
Dec-00
Jun-01
Dec-01
TBE
Analytics


Fe-59 IN FILTERS
200
180
160
140
120
100
80
60
40
20
0
Jan-98
Jul-98
Dec-98
Jun-99
Dec-99
Jun-00
Dec-00
Jun-01
Dec-01
TBE
Analytics

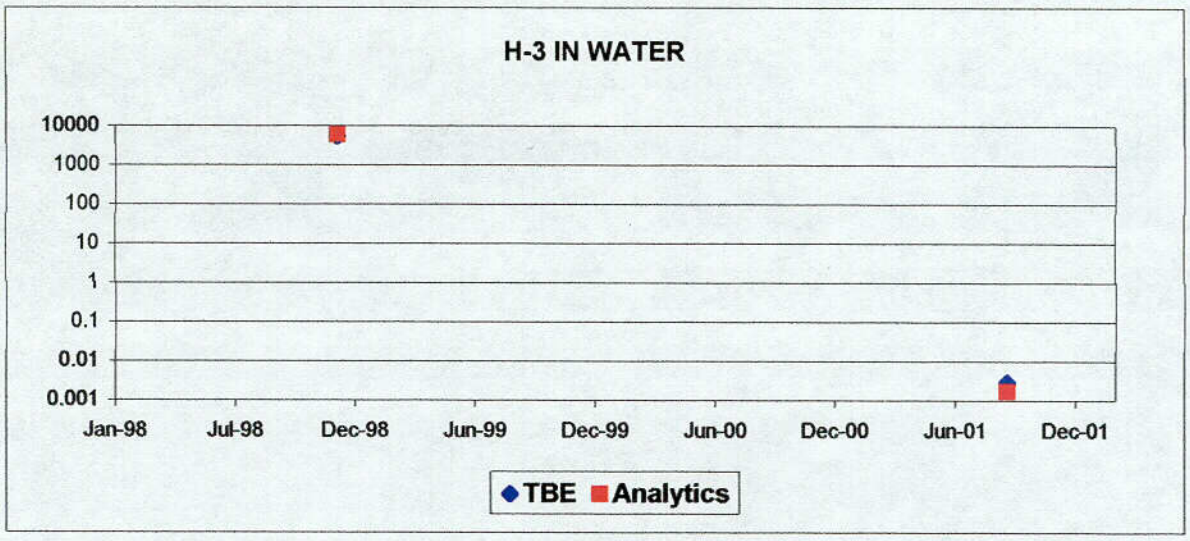
C17

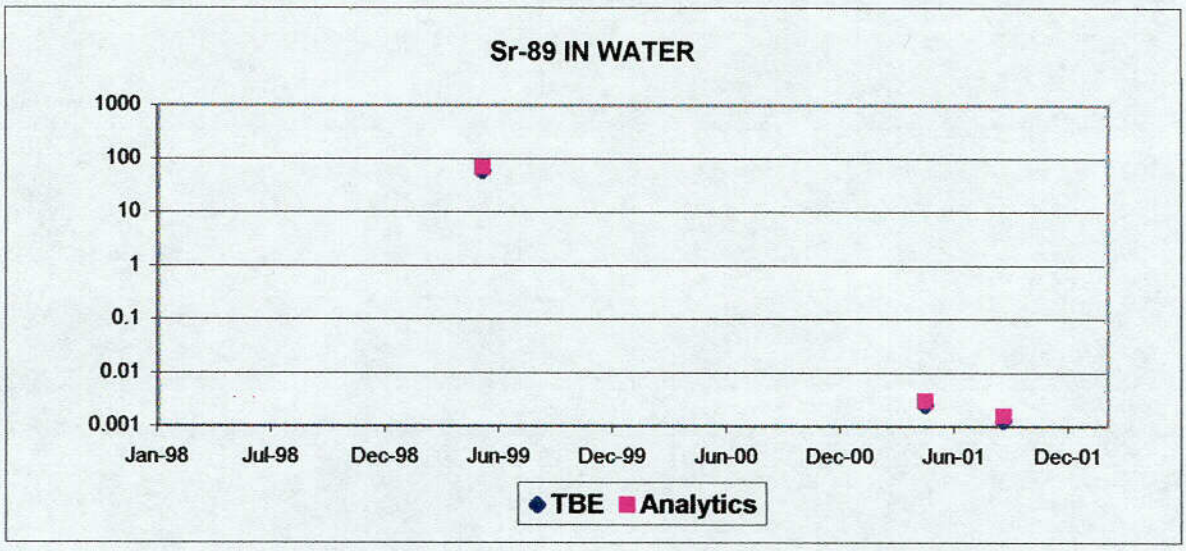

Zn-65 IN FILTERS
300
250
200
150
100
50
0
Jan-98
Jul-98
Dec-98
Jun-99
Dec-99
Jun-00
Dec-00
Jun-01
Dec-01
TBE
Analytics

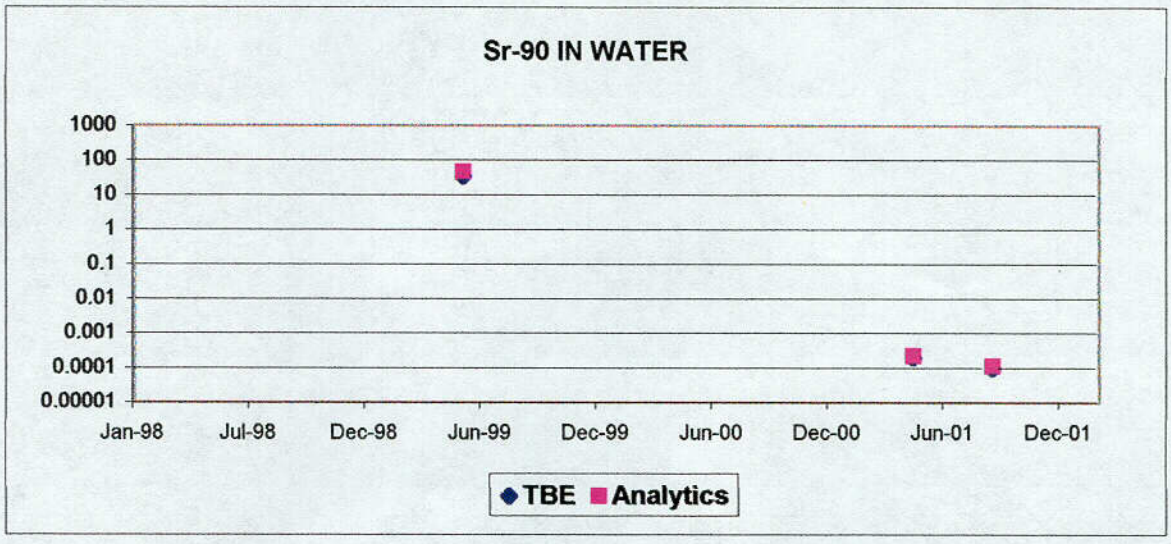

Co-60 IN FILTERS
300
250
200
150
100
50
0
Jan-98
Jul-98
Dec-98
Jun-99
Dec-99
Jun-00
Dec-00
Jun-01
Dec-01
TBE
Analytics


Co-58 IN FILTERS
200
180
160
140
120
100
80
60
40
20
0
Mar-00
Jun-00
Oct-00
Jan-01
Apr-01
Jul-01
Nov-01
Feb-02
TBE
Analytics

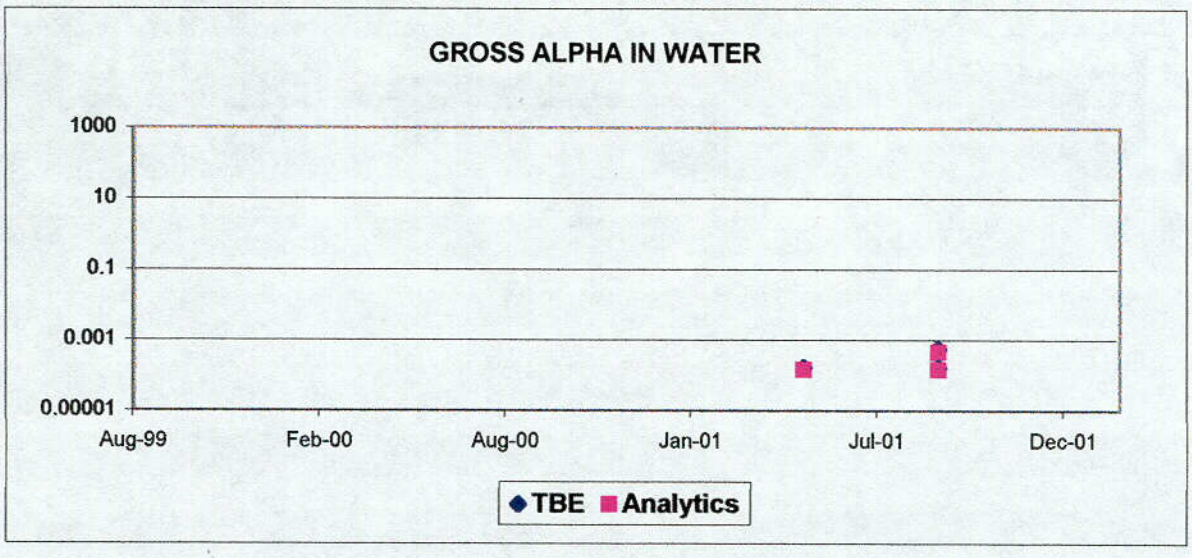
C18


H-3 IN WATER
10000
1000
100
10
1
0.1
0.01
0.001
Jan-98
Jul-98
Dec-98
Jun-99
Dec-99
Jun-00
Dec-00
Jun-01
Dec-01
TBE
Analytics

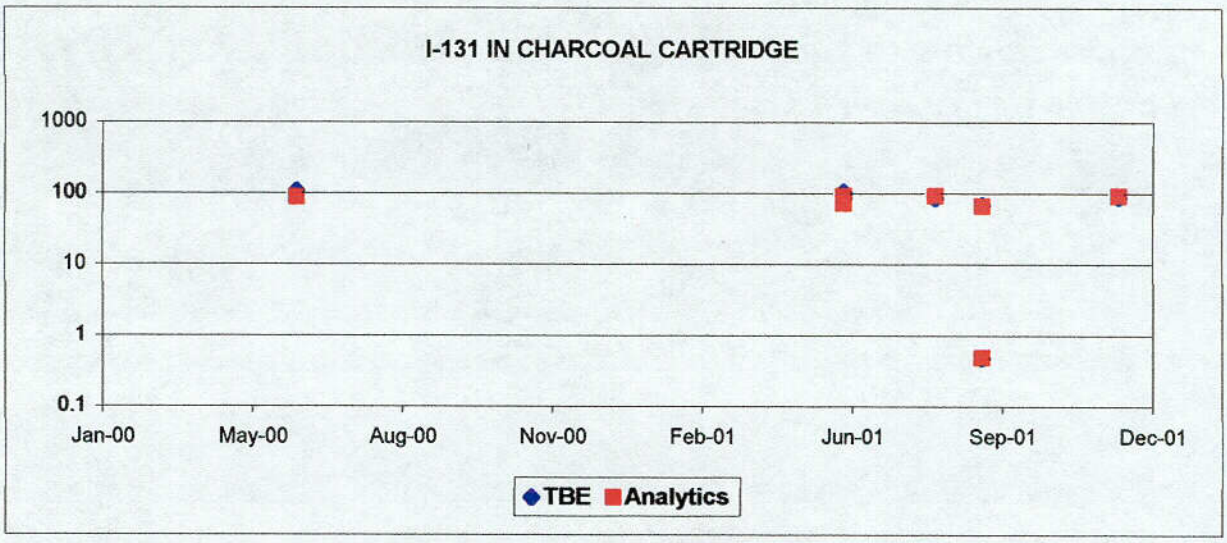

Sr-89 IN WATER
1000
100
10
1
0.1
0.01
0.001
Jan-98
Jul-98
Dec-98
Jun-99
Dec-99
Jun-00
Dec-00
Jun-01
Dec-01
TBE
Analytics


Sr-90 IN WATER
1000
100
10
1
0.1
0.01
0.001
0.0001
0.00001
Jan-98
Jul-98
Dec-98
Jun-99
Dec-99
Jun-00
Dec-00
Jun-01
Dec-01
TBE
Analytics

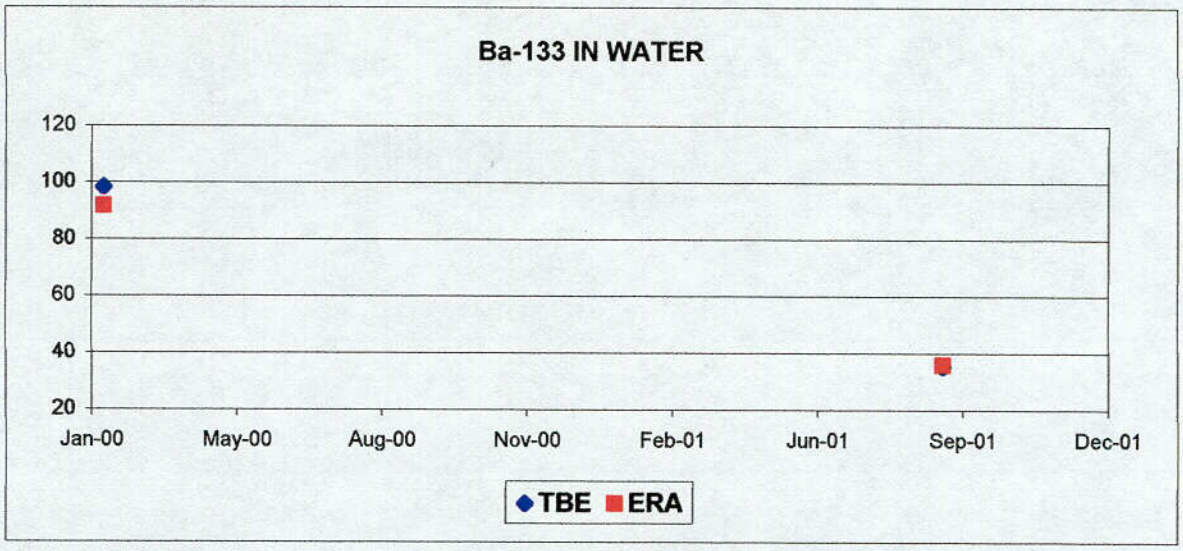
C19

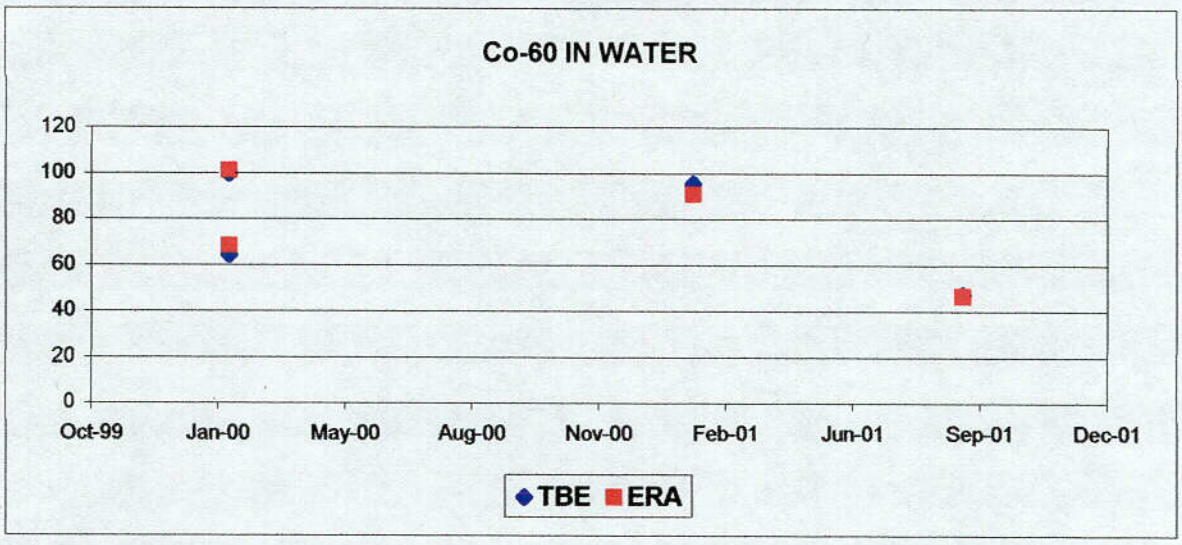

GROSS ALPHA IN WATER
1000
10
0.1
0.001
0.00001
Aug-99
Feb-00
Aug-00
Jan-01
Jul-01
Dec-01
TBE
Analytics

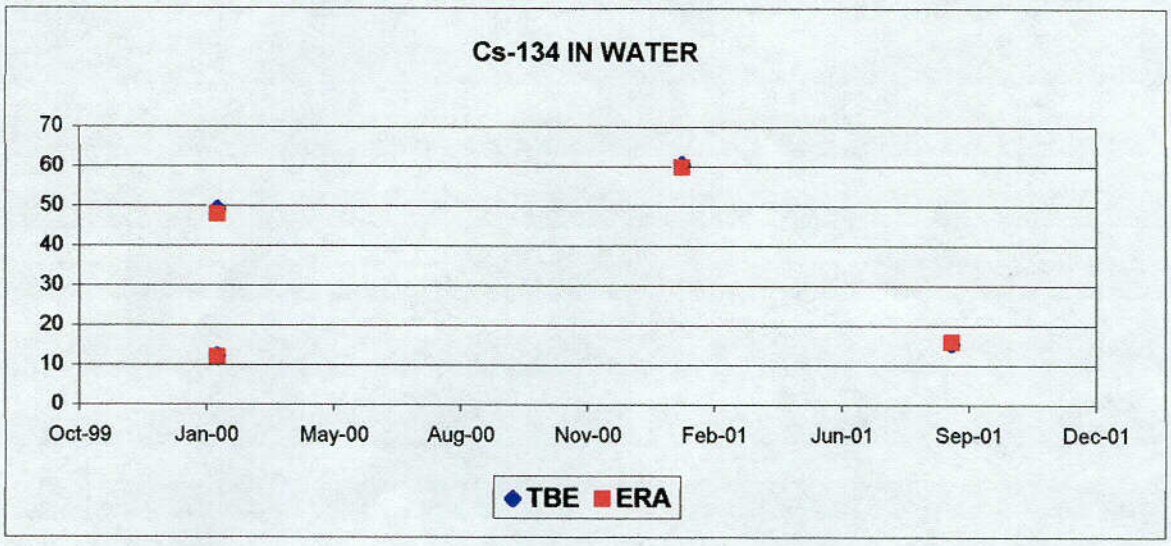
C20


I-131 IN CHARCOAL CARTRIDGE
1000
100
10
1
0.1
Jan-00
May-00
Aug-00
Nov-00
Feb-01
Jun-01
Sep-01
Dec-01
TBE
Analytics

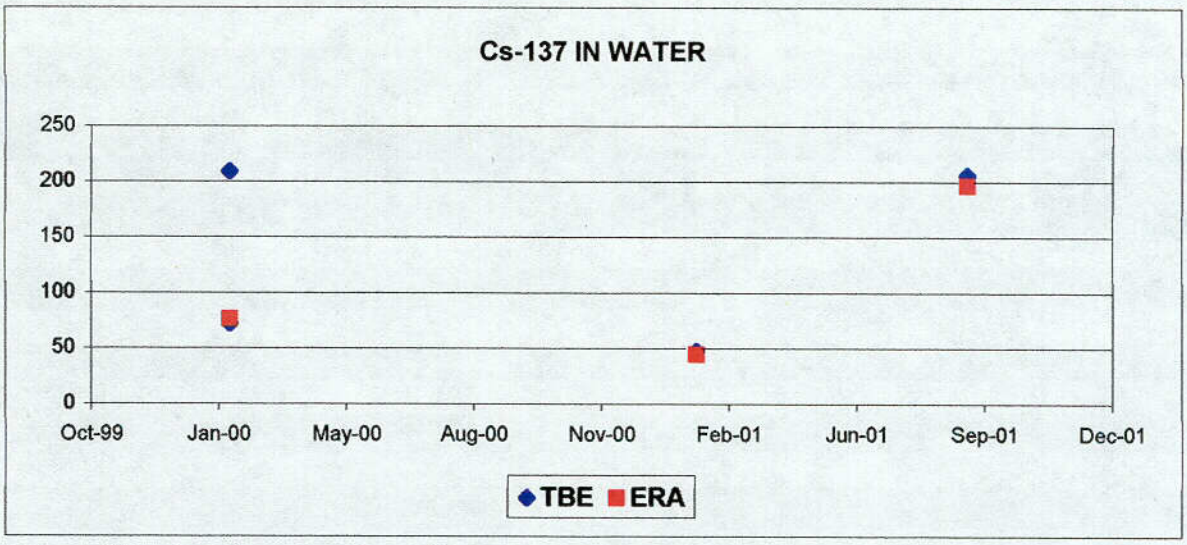
C21


Ba-133 IN WATER
120
100
80
60
40
20
Jan-00
May-00
Aug-00
Nov-00
Feb-01
Jun-01
Sep-01
Dec-01
TBE
ERA

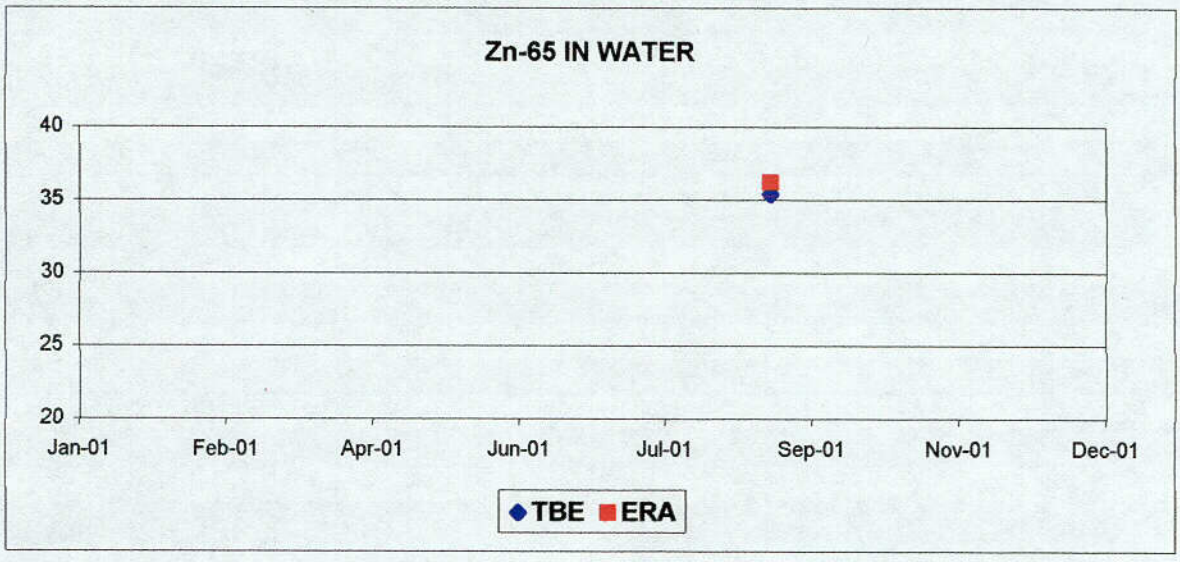

Co-60 IN WATER
120
100
80
60
40
20
0
Oct-99
Jan-00
May-00
Aug-00
Nov-00
Feb-01
Jun-01
Sep-01
Dec-01
TBE
ERA

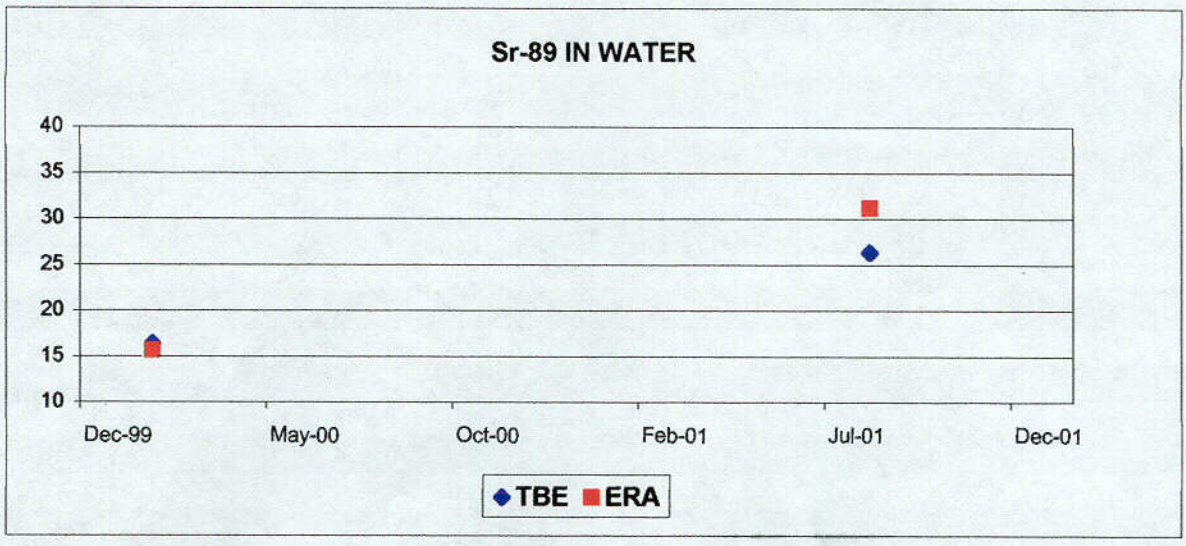

Cs-134 IN WATER
70
60
50
40
30
20
10
0
Oct-99
Jan-00
May-00
Aug-00
Nov-00
Feb-01
Jun-01
Sep-01
Dec-01
TBE
ERA

C22

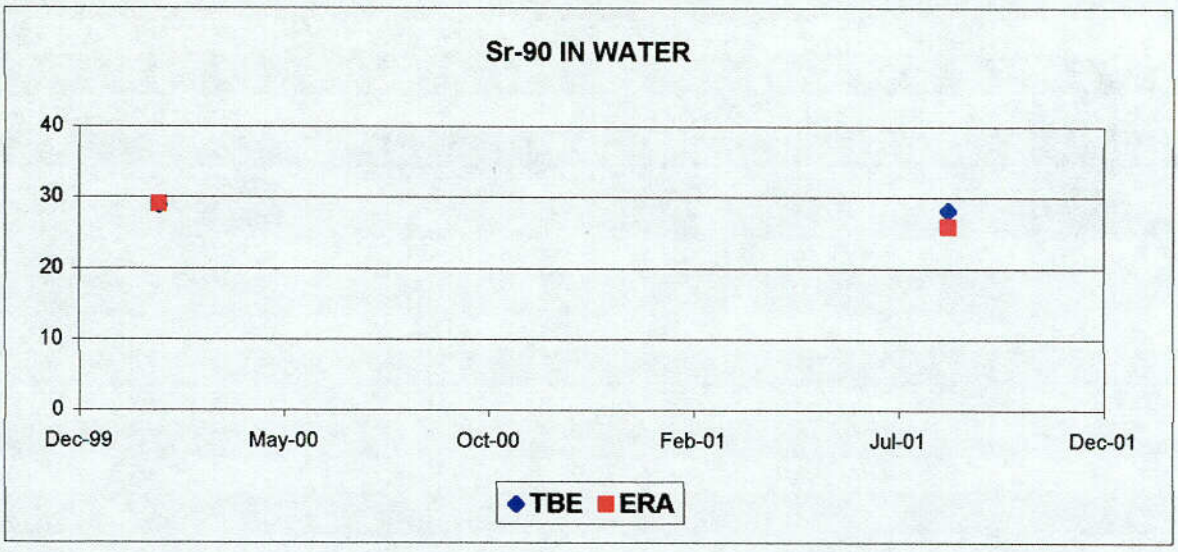


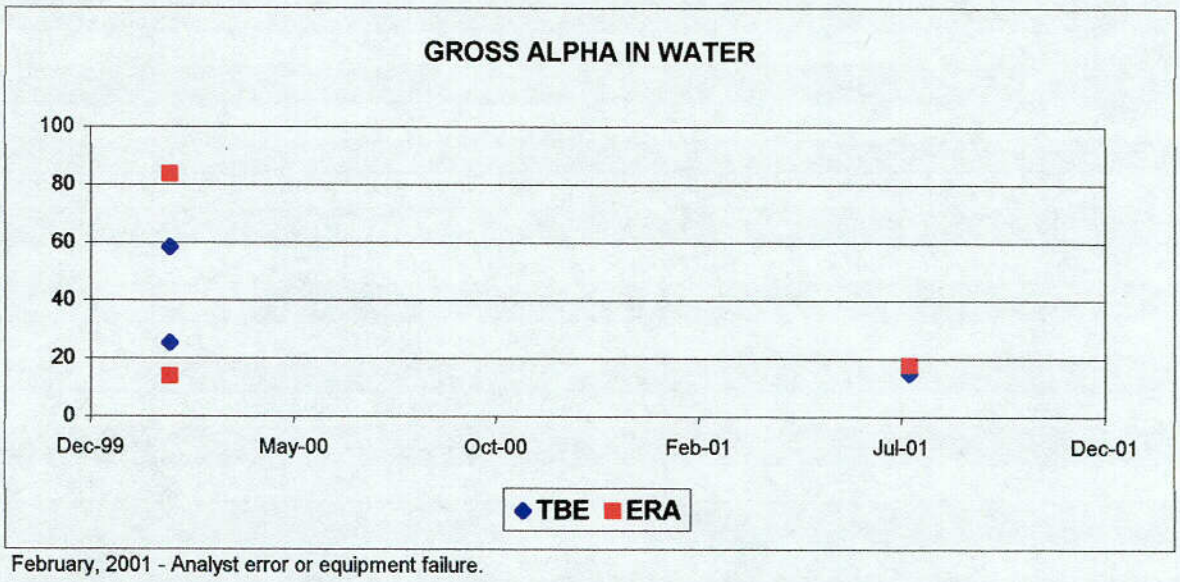
February, 2001 - Analyst error or equipment failure.



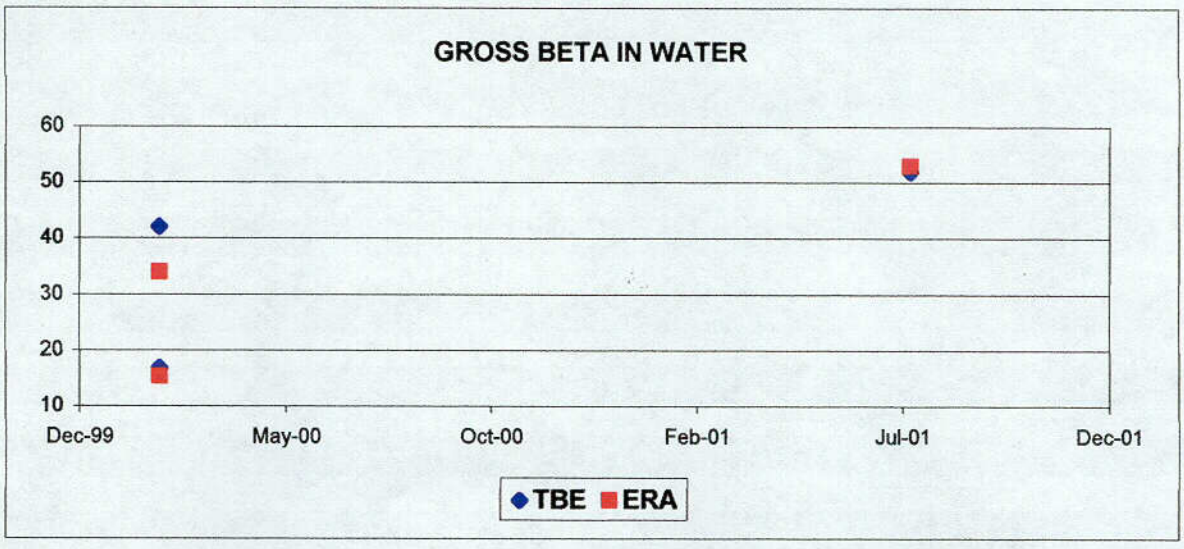


C23

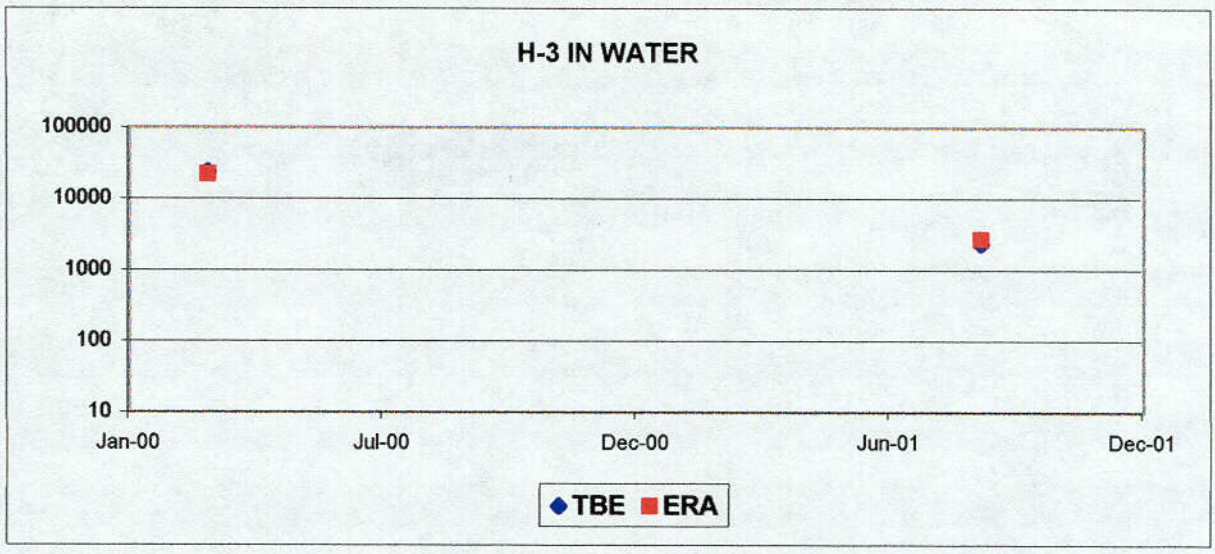


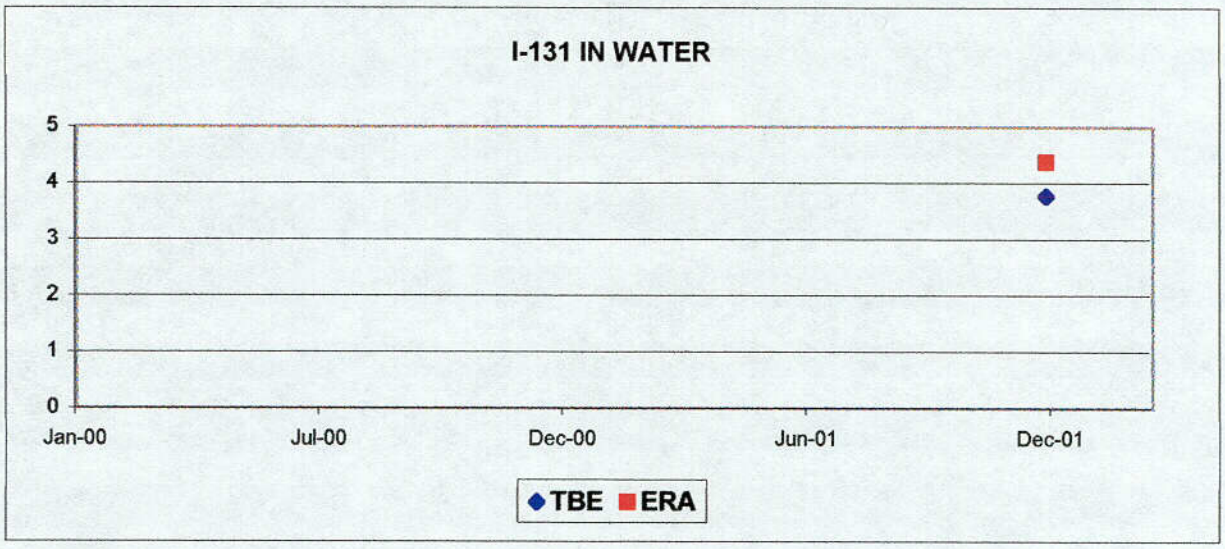


February, 2001 - Analyst error or equipment failure.

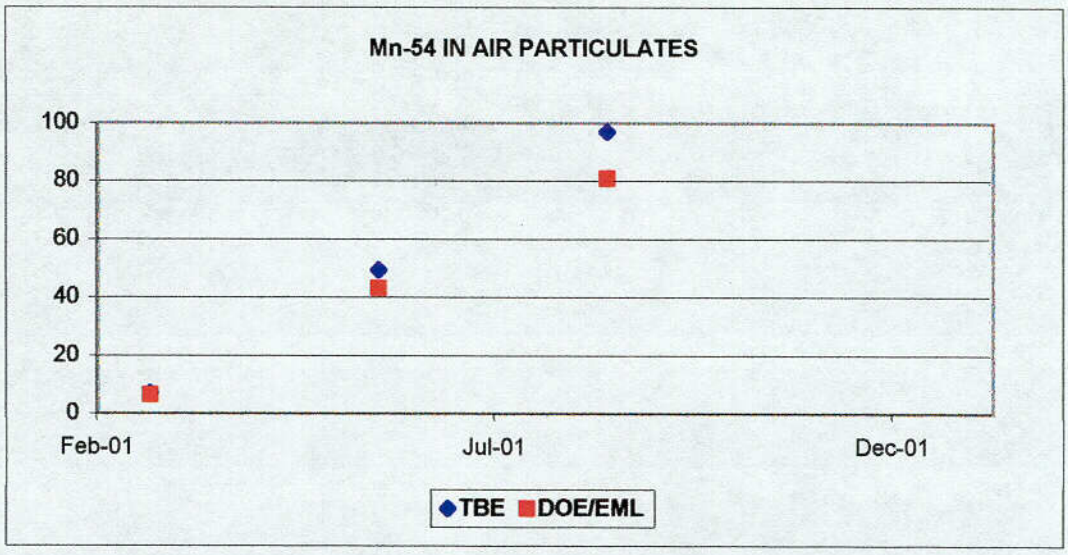


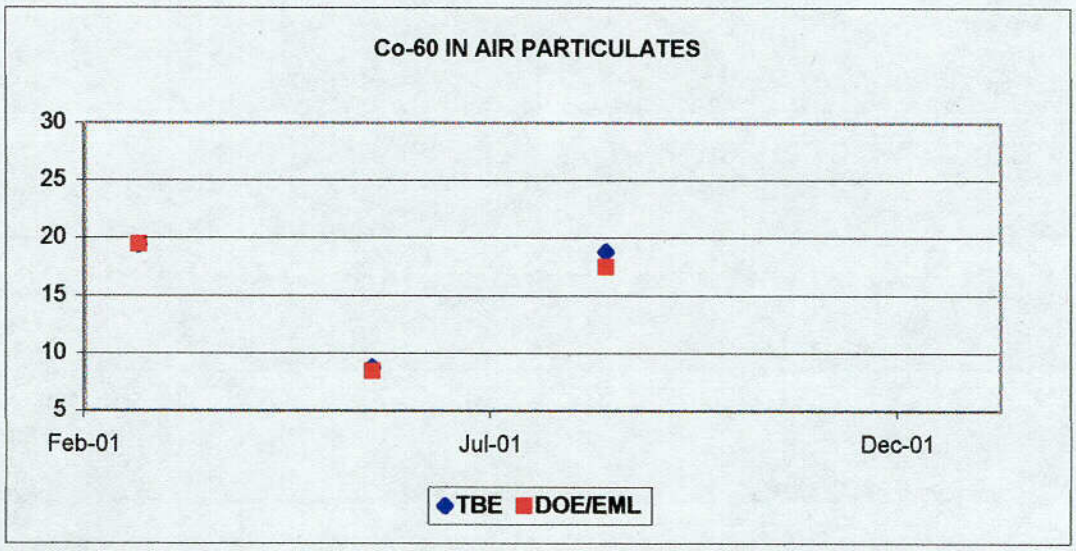
C 24

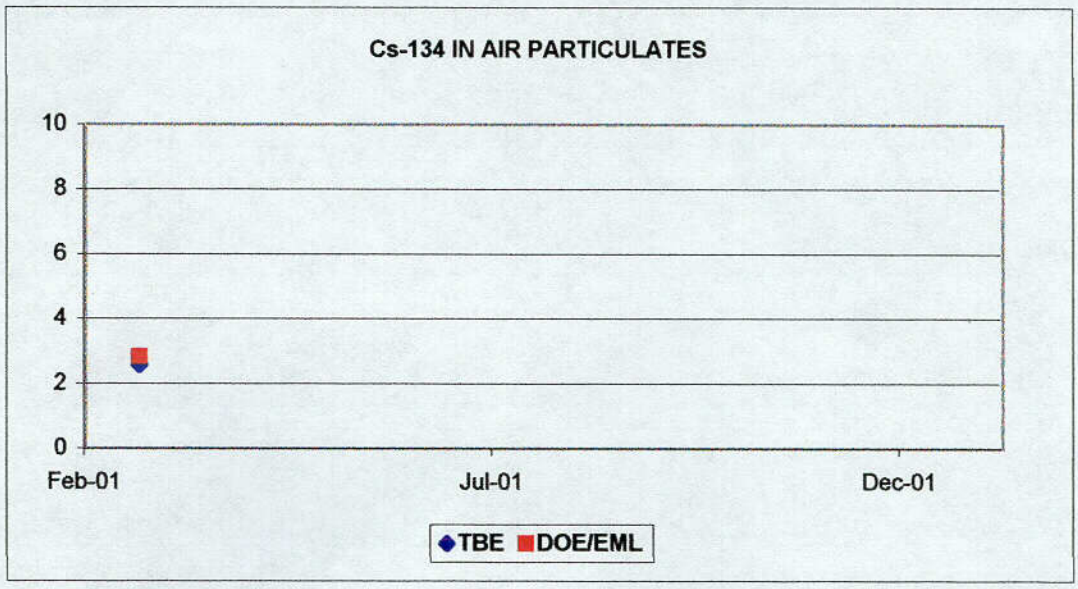

H-3 IN WATER
100000
10000
1000
100
10
Jan-00
Jul-00
Dec-00
Jun-01
Dec-01
TBE
ERA


I-131 IN WATER
5
4
3
2
1
0
Jan-00
Jul-00
Dec-00
Jun-01
Dec-01
TBE
ERA

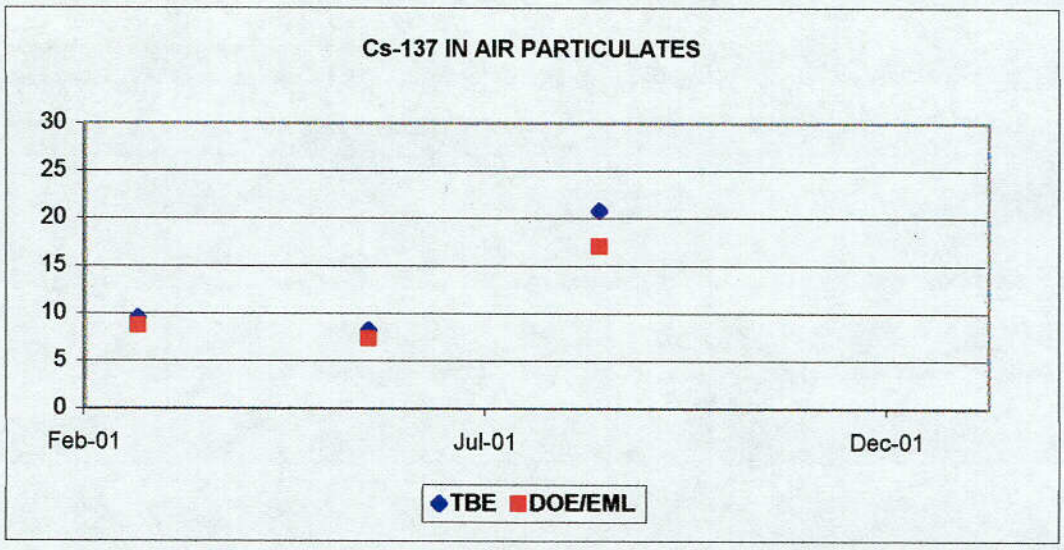
C25

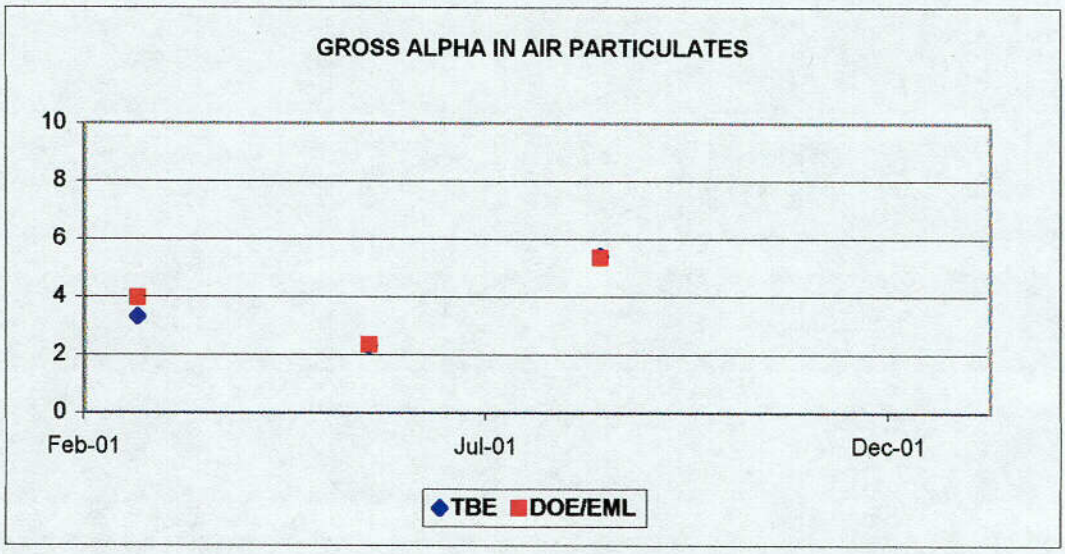

Mn-54 IN AIR PARTICULATES
100
80
60
40
20
0
Feb-01
Jul-01
Dec-01
TBE
DOE/EML

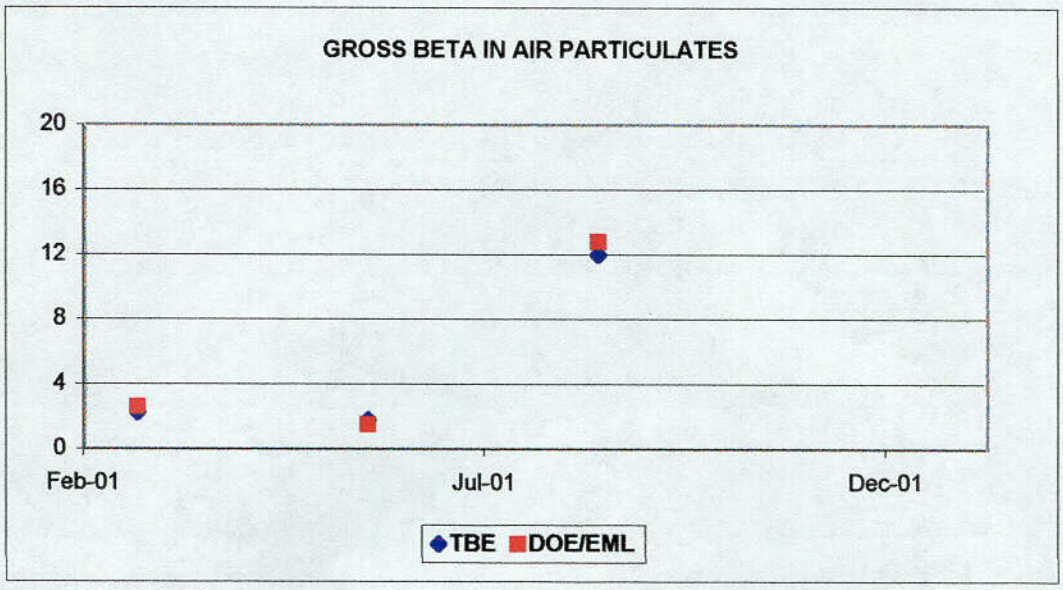

Co-60 IN AIR PARTICULATES
30
25
20
15
10
5
Feb-01
Jul-01
Dec-01
TBE
DOE/EML


Cs-134 IN AIR PARTICULATES
10
8
6
4
2
0
Feb-01
Jul-01
Dec-01
TBE
DOE/EML

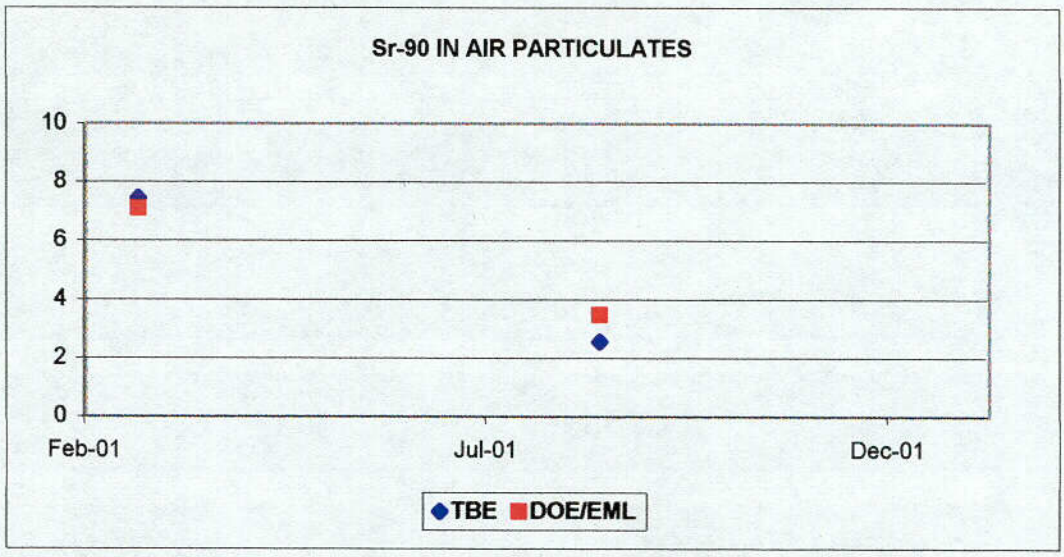
C26

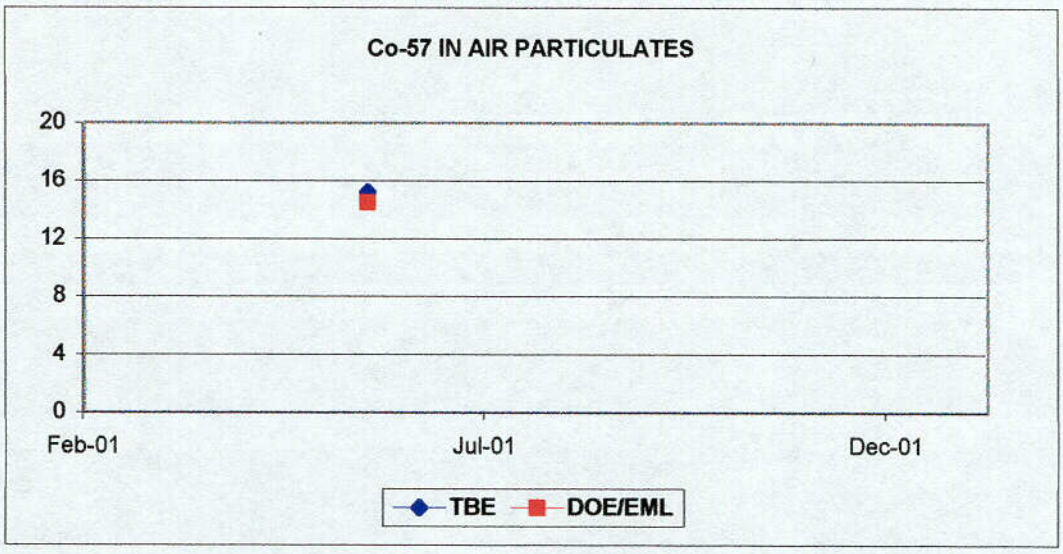

Cs-137 IN AIR PARTICULATES
30
25
20
15
10
5
0
Feb-01
Jul-01
Dec-01
TBE
DOE/EML


GROSS ALPHA IN AIR PARTICULATES
10
8
6
4
2
0
Feb-01
Jul-01
Dec-01
TBE
DOE/EML

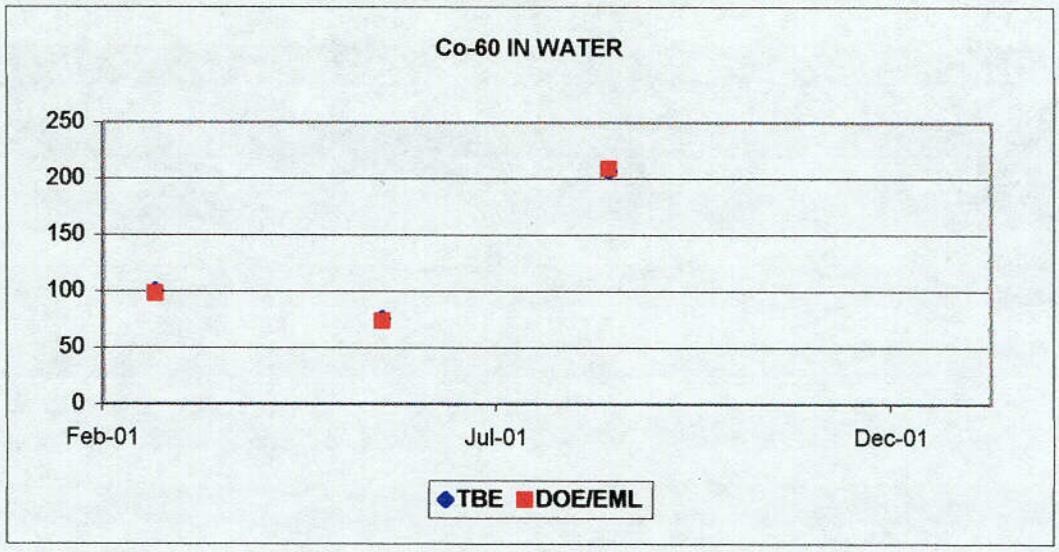

GROSS BETA IN AIR PARTICULATES
20
16
12
8
4
0
Feb-01
Jul-01
Dec-01
TBE
DOE/EML

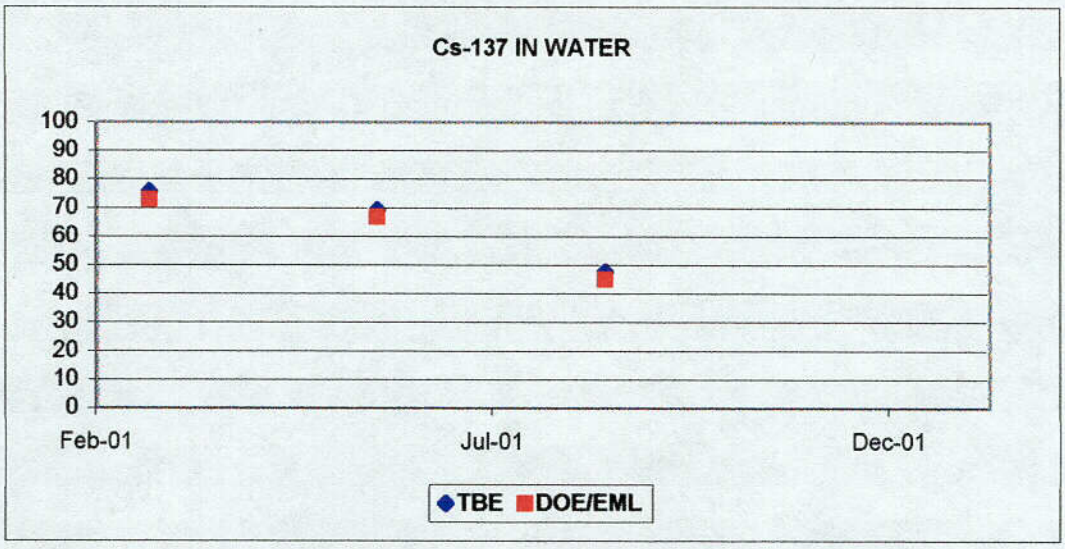
C27

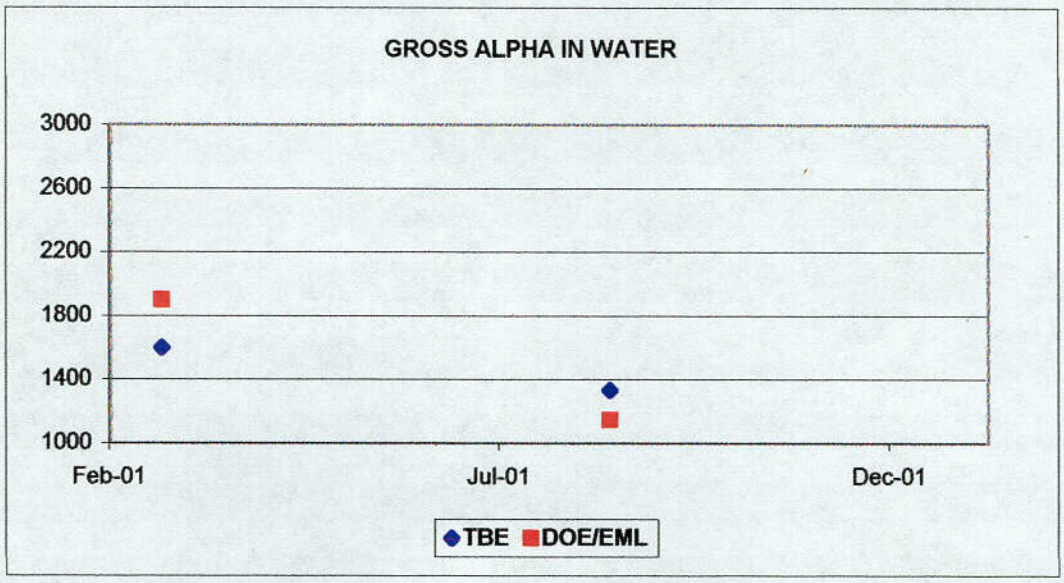

Sr-90 IN AIR PARTICULATES
10
8
6
4
2
0
Feb-01
Jul-01
Dec-01
TBE
DOE/EML


Co-57 IN AIR PARTICULATES
20
16
12
8
4
0
Feb-01
Jul-01
Dec-01
TBE
DOE/EML

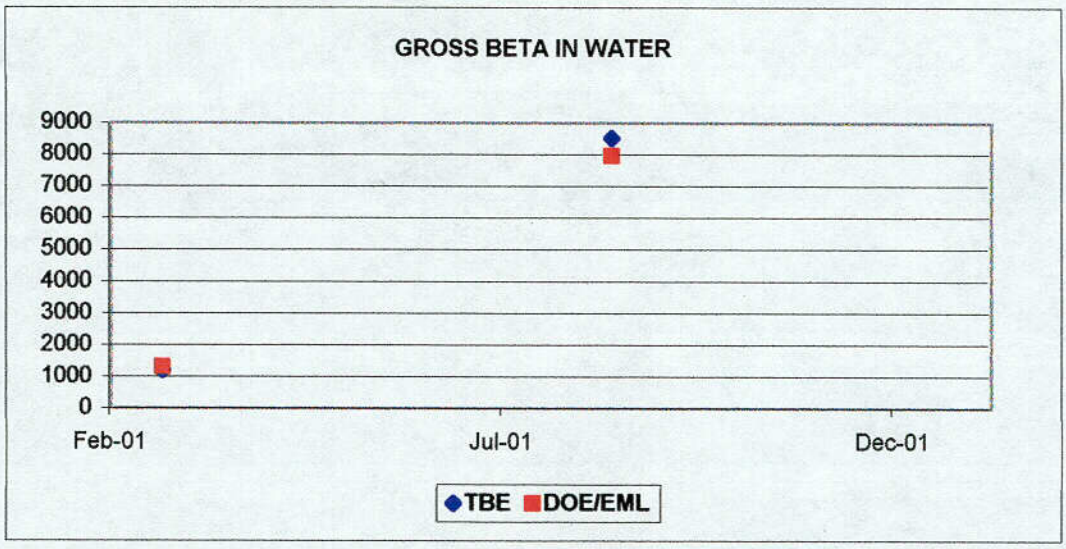
C28

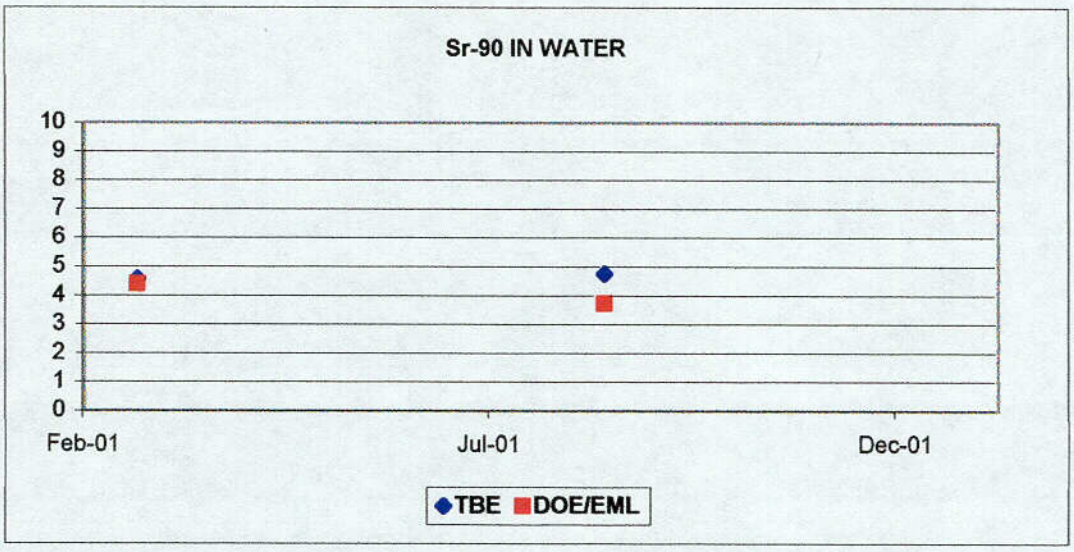

Co-60 IN WATER
250
200
150
100
50
0
Feb-01
Jul-01
Dec-01
TBE
DOE/EML

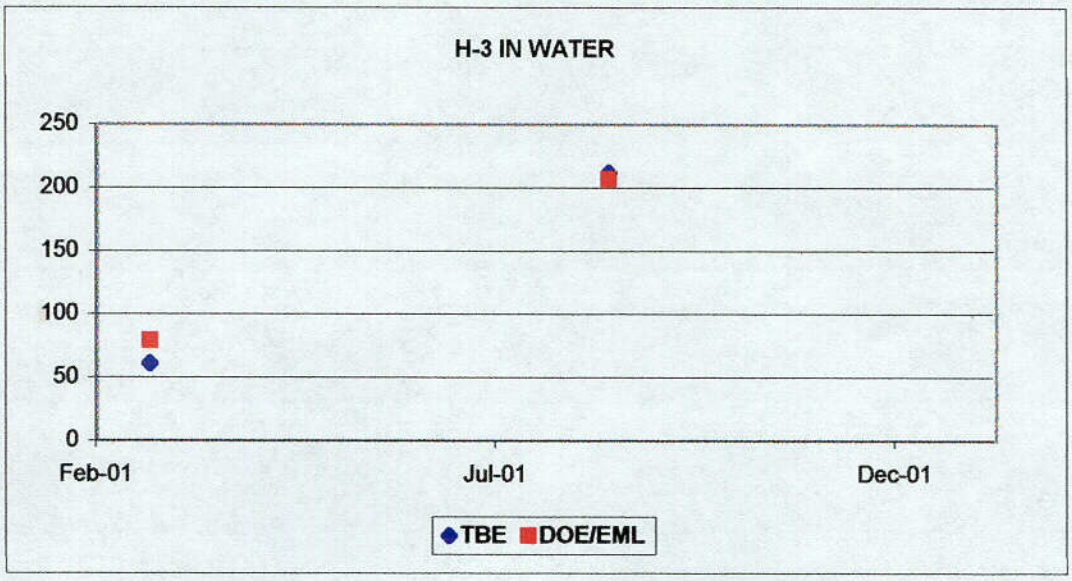

Cs-137 IN WATER
100
90
80
70
60
50
40
30
20
10
0
Feb-01
Jul-01
Dec-01
TBE
DOE/EML


GROSS ALPHA IN WATER
3000
2600
2200
1800
1400
1000
Feb-01
Jul-01
Dec-01
TBE
DOE/EML

C29


GROSS BETA IN WATER
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Feb-01
Jul-01
Dec-01
TBE
DOE/EML


Sr-90 IN WATER
10
9
8
7
6
5
4
3
2
1
0
Feb-01
Jul-01
Dec-01
TBE
DOE/EML


H-3 IN WATER
250
200
150
100
50
0
Feb-01
Jul-01
Dec-01
TBE
DOE/EML

C30