Radiological Environmental Monitoring Program

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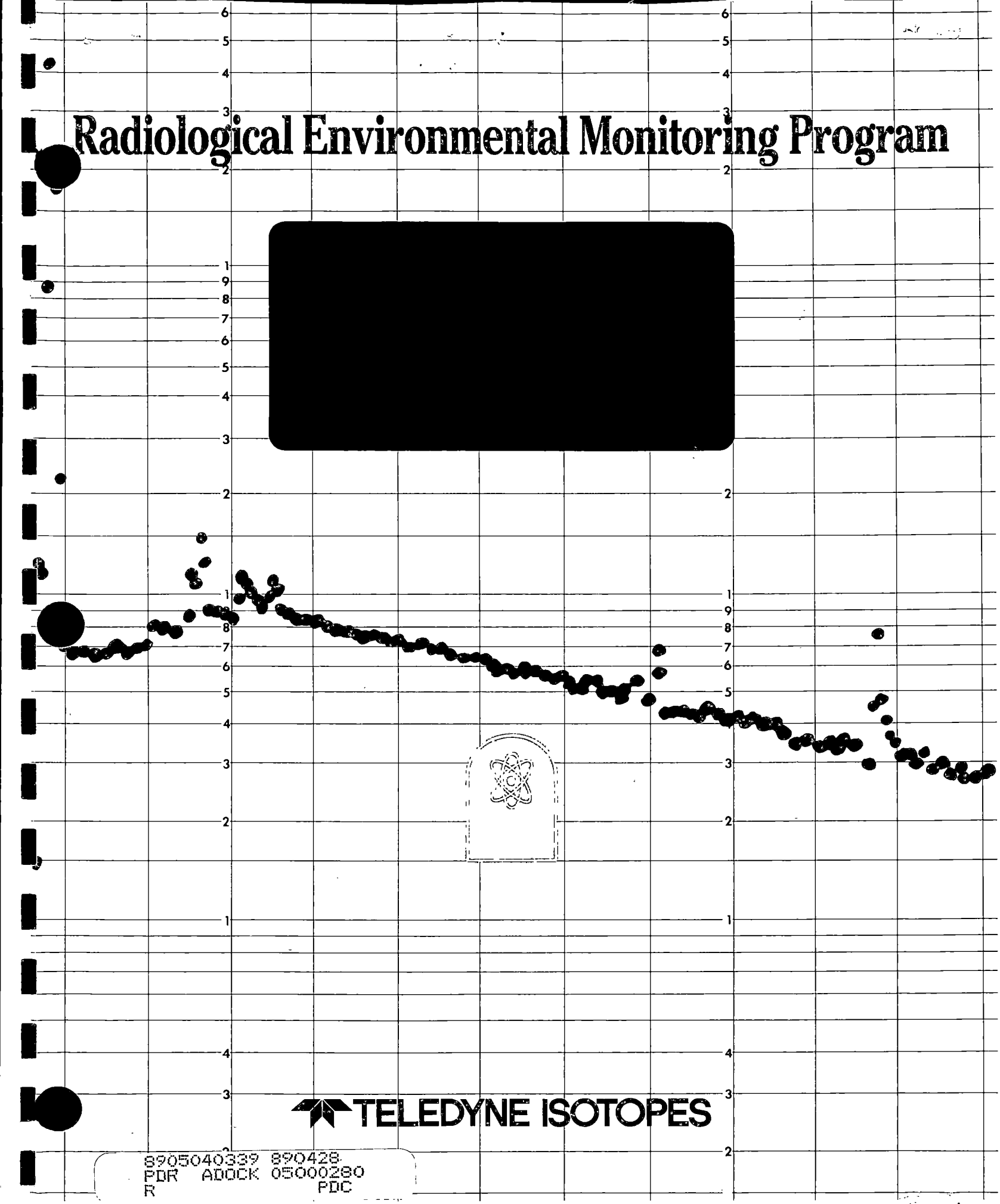

TELEDYNE ISOTOPES

VIRGINIA ELECTRIC AND POWER COMPANY

SURRY POWER STATION

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

FOR 1988

Prepared by

VIRGINIA ELECTRIC AND POWER COMPANY

and

TELEDYNE ISOTOPES

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

SURRY POWER STATION

JANUARY 1, 1988 to DECEMBER 31, 1988

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TABLE OF CONTENTS

TABLE OF CONTENTS (Cont)

LIST OF FIGURES

FORWARD

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

VIRGINIA ELECTRIC AND POWER COMPANY

SURRY POWER STATION

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

I. INTRODUCTION

The operational radiological environmental monitoring program conducted for the year 1988 for the Surry Power Station is provided in this report. The results of measurements and analyses of data obtained from samples collected from January 1, 1988 through December 31, 1988 is summarized.

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

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

environmental processes which might allow undue accumulation of radioactivity in the environment, a program for monitoring the plant environs is also included in Surry Power Station Technical Specifications.

C. Virginia Electric and Power Company is responsible for collecting the various indicator and control (background) environmental samples. Teledyne Isotopes is responsible for sample analysis and the submission of reports of radioanalyses. The results are used to determine if changes in radioactivity levels could be attributable to station operations. Measured values are compared with background 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 environmental media show the presence of man-made isotopes. As a method of referencing the measured radionuclide concentrations in the sample media to a dose consequence to man, the data may be compared to the reporting level concentrations listed in the USNRC Regulatory Guide 4.8 and Table 4.9-4 of Surry Power Station's Technical Specifications. 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 1988 and satisfies the following objectives of the program:

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

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

3. To identify changes of radioactivity in the environment.

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

II. SAMPLING AND ANALYSIS PROGRAM

A. Sampling Program

1. Table 1 summarizes the sampling program for Surry Power Station during 1988. The symbols on this table refer to the sample locations shown on Figures 1 through 3. Figure 1 indicates the locations of the land based samples while Figure 2 shows the locations of the river based samples. The small triangles in Figure 3 designate the position of environmental thermoluminescent dosimeters (TLDs) at the site boundary.

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

3. In addition to the Radiological Environmental Monitoring Program required by Surry Technical Specifications, Virginia Electric and Power Company splits samples with the Commonwealth of Virginia. All samples listed in Table 1 are collected by Vepco personnel except for those labeled state split. All samples are shipped to Teledyne Isotopes in Westwood, New Jersey.

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

B. Analysis Program

1. Table 2 summarizes the analysis program conducted by Teledyne Isotopes for Surry Power Station during 1988.

TABLE 1

VIRGINIA POWER - SURRY - 1988

RADIOLOGICAL SAMPLING STATION

DISTANCE AND DIRECTION FROM UNIT NO. 1

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

* TLD stored in a lead shield in environmental building.

TABLE 1 (Cont.)

VIRGINIA POWER - SURRY - 1988

RADIOLOGICAL SAMPLING STATION

DISTANCE AND DIRECTION FROM UNIT NO. 1

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

TABLE 1 (Cont.)

VIRGINIA POWER - SURRY - 1988

RADIOLOGICAL SAMPLING STATION

DISTANCE AND DIRECTION FROM UNIT NO. 1

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

* Well water sample taken onsite at Surry Environmental Building.

TABLE 1 (Cont.)

VIRGINIA POWER - SURRY - 1988

RADIOLOGICAL SAMPLING STATION

DISTANCE AND DIRECTION FROM UNIT NO. 1

SAMPLE MEDIA	LOCATION	DISTANCE MILES	DIRECTION	DEGREES	COLLECTION FREQUENCY	REMARKS
Crabs	Surry Station Discharge	0.6	NW	312°	Annually	
Fish	Surry Station Discharge	0.6	NW	312°	Semi-Annually	
Crops (Corn,Peanuts, Soybeans)	Brock's Farm	3.8	S	188°	Annually	State Split
	Slade's Farm	2.4	S	177°	Annually	State Split
(Cabbage,Kale)	Pool's Garden	2.3	S	182°	Annually	State Split
	Carter's Grove Garden	4.8	NE	56°	Annually	State Split
	Ryan's Garden	-	-	-	Annually	State Split/Control Loc. (Chester, Va.)
	Stone's Garden	-	-	-	Annually	State Split

FIGURE 1 LAND BASED SAMPLES

FIGURE 2 RIVER BASED SAMPLES

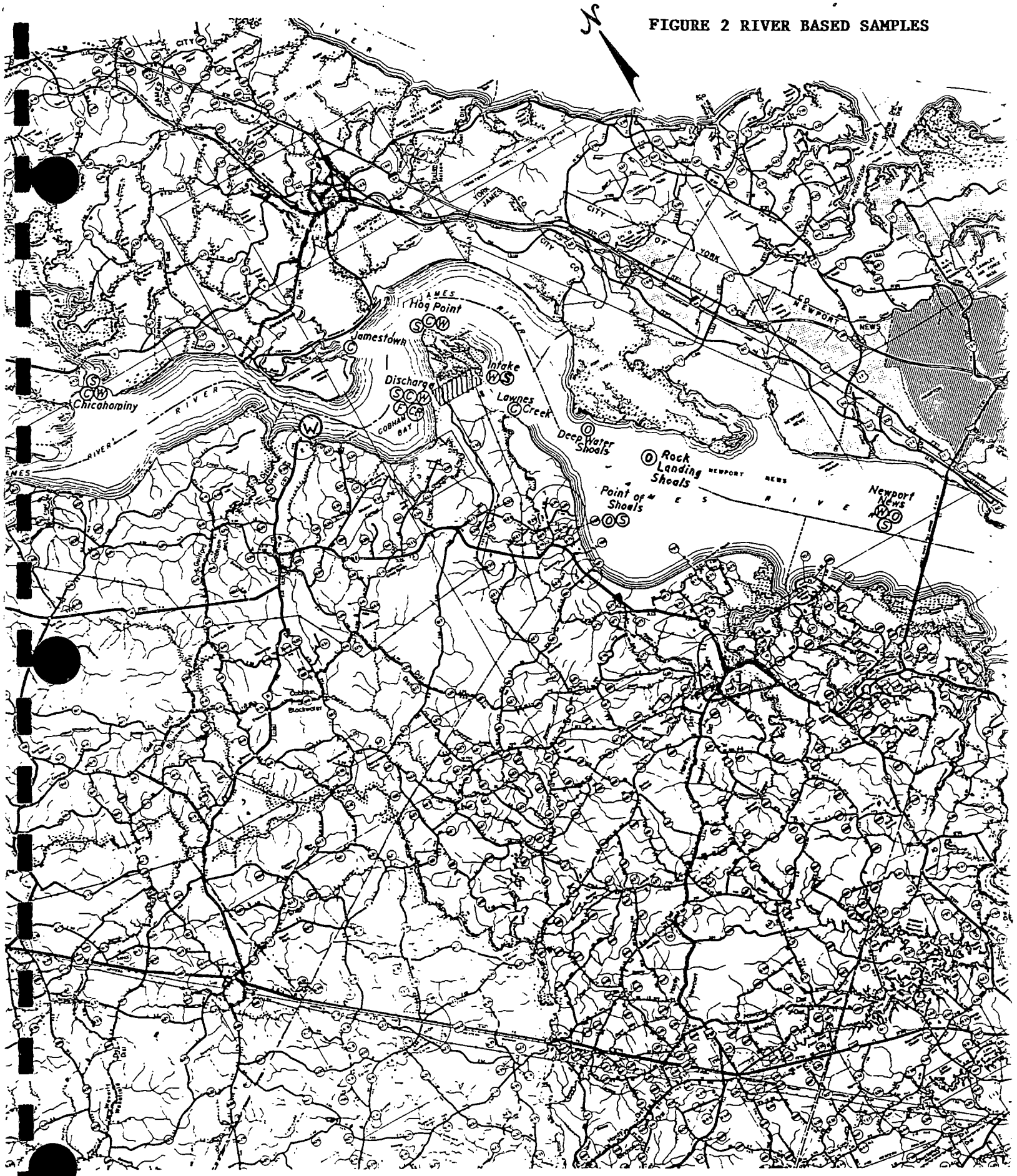


FIGURE 3 SITE BOUNDRY TLD's

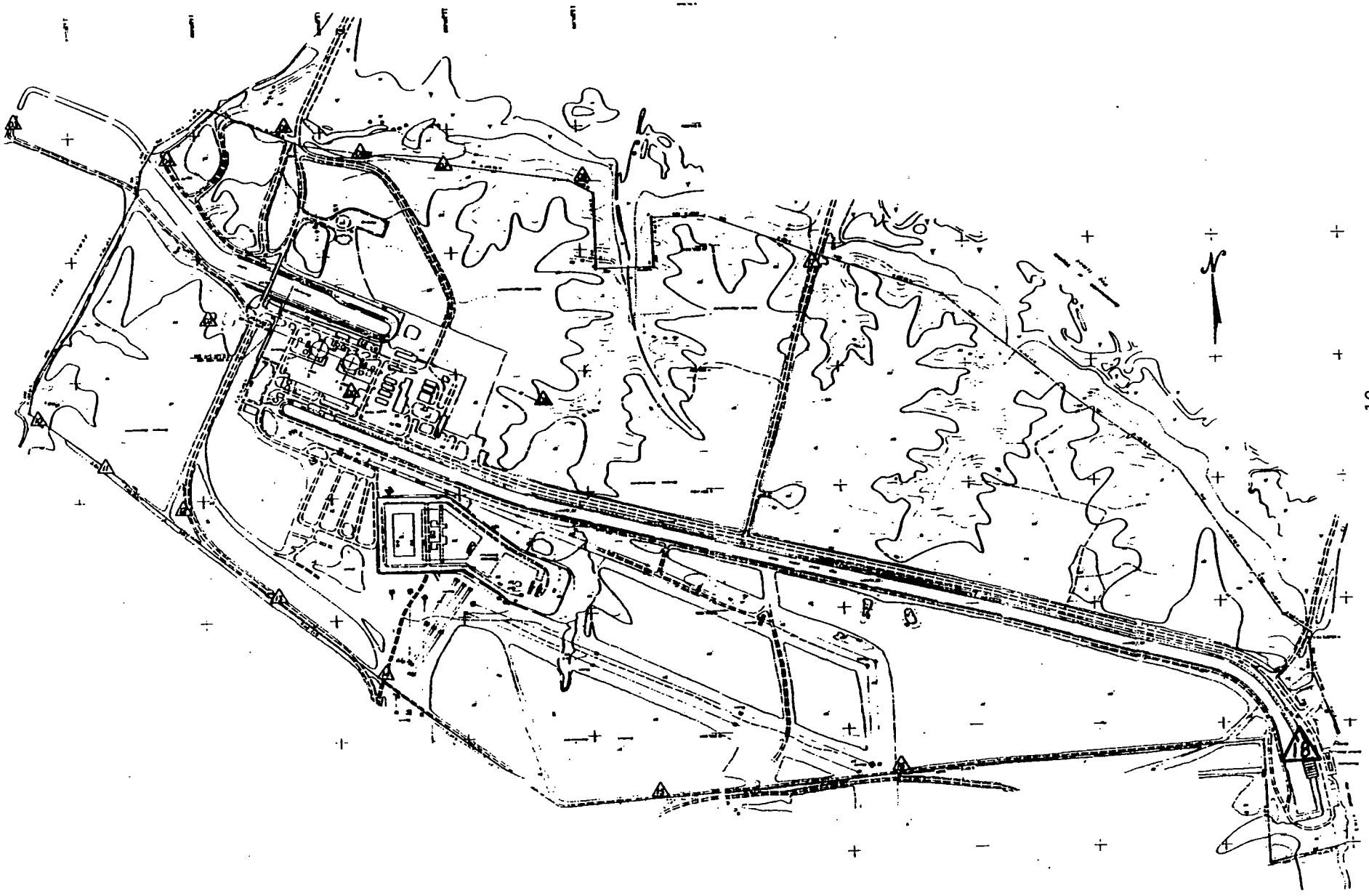


TABLE 2

SURRY POWER STATION

SAMPLE ANALYSIS PROGRAM

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

(1) Quarterly composites of each locations's weekly air particulate samples will be analysed for Gamma Emitters.

TABLE 2 (Cont.)

SURRY POWER STATION

SAMPLE ANALYSIS PROGRAM

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

TABLE 2 (Cont.)

SURRY POWER STATION

SAMPLE ANALYSIS PROGRAM

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

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

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

III. EXCEPTIONS

III. PROGRAM EXCEPTIONS

During this environmental reporting period, several samples were not available or the analysis of the samples did not meet the required sensitivity (LLD). The following is a discussion of the exceptions and actions taken to limit recurrence.

Three TLD samples were lost from sampling stations during 1988. The TLDs were discovered missing while performing monthly visual checks of TLDs at each TLD station. The loss is attributed to vandalism. When TLDs are found missing they are normally replaced. Such was the case with the missing TLDs in the first quarter. Replacement TLDs were not requested for the second quarter TLDs found missing in June because the third quarter TLDs were already in transit to the station. Upon arrival at the station, third quarter TLDs were installed at the missing TLD stations. Compared to the large number of TLD stations in the field the loss rate is low and not considered a problem. No corrective action is considered necessary.

One air iodine sample did not meet the station Technical Specification LLD requirement due to low sample volume. The fuse had blown on the power pole where the air sampler is located. Sample volume was calculated to be only 79 cubic meters as compared to a typical sample volume of 530 cubic meters. A minimum sample volume of 125 cubic meters is needed to meet the air iodine LLD.

River water samples are collected and composited at the Surry Discharge Canal (downstream location) and at Scotland Wharf (upstream control location) by the State of Virginia. These samples are split with VEPCO on a monthly basis. The analysis of these samples for barium/lanthanium-140 and iodine-131 failed to meet the required Lower Limit of Detection (LLD) in many of these

samples because of the delay in receipt of the samples from the State of Virginia. These samples are not used to comply with the requirements of the station's Technical Specifications. The monthly river water samples collected by Vepco personnel meet Technical Specification LLD requirements.

Station Technical Specifications require three samples of oysters bi-monthly. For the month of January only two samples were collected. Due to a microorganism infestation in the lower James River (MSX/Dermo), oyster shellstock has been virtually depleted at the Newport News (Naseway Shoal) sample location. Sampling has terminated at this location and will recommence when the oyster beds revitalize as determined by the Commonwealth of Virginia. An alternative sampling location was selected. This location, Rock Landing Shoals, is downstream of the power station as was the Newport News location. Sampling began in March and will continue until the Newport News location is approved for sampling.

The exceptions to the 1988 Radiological Environmental Monitoring Program are not indicative of programmatic weaknesses. Corrective actions were taken as appropriate and changes to the administration of the program are not deemed necessary.

REMP EXCEPTIONS FOR SCHEDULED

SAMPLING AND ANALYSIS DURING 1988

Location	Description	Date of Sampling	Reason(s) for Loss/ Exception
04	Direct Radiation	First Quarter (Sets 1/2)	TLD Vandalized
03/08	Direct Radiation	Second Quarter (Sets 1/2)	TLD Vandalized
NN	Oysters	January	Sample not collected due to shell stock depletion at sampling location.
SD, SW (State Split)	River Water I-131 Ba/La-140	 05/15/88 01/15/88-12/15/88	LLD's not met due to late receipt from State of Virginia.
ALL	Air Iodine	06/14/88-06/21/88	LLD not met due to loss of power at sampling location.

IV. SUMMARY AND DISCUSSION OF 1988 ANALYTICAL RESULTS

IV. SUMMARY AND DISCUSSION OF 1988 ANALYTICAL RESULTS

Data from the radiological analyses of environmental media collected during the report period are provided in this section. The procedures and specifications followed in the laboratory are in accordance with the Teledyne Isotopes Quality Assurance Manual and are explained in the Teledyne Isotopes Analytical Procedures. A synopsis of analytical procedures used for the environmental samples are provided in Section VII. In addition to internal quality control measures performed by Teledyne, the laboratory also participates in the Environmental Protection Agency's Interlaboratory Comparison Program. Participation in this program ensures that independent checks on the precision and accuracy of the measurements of radioactive material in environmental samples are performed. The results of the EPA Interlaboratory Comparison are provided in Section VIII.

Radiological analyses of environmental media characteristically approach and frequently fall below the detection limits of state-of-the-art measurement methods. Teledyne Isotopes analytical methods meet or exceed the Lower Limit of Detection (LLD) requirements given in Table 2 of the USNRC Branch Technical Position of Radiological Monitoring, Revision I, November 1979.

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

A. Airborne Exposure Pathway

1. Air Iodine/Air Particulates

Results of gross beta activities are presented in Table 5. The measurement of the gross beta activity on the weekly particulate filters is a good

indication of the levels of natural and/or manmade radioactivity in the environment. If sample results indicate normal levels of radioactivity, the filters are composited and analyzed for gamma emitting radioactivity. The gamma analysis will identify the type and origin of the radioactivity. If the beta analysis indicates results above the normal levels, gamma analysis may be done immediately to identify the cause.

The average concentration for the control location (Newport News) is 0.019 pCi/m^3 with a range of 0.010 to 0.033 pCi/m^3. The average measurement for the indicator locations is 0.018 pCi/m^3 with a range of 0.005 to 0.042 pCi/m^3. The required lower level of detection for the analysis is 0.010 pCi/m^3. The maximum permissible concentrations of radioactivity in air above natural background radioactivity in unrestricted areas is limited by the Code of Federal Regulations Title 10, Part 20, Table II, for gross beta, to less than 100.000 pCi/m^3.

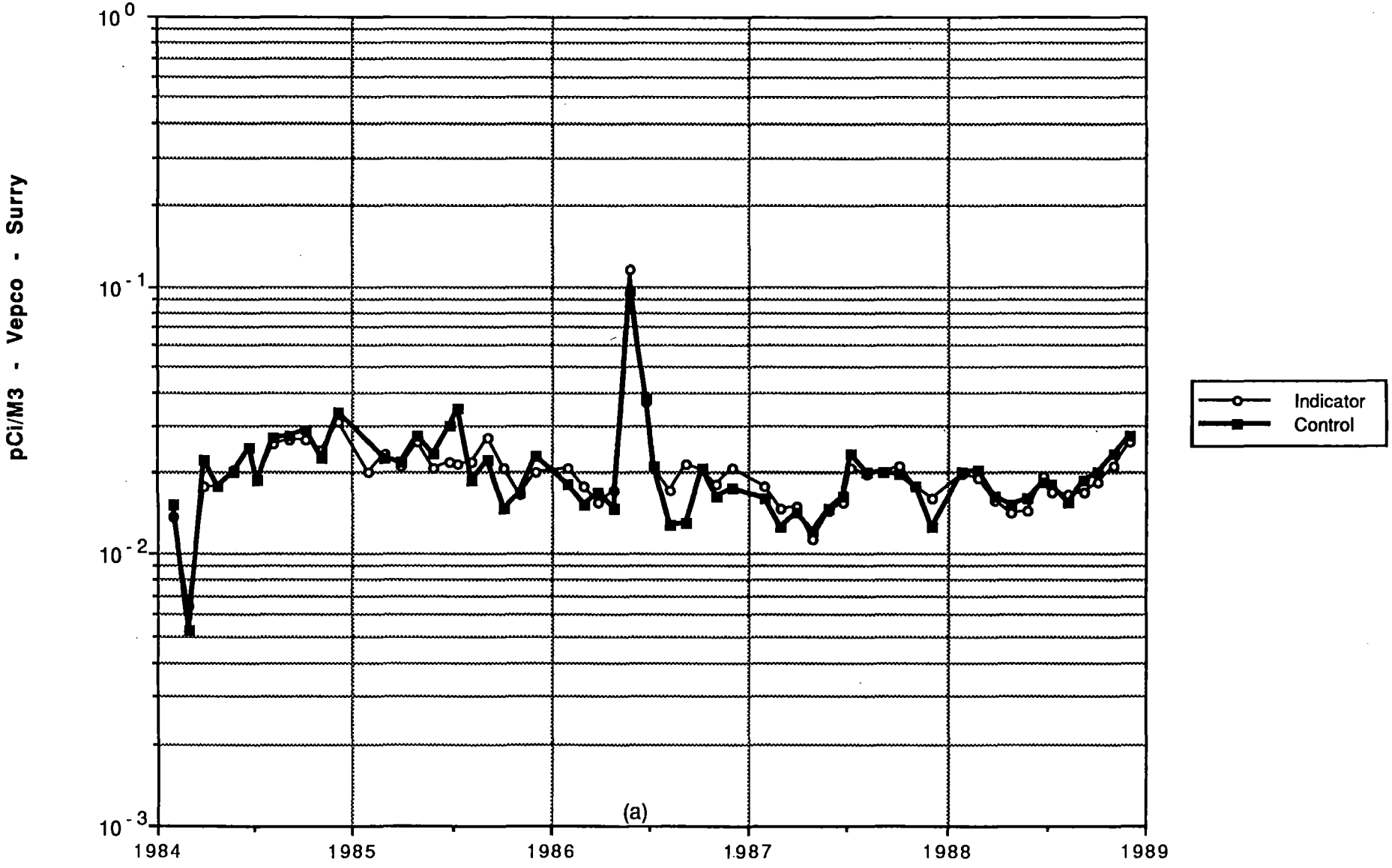
The monthly averages of the gross beta concentrations for the seven indicator and one control location are plotted for 1969 through 1988. The gross beta levels observed are comparable to the levels detected during the 1982-1987 period. Prior to this period the gross beta activities found during preoperational and the following operational period were higher due to atmospheric atomic weapons testing.

As mentioned previously, air particulate filters were composited by location on a quarterly basis and were analyzed by gamma ray spectroscopy. The results of this analysis are listed in Table 6. Beryllium-7, which is produced continuously in the upper atmosphere by cosmic radiation, was measured in all 32 composite samples (control and indicator locations) with an average activity of 0.063 pCi/m^3 and a range between 0.037 to 0.087 pCi/m^3. Naturally occurring potassium-40 was detected in five samples with

an average activity of 0.005 pCi/m^3 and a range of 0.004 to 0.007 pCi/m^3. The results indicate that no other gamma emitting radioactivity was detected.

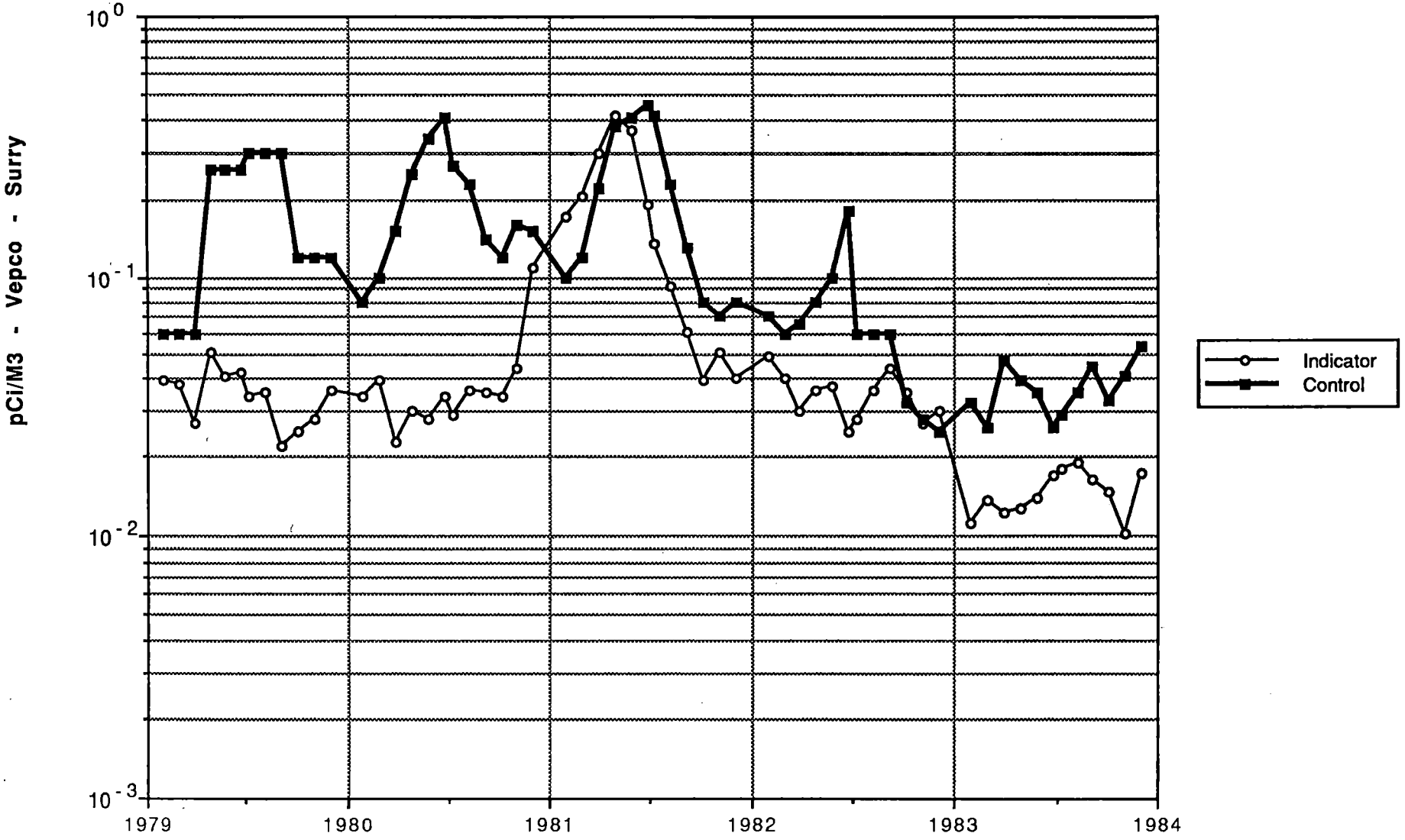
Charcoal cartridges are installed downstream of the particulate filters and are used to collect airborne radioiodine. The results of the weekly analysis of the charcoal cartridges are presented in Table 4. All results were below the lower level of detection with no positive activity detected.

GROSS BETA IN AIR PARTICULATES

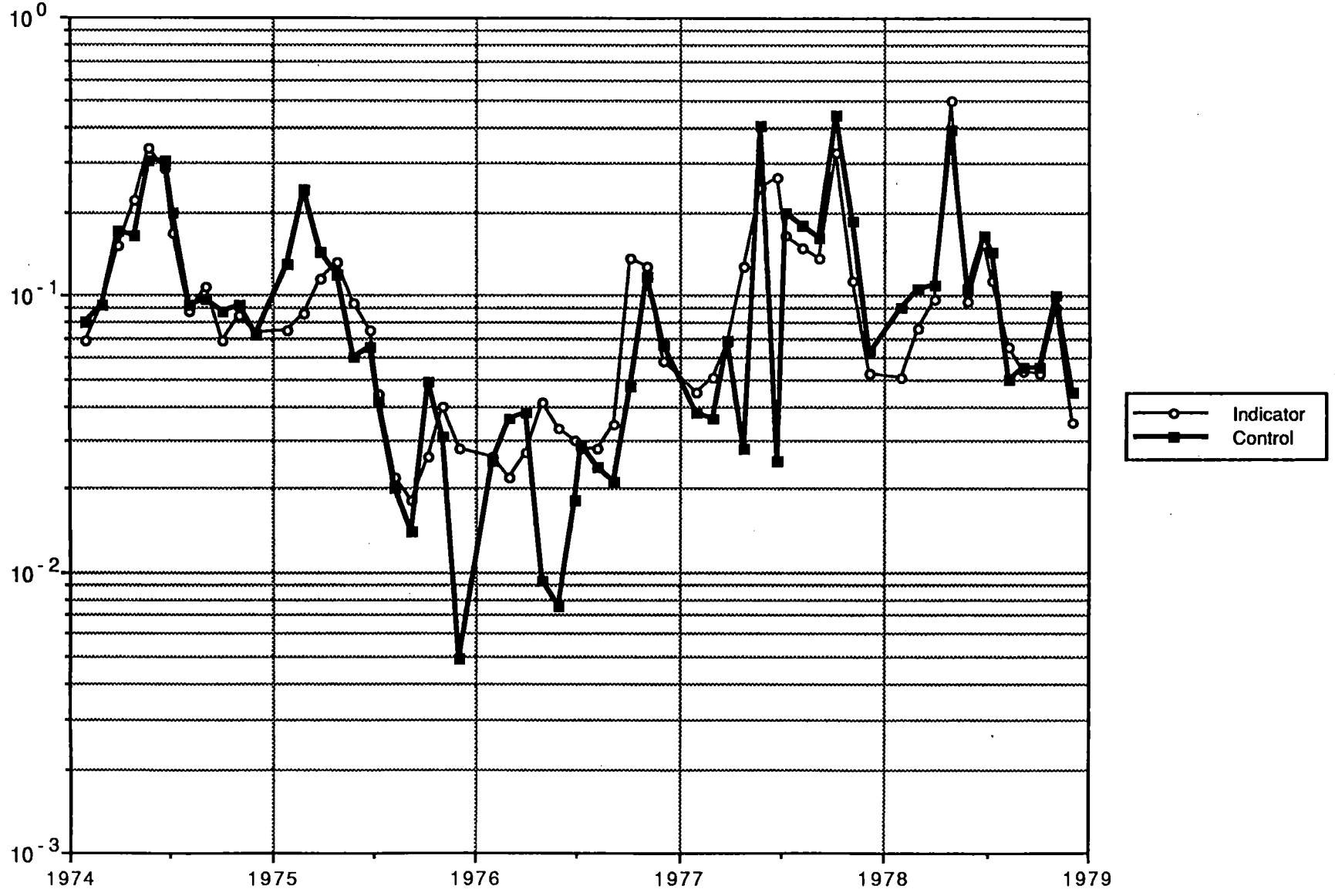


(a) Chernobyl Accident

GROSS BETA IN AIR PARTICULATES



GROSS BETA IN AIR PARTICULATES



GROSS BETA IN AIR PARTICULATES

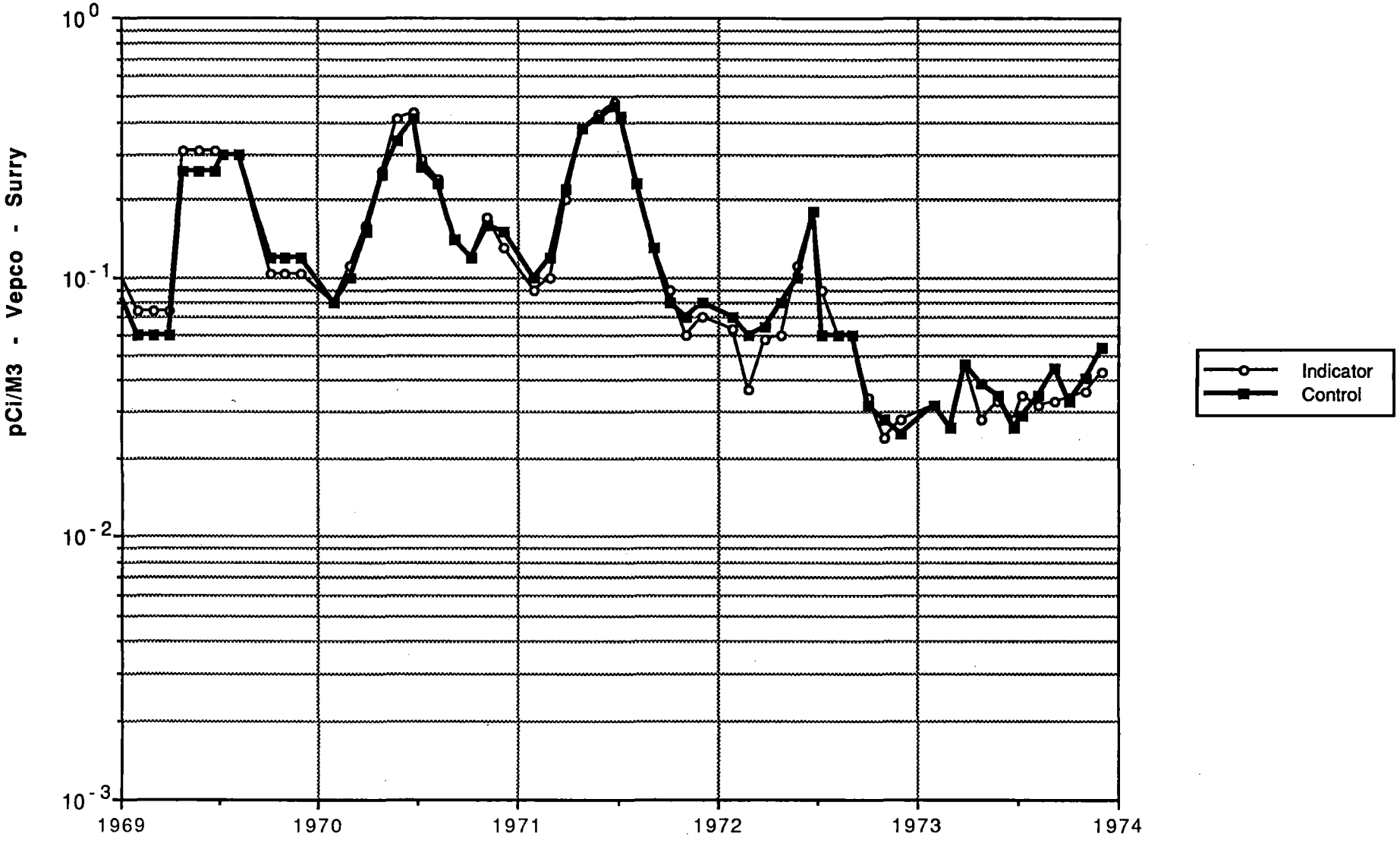


TABLE 3

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SURRY NUCLEAR POWER STATION DOCKET NO. 5-280-281

SURRY COUNTY, VIRGINIA JANUARY 1, to DECEMBER 31, 1988

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED		LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Air Iodine (pCi/m^3)	I-131	424	0.07	-(0/371) -	N/A	N/A	-(0/53) -	0
Airborne Particulates (1E-03 pCi/m^3)	Gross Beta	424	10	18.4(371/371) (5.2-42)	BC	20.1(53/53) (12-41)	19.3(53/53) (10-33)	0
	Gamma Spec Quarterly	32						
	Be-7	32	-	62.4(28/28) (36.8-86.5)	FE	68.9(4/4) (55.7-86.5)	67.9(4/4) (54.4-84.5)	0
	K-40	32	-	5.34(3/28) (4.04-6.59)	CP	5.40(1/4) -	4.90(2/4) (4.65-5.14)	0

(1) LLD is lower limit of detection as defined and required in USNRC Branch Technical Position on an Acceptable Radiological Environmental Monitoring Program, Revision 1, November 1979.

TABLE 4

(Page 1 of 4)

VIRGINIA POWER - SURRY - 1988

CONCENTRATIONS OF IODINE-131 IN FILTERED AIR

pCi/m3 ± 2 Sigma

STATIONS COLLECTION DATE	SS	HIR	BC	ALL	CP	DOW	FE	NN
JANUARY								
12/29/87-01/05/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
01/05/88-01/12/88	<.01	<.01	<.01	<.01	<.02	<.02	<.02	<.02
01/12/88-01/19/88	<.02	<.02	<.02	<.02	<.01	<.01	<.01	<.01
01/19/88-01/26/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
01/26/88-02/02/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
FEBRUARY								
02/02/88-02/09/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
02/09/88-02/16/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
02/16/88-02/23/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
02/23/88-03/01/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
MARCH								
03/01/88-03/08/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
03/08/88-03/15/88	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
03/15/88-03/22/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
03/22/88-03/29/88	<.01	<.01	<.01	<.01	<.02	<.02	<.02	<.02

TABLE 4

(Page 2 of 4)

VIRGINIA POWER - SURRY - 1988

CONCENTRATIONS OF IODINE-131 IN FILTERED AIR

pCi/m3 ± 2 Sigma

STATIONS COLLECTION DATE	SS	HIR	BC	ALL	CP	DOW	FE	NN
APRIL								
03/29/88-04/05/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
04/05/88-04/12/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
04/12/88-04/19/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
04/19/88-04/26/88	<.009	<.01	<.01	<.01	<.02	<.02	<.02	<.02
04/26/88-05/03/88	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
MAY								
05/03/88-05/10/88	<.03	<.03	<.03	<.03	<.01	<.01	<.01	<.01
05/10/88-05/17/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
05/17/88-05/24/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
05/24/88-05/31/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
JUNE								
05/31/88-06/07/88	<.01	<.02	<.02	<.02	<.01	<.01	<.01	<.01
06/07/88-06/14/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
06/14/88-06/21/88	<.02	<.02	<.02	<.1 (a)	<.05 (b)	<.02	<.02	<.02
06/21/88-06/28/88	<.02	<.03	<.02	<.02	<.02	<.02	<.02	<.02

(a) LLD not met due to power outage; low volume.
(b) Power outage; low volume.

TABLE 4

(Page 3 of 4)

VIRGINIA POWER - SURRY - 1988

CONCENTRATIONS OF IODINE-131 IN FILTERED AIR

pCi/m3 ± 2 Sigma

STATIONS COLLECTION DATE	SS	HIR	BC	ALL	CP	DOW	FE	NN
JULY								
06/28/88-07/05/88	<.02	<.02	<.02	<.02	<.01	<.01	<.01	<.01
07/05/88-07/12/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
07/12/88-07/19/88	<.01	<.02	<.01	<.02	<.01	<.01	<.01	<.01
07/19/88-07/26/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
07/26/88-08/02/88	<.01	<.01	<.01	<.02	<.02	<.02	<.02	<.02
AUGUST								
08/02/88-08/09/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
08/09/88-08/16/88	<.02	<.02	<.02	<.03	<.02	<.02	<.02	<.02
08/16/88-08/23/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.01
08/23/88-08/29/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
SEPTEMBER								
08/29/88-09/06/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
09/06/88-09/13/88	<.01	<.01	<.01	<.01	<.02	<.02	<.02	<.02
09/13/88-09/20/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
09/20/88-09/27/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02

TABLE 4

(Page 4 of 4)

VIRGINIA POWER - SURRY - 1988

CONCENTRATIONS OF IODINE-131 IN FILTERED AIR

pCi/m3 ± 2 Sigma

STATIONS COLLECTION DATE	SS	HIR	BC	ALL	CP	DOW	FE	NN
OCTOBER								
09/27/88-10/04/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
10/04/88-10/11/88	<.02	<.02	<.02	<.03	<.02	<.02	<.02	<.02
10/11/88-10/18/88	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
10/18/88-10/25/88	<.01	<.02	<.01	<.01	<.02	<.02	<.02	<.02
10/25/88-11/02/88	<.02	<.02	<.02	<.02	<.01	<.01	<.01	<.01
NOVEMBER								
11/02/88-11/08/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
11/08/88-11/15/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
11/15/88-11/22/88	<.05	<.03	<.02	<.02	<.03	<.03	<.03	<.03
11/22/88-11/29/88	<.02	<.03	<.02	<.02	<.01	<.01	<.01	<.01
DECEMBER								
11/29/88-12/06/88	<.01	<.01	<.01	<.01	<.01	<.01	<.03	<.01
12/06/88-12/13/88	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02
12/13/88-12/20/88	<.02	<.03	<.03	<.02	<.02	<.02	<.02	<.02
12/20/88-12/27/88	<.01	<.02	<.02	<.02	<.01	<.01	<.01	<.01
12/27/88-01/03/89	<.02	<.02	<.02	<.02	<.009	<.009	<.009	<.009

TABLE 5

(Page 1 of 4)

VIRGINIA POWER - SURRY 1988

CONCENTRATIONS OF GROSS BETA IN AIR PARTICULATES

10^{-3} pCi/m3 ± 2 Sigma

STATION COLLECTION DATE	SS	HIR	BC	ALL	CP	DOW	FE	NN	Average ± 2 s.d
JANUARY									
12/29/87-01/05/88	16 ± 2	16 ± 2	22 ± 2	24 ± 2	19 ± 2	20 ± 2	19 ± 2	19 ± 2	19 ± 5
01/05/88-01/12/88	25 ± 2	29 ± 2	22 ± 2	26 ± 2	27 ± 2	22 ± 2	22 ± 2	25 ± 2	25 ± 5
01/12/88-01/19/88	15 ± 2	16 ± 2	20 ± 2	20 ± 2	17 ± 2	17 ± 2	19 ± 2	17 ± 2	18 ± 4
01/19/88-01/26/88	14 ± 2	14 ± 2	18 ± 2	16 ± 2	15 ± 2	16 ± 2	16 ± 2	16 ± 2	16 ± 3
01/26/88-02/02/88	20 ± 2	20 ± 2	24 ± 2	24 ± 2	21 ± 2	24 ± 2	20 ± 2	23 ± 2	22 ± 4
FEBRUARY									
02/02/88-02/09/88	14 ± 2	17 ± 2	21 ± 2	15 ± 2	20 ± 2	18 ± 2	18 ± 2	18 ± 2	18 ± 5
02/09/88-02/16/88	18 ± 2	21 ± 2	27 ± 2	23 ± 2	18 ± 2	25 ± 2	26 ± 2	24 ± 2	23 ± 7
02/16/88-02/23/88	16 ± 2	20 ± 2	22 ± 2	17 ± 2	20 ± 2	17 ± 2	25 ± 2	20 ± 2	20 ± 6
02/23/88-03/01/88	16 ± 2	16 ± 2	21 ± 2	15 ± 2	16 ± 2	15 ± 2	16 ± 2	20 ± 2	17 ± 5
MARCH									
03/01/88-03/08/88	18 ± 2	20 ± 2	21 ± 2	17 ± 2	16 ± 2	19 ± 2	20 ± 2	17 ± 2	19 ± 4
03/08/88-03/15/88	11 ± 2	13 ± 2	18 ± 2	16 ± 2	15 ± 2	12 ± 2	10 ± 2	19 ± 2	14 ± 7
03/15/88-03/22/88	11 ± 2	15 ± 2	14 ± 2	12 ± 2	15 ± 2	15 ± 2	17 ± 2	11 ± 2	14 ± 4
03/22/88-03/29/88	10 ± 1	18 ± 2	18 ± 2	15 ± 2	18 ± 2	20 ± 2	19 ± 2	18 ± 2	17 ± 6
Quarter Average ± 2 s.d.	16 ± 8	18 ± 8	21 ± 6	18 ± 9	18 ± 7	18 ± 7	19 ± 8	19 ± 7	18 ± 3

TABLE 5

(Page 2 of 4)

VIRGINIA POWER - SURRY 1988

CONCENTRATIONS OF GROSS BETA IN AIR PARTICULATES

10^{-3} pCi/m3 ± 2 Sigma

STATION COLLECTION DATE	SS	HIR	BC	ALL	CP	DOW	FE	NN	Average ± 2 s.d
APRIL									
03/29/88-04/05/88	11 ± 2	14 ± 2	21 ± 2	21 ± 2	18 ± 2	17 ± 2	21 ± 2	18 ± 2	18 ± 7
04/05/88-04/12/88	10 ± 1	13 ± 2	13 ± 2	13 ± 2	13 ± 2	11 ± 2	14 ± 2	14 ± 2	13 ± 3
04/12/88-04/19/88	8.6 ± 1.6	12 ± 2	15 ± 2	12 ± 2	13 ± 2	13 ± 2	14 ± 2	15 ± 2	13 ± 4
04/19/88-04/26/88	13 ± 2	15 ± 2	21 ± 2	17 ± 2	15 ± 2	10 ± 1	20 ± 2	17 ± 2	16 ± 7
04/26/88-05/03/88	10 ± 2	12 ± 2	15 ± 2	13 ± 2	12 ± 2	12 ± 2	14 ± 2	14 ± 2	13 ± 3
MAY									
05/03/88-05/10/88	10 ± 2	14 ± 2	14 ± 2	16 ± 2	15 ± 2	14 ± 2	14 ± 2	17 ± 2	14 ± 4
05/10/88-05/17/88	12 ± 2	17 ± 2	15 ± 2	16 ± 2	17 ± 2	19 ± 2	13 ± 2	18 ± 2	16 ± 5
05/17/88-05/24/88	13 ± 2	13 ± 2	17 ± 2	14 ± 2	12 ± 2	16 ± 2	15 ± 2	15 ± 2	14 ± 3
05/24/88-05/31/88	12 ± 2	12 ± 2	15 ± 2	16 ± 2	11 ± 2	14 ± 2	15 ± 2	14 ± 2	14 ± 4
JUNE									
05/31/88-06/07/88	12 ± 2	17 ± 2	20 ± 2	18 ± 2	17 ± 2	18 ± 2	20 ± 2	19 ± 2	18 ± 5
06/07/88-06/14/88	12 ± 2	11 ± 2	24 ± 2	21 ± 2	17 ± 2	20 ± 2	21 ± 2	14 ± 2	18 ± 10
06/14/88-06/21/88	25 ± 2	13 ± 2	22 ± 2	42 ± 9 (a)	24 ± 3 (a)	25 ± 2	24 ± 2	22 ± 2	25 ± 16
06/21/88-06/28/88	15 ± 2	11 ± 2	19 ± 2	21 ± 2	14 ± 2	17 ± 2	18 ± 2	18 ± 2	17 ± 6
Quarter Average ± 2 s.d.	13 ± 8	13 ± 4	18 ± 7	19 ± 15	15 ± 7	16 ± 8	17 ± 7	17 ± 5	16 ± 4

(a) Power outage; low volume.

TABLE 5

(Page 3 of 4)

VIRGINIA POWER - SURRY 1988

CONCENTRATIONS OF GROSS BETA IN AIR PARTICULATES

10^{-3} pCi/m3 ± 2 Sigma

STATION COLLECTION DATE	SS	HIR	BC	ALL	CP	DOW	FE	NN	Average ± 2 s.d
JULY									
06/28/88-07/05/88	12 ± 2	7.3 ± 1.4	12 ± 2	14 ± 2	9.3 ± 1.5	12 ± 2	14 ± 2	11 ± 2	12 ± 5
07/05/88-07/12/88	27 ± 2	11 ± 2	17 ± 2	26 ± 2	26 ± 2	24 ± 2	22 ± 2	25 ± 2	22 ± 11
07/12/88-07/19/88	22 ± 2	9.0 ± 1.6	18 ± 2	20 ± 2	23 ± 2	19 ± 2	20 ± 2	21 ± 2	19 ± 9
07/19/88-07/26/88	5.2 ± 1.3	12 ± 2	13 ± 2	9.6 ± 1.5	9.5 ± 1.5	12 ± 2	14 ± 2	10 ± 2	11 ± 6
07/26/88-08/02/88	24 ± 2	21 ± 2	25 ± 2	24 ± 2	20 ± 2	15 ± 2	24 ± 2	23 ± 2	22 ± 7
AUGUST									
08/02/88-08/09/88	11 ± 2	11 ± 2	12 ± 2	12 ± 2	11 ± 2	9.9 ± 1.4	8.0 ± 1.4	11 ± 2	11 ± 3
08/09/88-08/16/88	11 ± 2	11 ± 2	12 ± 2	10 ± 2	12 ± 2	9.8 ± 1.5	11 ± 2	10 ± 2	11 ± 2
08/16/88-08/23/88	16 ± 2	26 ± 2	20 ± 2	22 ± 2	22 ± 2	19 ± 2	20 ± 2	18 ± 2	20 ± 6
08/23/88-08/29/88	24 ± 2	21 ± 2	23 ± 2	26 ± 2	25 ± 2	21 ± 2	26 ± 2	23 ± 2	24 ± 4
SEPTEMBER									
08/29/88-09/06/88	17 ± 2	14 ± 2	16 ± 2	18 ± 2	24 ± 2	10 ± 2	18 ± 2	14 ± 2	16 ± 8
09/06/88-09/13/88	13 ± 2	18 ± 2	18 ± 2	19 ± 2	17 ± 2	18 ± 2	18 ± 2	18 ± 2	17 ± 4
09/13/88-09/20/88	11 ± 2	18 ± 2	16 ± 2	12 ± 2	17 ± 2	18 ± 2	18 ± 2	23 ± 2	17 ± 8
09/20/88-09/27/88	15 ± 2	19 ± 2	15 ± 2	20 ± 2	15 ± 2	20 ± 2	22 ± 2	20 ± 2	18 ± 6
Quarter Average ± 2 s.d.	16 ± 13	15 ± 11	17 ± 8	18 ± 12	18 ± 12	16 ± 10	18 ± 10	18 ± 11	17 ± 2

TABLE 5

(Page 4 of 4)

VIRGINIA POWER - SURRY 1988

CONCENTRATIONS OF GROSS BETA IN AIR PARTICULATES

10^{-3} pCi/m3 ± 2 Sigma

STATION COLLECTION DATE	SS	HIR	BC	ALL	CP	DOW	FE	NN	Average ± 2 s.d
OCTOBER									
09/27/88-10/04/88	15 ± 2	23 ± 2	26 ± 2	14 ± 2	22 ± 2	20 ± 2	22 ± 2	24 ± 2	21 ± 9
10/04/88-10/11/88	15 ± 2	16 ± 2	19 ± 2	17 ± 2	13 ± 2	19 ± 2	17 ± 2	18 ± 2	17 ± 4
10/11/88-10/18/88	12 ± 2	13 ± 2	21 ± 2	20 ± 2	17 ± 2	20 ± 2	18 ± 2	19 ± 2	18 ± 7
10/18/88-10/25/88	12 ± 2	18 ± 2	17 ± 2	18 ± 2	16 ± 2	17 ± 2	15 ± 2	17 ± 2	16 ± 4
10/25/88-11/02/88	14 ± 1	21 ± 2	23 ± 2	23 ± 2	23 ± 2	23 ± 2	22 ± 2	23 ± 2	22 ± 6
NOVEMBER									
11/02/88-11/08/88	16 ± 2	19 ± 2	26 ± 3	24 ± 2	22 ± 2	25 ± 3	22 ± 2	26 ± 3	23 ± 7
11/08/88-11/15/88	14 ± 2	21 ± 2	23 ± 2	25 ± 2	22 ± 2	24 ± 2	24 ± 2	23 ± 2	22 ± 7
11/15/88-11/22/88	12 ± 2	20 ± 2	21 ± 2	22 ± 2	19 ± 2	21 ± 2	22 ± 2	21 ± 2	20 ± 7
11/22/88-11/29/88	14 ± 2	23 ± 2	23 ± 2	24 ± 2	18 ± 2	25 ± 2	21 ± 2	23 ± 2	21 ± 7
DECEMBER									
11/29/88-12/06/88	13 ± 2	19 ± 2	24 ± 2	25 ± 2	19 ± 2	20 ± 2	28 ± 4	24 ± 2	22 ± 9
12/06/88-12/13/88	20 ± 2	31 ± 3	35 ± 3	32 ± 2	29 ± 2	32 ± 2	33 ± 3	33 ± 3	31 ± 9
12/13/88-12/20/88	16 ± 2	28 ± 3	41 ± 3	32 ± 2	28 ± 2	31 ± 2	22 ± 2	22 ± 2	28 ±15
12/20/88-12/27/88	24 ± 2	25 ± 2	28 ± 2	21 ± 2	22 ± 2	26 ± 2	26 ± 2	30 ± 2	25 ± 6
12/27/88-01/03/89	29 ± 2	32 ± 3	31 ± 2	28 ± 2	25 ± 2	27 ± 2	28 ± 2	29 ± 2	29 ± 4
Quarter Average ± 2 s.d.	16 ± 10	22 ± 11	26 ± 13	23 ± 10	21 ± 9	24 ± 9	23 ± 10	24 ± 9	22 ± 6
Annual Average ± 2 s.d.	15 ± 10	17 ± 11	20 ± 11	20 ± 12	18 ± 10	19 ± 11	19 ± 10	19 ± 10	18 ± 3

TABLE 6

(Page 1 of 2)

VIRGINIA POWER - SURRY - 1988

CONCENTRATIONS OF GAMMA EMITTERS* IN QUARTERLY AIR PARTICULATES

10^{-3} pCi/m^3 ± 2 sigma

STATION	NUCLIDE	FIRST QUARTER 12/29/87-03/29/88	SECOND QUARTER 03/29/88-06/28/88	THIRD QARTER 06/28/88-09/27/88	FOURTH QUARTER 09/27/88-01/03/89	AVERAGE ± 2.s.d.
SS	Be-7	45.3 ± 4.5	67.7 ± 6.8	51.3 ± 5.1	36.8 ± 3.7	50.3 ± 26.1
	K-40	<5	<5	<5	<4	-
	Co-60	<0.3	<0.3	<0.3	<0.3	-
	Cs-134	<0.3	<0.2	<0.2	<0.2	-
	Cs-137	<0.3	<0.3	<0.2	<0.2	-
	Th-228	<0.4	<0.4	<0.4	<0.4	-
HIR	Be-7	65.0 ± 6.5	63.0 ± 6.3	61.4 ± 6.1	54.8 ± 5.5	61.1 ± 8.8
	K-40	<5	<4	4.04 ± 2.30	6.59 ± 2.36	5.32 ± 3.61
	Co-60	<0.2	<0.2	<0.3	<0.2	-
	Cs-134	<0.2	<0.2	<0.3	<0.2	-
	Cs-137	<0.2	<0.2	<0.3	<0.2	-
	Th-228	<0.3	<0.3	<0.4	<0.3	-
BC	Be-7	68.6 ± 6.9	80.7 ± 8.1	62.5 ± 6.3	54.4 ± 5.4	66.6 ± 22.2
	K-40	<6	<6	<4	<6	-
	Co-60	<0.4	<0.3	<0.2	<0.3	-
	Cs-134	<0.3	<0.3	<0.2	<0.3	-
	Cs-137	<0.3	<0.3	<0.2	<0.3	-
	Th-228	<0.5	<0.5	<0.3	<0.5	-
ALL	Be-7	58.4 ± 5.8	74.6 ± 7.5	56.7 ± 5.7	52.9 ± 5.3	60.7 ± 19.2
	K-40	<8	<8	<6	<6	-
	Co-60	<0.4	<0.3	<0.3	<0.2	-
	Cs-134	<0.3	<0.3	<0.3	<0.2	-
	Cs-137	<0.3	<0.3	<0.3	<0.2	-
	Th-228	<0.5	<0.4	<0.5	<0.3	-

* All other gamma emitters were <LLD.

TABLE 6

(Page 2 of 2)

VIRGINIA POWER - SURRY - 1988

CONCENTRATIONS OF GAMMA EMITTERS* IN QUARTERLY AIR PARTICULATES

10^{-3} pCi/m^3 ± 2 sigma

STATION	NUCLIDE	FIRST QUARTER 12/29/87-03/29/88	SECOND QUARTER 03/29/88-06/28/88	THIRD QARTER 06/28/88-09/27/88	FOURTH QUARTER 09/27/88-01/03/89	AVERAGE ± 2.s.d.
CP	Be-7	68.3 ± 6.8	71.9 ± 7.2	59.5 ± 5.9	51.2 ± 5.1	62.7 ± 18.6
	K-40	<3	<4	5.40 ± 2.40	<4	5.40 ± 2.40
	Co-60	<0.2	<0.2	<0.3	<0.2	-
	Cs-134	<0.2	<0.2	<0.3	<0.2	-
	Cs-137	<0.2	<0.2	<0.3	<0.2	-
	Th-228	<0.3	<0.3	<0.4	<0.3	-
DOW	Be-7	67.1 ± 6.7	79.7 ± 8.0	62.9 ± 6.3	56.4 ± 5.6	66.5 ± 19.6
	K-40	<4	<5	<4	<5	-
	Co-60	<0.3	<0.2	<0.2	<0.2	-
	Cs-134	<0.2	<0.2	<0.2	<0.2	-
	Cs-137	<0.2	<0.2	<0.2	<0.2	-
	Th-228	<0.3	<0.4	<0.3	<0.4	-
FE	Be-7	64.4 ± 6.4	86.5 ± 8.7	68.8 ± 6.9	55.7 ± 5.6	68.9 ± 25.9
	K-40	<4	<4	<10	<5	-
	Co-60	<0.2	<0.2	<0.4	<0.2	-
	Cs-134	<0.2	<0.2	<0.4	<0.2	-
	Cs-137	<0.2	<0.2	<0.4	<0.2	-
	Th-228	<0.3	<0.3	<0.5	<0.3	-
NN	Be-7	54.4 ± 5.4	84.5 ± 8.5	69.9 ± 7.0	62.9 ± 6.3	67.9 ± 25.5
	K-40	5.14 ± 2.16	4.65 ± 2.22	<5	<4	4.90 ± 0.7
	Co-60	<0.2	<0.2	<0.3	<0.2	-
	Cs-134	<0.2	<0.2	<0.3	<0.2	-
	Cs-137	<0.2	<0.2	<0.2	<0.2	-
	Th-228	<0.4	<0.4	<0.4	<0.3	-

* All other gamma emitters were <LLD.

B. Waterborne Exposure Pathway

1. River Water

The James River is an estuary near Surry Power Station and undergoes tidal exchange with the Chesapeake Bay. River water samples thus represent saline bay water. Samples of James River water are collected as both monthly grab samples at the Surry Discharge and Scotland Wharf stations and bi-monthly grab samples at the Hog Island Point, Newport News, Chickahominy River, and Surry Intake stations. All the samples were analyzed by gamma spectrometry and for Iodine-131 by a radiochemical procedure. The samples were also composited and analyzed for tritium on a quarterly basis. The results are presented in Table 8. Naturally occurring potassium-40 was measured in sixteen of the samples with an average concentration of 106 pCi/ℓ and a range of 65.1 to 234 pCi/ℓ. No other gamma emitters were detected. Radiochemical analysis of the samples detected no iodine-131 when analyzed to levels well below the required sensitivity (LLD).

Tritium was measured in sixteen out of the twenty-four quarterly composite samples. The average tritium activity for all the indicator stations was 411 pCi/ℓ with a range of 150 to 820 pCi/ℓ. The 820 pCi/ℓ sample (Station Intake) was confirmed by reanalysis. The average tritium activity of Surry Discharge was 450 pCi/ℓ with a range of 420 to 490 pCi/ℓ. For the control stations (Chickahominy and Scotland Wharf) the average concentration was 280 pCi/ℓ with a range of 140 to 440 pCi/ℓ.

Except for the one high sample (820 pCi/ℓ) from the Surry Station Intake location, the tritium activity of the indicator locations compared well with the control locations. All of the samples were analyzed to activity levels well below the required lower level of detection (2000 pCi/ℓ).

Monthly samples of river water are also collected by the Commonwealth of Virginia for the state split sampling program. Results of the gamma spectrometry and tritium analysis on these samples are presented in Table 9. Except for naturally occurring potassium-40, all gamma emitting radionuclides were below their respective lower level of detection. Potassium-40 was measured twelve times with an average activity of 79 pCi/ℓ and a range of 45 to 106 pCi/ℓ. The average tritium activity for the four quarterly samples collected at Surry Discharge location was 613 pCi/ℓ and a range from 120 to 1100 pCi/ℓ.

The attached trend graphs provides a comparison of tritium activity measured in the downstream sample (Surry Discharge) and in the upstream control location (Scotland Wharf). As expected, the grab samples taken from the Surry Discharge Canal by VEPCO personnel measured the discharge of tritium from the station. The average concentration of tritium activity in samples taken from liquid prior to release from the station was 500 pCi/ℓ. This compares well with the average of 613 pCi/ℓ from the state split samples and 450 pCi/ℓ from the VEPCO grab samples of the discharge canal.

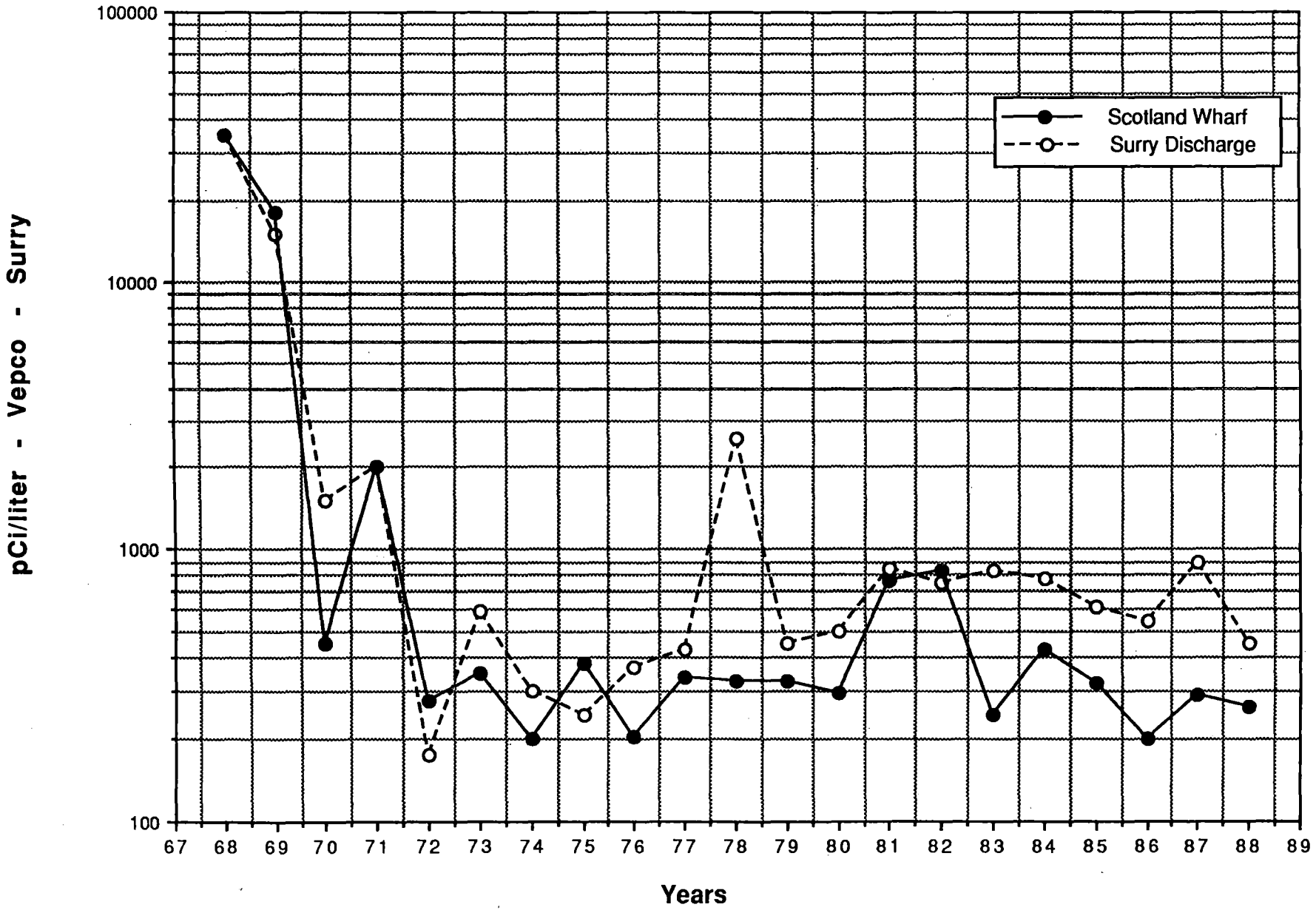
Two additional graphs are provided which draw comparisons with the quarterly tritium results of the state split and VEPCO environmental samples of the Station Discharge and samples taken prior to release. The results from the VEPCO grab samples compare well with the levels of tritium projected from in plant samples except for the fourth quarter results. The state samples which are taken several times during the day and then composited for a quarterly analysis, compared well with the elevated releases made during the fourth quarter.

Variations between the samples may be due to the sampling methodology. The frequency of the composite sampling done for the state split environmental

program should result in a more accurate sample of the environmental discharge of radioactive liquids. Variations may also be the result of the low activity level of the samples. The required lower level of detection for tritium is 2000 pCi/ℓ.

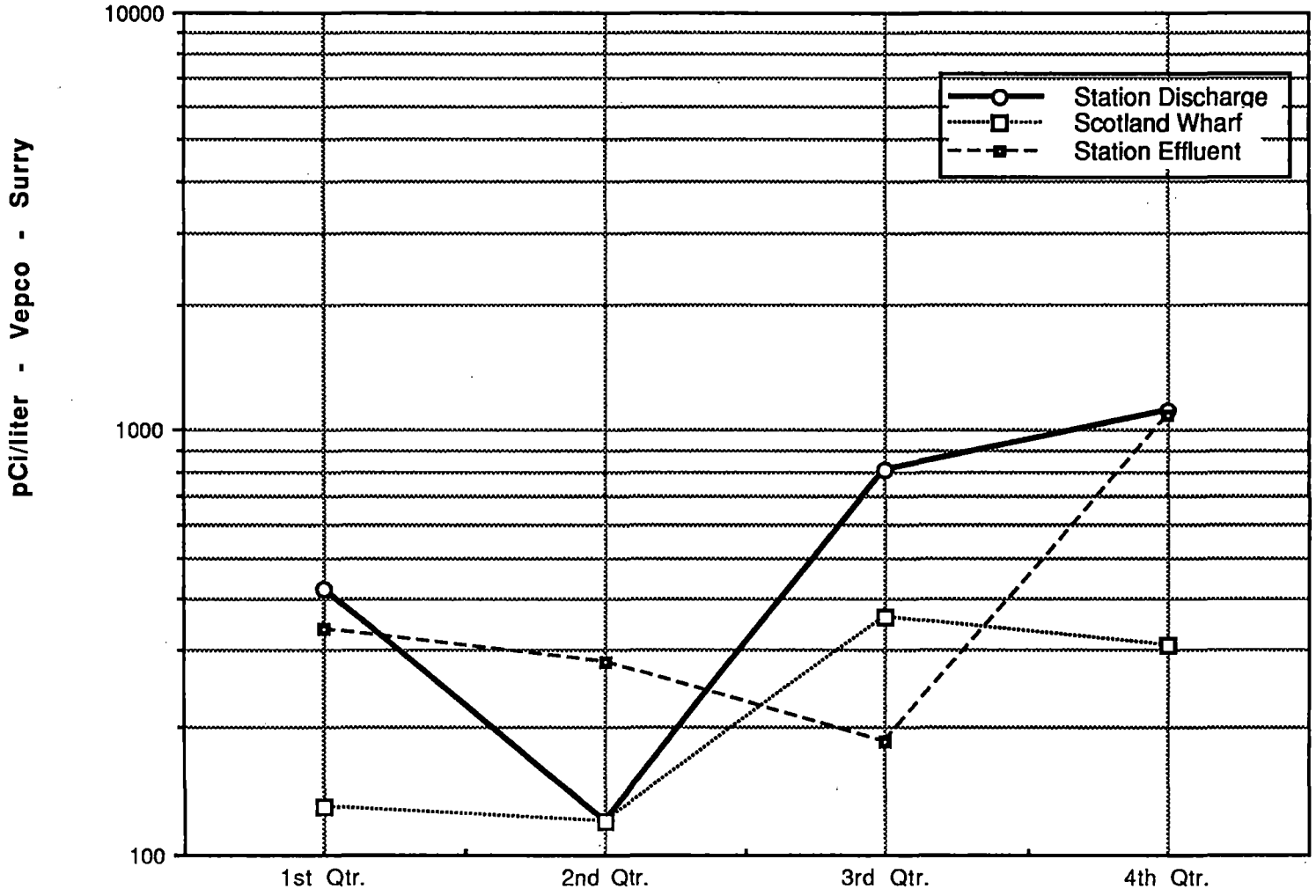
The water in the discharge canal is further diluted by the river water beyond the discharge structure. Excluding the one high sample from the Station Intake location the average tritium concentration in the samples taken downstream of the station (265 pCi/ℓ) compare well with samples taken at the upstream control location (280 pCi/ℓ).

TRITIUM IN RIVER WATER



RIVER WATER TRITIUM-1988

STATE SPLIT VS. STATION EFFLUENT



RIVER WATER TRITIUM-1988
VEPCO VS. STATION EFFLUENT

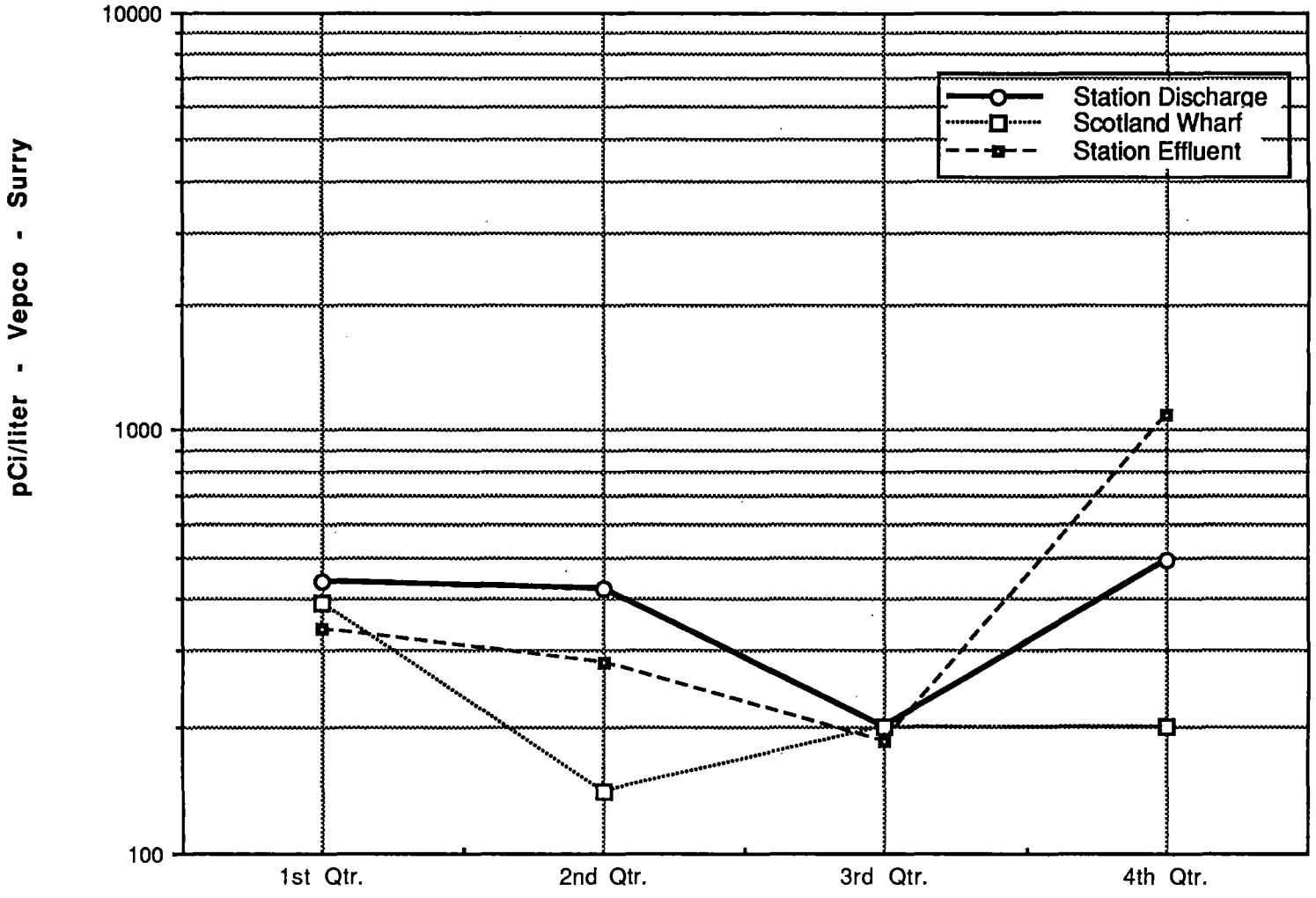


TABLE 7

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SURRY NUCLEAR POWER STATION DOCKET NO. 5-280-281

SURRY COUNTY, VIRGINIA JANUARY 1 to DECEMBER 31, 1988

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED		LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
River Water (a) (pCi/ℓ)	Gamma	48						
	K-40	48	-	107(14/36) (65.1-234)	NN	158(5/6) (70.8-234)	96.0(2/12) (87.0-105)	0
	Tritium (Quarterly)	24	2000	370(12/20) (140-820)	SD	450(3/4) (420-490)	288(4/4) (220-440)	0
River Water (b) pCi/ℓ - State Split	Gamma	24						
	K-40	24	-	79.2(7/12) (60.0-106)	SD	79.2(7/12) (60.0-106)	79.1(5/12) (45.1-103)	0
	Tritium	8	2000	613(4/4) (120-1100)	SD	613(4/4) (120-1100)	267(3/4) (130-360)	0

(1) LLD is lower limit of detection as defined and required in USNRC Branch Technical Position on an Acceptable Radiological Environmental Monitoring Program, Revision 1, November 1979.
(a) Analyses for monthly and bi-monthly samples listed in Table 8.
(b) Monthly State Split analyses presented in Table 9.

TABLE 8

(Page 1 of 3)

VIRGINIA POWER - SURRY - 1988

CONCENTRATIONS OF GAMMA EMITTERS* AND TRITIUM IN RIVER WATER

pCi/ℓ ± 2 Sigma

STATION	DATE	Be-7	K-40	I-131	Cs-137	Ba-140	La-140	TH-228	H-3
JANUARY									
CHIC	01/27/88	<30	71.0 ± 35.6	<0.5	<3	<20	<7	<7	440 ± 90
HIP	01/27/88	<30	<40	<0.4	<3	<20	<7	<6	480 ± 120
NN	01/27/88	<30	<60	<0.4	<4	<20	<8	<6	350 ± 120
SD	01/27/88	<30	<60	<0.4	<4	<20	<7	<7	440 ± 90
SI	01/27/88	<30	<50	<0.6	<3	<20	<8	<6	820 ± 120 (a)
SW	01/27/88	<30	<50	<0.3	<3	<20	<7	<7	390 ± 120
FEBRUARY									
SD	02/16/88	<30	<60	<0.2	<3	<10	<6	<7	
SW	02/16/88	<50	<100	<0.2	<5	<20	<8	<9	
MARCH									
CHIC	03/24/88	<40	<100	<0.2	<5	<20	<6	<9	
HIP	03/17/88	<20	<50	<0.3	<3	<10	<5	<5	
NN	03/17/88	<30	156 ± 44	<0.4	<3	<10	<7	<7	
SD	03/17/88	<40	<70	<0.3	<4	<20	<6	<9	
SI	03/17/88	<40	<100	<0.4	<4	<20	<7	<7	
SW	03/24/88	<40	<90	<0.2	<5	<20	<6	<10	
APRIL									
SD	04/19/88	<30	65.1 ± 26.6	<0.3	<3	<10	<5	<6	
SW	04/19/88	<30	<60	<0.2	<4	<10	<6	<7	

* All other gamma emitters were <LLD.
(a) Confirmed by recount.

TABLE 8

(Page 2 of 3)

VIRGINIA POWER - SURRY - 1988

CONCENTRATIONS OF GAMMA EMITTERS* AND TRITIUM IN RIVER WATER

pCi/ℓ ± 2 Sigma

STATION	DATE	Be-7	K-40	I-131	Cs-137	Ba-140	La-140	TH-228	H-3
MAY									
CHIC	05/12/88	<30	<50	<0.4	<3	<10	<6	<6	220 ± 110
HIP	05/11/88	<30	<60	<0.4	<4	<20	<7	<7	<100
NN	05/11/88	<40	70.8 ± 33.9	<0.4	<4	<20	<6	<10	<100
SD	05/11/88	<30	<50	<0.3	<3	<10	<6	<5	420 ± 110
SI	05/11/88	<30	55.2 ± 24.4	<0.4	<3	<10	<5	<5	150 ± 110
SW	05/12/88	<20	<40	<0.2	<3	<10	<5	<5	140 ± 70
JUNE									
SD	06/21/88	<30	<60	<0.4	<4	<10	<7	<6	
SW	06/21/88	<30	<50	<0.2	<3	<10	<5	<6	
JULY									
CHIC	07/07/88	<40	<90	<0.4	<4	<20	<6	<7	270 ± 80
HIP	07/06/88	<60	<200	<0.4	<7	<20	<10	<10	280 ± 100
NN	07/06/88	<40	135 ± 46	<0.4	<6	<20	<8	<10	<100
SD	07/07/88	<30	<60	<0.4	<3	<10	<6	<6	<200
SI	07/06/88	<70	<200	<0.4	<8	<30	<10	<20	<200
SW	07/07/88	<30	<60	<0.4	<4	<20	<6	<7	<200
AUGUST									
SD	08/16/88	<40	<100	<0.2	<4	<10	<6	<8	
SW	08/16/88	<30	<50	<0.3	<3	<9	<5	<5	

* All other gamma emitters were <LLD.

TABLE 8

(Page 3 of 3)

VIRGINIA POWER - SURRY - 1988

CONCENTRATIONS OF GAMMA EMITTERS* AND TRITIUM IN RIVER WATER

pCi/ℓ ± 2 Sigma

STATION	DATE	Be-7	K-40	I-131	Cs-137	Ba-140	La-140	TH-228	H-3
SEPTEMBER									
CHIC	09/08/88	<30	<60	<0.3	<4	<10	<5	<7	
HIP	09/07/88	<60	<200	<0.2	<6	<30	<10	<10	
NN	09/07/88	<30	194 ± 37	<0.3	<3	<10	<7	<6	
SD	09/08/88	<30	65.4 ± 33.4	<0.3	<4	<10	<5	<7	
SI	09/07/88	<30	80.1 ± 34.8	<0.3	<3	<10	<7	<7	
SW	09/08/88	<40	<100	<0.3	<5	<20	<8	<8	
OCTOBER									
SD	10/18/88	<30	116 ± 33	<0.4	<4	<9	<5	<6	
SW	10/18/88	<20	105 ± 27	<0.3	<3	<10	<5	<5	
NOVEMBER									
CHIC	11/10/88	<40	<80	<0.4	<5	<20	<7	<10	220 ± 80
HIP	11/09/88	<30	88.0 ± 30.9	<0.4	<3	<10	<7	<6	220 ± 120
NN	11/09/88	<30	234 ± 33	<0.5	<3	<10	<5	<5	<200
SD	11/10/88	<30	85.3 ± 30.0	<0.3	<3	<10	<5	<6	490 ± 80
SI	11/09/88	<40	<100	<0.4	<4	<20	<7	<7	260 ± 80
SW	11/10/88	<50	<200	<0.4	<6	<20	<10	<10	<200
DECEMBER									
SD	12/20/88	<20	87.0 ± 29.8	<0.5	<3	<9	<4	<6	
SW	12/20/88	<30	87.0 ± 29.7	<0.3	<4	<10	<4	<6	

* All other gamma emitters were <LLD.

TABLE 9

VIRGINIA POWER - SURRY - 1988

CONCENTRATIONS OF GAMMA EMITTERS* AND TRITIUM IN RIVER WATER

pCi/ℓ ± 2 Sigma - STATE SPLIT

MONTH	COLL. DATES 1988	Be-7	K-40	I-131	Cs-137	Ba-140	La-140	Th-228	H-3
SCOTLAND WH. (SW)									
January	01/15/88	<50	45.1 ± 24.6	<10	<3	<200 (a)	<60 (a)	<6	130 ± 70
February	02/15/88	<40	<50	<5	<3	<60 (a)	<20 (a)	<6	
March	03/15/88	<40	<40	<9	<3	<70 (a)	<30 (a)	<5	
April	04/15/88	<50	<60	<7	<3	<100 (a)	<40 (a)	<7	<120
May	05/15/88	<70	<100	<20 (a)	<5	<200 (a)	<90 (a)	<8	
June	06/15/88	<50	<60	<5	<4	<80 (a)	<40 (a)	<8	
July	07/15/88	<70	97.5 ± 45.0	<4	<6	<100 (a)	<40 (a)	<9	360 ± 130
August	08/15/88	<50	60.4 ± 31.6	<3	<4	<60 (a)	<30 (a)	<8	
September	09/15/88	<50	103 ± 33	<7	<4	<90 (a)	<40 (a)	<7	
October	10/15/88	<40	89.3 ± 32.9	<2	<4	<30 (a)	<20 (a)	<6	310 ± 120
November	11/15/88	<50	<50	<4	<4	<60 (a)	<30 (a)	<6	
December	12/15/88	<30	<60	<4	<3	<40 (a)	<20 (a)	<6	
Average ± 2 s.d.			79.1 ± 50.2						267 ± 242
SURRY DIS. (SD)									
January	01/15/88	<50	63.4 ± 26.1	<10	<3	<100 (a)	<60 (a)	<5	420 ± 80
February	02/15/88	<40	<50	<5	<3	<50 (a)	<30 (a)	<5	
March	03/15/88	<60	<90	<9	<4	<100 (a)	<50 (a)	<8	
April	04/15/88	<40	65.8 ± 26.1	<8	<3	<100 (a)	<50 (a)	<6	120 ± 90
May	05/15/88	<60	<60	<20 (a)	<4	<200 (a)	<70 (a)	<7	
June	06/15/88	<50	77.6 ± 35.0	<5	<4	<90 (a)	<40 (a)	<8	
July	07/15/88	<50	93.3 ± 35.8	<4	<4	<70 (a)	<20 (a)	<8	810 ± 130
August	08/15/88	<40	60.0 ± 28.4	<2	<3	<50 (a)	<20 (a)	<7	
September	09/15/88	<70	<200	<8	<5	<100 (a)	<50 (a)	<9	
October	10/15/88	<40	106 ± 43	<2	<4	<40 (a)	<20 (a)	<7	1100 ± 100
November	11/15/88	<60	<200	<5	<5	<90 (a)	<30 (a)	<8	
December	12/15/88	<40	88.1 ± 26.4	<4	<4	<50 (a)	<20 (a)	<6	
Average ± 2 s.d.			79.2 ± 34.6						613 ± 861

* All other gamma emitters were <LLD.
(a) LLD not met because of late receipt of sample from the State of Virginia.

2. Well Water

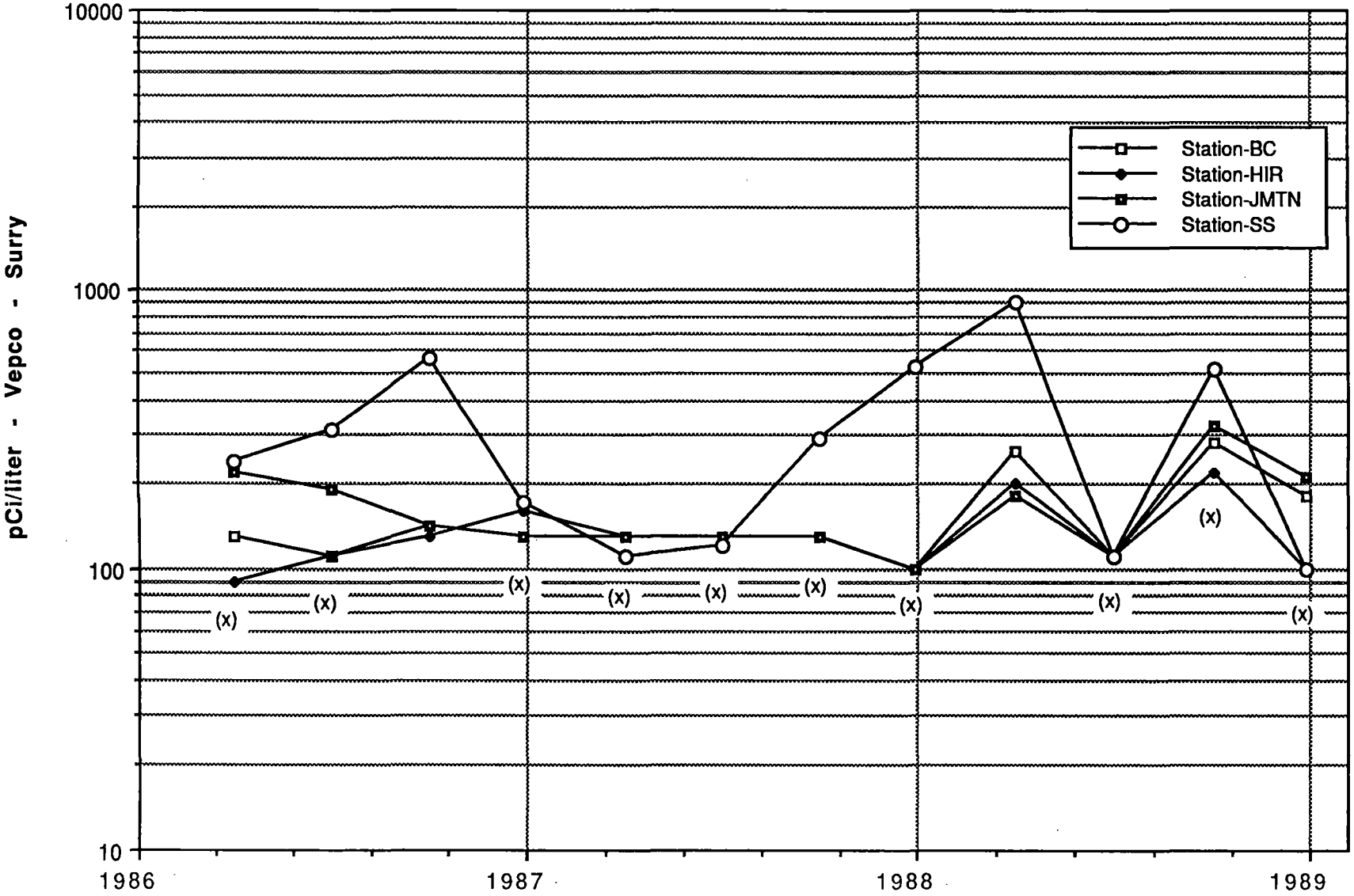
Well water is collected from the four indicator locations during the months of March, June, September and December. Ground water is not considered to be affected by station operations since there are no discharges made to this pathway.

The results of the analysis of well water samples are preseted in Table 11. The samples were analyzed by gamma spectroscopy and indicated that no gamma emitting radionuclides were present. Also, the analysis indicated that no naturally occurring gamma emitting radioisotopes were present. All samples were analyzed to well below the required lower level of detection for gamma emitting radionuclides.

Tritium was measured in ten of the sixteen samples with an average activity of 328 pCi/ℓ and a range of 180 pCi/ℓ to 910 pCi/ℓ. As indicated by the trend graph, the Surry Station sample continues to indicate a higher tritium concentration than the other indicator locations. Large variations between the quarterly samples from the Surry Station indicate higher than normal positive results one quarter, then no positive indication of tritium from the next quarterly sample.

Samples from the other indicator locations indicate results either below the lower limit of detection or positive results above the detection level with a high degree of analysis error. The results from the locations other than the Surry Site indicate very little influence of tritium contamination of ground water.

TRITIUM IN GROUND/WELL WATER



(x) Less than lower limit of detection (LLD)

TABLE 10

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SURRY NUCLEAR POWER STATION DOCKET NO. 5-280-281

SURRY COUNTY, VIRGINIA JANUARY 1 to DECEMBER 31, 1988

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED		LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Well Water (pCi/ℓ)	Tritium	16	2000	328(10/16) (180-910)	SS	715(2/4) (520-910)	NONE	0
	K-40	16	-	-(0/16) -	N/A	N/A	NONE	0

(1) LLD is lower limit of detection as defined and required in USNRC Branch Technical Position on an Acceptable Radiological Environmental Monitoring Program, Revision 1, November 1979.

TABLE 11

VIRGINIA POWER - SURRY-1988

CONCENTRATIONS OF TRITIUM AND GAMMA EMITTERS* IN WELL WATER

pCi/ℓ ± 2 Sigma

DATE	STATION	Be-7	K-40	I-131	Cs-137	Ba-140	La-140	Th-228	H-3
FIRST QUARTER									
03/22/88	BC	<40	<100	<0.2	<5	<20	<7	<9	260 ± 80
03/22/88	HIR	<50	<90	<0.2	<5	<20	<6	<10	200 ± 110
03/22/88	JMTN	<30	<50	<0.2	<3	<10	<6	<6	180 ± 110
03/22/88	SS	<30	<60	<0.2	<4	<10	<5	<7	910 ± 80
SECOND QUARTER									
06/21/88	BC	<30	<60	<0.2	<3	<20	<8	<7	<110
06/21/88	HIR	<40	<100	<0.2	<5	<20	<8	<8	<110
06/21/88	JMTN	<50	<80	<0.2	<5	<20	<9	<10	<110
06/21/88	SS	<30	<50	<0.2	<3	<10	<6	<6	<110
THIRD QUARTER									
09/20/88	BC	<50	<100	<0.2	<6	<20	<9	<10	280 ± 80
09/20/88	HIR	<60	<200	<0.2	<7	<20	<8	<10	220 ± 120
09/20/88	JMTN	<40	<100	<0.2	<5	<20	<6	<9	320 ± 130
09/20/88	SS	<30	<50	<0.3	<4	<10	<6	<6	520 ± 80
FOURTH QUARTER									
12/20/88	BC	<40	<80	<0.2	<4	<10	<6	<10	180 ± 80
12/20/88	HIR	<30	<50	<0.2	<4	<10	<4	<6	<100
12/20/88	JMTN	<30	<80	<0.2	<4	<10	<4	<7	210 ± 80
12/21/88	SS	<30	<50	<0.2	<3	<9	<4	<6	<100

* All other gamma emitters were <LLD.

C. Aquatic Exposure Pathway

1. Silt

Silt samples or river sediment were taken to determine the build up of radionuclides in the environment due to the operation of the power station. The activity in the silt comes from the precipitation of radionuclides in the waste discharges and the subsequent dispersion of material by the current. Although the silt itself does not constitute a direct dose pathway for humans, the concentration of radionuclides on the river bottom provides a good indication of the dispersion effects of discharge to the river. Buildup of radionuclides in silt may indirectly lead to increasing activity levels in clams, oysters and fish.

Silt samples were collected semiannually during March and September from each of six locations. A dredge is used to collect each sample from approximately the same location and is washed thoroughly after each use. The samples are individually bagged and analyzed by gamma spectroscopy. The results are presented in Table 13.

A number of man-made and naturally occurring radioisotopes were measured. At the indicator sample locations cobalt-58 was measured with an average activity of 62.4 pCi/kg (dry weight) and a range of 46.1 to 78.6 pCi/kg (dry weight). There was no cobalt-58 measured at the control location (Chickahominy).

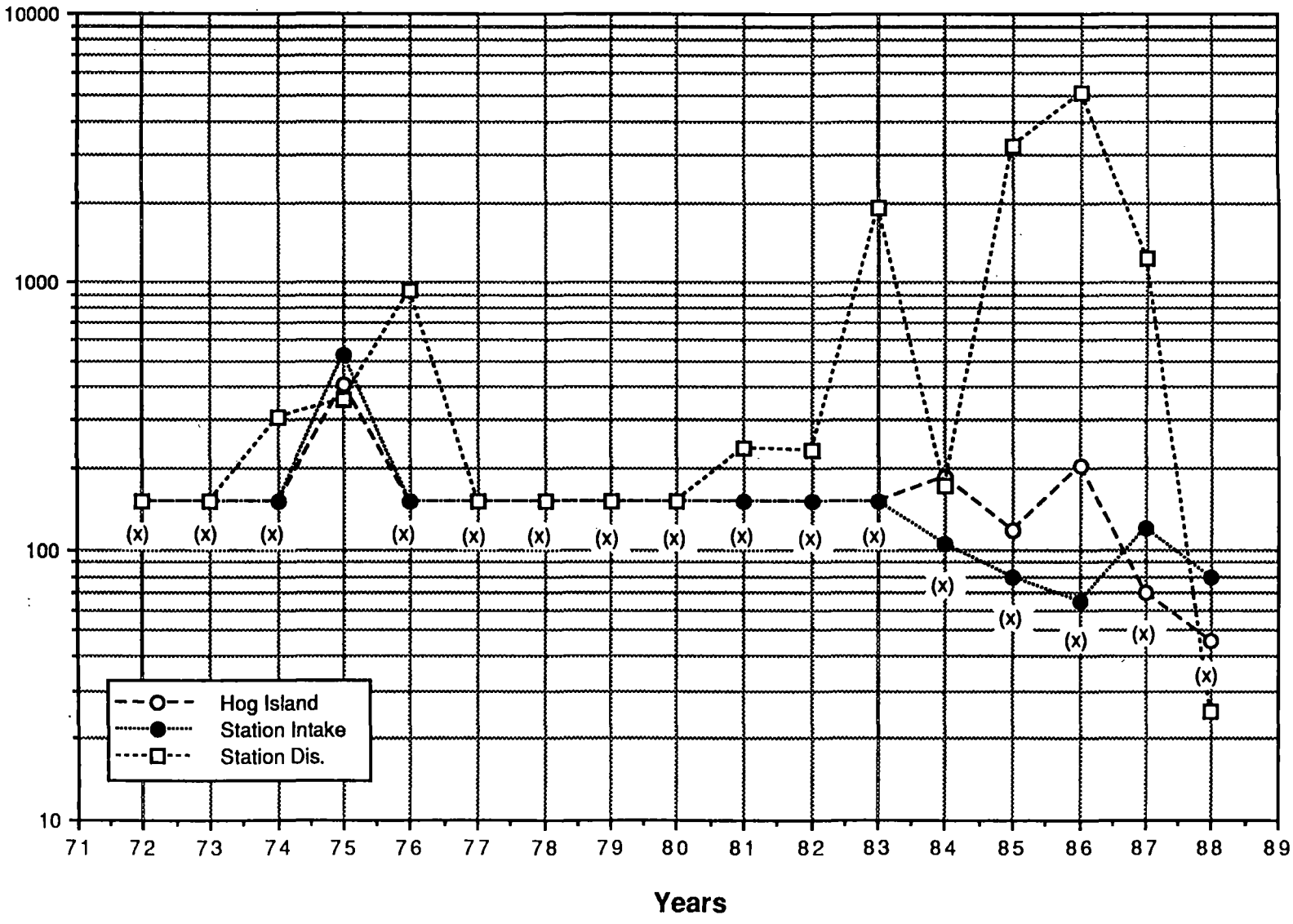
Cobalt-60 was measured in the two samples at the control station, Chickahominy, with an average activity of 244 pCi/kg (dry weight) and a range of 218 to 269 pCi/kg (dry weight). The indicator locations measured cobalt-60 at an average of 349 pCi/kg (dry weight) and a range of 81.6 to 728 pCi/kg (dry weight). Samples taken at downstream location Hog Island Point, Surry Intake, Point of Shoals and Newport News indicate the dilution provided by the James River.

Cesium-134 was measured in all locations except Newport News with the highest location at Surry Intake. Cesium-134 was measured in one sample at Surry Intake with an activity of 134 pCi/kg (dry weight).

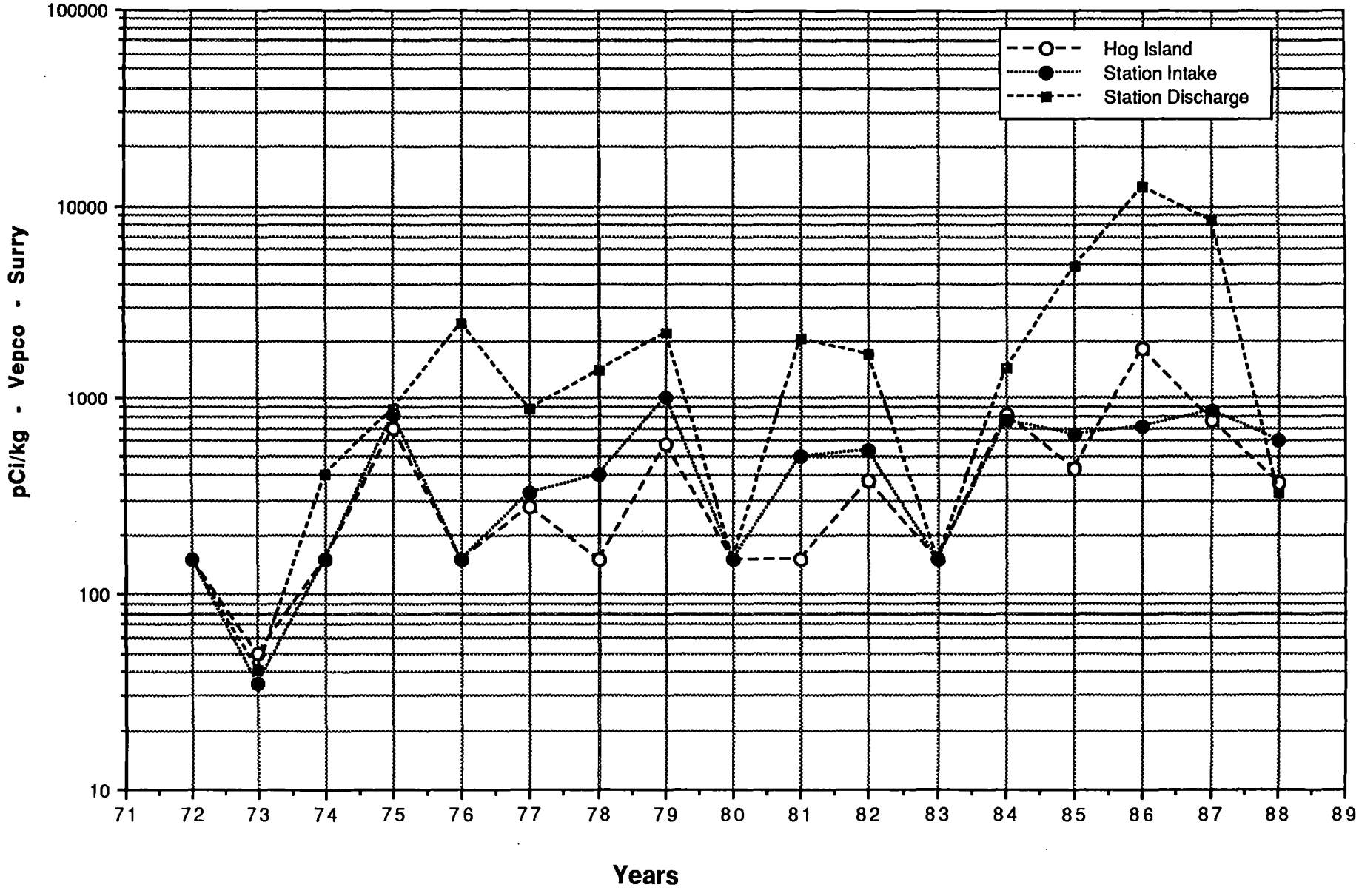
Cesium-137 was measured in all samples, with the highest activity at Surry Intake. The average at this location was 827 pCi/kg (dry weight) and a range of 707 to 946 pCi/kg (dry weight). The average from the ten indicator samples was 461 pCi/kg (dry weight) and a range of 88.9 to 946 pCi/kg (dry weight). The average from the control location (CHIC) was 776 pCi/kg (dry weight) with a range of 743 to 808 pCi/kg (dry weight).

The results of analysis of the samples as presented in the trend graphs, indicate that all the man made radionuclides show a decreasing trend. The decrease was most notable in the Surry Discharge samples. This correlates well with the declining radionuclide activity in the station effluent samples. Data from the semiannual Radioactive Effluent Report indicates that the activity in the 1988 liquid effluent was approximately half the activity of the 1987 liquid effluent.

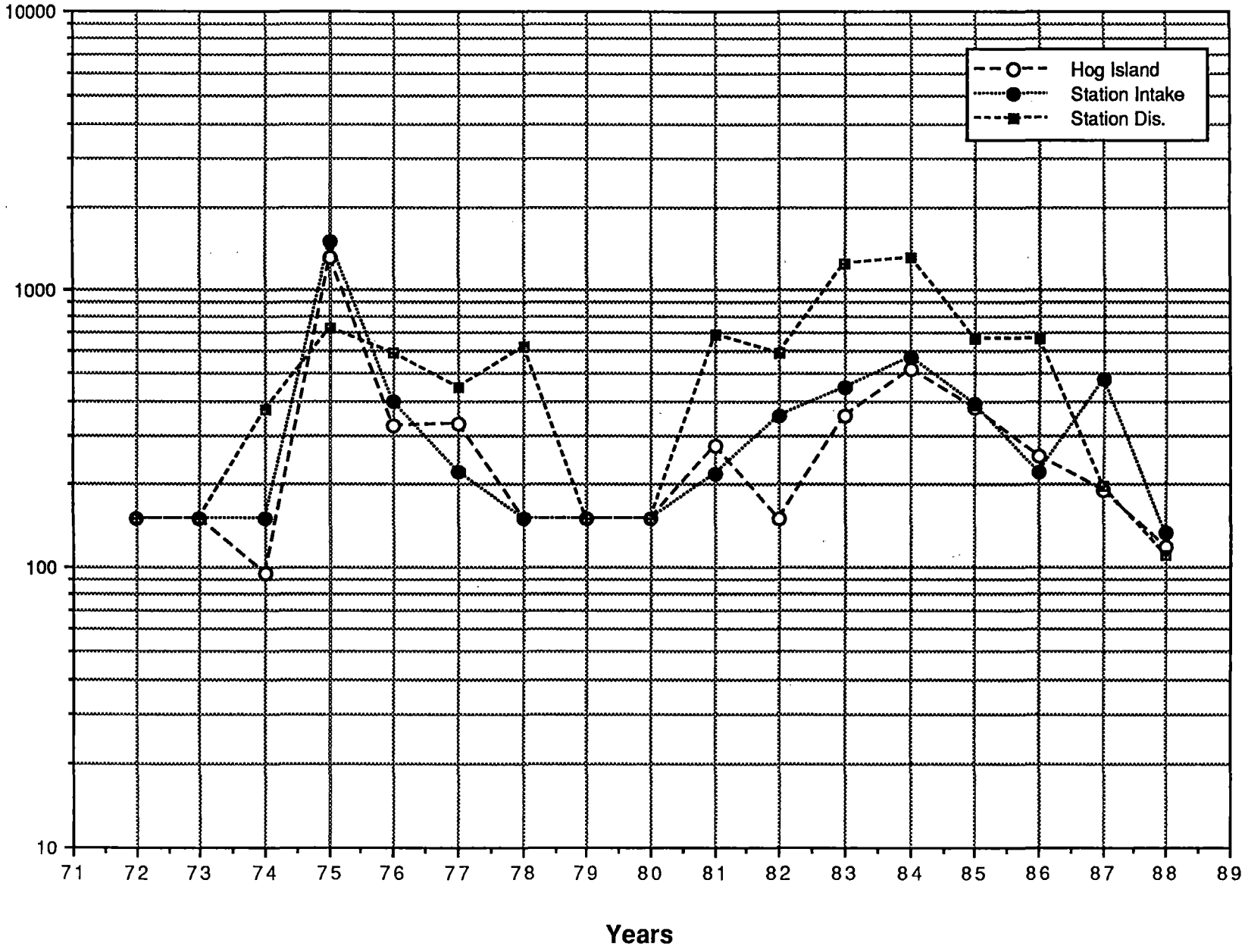
COBALT-58 IN SILT



COBALT-60 IN SILT



CESIUM-134 IN SILT



CESIUM-137 IN SILT

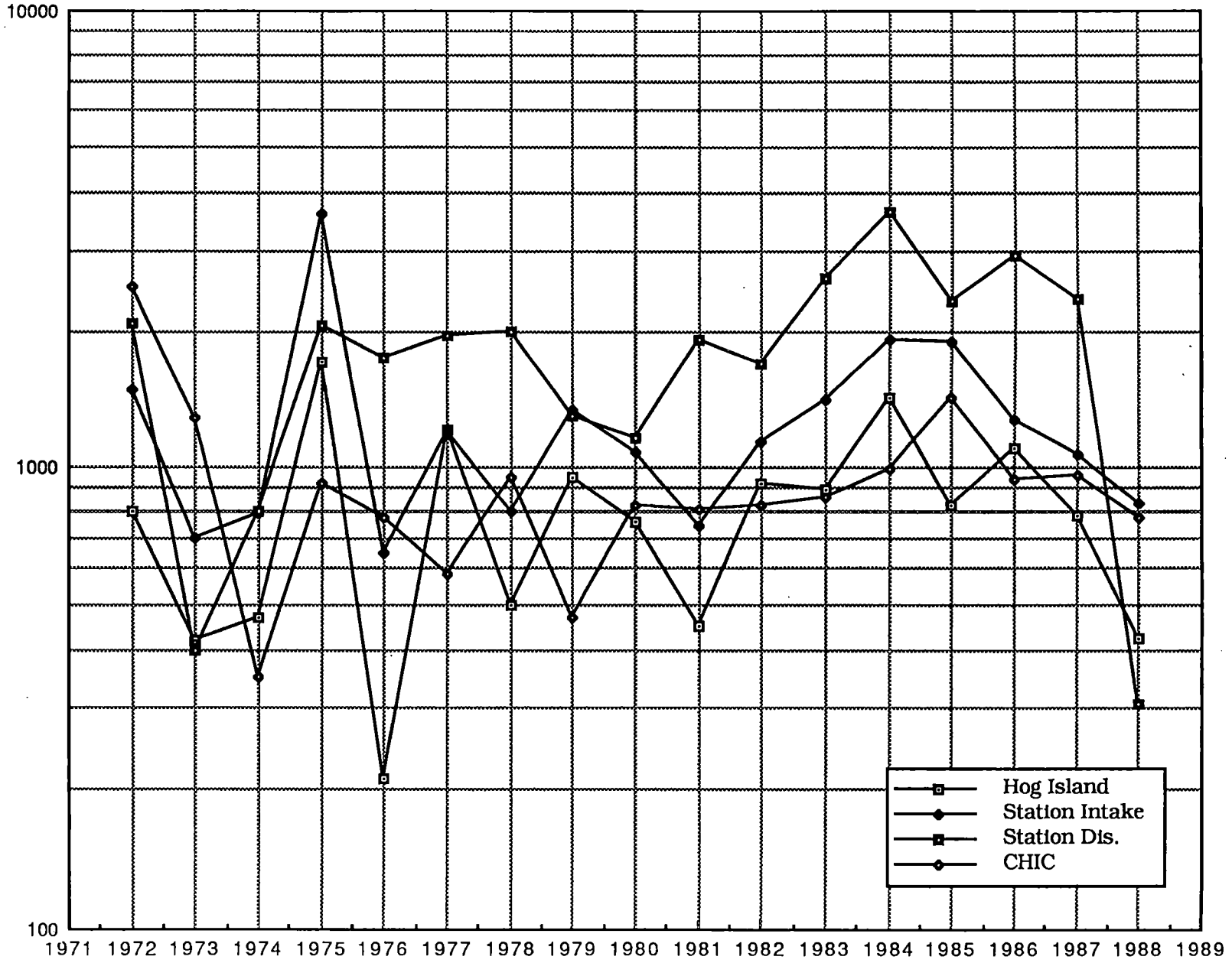


TABLE 12

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SURRY NUCLEAR POWER STATION — DOCKET NO. 5-280-281

SURRY COUNTY, VIRGINIA — JANUARY 1 to DECEMBER 31, 1988

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED		LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Silt (pCi/kg dry)	Gamma Spec	12						
	Be-7	12	-	1139(5/10) (463-2260)	SI	1491(2/2) (722-2260)	549(1/2) -	0
	K-40	12	-	11927(10/10) (4730-16400)	SI	15100(2/2) (14800-15400)	14850(2/2) (14100-15600)	0
	Co-58	12	-	62.4(2/10) (46.1-78.6)	SI	78.6(1/2) -	-(0/2) -	0
	Co-60	12	-	349(10/10) (81.6-728)	SI	604(2/2) (480-728)	244(2/2) (218-269)	0
	Cs-134	12	150	121(4/10) (110-134)	SI	134(1/2) -	97.9(1/2) -	0
	Cs-137	12	180	461(10/10) (88.9-946)	SI	827(2/2) (707-946)	776(2/2) (743-808)	0
	Ra-226	12	-	1669(10/10) (1110-2380)	CHIC	2460(2/2) (2400-2520)	2460(2/2) (2400-2520)	0
	Th-228	12	-	905(10/10) (658-1170)	CHIC	1260(2/2) (1080-1440)	1260(2/2) (1080-1440)	0

(1) LLD is lower limit of detection as defined and required in USNRC Branch Technical Position on an Acceptable Radiological Environmental Monitoring Program, Revision 1, November 1979.

TABLE 13

(Page 1 of 2)

VIRGINIA POWER - SURRY-1988

CONCENTRATIONS OF GAMMA* EMITTERS IN SILT

pCi/kg (dry) ± 2 Sigma

STATION COLLECTION DATE	CHIC 03/24/88	HIP 03/17/88	NN 03/17/88	POS 03/17/88	SD 03/17/88	SI 03/17/88
Be-7	549 ± 194	811 ± 199	<200	1440 ± 270	<200	2260 ± 300
K-40	15600 ± 1600	13000 ± 1300	11700 ± 1200	16400 ± 1600	4730 ± 470	15400 ± 1500
Mn-54	<20	<20	<20	<30	<20	<30
Co-58	<20	46.1 ± 20.4	<20	<30	<20	78.6 ± 25.4
Co-60	218 ± 27	586 ± 59	81.6 ± 19.5	617 ± 62	106 ± 21	728 ± 73
Cs-134	97.9 ± 24.2	119 ± 24	<30	119 ± 27	<20	134 ± 25
Cs-137	808 ± 81	686 ± 69	204 ± 26	801 ± 80	88.9 ± 10.4	946 ± 95
Ra-226	2400 ± 340	1510 ± 360	1300 ± 370	2260 ± 440	1270 ± 280	2380 ± 460
Th-228	1440 ± 140	887 ± 89	658 ± 66	1150 ± 110	906 ± 91	1170 ± 120

* All other gamma emitters were <LLD.

TABLE 13

(Page 2 of 2)

VIRGINIA POWER - SURRY-1988

CONCENTRATIONS OF GAMMA* EMITTERS IN SILT

pCi/kg (dry) ± 2 Sigma

STATION COLLECTION DATE	CHIC 09/08/88	HIP 09/08/88	NN 09/09/88	POS 09/09/88	SD 09/08/88	SI 09/09/88	Average ± 2 s.d
Be-7	<500	<400	<300	<400	463 ± 235	722 ± 326	1041 ± 1379
K-40	14100 ± 1400	10400 ± 1600	13300 ± 1300	11500 ± 1200	8040 ± 800	14800 ± 1500	12414 ± 6828
Mn-54	<40	<40	<30	<30	<30	<40	-
Co-58	<50	<50	<30	<40	<30	<40	62.4 ± 46
Co-60	269 ± 43	145 ± 40	104 ± 29	98.9 ± 28.8	547 ± 55	480 ± 48	332 ± 483
Cs-134	<50	<40	<30	<40	110 ± 27	<50	116 ± 27
Cs-137	743 ± 74	165 ± 36	356 ± 39	137 ± 33	522 ± 52	707 ± 71	514 ± 615
Ra-226	2520 ± 630	1110 ± 460	1390 ± 370	1380 ± 510	1850 ± 410	2240 ± 530	1801 ± 1055
Th-228	1080 ± 110	728 ± 73	694 ± 69	842 ± 84	995 ± 100	1020 ± 100	964 ± 454

* All other gamma emitters were <LLD.

2. Shoreline Sediment

Unlike river bottom silt, the shoreline sediment can provide a direct dose to humans. Buildup of radionuclides along the shoreline may provide a source of direct exposure for those using the shoreline for commercial or recreational purposes. Samples were taken in February and August at Hog Island Reserve and Burwell's Bay. The samples were analyzed by gamma spectroscopy. The results are presented in Table 15.

The analytical results indicated the predominance of three naturally occurring radioisotopes. Potassium-40 was measured in all samples at an average concentration of 4170 pCi/kg (dry weight) and a range of 2450 to 5900 pCi/kg (dry weight). Radium-226 was measured in two of the four samples with an average concentration of 426 pCi/kg (dry weight) and a range of 394 to 458 pCi/kg (dry weight). Thorium-228 was also measured in two samples with an average of 80.0 pCi/kg (dry weight) and a range of 75.4 to 84.6 pCi/kg (dry weight). Cesium-137 was the only manmade isotope found and was measured in one sample from Burwell's Bay. The activity of the sample was 16.3 pCi/kg (dry weight).

The sample results for cesium-137 are lower than in previous years and indicate a downward trend in activity. The lower values in the shoreline samples correlates well with the decreasing trends in the river bottom silt and in the activity released in the station effluents.

TABLE 14

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SURRY NUCLEAR POWER STATION DOCKET NO. 5-280-281

SURRY COUNTY, VIRGINIA JANUARY 1 to DECEMBER 31, 1988

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED		LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Shoreline Sediment (pCi/kg dry)	Gamma Spec	4						
	K-40	4		4170(4/4) (2450-5900)	HIR	5535(2/2) (5170-5900)	NONE	0
	Cs-137	4	180	16.3(1/4) -	BURNELL'S	16.3(1/2) -	NONE	0
	Ra-226	4		426(2/4) (394-458)	BURWELL'S	426(2/2) (394-458)	NONE	0
	Th-228	4		80.0(2/4) (75.4-84.6)	HIR	84.6(1/2) -	NONE	0

(1) LLD is lower limit of detection as defined and required in USNRC Branch Technical Position on an Acceptable Radiological Environmental Monitoring Program, Revision 1, November 1979.

TABLE 15

VIRGINIA POWER - SURRY-1988

CONCENTRATIONS OF GAMMA EMITTERS* IN SHORELINE SEDIMENT

pCi/kg (dry) ± 2 Sigma

STATION COLLECTION DATE	HIR 02/23/88	BURWELL'S 02/23/88	HIR 08/23/88	BURWELL'S 08/23/88	AVERAGE ± 2.s.d.
Be-7	<100	<70	<100	<100	-
K-40	5170 ± 520	3160 ± 320	5900 ± 590	2450 ± 240	4170 ± 3260
Co-60	<10	<8	<10	<20	-
Cs-134	<10	<8	<10	<10	-
Cs-137	<10	16.3 ± 8.0	<10	<20	16.3 ± 8.0
Ra-226	<200	394 ± 147	<200	458 ± 224	426 ± 91
Th-228	<20	75.4 ± 7.7	84.6 ± 8.5	<30	80.0 ± 13.0

* All other gamma emitters searched for were <LLD.

D Ingestion Exposure Pathway

1. Milk

Milk samples are an important indicator for measuring the affect of radioactive iodine in particular, and other radionuclides in airborne releases from the power station. The dose consequence to man is from both a direct and indirect exposure pathway. The direct exposure pathway is from the inhalation of radioactive material. The indirect exposure pathway is from the grass-cow-milk pathway. In this pathway radioactive material is desposited on the plants consumed by the dairy animals. The radioactive material is in turn passed on to man via the milk.

The results of iodine-131 and gamma analysis of milk samples are presented in Table 17. A total of 60 analyses were performed, 48 from indicator locations and 12 from the control location. Iodine was not detected in any of the sixty samples, therefore, a lower limit of detection 0.5 pCi/ℓ or better was achieved in all samples.

Naturally occurring potassium-40 was detected in all samples. The average for the control location (WMS) was 1300 pCi/ℓ and the range was 1140 to 1460 pCi/ℓ. The average measurement for the 48 indicator samples was 1347 pCi/ℓ with a range of 1020 to 1570 pCi/ℓ.

Cesium-137 continues to be detected on an occasional, infrequent basis. This is very consistent with historical data and does not indicate a positive trend. Cesium-137 has typically been detected since 1983, in one to four out of sixty samples obtained and found to be in the range of 5.2 to 9.8 pCi/ℓ. The data from 1988 identified two samples with an average activity of 7.5 pCi/ℓ and a range of 6.3 to 8.8

pCi/ℓ. These results are very close to the lower level of detection and are well below the required detection level of 18 pCi/ℓ. This occasional detection of cesium-137 may be attributable to past atmospheric atomic weapons testing (global fallout) rather than station operation.

The twelve milk samples collected in participation with the state split sampling program, Lee Hall, Epps and Colonial Parkway were also analyzed for strontium-89 and strontium-90. Strontium-89 was not detected in any of the samples. Strontium-90 was observed in ten of the twelve indicator milk samples with an average activity of 2.45 pCi/ℓ and a range of 0.71 to 4.5 pCi/ℓ. During the preoperational radiological monitoring program for Surry Power station, strontium-90 was detected in milk samples in the range of 5.2 to 13 pCi/ℓ.

TABLE 16

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SURRY NUCLEAR POWER STATION DOCKET NO. 5-280-281

SURRY COUNTY, VIRGINIA JANUARY 1 to DECEMBER 31, 1988

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED		LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Milk (pCi/ℓ)	Gamma Spec	60						
	K-40	60	-	1347(48/48) (1020-1570)	CP	1403(12/12) (1270-1570)	1300(12/12) (1140-1460)	0
	I-131	60	1	-(0/48) -	N/A	N/A	-(0/12) -	0
	Cs-137	60	10	7.53(2/48) (6.30-8.76)	CP	8.76(1/12) -	-(0/12) -	0
	Sr-89	12	-	-(0/12) -	N/ A	N/A	-(0/0) -	0
	Sr-90	12	-	2.50(10/12) (0.71-4.5)	LEE HALL	2.5(3/4) (0.64-4.5)	-(0/0) -	0

(1) LLD is lower limit of detection as defined and required in USNRC Branch Technical Position on an Acceptable Radiological Environmental Monitoring Program, Revision 1, November 1979.

TABLE 17

(Page 1 of 3)

VIRGINIA POWER - SURRY - 1988

CONCENTRATIONS OF STRONTIUM-89 AND -90 AND GAMMA EMITTERS** IN MILK

pCi/ℓ ± 2 sigma

MONTH	NUCLIDE	LEE HALL*	EPPS*	CP	WMS	JDKS
JANUARY	Sr-89	<2 (a)	<2 (a)	<2 (a)		
	Sr-90	0.64 ± 0.36 (a)	2.4 ± 0.6 (a)	2.9 ± 0.6 (a)		
	K-40	1290 ± 130	1060 ± 110	1320 ± 130	1230 ± 120	1310 ± 130
	Cs-137	<4	<5	<4	<6	6.30 ± 3.14
	I-131	<0.2	<0.3	<0.2	<0.3	<0.2
FEBRUARY	Sr-89					
	Sr-90					
	K-40	1370 ± 140	1200 ± 120	1290 ± 130	1250 ± 120	1350 ± 130
	Cs-137	<6	<4	<4	<4	<4
	I-131	<0.2	<0.3	<0.2	<0.2	<0.3
MARCH	Sr-89					
	Sr-90					
	K-40	1020 ± 100	1350 ± 140	1370 ± 140	1250 ± 130	1170 ± 120
	Cs-137	<7	<4	<4	<4	<6
	I-131	<0.2	<0.3	<0.3	<0.3	<0.3
APRIL	Sr-89	<6 (a)	<5 (a)	<3 (a)		
	Sr-90	<2 (a)	0.73 ± 0.51 (a)	<0.9 (a)		
	K-40	1340 ± 130	1500 ± 150	1330 ± 130	1260 ± 130	1310 ± 130
	Cs-137	<4	<4	<4	<4	<4
	I-131	<0.3	<0.3	<0.3	<0.2	<0.2

* State split

** All other gamma emitters were LLD.

(a) Strontium-89 and 90 sample analysis done on a quarterly composite of state split samples and Colonial Parkway(CP) sample at the request of the State of Virginia.

TABLE 17

(Page 2 of 3)

VIRGINIA POWER - SURRY - 1988

CONCENTRATIONS OF STRONTIUM-89 AND -90 AND GAMMA EMITTERS** IN MILK

pCi/ℓ ± 2 sigma

MONTH	NUCLIDE	LEE HALL*	EPPS*	CP	WMS	JDKS
MAY	Sr-89					
	Sr-90					
	K-40	1350 ± 140	1110 ± 110	1280 ± 130	1140 ± 110	1230 ± 120
	Cs-137	<4	<4	<4	<4	<6
	I-131	<0.3	<0.3	<0.3	<0.3	<0.3
JUNE	Sr-89					
	Sr-90					
	K-40	1430 ± 140	1510 ± 150	1570 ± 160	1360 ± 140	1330 ± 130
	Cs-137	<4	<4	<4	<4	<4
	I-131	<0.3	<0.3	<0.3	<0.2	<0.3
JULY	Sr-89	<10 (a)	<1 (a)	<2 (a)		
	Sr-90	2.2 ± 1.3 (a)	0.71 ± 0.48 (a)	2.3 ± 1.0 (a)		
	K-40	1450 ± 150	1460 ± 150	1570 ± 160	1280 ± 130	1320 ± 130
	Cs-137	<6	<6	<4	<6	<5
	I-131	<0.3	<0.3	<0.3	<0.3	<0.3
AUGUST	Sr-89					
	Sr-90					
	K-40	1480 ± 150	1350 ± 140	1370 ± 140	1350 ± 130	1330 ± 130
	Cs-137	<5	<5	<5	<4	<4
	I-131	<0.3	<0.3	<0.3	<0.3	<0.4

* State split
** All other gamma emitters were LLD.
(a) Strontium-89 and 90 sample analysis done on a quarterly composite of state split samples and Colonial Parkway(CP) sample at the request of the State of Virginia.

TABLE 17

(Page 3 of 3)

VIRGINIA POWER - SURRY - 1988

CONCENTRATIONS OF STRONTIUM-89 AND -90 AND GAMMA EMITTERS** IN MILK

pCi/ℓ ± 2 sigma

MONTH	NUCLIDE	LEE HALL*	EPPS*	CP	WMS	JDKS
SEPTEMBER	Sr-89					
	Sr-90					
	K-40	1290 ± 130	1240 ± 120	1270 ± 130	1330 ± 130	1080 ± 110
	Cs-137	<6	<4	<4	<5	<8
	I-131	<0.3	<0.3	<0.2	<0.3	<0.3
OCTOBER	Sr-89	<5 (a)	<2 (a)	<2 (a)		
	Sr-90	4.5 ± 1.8 (a)	0.95 ± 0.69 (a)	1.4 ± 0.6 (a)		
	K-40	1430 ± 140	1400 ± 140	1460 ± 150	1460 ± 150	1420 ± 140
	Cs-137	<4	<4	<6	<4	<5
	I-131	<0.2	<0.2	<0.3	<0.2	<0.2
NOVEMBER	Sr-89					
	Sr-90					
	K-40	1530 ± 150	1390 ± 140	1450 ± 140	1270 ± 130	1420 ± 140
	Cs-137	<5	<5	<4	<4	<5
	I-131	<0.3	<0.2	<0.3	<0.2	<0.2
DECEMBER	Sr-89					
	Sr-90					
	K-40	1440 ± 140	1310 ± 130	1550 ± 160	1420 ± 140	1270 ± 130
	Cs-137	<5	<5	8.76 ± 3.92	<6	<5
	I-131	<0.3	<0.3	<0.3	<0.3	<0.3

* State split
** All other gamma emitters were LLD.
(a) Strontium-89 and 90 sample analysis done on a quarterly composite of state split samples and Colonial Parkway(CP) sample at the request of the State of Virginia.

2. Aquatic Biota

Marine biota can be sensitive indicators of radionuclide accumulation in the environment because of their ability to concentrate certain chemical elements which have radioactive isotopes. Gamma spectrometry was performed on bi-monthly samples of clams and oysters from the James River. The results are shown in Table 19 for clams and Table 20 for oysters. As expected, naturally occurring potassium-40 was the nuclide most frequently detected.

For the clam samples the average potassium-40 activity was 583 pCi/kg (wet weight) and a range from 255 to 1060 pCi/kg (wet weight). Cobalt-60 was measured in two samples (one from Surry Discharge and one from Hog Island Point) with an average activity of 39.1 pCi/kg (wet weight) and a range of 21.1 to 57.1 pCi/kg (wet weight). The activity measured in the 1983 through 1987 clam samples taken at the same locations is comparable with the 1988 results.

Cesium-137 was measured in one sample from Surry Discharge with an activity of 14.2 pCi/kg (wet weight). This positive result was well below the required lower level of detection (LLD) and compared well to samples taken in recent years. Cesium-137 was not detected in any of the other samples from the indicator locations.

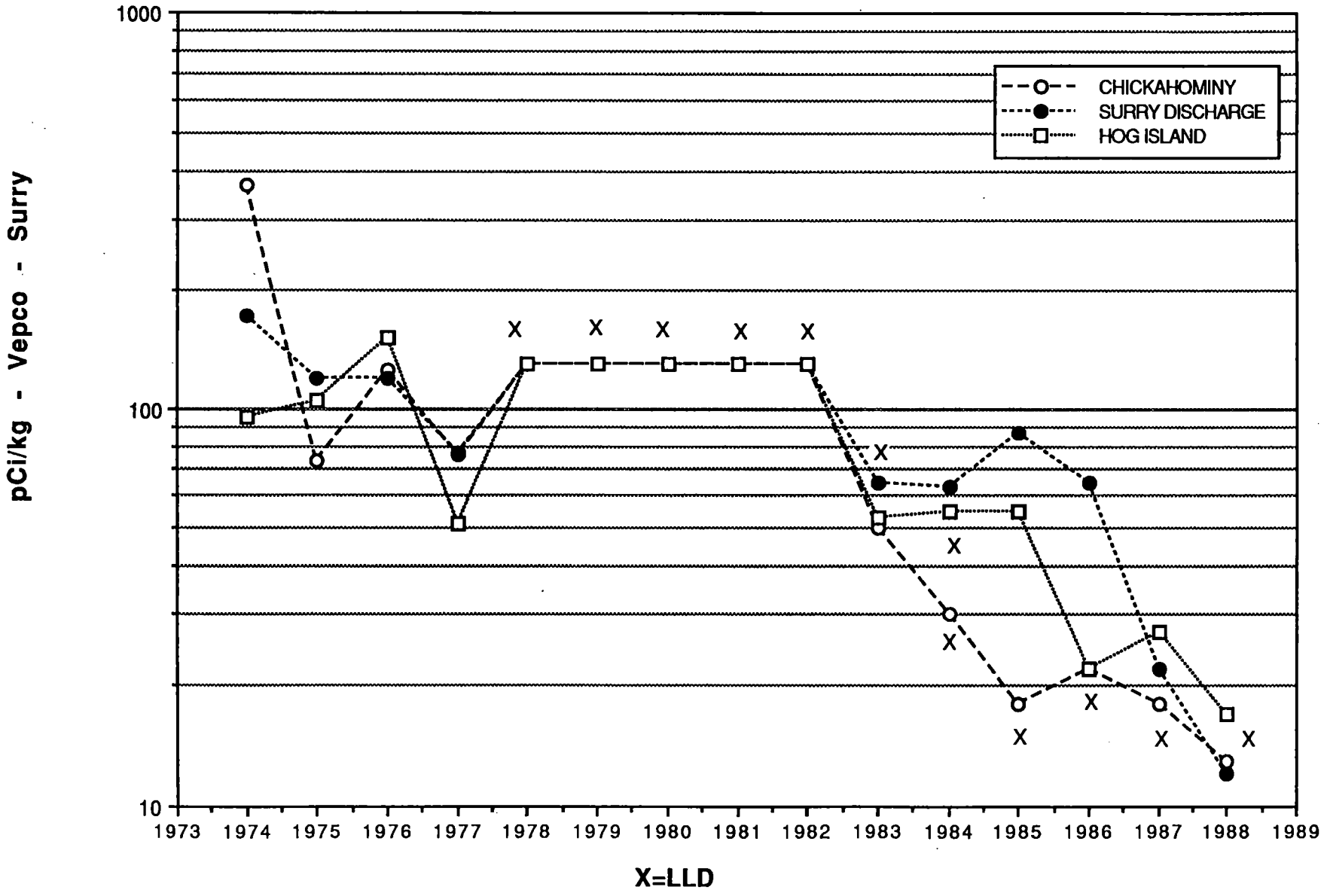
No other gamma emitting isotopes, attributable to plant discharges, were detected in any of the samples. An overall decreasing trend of activity in the clam population is evident from the trend graphs provided.

For oyster samples the average potassium-40 activity for 15 of the 17 samples was 666 pCi/kg (wet weight) with a range of 400 to 916 pCi/kg (wet weight). This was lower than activity measured in 1987. All other gamma emitters were well below the required LLDs listed in Table 2 with no positive activity detected.

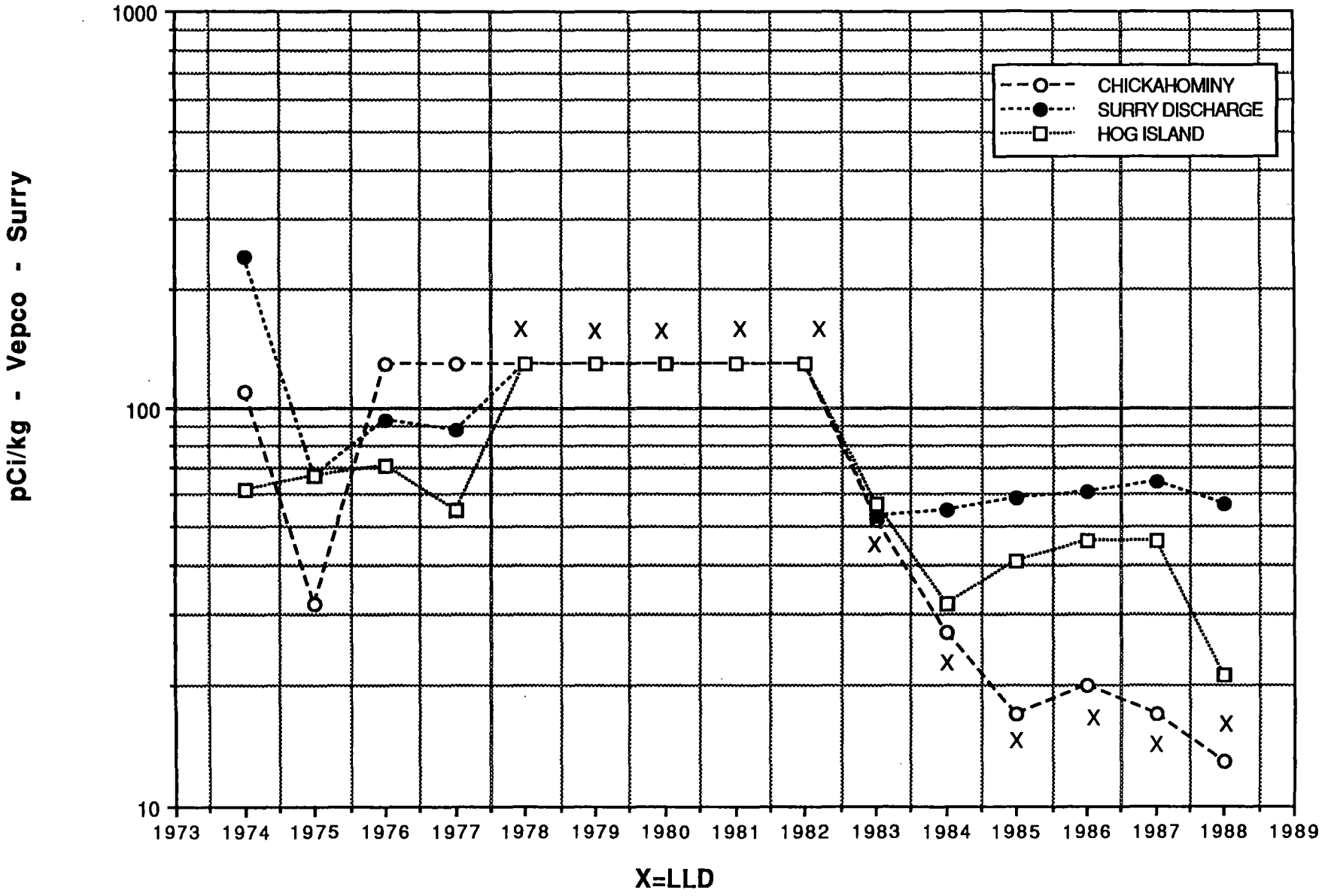
One crab sample was collected in June from the Surry Discharge (SD) location and analyzed by gamma spectrometry. Naturally occurring potassium-40 was measured with an activity of 2480 pCi/kg (wet weight) as presented in Table 21. All other gamma emitters were well below the LLDs required in Table 2 with no positive activity detected.

Four fish samples (catfish and white perch) were collected during May and October from the same Surry Discharge location (SD). Potassium-40 was measured in all four samples with an average activity of 1575 pCi/kg (wet weight) and a range of 1380 to 1770 pCi/kg (wet weight). The results of gamma spectrometry on these samples are presented in Table 23. Cesium-137 was observed in one of the fish samples with an activity of 17.7 pCi/kg (wet weight). The results from the 1988 fish samples indicated lower cesium-137 activity in comparison to results from recent years. The 1987 samples averaged 24 pCi/kg (wet weight) while in 1986 the samples averaged 45.5 pCi/kg (wet weight). During 1985 cesium-137 was measured in the fish samples at an average of 87.1 pCi/kg (wet weight). All other gamma emitters were well below the LLDs required in Table 2 with no positive activity detected.

COBALT-58 IN CLAM SAMPLES



COBALT-60 IN CLAM SAMPLES



CESIUM-137 IN CLAM SAMPLES

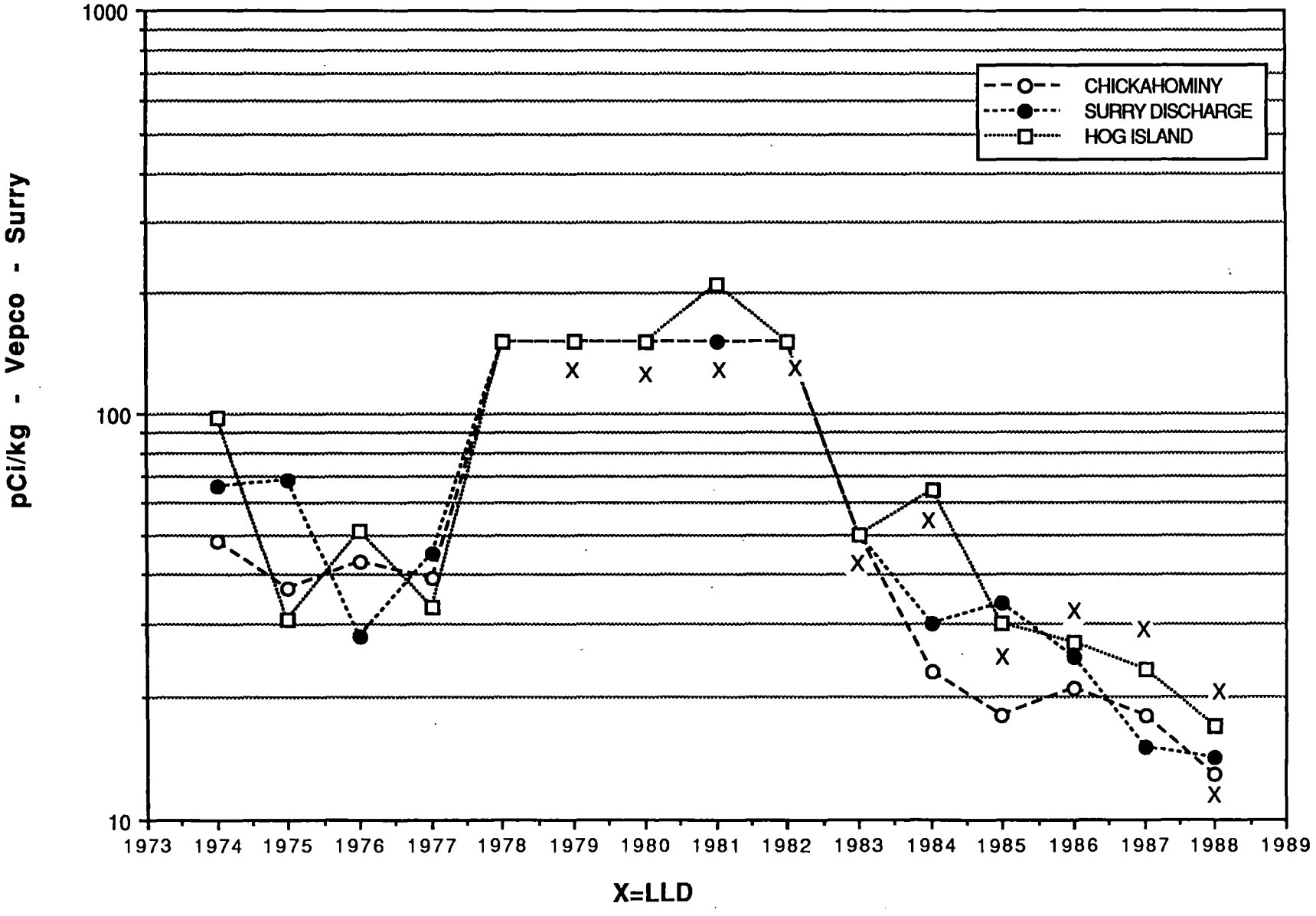


TABLE 18

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SURRY NUCLEAR POWER STATION — DOCKET NO. 5-280-281

SURRY COUNTY, VIRGINIA — JANUARY 1 to DECEMBER 31, 1988

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Clams (pCi/kg wet)	Gamma Spec 30						
	K-40	-	614(22/24) (255-1060)	SD	679(6/6) (378-1060)	471(6/6) (298-583)	0
	Co-60	130	39.1(2/24) (21.1-57.1)	SD	57.1(1/6) -	-(0/6) -	0
	Cs-137	150	14.2(1/24) -	SD	14.2(1/6) -	-(0/6) -	0
Oysters (pCi/kg wet)	Gamma Spec 17						
	K-40	-	666(15/17) (400-916)	NN	750(4/5) (625-916)	NONE	0
Crabs (pCikg wet)	Gamma Spec 1	-	2480(1/1) -	SD	2480(1/1) -	NONE	0
	K-40						

(1) LLD is lower limit of detection as defined and required in USNRC Branch Technical Position on an Acceptable Radiological Environmental Monitoring Program, Revision 1, November 1979.

TABLE 19

VIRGINIA POWER - SURRY - 1988

CONCENTRATIONS OF GAMMA EMITTERS* CLAMS

pCi/kg (wet) ± 2 Sigma

STATION	DATE	SAMPLE TYPE	Be-7	K-40	Co-58	Co-60	Cs-137	Ra-226	Th-228
CHIC	01/27/88	Clams	<100	298 ± 103	<10	<10	<10	<200	<20
	03/24/88	Clams	<100	428 ± 107	<10	<10	<10	<300	<20
	05/12/88	Clams	<100	430 ± 113	<10	<10	<10	<200	<20
	07/07/88	Clams	<100	583 ± 116	<10	<10	<10	<300	<20
	09/08/88	Clams	<200	502 ± 136	<20	<20	<20	<300	<40
	11/10/88	Clams	<200	582 ± 148	<20	<20	<20	<300	<40
JMTN	01/27/88	Clams	<200	474 ± 140	<20	<20	<20	<400	<30
	03/17/88	Clams	<100	<500	<20	<20	<20	<300	<30
	05/11/88	Clams	<200	652 ± 146	<20	<20	<20	<300	<30
	07/06/88	Clams	<100	574 ± 95	<10	<10	<10	<200	<20
	09/07/88	Clams	<200	279 ± 141	<20	<20	<20	<300	<30
	11/09/88	Clams	<100	535 ± 141	<20	<10	<10	<300	<30
SD	01/27/88**	Clams	<200	378 ± 161	<20	57.1 ± 12.4	14.2 ± 7.8	<300	<30
	03/02/88**	Clams	<100	454 ± 146	<10	<10	<10	<200	<20
	05/09/88**	Clams	<100	526 ± 128	<10	<10	<10	<300	<30
	07/07/88**	Clams	<90	841 ± 105	<10	<10	<10	<100	<10
	09/26/88**	Clams	<100	1060 ± 150	<10	<10	<10	<200	<20
	11/07/88**	Clams	<100	816 ± 134	<10	<10	<10	<200	<20
HIP	01/27/88	Clams	<200	564 ± 116	<10	<20	<10	<300	<20
	03/17/88	Clams	<200	<800	<20	<30	<30	<400	<40
	05/11/88	Clams	<200	554 ± 147	<20	<20	<20	<300	<40
	07/06/88	Clams	<200	255 ± 149	<20	<20	<20	<300	<20
	09/07/88	Clams	<100	925 ± 150	<10	21.1 ± 7.9	<10	<300	<20
	11/09/88	Clams	<200	905 ± 150	<20	<20	<10	<300	<30
LC	01/27/88	Clams	<200	514 ± 153	<20	<20	<20	<300	<40
	03/17/88	Clams	<100	726 ± 131	<10	<20	<10	<300	<30
	05/11/88	Clams	<200	674 ± 200	<20	<20	<20	<400	<40
	07/06/88	Clams	<100	574 ± 106	<10	<10	<10	<200	<20
	09/07/88	Clams	<200	522 ± 118	<10	<20	<20	<300	<30
	11/09/88	Clams	<200	703 ± 151	<10	<10	<20	<300	<30
Average ± 2 s.d.				583 ± 392		39.1 ± 50.9	14.2 ± 7.8		

* All other gamma emitters were <LLD.
** State Split

TABLE 20

VIRGINIA POWER - SURRY - 1988

CONCENTRATIONS OF GAMMA EMITTERS* OYSTERS

pCi/kg (wet) ± 2 Sigma

STATION	DATE	SAMPLE TYPE	Be-7	K-40	Co-58	Co-60	Cs-137	Ra-226	Th-228
NN	01/27/88**	Oysters (a)							
	03/17/88**	Oysters (b)	<100	<200	<10	<20	<10	<200	<20
	05/11/88**	Oysters (b)	<100	625 ± 139	<10	<10	<10	<300	<20
	07/06/88**	Oysters (b)	<200	697 ± 125	<10	<10	<10	<300	<20
	09/07/88**	Oysters (b)	<100	762 ± 131	<10	<10	<10	<300	<30
	11/09/88**	Oysters (b)	<200	916 ± 136	<20	<10	<20	<300	<30
DWS	01/27/88	Oysters	<100	400 ± 137	<10	<10	<10	<300	<30
	03/17/88	Oysters	<200	<800	<20	<20	<20	<400	<40
	05/11/88	Oysters	<100	527 ± 140	<10	<10	<10	<300	<30
	07/06/88	Oysters	<100	791 ± 127	<10	<10	<10	<200	<20
	09/07/88	Oysters	<100	747 ± 186	<10	<10	<10	<300	<20
	11/09/88	Oysters	<200	764 ± 129	<20	<10	<10	<300	<20
POS	01/27/88	Oysters	<200	537 ± 130	<20	<10	<20	<300	<30
	03/17/88	Oysters	<100	557 ± 118	<10	<10	<10	<200	<20
	05/11/88	Oysters	<100	556 ± 151	<20	<10	<20	<300	<30
	07/06/88	Oysters	<100	788 ± 121	<10	<10	<10	<200	<20
	09/07/88	Oysters	<100	541 ± 179	<10	<20	<20	<300	<30
	11/09/88	Oysters	<200	788 ± 172	<20	<20	<20	<300	<40
Average ± 2 s.d.				666 ± 284					

* All other gamma emitters were <LLD.
** State Split
(a) Sample not available due to shell stock depletion at sample location.
(b) Substitute sample from RLS.

TABLE 21

VIRGINIA POWER - SURRY - 1988

CONCENTRATIONS OF GAMMA EMITTERS* IN CRABS

pCi/kg (wet) ± 2 Sigma

STATION	DATE	SAMPLE TYPE	Be-7	K-40	Co-58	Co-60	Cs-137	Ra-226	Th-228
SD	06/23/88	Crabs	<200	2480 ± 250	<10	<20	<10	<300	<30

* All other gamma emitters were <LLD

TABLE 22

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SURRY NUCLEAR POWER STATION DOCKET NO. 5-280-281

SURRY COUNTY, VIRGINIA JANUARY 1 to DECEMBER 31, 1988

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED		LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Fish (pCi/kg wet)	Gamma Spec	4						
	K-40	4	-	1575(4/4) (1380-1770)	SD	1575(4/4) (1380-1770)	NONE	0
	Cs-137	4	150	17.7(1/4) -	SD	17.7(1/4) -	NONE	0

(1) LLD is lower limit of detection as defined and required in USNRC Branch Technical Position on an Acceptable Radiological Environmental Monitoring Program, Revision 1, November 1979.

TABLE 23

VIRGINIA POWER - SURRY - 1988

CONCENTRATIONS OF GAMMA* EMITTERS IN FISH

pCi/kg (wet) ± 2 sigma

COLLECTION DATE	STATION	SAMPLE TYPE	K-40	Co-58	Cs-134	Cs-137
05/12/88	SD	CATFISH	1380 ± 140	<10	<10	17.7 ± 7.8
05/24/88	SD	WHITE PERCH	1600 ± 350	<30	<30	<40
10/11/88	SD	WHITE PERCH	1550 ± 190	<20	<20	<20
10/11/88	SD	CATFISH	1770 ± 250	<30	<20	<20
Average ± 2 S.D.			1575 ± 321			17.7 ± 7.8

* All other gamma emitters were below <LLD.

3. Food Products

Ten food samples were collected from six locations and analyzed by gamma spectrometry. The samples consisted of kale, brocolli, cabbage, corn, soybeans and peanuts. No man made isotopes attributable to station discharges were detected in any of these samples. Naturally occurring potassium-40 was observed in all samples with an average activity of 6663 pCi/kg (wet weight) and a range of 2180 to 15700 pCi/kg (wet weight). Cosmogenic beryllium-7 was measured in one sample from Stone's garden with an activity of 314 pCi/kg (wet weight). These results are comparable with previous years.

TABLE 24

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SURRY NUCLEAR POWER STATION — DOCKET NO. 5-280-281

SURRY COUNTY, VIRGINIA — JANUARY 1 to DECEMBER 31, 1988

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Vegetation (pCi/kg wet)	Gamma Spec K-40	10 -	6663(10/10) (2180-15700)	Brock's	7853(3/3) (2180-15700)	NONE	0
	Be-7	10 -	314(1/10) -	Stone's	314(1/1) -	NONE	0

(1) LLD is lower limit of detection as defined and required in USNRC Branch Technical Position on an Acceptable Radiological Environmental Monitoring Program, Revision 1, November 1979.

TABLE 25

VIRGINIA POWER - SURRY - 1988

CONCENTRATIONS OF GAMMA* EMITTERS IN VEGETATION

pCi/kg (wet) ± 2 sigma

STATION	SAMPLE TYPE	COLLECTION DATE	Be-7	K-40	I-131	Cs-134	Cs-137
Poole's Garden **	Kale	06/21/88	<200	6130 ± 610	<20	<20	<20
Ryan's Garden **	Brocolli	06/21/88	<200	4840 ± 480	<20	<20	<20
Carter's Garden **	Cabbage	07/11/88	<200	5040 ± 500	<20	<20	<20
Stone's Garden **	Cabbage	07/24/88	314 ± 108	3530 ± 350	<4	<10	<10
Brock's Garden	Corn	10/25/88	<70	2180 ± 220	<10	<9	<8
Brock's Garden **	Peanuts	10/25/88	<100	5680 ± 570	<20	<10	<20
Slade's Garden	Peanuts	11/02/88	<100	5130 ± 510	<20	<10	<10
Slade's Garden **	Corn	11/02/88	<40	3200 ± 320	<6	<5	<5
Brock's Garden	Soybeans	11/29/88	<60	15700 ± 1600	<10	<9	<9
Slade's Garden **	Soybeans	12/01/88	<60	15200 ± 1500	<7	<7	<8
Average ± 2 s.d.				6663 ± 9569			

* All other gamma emitters were <LLD.
** State Split

E. DIRECT RADIATION EXPOSURE PATHWAY

1. TLD Dosimeters

Thermoluminescent dosimeters (TLDs) are placed in two concentric rings around the station environs at the site boundary and approximately 5 miles in each of sixteen sectors. TLDs are also placed in special interest locations such as population areas and nearby residents. Several TLDs also serve as controls. These dosimeters measure external radiation exposure from several sources including naturally occurring radionuclides in the air and soil, radiation from cosmic origin, fallout from atomic weapons testing, potential radioactive airborne releases from the power station and direct radiation from the power station. The TLDs record the exposure from all of these potential sources and then are processed on a quarterly basis.

Two sets of TLD badges each with four readout areas are placed at each location. The average value of the four readings from each badge (calibrated individually for response to a known dose and for intransit exposure) are presented in Tables 27 and 28.

Table 26 provides a statistical summary of the four quarters 1988 data. Individual measurements of external radiation levels in the environs of the Surry site for stations 02 through 43 had an average dose of 6.3 mR/standard month period. The average dose for the control stations (39,40) was 5.7 mR/standard month with a range of 5.1 to 6.6 mR/standard month. The indicator locations had an average activity of 6.3 mR/standard month with a range of 4.2 to 9.2 mR/standard month. A trend graph is provided by average readings of TLDs located at the site boundary to those located at approximately five miles from the station.

DIRECT RADIATION MEASUREMENT-TLD RESULTS

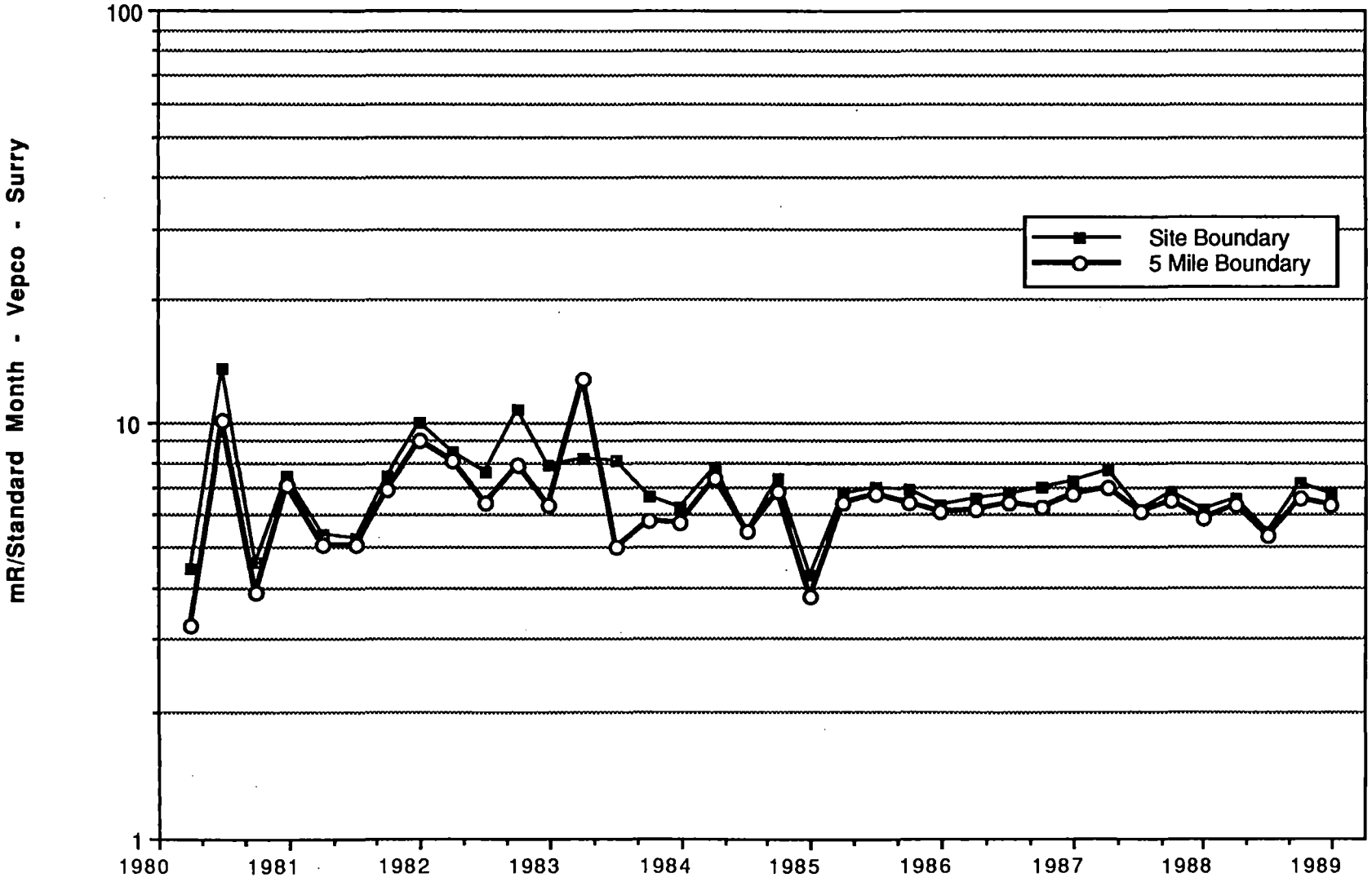


TABLE 26

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SURRY NUCLEAR POWER STATION DOCKET NO. 5-280-281

SURRY COUNTY, VIRGINIA JANUARY 1 to DECEMBER 31, 1988

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED		LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Direct Radiation TLD's (mr/std. month)	Gamma	330	2	6.3(314/314) (4.2-9.2)	38	8.1(8/8) (6.7-8.8)	5.7(16/16) (5.1-6.6)	0

VIRGINIA POWER - SURRY - 1988

DIRECT RADIATION MEASUREMENTS - QUARTERLY TLD RESULTS
mR/month ± 2 Sigma - Set 1 - 098

STATION NUMBER	FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER	AVERAGE ± 2 s.d.
02	7.8 ± 0.3	6.0 ± 1.1	8.5 ± 0.2	7.9 ± 1.1	7.8 ± 2.2
03	4.6 ± 0.2	(b)	8.3 ± 0.3	8.2 ± 0.7	7.0 ± 4.2
04	14.7 ± 6.8 (a)	5.9 ± 0.8	7.1 ± 0.2	6.8 ± 0.7	6.6 ± 1.2
05	6.5 ± 0.3	5.9 ± 0.6	7.4 ± 0.1	6.3 ± 0.2	6.5 ± 1.3
06	7.4 ± 0.7	6.8 ± 0.5	7.5 ± 0.2	7.0 ± 0.5	7.2 ± 0.7
07	6.7 ± 0.2	5.6 ± 0.6	6.9 ± 0.3	6.7 ± 0.6	6.5 ± 1.2
08	6.9 ± 0.2	(b)	7.0 ± 0.4	6.6 ± 0.6	6.8 ± 0.4
09	6.5 ± 0.5	5.9 ± 0.4	6.9 ± 0.1	7.2 ± 0.4	6.6 ± 1.1
10	6.5 ± 0.5	5.8 ± 0.6	6.9 ± 0.2	6.0 ± 1.7	6.3 ± 1.0
11	6.7 ± 0.2	6.3 ± 0.7	7.6 ± 0.6	6.3 ± 0.5	6.7 ± 1.2
12	6.6 ± 0.6	5.9 ± 0.9	7.0 ± 0.3	6.8 ± 0.3	6.6 ± 1.0
13	6.7 ± 0.3	6.0 ± 0.5	7.3 ± 0.8	6.9 ± 0.5	6.7 ± 1.1
14	6.8 ± 0.5	6.3 ± 0.6	7.2 ± 0.4	6.8 ± 0.3	6.8 ± 0.7
15	6.3 ± 0.3	4.6 ± 1.6	6.4 ± 0.3	6.4 ± 0.4	5.9 ± 1.8
16	6.7 ± 0.8	5.8 ± 0.5	6.7 ± 0.4	6.5 ± 0.8	6.4 ± 0.9
17	6.2 ± 0.3	5.6 ± 0.7	6.6 ± 0.4	6.2 ± 0.1	6.2 ± 0.8
18	5.3 ± 0.4	4.8 ± 0.3	5.6 ± 0.3	5.6 ± 0.2	5.3 ± 0.8
19	6.2 ± 0.4	5.4 ± 0.4	6.0 ± 0.4	6.4 ± 0.8	6.0 ± 0.9
20	5.6 ± 0.4	5.1 ± 0.5	5.7 ± 0.6	5.9 ± 0.6	5.6 ± 0.7
21	5.9 ± 0.1	4.4 ± 0.5	6.2 ± 0.5	6.2 ± 0.1	5.7 ± 1.7
22	5.7 ± 0.4	4.7 ± 0.8	5.8 ± 0.4	5.6 ± 0.7	5.5 ± 1.0

(a) TLD found missing; replaced 03/09/88. The replacement TLDs for the period 03/09/88 through 04/04/88 appeared to have received a non-uniform dose concentrated in area 4 in particular and to a lesser extent in area 3. It appears the replacement TLD for station number 04, Set 1-098 was positioned such that it partially shielded the replacement TLD for station number 04, Set 2-099 and the associated control TLD. This possibly indicates that a spurious dose was received in transit or receipt at the station. The data for TLD station number 04 for this time period was not included in the averages.

(b) TLD vandalized; third quarter TLDs placed in field early as replacements.

TABLE 27

(Page 2 of 2)

VIRGINIA POWER - SURRY - 1988

DIRECT RADIATION MEASUREMENTS - QUARTERLY TLD RESULTS
mR/month ± 2 Sigma - Set 1 - 098

STATION NUMBER	FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER	AVERAGE ± 2 s.d.
23	6.6 ± 0.4	6.6 ± 0.5	6.8 ± 0.1	6.8 ± 0.3	6.7 ± 0.2
24	6.2 ± 0.5	5.2 ± 0.5	6.4 ± 0.3	5.9 ± 0.9	5.9 ± 1.1
25	6.6 ± 0.3	6.3 ± 0.7	6.7 ± 0.3	7.0 ± 0.7	6.7 ± 0.6
26	6.4 ± 0.2	5.4 ± 1.8	6.3 ± 0.1	6.3 ± 0.5	6.1 ± 0.9
27	5.6 ± 0.4	5.0 ± 0.6	6.0 ± 0.3	5.7 ± 0.9	5.6 ± 0.8
28	6.5 ± 0.4	5.7 ± 0.9	6.4 ± 0.3	5.7 ± 1.5	6.1 ± 0.9
29	5.5 ± 0.2	5.1 ± 0.8	6.3 ± 0.6	5.4 ± 0.7	5.6 ± 1 0
30	6.2 ± 0.4	4.7 ± 0.6	6.2 ± 0.3	5.7 ± 0.5	5.7 ± 1.4
31	5.9 ± 0.2	5.1 ± 0.3	5.6 ± 0.5	5.7 ± 0.3	5.6 ± 0.7
32	6.4 ± 0.2	5.9 ± 0.6	6.4 ± 0.4	5.9 ± 0.6	6.2 ± 0.6
33	6.6 ± 0.3	5.8 ± 1.9	6.8 ± 0.6	6.7 ± 0.3	6.5 ± 0.9
34	6.8 ± 0.8	6.8 ± 0.7	6.8 ± 0.1	6.6 ± 0.7	6.8 ± 0.2
35	7.3 ± 0.4	6.4 ± 0.8	7.2 ± 0.7	6.6 ± 0.6	6.9 ± 0.9
36	7.5 ± 0.6	6.4 ± 0.7	7.3 ± 1.3	7.5 ± 0.8	7.2 ± 1.1
37	6.8 ± 0.1	6.0 ± 1.0	6.4 ± 1.0	6.4 ± 0.4	6.4 ± 0.7
38	8.2 ± 0.6	7.5 ± 0.9	8.8 ± 0.4	7.9 ± 0.7	8.1 ± 1.1
39	6.4 ± 0.4	6.2 ± 0.3	6.2 ± 0.2	6.1 ± 0.1	6.2 ± 0.3
40	5.2 ± 0.2	4.7 ± 0.6	5.5 ± 0.4	5.3 ± 0.2	5.2 ± 0.7
41	6.8 ± 0.4	6.2 ± 0.5	7.2 ± 0.5	6.8 ± 0.6	6.8 ± 0.8
42	6.4 ± 0.4	5.5 ± 0.9	6.5 ± 0.5	6.0 ± 0.4	6.1 ± 0.9
43	5.0 ± 0.1	5.9 ± 0.9	6.2 ± 0.2	6.5 ± 0.7	5.9 ± 1.3
Average ± 2 s.d.	6.4 ± 1.4	5.7 ± 1.4	6.7 ± 1.5	6.4 ± 1.3	6.3 ± 0.8

VIRGINIA POWER - SURRY - 1988

DIRECT RADIATION MEASUREMENTS - QUARTERLY TLD RESULTS
mR/month ± 2 Sigma - Set 2 - 099

STATION NUMBER	FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER	AVERAGE ± 2 s.d.
02	7.9 ± 0.3	6.5 ± 0.5	8.7 ± 1.4	9.2 ± 1.5	8.1 ± 2.4
03	4.4 ± 0.1	(b)	8.0 ± 0.4	7.7 ± 2.1	6.7 ± 4.0
04	8.3 ± 6.3 (a)	4.8 ± 0.5	7.7 ± 0.5	6.8 ± 0.5	6.4 ± 3.0
05	7.1 ± 0.6	5.1 ± 0.6	7.5 ± 0.7	6.7 ± 0.5	6.6 ± 2.1
06	7.6 ± 0.6	5.7 ± 0.8	7.8 ± 0.4	7.3 ± 0.6	7.1 ± 1.9
07	6.5 ± 0.4	5.0 ± 0.9	7.2 ± 0.4	6.8 ± 0.2	6.4 ± 1.9
08	7.0 ± 0.4	(b)	6.3 ± 0.5	6.8 ± 0.6	6.7 ± 0.7
09	6.9 ± 0.4	5.6 ± 0.9	7.3 ± 0.3	7.2 ± 0.7	6.8 ± 1.6
10	6.5 ± 0.1	4.2 ± 1.9	6.9 ± 0.4	6.3 ± 1.3	6.0 ± 2.4
11	6.8 ± 0.2	4.9 ± 1.0	7.1 ± 0.3	6.6 ± 0.6	6.4 ± 2.0
12	7.0 ± 0.3	4.9 ± 0.5	7.1 ± 0.5	6.7 ± 0.7	6.4 ± 2.1
13	6.9 ± 0.1	6.4 ± 0.8	7.3 ± 0.4	6.6 ± 0.3	6.8 ± 0.8
14	6.9 ± 1.0	5.4 ± 1.2	7.5 ± 0.6	6.0 ± 0.7	6.5 ± 1.9
15	6.6 ± 0.4	4.6 ± 0.4	6.7 ± 0.4	6.4 ± 0.6	6.1 ± 2.0
16	6.6 ± 0.3	5.0 ± 0.8	6.7 ± 0.4	6.4 ± 0.9	6.2 ± 1.6
17	6.2 ± 0.5	4.7 ± 0.3	6.4 ± 0.4	6.3 ± 0.7	5.9 ± 1.6
18	5.9 ± 0.2	4.5 ± 0.2	5.7 ± 0.4	4.6 ± 2.1	5.2 ± 1.5
19	6.1 ± 0.1	4.9 ± 0.6	6.5 ± 1.2	5.8 ± 0.7	5.8 ± 1.4
20	5.6 ± 0.2	4.2 ± 0.5	6.0 ± 0.3	5.2 ± 1.3	5.3 ± 1.5
21	6.2 ± 0.5	4.8 ± 1.2	6.4 ± 0.2	6.3 ± 0.3	5.9 ± 1.5
22	5.6 ± 0.2	4.8 ± 0.3	5.7 ± 0.5	5.4 ± 0.7	5.4 ± 0.8

(a) TLD found missing; replaced 03/09/88. The replacement TLDs for the period 03/09/88 through 04/04/88 appeared to have received a non-uniform dose concentrated in area 4 in particular and to a lesser extent in area 3. It appears the replacement TLD for station number 04, Set 1-098 was positioned such that it partially shielded the replacement TLD for station number 04, Set 2-099 and the associated control TLD. This possibly indicates that a spurious dose was received in transit or receipt at the station. The data for TLD station number 04 for this time period was not included in the averages

(b) TLD vandalized; third quarter TLDs placed in the field early as replacements.

VIRGINIA POWER - SURRY - 1988

DIRECT RADIATION MEASUREMENTS - QUARTERLY TLD RESULTS
mR/month ± 2 Sigma - Set 2 - 099

STATION NUMBER	FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER	AVERAGE ± 2 s.d.
23	7.6 ± 0.2	5.3 ± 0.7	6.9 ± 0.5	6.8 ± 0.7	6.7 ± 1.9
24	6.4 ± 0.4	5.7 ± 0.5	6.6 ± 0.7	6.1 ± 0.8	6.2 ± 0.8
25	6.0 ± 0.4	5.1 ± 0.5	7.1 ± 0.5	6.3 ± 1.2	6.1 ± 1.7
26	5.8 ± 0.7	4.8 ± 0.3	6.7 ± 0.8	6.6 ± 0.3	6.0 ± 1.8
27	5.6 ± 0.6	4.2 ± 0.6	6.3 ± 0.5	5.8 ± 0.3	5.5 ± 1.8
28	6.4 ± 0.2	4.7 ± 0.6	6.6 ± 0.5	6.5 ± 0.4	6.1 ± 1.8
29	5.4 ± 0.2	4.4 ± 0.9	6.2 ± 0.6	5.9 ± 0.3	5.5 ± 1.6
30	5.8 ± 0.3	4.2 ± 0.6	6.7 ± 0.7	6.0 ± 0.2	5.7 ± 2.1
31	5.6 ± 0.2	4.2 ± 0.8	5.7 ± 0.2	5.8 ± 0.7	5.3 ± 1.5
32	6.0 ± 0.3	4.8 ± 0.2	6.4 ± 0.3	6.1 ± 0.3	5.8 ± 1.4
33	6.6 ± 0.7	5.2 ± 0.6	7.1 ± 0.3	6.6 ± 0.4	6.4 ± 1.6
34	6.3 ± 0.3	5.3 ± 0.8	6.9 ± 0.6	6.9 ± 0.4	6.4 ± 1.5
35	7.4 ± 0.7	5.5 ± 0.4	7.1 ± 0.6	7.3 ± 1.1	6.8 ± 1.8
36	7.1 ± 0.5	5.2 ± 1.1	7.2 ± 0.4	7.3 ± 0.6	6.7 ± 2.0
37	6.4 ± 0.4	5.4 ± 0.5	6.7 ± 0.5	6.6 ± 0.4	6.3 ± 1.2
38	8.4 ± 0.7	6.7 ± 1.3	8.6 ± 1.1	8.4 ± 0.7	8.0 ± 1.8
39	6.0 ± 0.4	5.2 ± 0.4	6.6 ± 0.1	6.3 ± 0.9	6.0 ± 1.2
40	5.3 ± 0.1	5.1 ± 0.1	5.3 ± 0.4	5.1 ± 0.5	5.2 ± 0.2
41	6.6 ± 0.5	5.5 ± 0.8	7.2 ± 0.5	7.0 ± 0.3	6.6 ± 1.5
42	6.0 ± 0.2	5.5 ± 0.2	7.1 ± 1.3	6.1 ± 0.4	6.2 ± 1.3
43	6.1 ± 0.2	5.1 ± 0.7	5.9 ± 0.5	6.2 ± 0.4	5.8 ± 1.0
Average ± 2 s.d.	6.4 ± 1.5	5.1 ± 1.2	6.8 ± 1.4	6.5 ± 1.6	6.2 ± 1.5

V. CONCLUSIONS

V. CONCLUSIONS

The results of the 1988 Radiological Environmental Monitoring Program for Surry Nuclear Power Station have been presented. The results were as expected for normal environmental samples. Naturally occurring radioactivity 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 NRC Regulatory Guide 4.8. 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." Specific examples of sample media with positive analysis results are discussed below.

Air particulate gross beta concentrations of all the indicator locations for 1988 appear to follow 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 1986 which was influenced by the Chernobyl accident. Gamma isotopic analysis of the particulate samples identified the gamma emitting isotopes as natural products (beryllium-7 and potassium-40). No man-made activity was found in the particulate media during 1988. No iodine-131 was detected in charcoal filters in 1988.

The tritium concentrations in the Surry Discharge Canal samples were similar to the predicted effluent tritium concentrations. The average tritium concentration from the VEPCO grab samples was 450 pCi/ℓ. The average tritium concentration from the State Split samples from the canal was 613 pCi/ℓ. Samples taken from liquid tanks in the plant prior to release mixed with the volume of cooling water from the plant indicates that the average concentration of tritium from the station should be 500 pCi/ℓ. Considering the variability of the environmental sampling methodology the results of the environmental samples compared well to the predicted concentrations of tritium in liquid effluents.

Since there is no supply of potable drinking water downstream of Surry and the river water is not used to irrigate crops for food production, the remaining pathway to man is uptake by fish and then consumption of the fish by man. The concentration of tritium in the State Split discharge canal sample represents 2.0% of the reporting level concentrations. The discharge canal water is further diluted when mixed with river water. No gamma emitting radionuclides were detected.

Tritium was also detected in well water samples taken from the vicinity of the power station. Ten of the sixteen well water samples for 1988 had measurable concentrations of tritium. Ground water is not normally considered to be affected by station operations since there are no discharges. The sample taken at Surry Station, however, indicates a higher level of tritium than the other three indicator locations.

Large variations between the quarterly well water tritium results from Surry Station indicates higher than normal levels one quarter, then less than detectable results the next quarter. An increased frequency of sampling may be warranted to determine the cause for the wide variations.

The average concentration of tritium in well water from the Surry Station sample represents 3.6% of the reporting level concentration for drinking water samples.

Silt is a sensitive indicator of discharges from nuclear power stations. The silt from Surry environmental samples indicates a number of man-made isotopes present as a result of the operation of the power station. The trend graphs indicate the extent and magnitude of the contamination. Cobalt-60 and cesium-137 were detected in the samples from all locations. Cobalt-58 was detected in two of the eight downstream samples. Cesium-134 was detected in five samples at several locations upstream and downstream of the plant discharge.

The preoperational program analyzed silt samples but found no gamma emitting radionuclides above the sensitivity of the analysis (<5000 pCi/kg). The current sensitivity is approximately 180 pCi/kg. The low sensitivity of the preoperational sample analysis eliminates the ability to make direct comparisons to operational data. As well, no reporting level concentrations have been assigned to this media because silt contamination does not provide a direct pathway to man. A review of the trend graphs indicates that all of the contaminates show a decline in the levels during 1988. This correlates well with the lower activity levels in station effluents.

Iodine-131 was not measured in any of the sixty milk samples. During environmental sampling following the Chernobyl accident in 1986, cesium-137 was detected more frequently and in higher concentrations than in previous years. However, the sample results for 1988 indicate the detection of cesium-137 in the frequency and activity ranges seen due to past nuclear weapons testing as opposed to the operation of the power station.

Twelve milk samples from three indicator stations were analyzed for strontium. No strontium-89 was detected in any of the milk samples. Strontium-90 was measured in ten of the twelve samples. These values were comparable to values seen in recent years and indicates a decreasing trend from the strontium-90 activity found during the preoperational years. The activity found during those years is attributable to past atmospheric nuclear weapons testing.

Activity in clam and fish samples does present a direct dose pathway to man. Clam samples from 1988 indicate the presence of low level man-made radioactivity. This activity was determined at levels well below the required sensitivity. Comparison of the 1988 data to 1983-1987 data and to data prior to 1978, does not indicate increasing trends. Samples taken during 1978-1982 were not analyzed below the required sensitivity level (<130 pCi/kg) and therefore cannot be compared to the low level activity found in the 1983-1988 samples. Preoperational clam samples were analyzed for gross beta and potassium-40 and are not directly comparable to operational data.

The average concentration of activity in the Surry Discharge clam samples taken during 1988 was 0.57% of the reporting level concentrations for cobalt-60 and 0.71% for cesium-137.

Cesium-137 was observed in 1 of the 4 fish samples. Trends in activity in the fish samples is difficult to establish because previous samples were analyzed only to the required sensitivity (130 pCi/kg). Preoperational samples were analyzed for gross beta and therefore the data is not comparable to the gamma analysis. The concentration of cesium-137 in this one positive

result represents 0.9% of the reporting level concentrations. Since 1984, detectable levels of cesium-137 has steadily decreased from 87.1 to 17.7 pCi/kg.

Based upon the evidence of the environmental monitoring program the station appears to be operating within regulatory limits. Where possible, good correlations existed between predicted releases and actual environmental samples. There appears to be no buildup of activity and concurrent with declining effluent releases, environmental samples are indicating decreasing trends.

VI. 1988 LAND USE CENSUS RESULTS

FOR SURRY POWER STATION

VI. LAND USE CENSUS

Surry Technical Specifications require that a Land Use Census be conducted within a distance of 8 Km (5 miles) from Surry Power Station on an annual basis. This census identifies, in each of 16 meteorological sectors, the location of the nearest milk cow, the nearest resident and the nearest garden of greater than 50 m^2 (500 ft^2) producing broad leaf vegetation. The census also identifies the nearest milk goat within a distance of 9.7 Km (6 miles) from the station.

The results of the Land Use Census are used to calculate the principal exposure pathway from gaseous effluents. This pathway analysis is compared to previous analysis to determine the requirements for modification of the Radiological Environmental Monitoring Program and/or the calculational model used for determining dose contributions to the unrestricted area.

Based on the results of the 1988 Land Use Census, no change to the Monitoring Program nor calculational model is required.

The results of the Land Use Census are presented in tabular form in Table 29. A map indicating the locations of the nearest resident, nearest milk animal, and the nearest garden greater than 50 m^2 producing broad leaf vegetation is presented on Figure 4.

TABLE 29

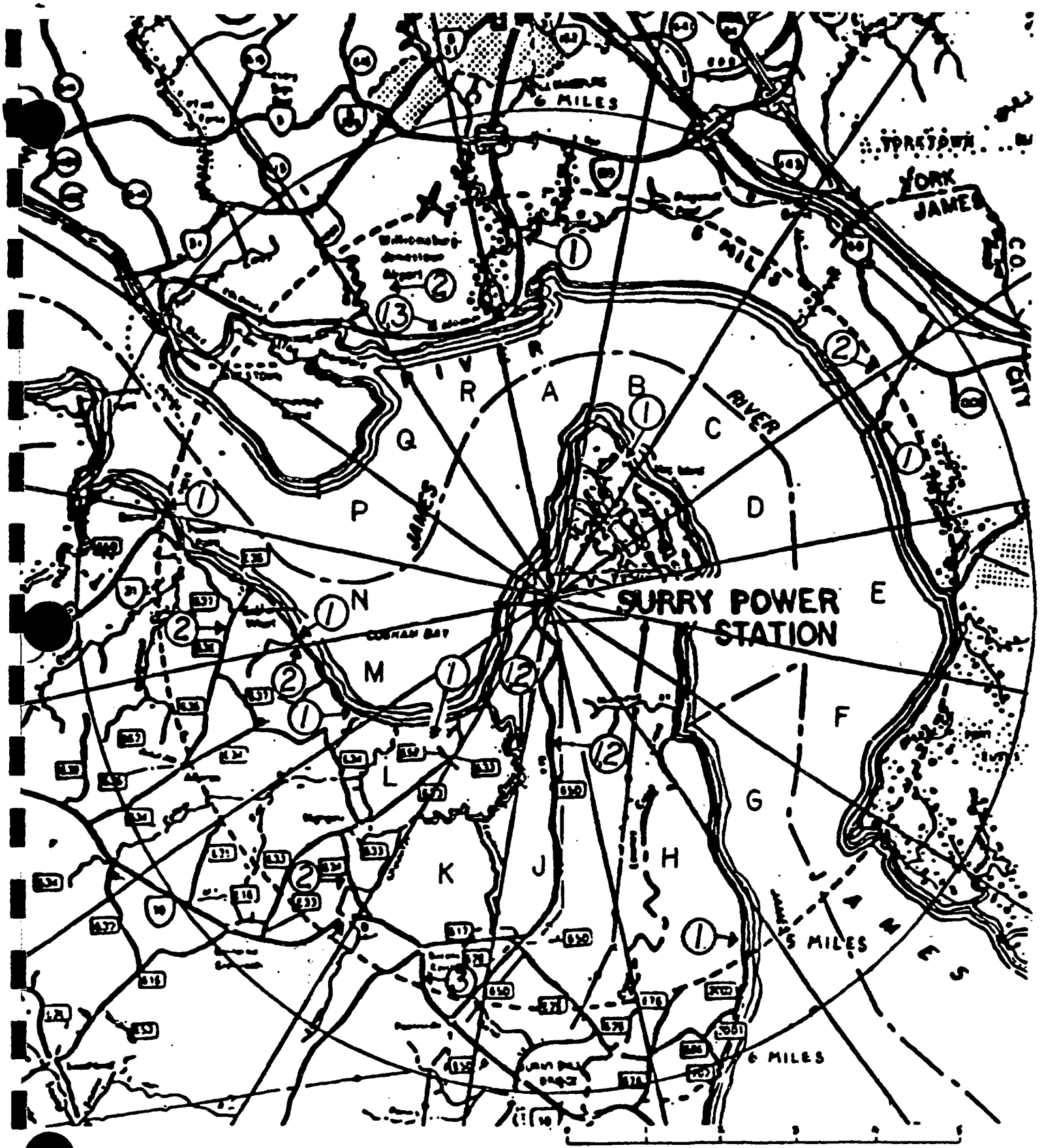
CENSUS FOR SURRY POWER STATION - 1988

SECTOR	NEAREST RESIDENT	NEAREST GARDEN	NEAREST COW	NEARSET GOAT
A-(N)	4.75@358°	*	*	*
B-(NNE)	1.95@34°	*	*	*
C-(NE)	*	4.90@56°	*	*
D-(ENE)	4.90@63°	*	*	*
E-(E)	*	*	*	*
F-(ESE)	*	*	*	*
G-(SE)	*	*	*	*
H-(SSE)	4.70@152°	*	*	*
J-(S)	1.60@182°	1.90@182°	*	*
K-(SSW)	1.88@193°	1.88@193°	4.75@201°	*
L-(SW)	2.25@220°	3.67@224°	*	*
M-(WSW)	2.80@243°	3.42@258°	*	*
N-(W)	3.20@261°	4.33@262°	*	*
P-(WNW)	4.86@281°	*	*	*
Q-(NW)	*	*	*	*
R-(NNW)	3.75@339°	4.38@336°	3.65@337°	*

* None

FIGURE 4

RESULTS OF LAND USE CENSUS FOR SURRY POWER STATION



LAND USE CENSUS LOCATION MAP, YEAR 1988.

1 = NEAREST RESIDENT 2= NEAREST GARDEN 3= NEAREST COW 4= NEAREST GOAT

VII. SYNOPSIS OF ANALYTICAL PROCEDURES

VII. ANALYTICAL PROCEDURES SYNOPSIS

Appendix B is a synopsis of the analytical procedures performed on samples collected for the Surry Power Station Radiological Environmental Monitoring Program. All analyses have been mutually agreed upon by VEPCO and Teledyne Isotopes and include those requested by the USNRC Regulatory Guide 4.8,BTP, Rev. 1, November 1979.

ANALYSIS TITLE PAGE

GROSS BETA AND GROSS ALPHA ANALYSIS OF AIR PARTICULATE SAMPLES

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. The sample is counted at one operating voltage for gross beta and then changed to a second operating voltage for gross alpha.

Calculation of the results, the two sigma error and the lower limit of detection (LLD).

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

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

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

where:

S = Gross counts of sample

B = Counts of background (different for alpha and beta)

E = Counting efficiency (different for alpha and beta)

T = Number of minutes sample was counted

t = Number of minutes background was counted

V = Sample aliquot size (cubic meters)

GROSS BETA ANALYSIS OF WATER SAMPLES

One liter of sample is evaporated to near dryness and the residue is transferred to a tared, 2" diameter planchet and final evaporation to dryness takes place under heat lamps. The planchet is weighed and then counted in a gas-flow proportional counter.

Calculation of the results, the two sigma error and the lower limit of detection (LLD).

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

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

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

where:

S = Gross counts of sample

B = Counts of background

E = Counting efficiency

T = Number of minutes sample was counted

t = Number of minutes background was counted

V = Sample aliquot size (liter)

ANALYSIS OF SAMPLES FOR TRITIUM

Water

Approximately 2 ml of water are converted to hydrogen by passing the water, heated to its vapor state, over a granular zinc conversion column heated to 400° C. The hydrogen is loaded into a one liter proportional detector and the volume is determined by recording the pressure.

The proportional detector is passively shielded by lead and steel and an electronic, anticoincidence system provides additional shielding from cosmic rays.

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

RESULT $= 3.234\ T_N\ V_N(C_G - B)/(C_N\ V_S)$

TWO SIGMA ERROR $= 2((C_G + B)\Delta t)^{1/2} 3.234\ T_N\ V_N/((C_N\ V_S)(C_G - B))$

LLD $= 4.66\ (3.234) T_N\ V_N(C_G)^{1/2}/(\Delta t\ C_N\ V_S)$

where:

T_N = tritium units of the standard

3.234 = conversion factor changing tritium units to pCi/ℓ

V_N = volume of the standard used to calibrate the efficiency of the detector in psia

V_S = volume of the sample loaded into the detector in psia

C_N = the cpm activity of the standard of volume V_N

C_G = the gross activity in cpm of the sample of volume V_S and the detector volume

B = the background of the detector in cpm

Δt = counting time for the sample

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 precipitate is weighed for chemical yield and is mounted on a nylon planchet for low level beta counting. The chemical yield is corrected by measuring the stable iodide content of the milk or the water with a specific ion electrode.

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

RESULT = $(N/\Delta t - B)/(2.22\ E\ V\ Y\ DF)$

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

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

where:

- N = total counts from sample (counts)
- Δt = counting time for sample (min)
- B = background rate of counter (cpm)
- 2.22 = dpm/pCi
- V = volume or weight of sample analyzed
- Y = chemical yield of the mount or sample counted
- DF = decay factor from the mid-collection date 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 at least 1000 minutes with a shielded Ge(Li) detector coupled to a mini-computer-based data acquisition system which performs pulse height analysis.

Dried Solids Other Than Soils and Sediments

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

Fish

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

Soils and Sediments

Soils and sediments are dried to 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 at least six hours with a shielded Ge(Li) detector coupled to a mini-computer-based data acquisition system which performs pulse height analysis.

Charcoal Cartridges (Air Iodine)

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

Air Particulate

The four or five (depending on the calendar month) air particulate filters for a monthly composite for each field station are aligned one in front of another and then counted for at least six hours with a shielded Ge(Li) detector coupled to a mini-computer-based data acquisition system which performs pulse height analysis.

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

$$\text{RESULT} = (S-B)/(2.22\ t\ E\ V\ F\ DF)$$

$$\text{TWO SIGMA ERROR} = 2(S+B)^{1/2}/(2.22\ t\ E\ V\ F\ DF)$$

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

where:

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

ENVIRONMENTAL DOSIMETRY

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

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

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

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

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

where D_1 = the net mR of area 1 of the TLD, and similarly for D_2, D_3, and D_4

$D_1 = I_1 K/R_1 - A$

I_1 = the instrument reading of the field dose in area 1

K = the known exposure by the Cs-137 source

R_1 = the instrument reading due to the Cs-137 dose on area 1

A = average dose in mR, calculated in similar manner as above, of the transit control TLDs

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 5 to 7 day period for yttrium ingrowth. Yttrium is then precipitated as hydroxide, is dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchet 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 planchet 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 trichloracetic acid (TCA) is added to produce a curd. The curd is separated by filtration and is discarded. An oxalate precipitation is performed on the filtrate and the precipitate is ashed in a muffle furnace. The ash is dissolved and strontium is 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 7 to 10 days for yttrium ingrowth. Yttrium is then precipitated as hydroxide, is dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchet 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 planchet 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 a 10 gram aliquot is taken. Stable strontium carrier is added and the sample is leached in nitric acid. The mixture is filtered and the liquid portion is reduced in volume by evaporation. 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 7 to 10 days for yttrium ingrowth. Yttrium is then precipitated as hydroxide, is dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchet 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 planchet and is covered with an 80 mg/cm^2 aluminum absorber for low level beta counting.

Organic Solids

A 200g 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 nitric acid. The sample is filtered and the volume is reduced by evaporation. Strontium is precipitated as $Sr(NO_3)_2$ using fuming (90%) nitric acid. 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 precipitatd as hydroxide, is dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchet and is counted in a low level beta counter to infer strontium-90 activity. Strontium-89 activity is determined by precipitating $SrCO_3$ from the sample after yttrium separation. This precipitate is mounted on a nylon planchet 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. 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, is dissolved and re-precipitated as oxalate. The yttrium oxalate is mounted on a nylon planchet and is counted in a low level beta counter to infer strontium-90 activity. Strontium-89 activity is determined by precipitating $SrCO_3$ from the sample after yttrium separation. This precipitate is mounted on a nylon planchet and is covered with 80 mg/cm^2 aluminum absorber for level beta counting.

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

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

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

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

RESULT Sr-90 $= (N/\Delta t - B)/(2,22\ V\ Y_1\ Y_2\ DF\ IF\ E)$

TWM 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 $= 4.64(B/\Delta t)^{1/2}/(2.22\ V\ Y_1\ Y_2\ IF\ DF\ E)$

where:

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

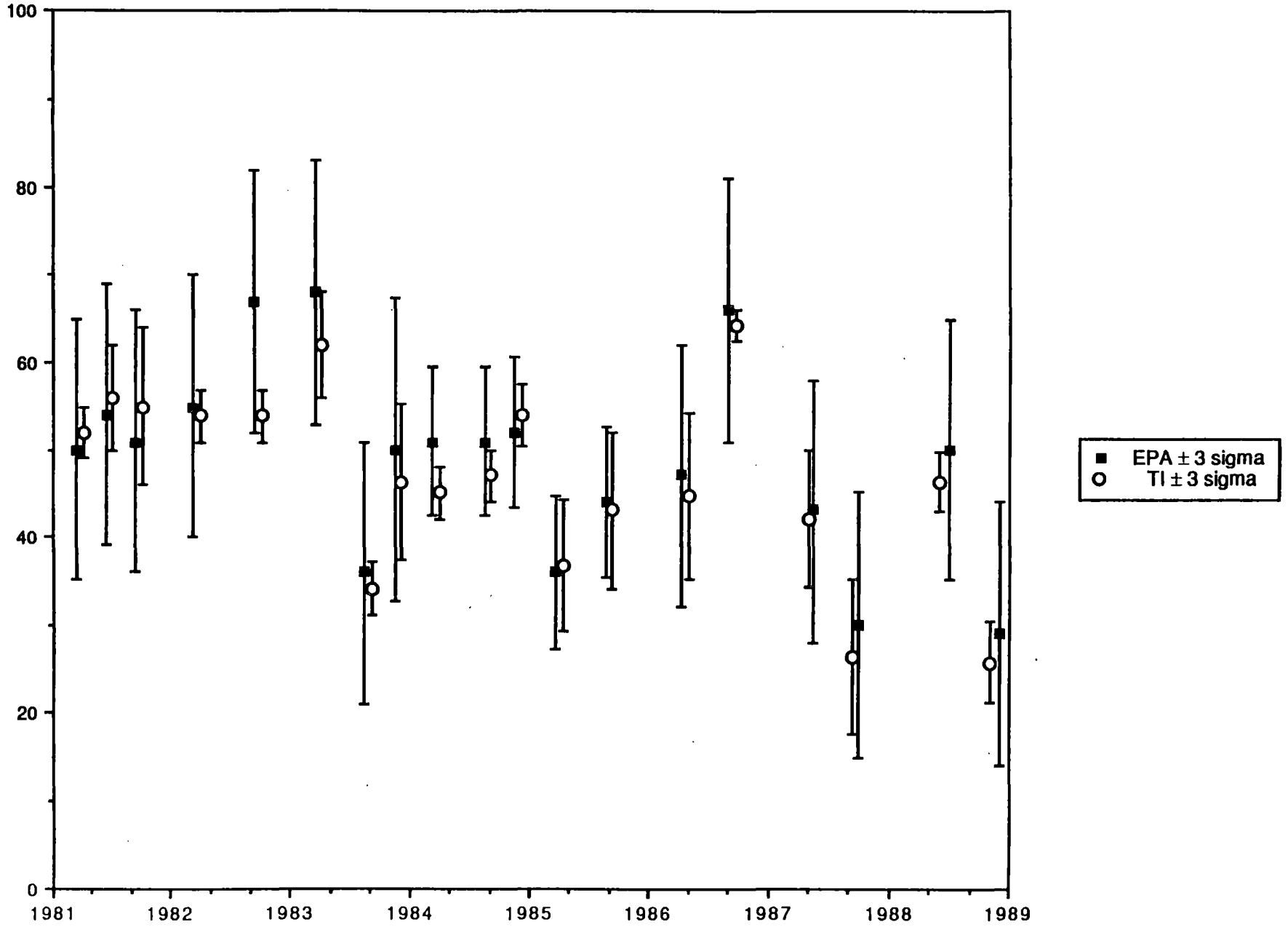
VIII. EPA INTERLABORATORY COMPARISON PROGRAM

VIII. EPA INTERLABORATORY COMPARISON PROGRAM

Teledyne Isotopes participates in the US EPA Interlaboratory Comparison Program to the fullest extent possible. That is, we participate in the program for all radioactive isotopes prepared and at the maximum frequency of availability. In this section trending graphs (since 1981) and the 1988 data summary tables are presented for isotopes in the various sample media applicable to the Surry Power Stations Radiological Environmental Monitoring Program. The footnotes of the table discuss investigations of problems encountered in a few cases.

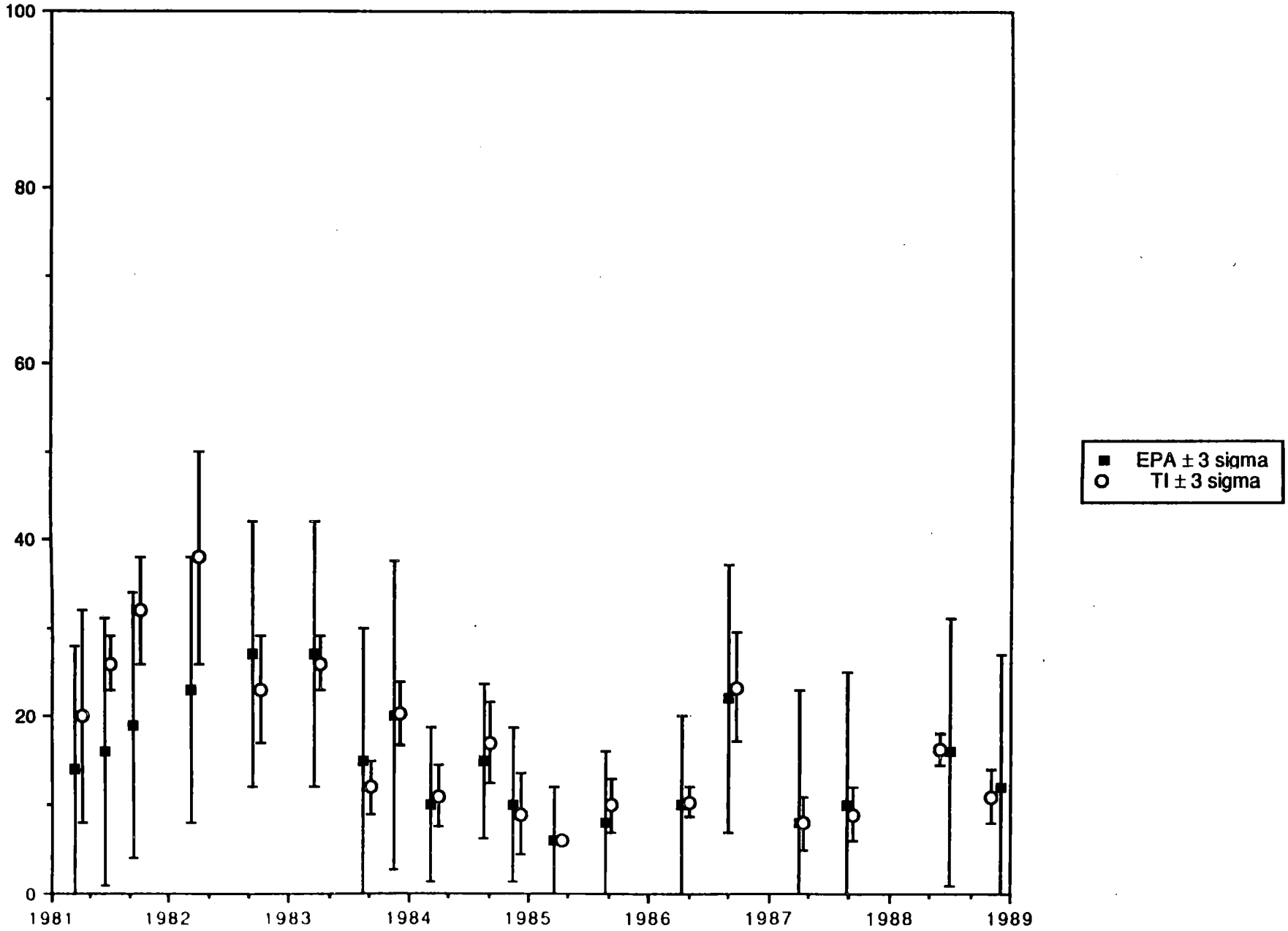
US EPA CROSS CHECK PROGRAM

GROSS BETA IN AIR PARTICULATES



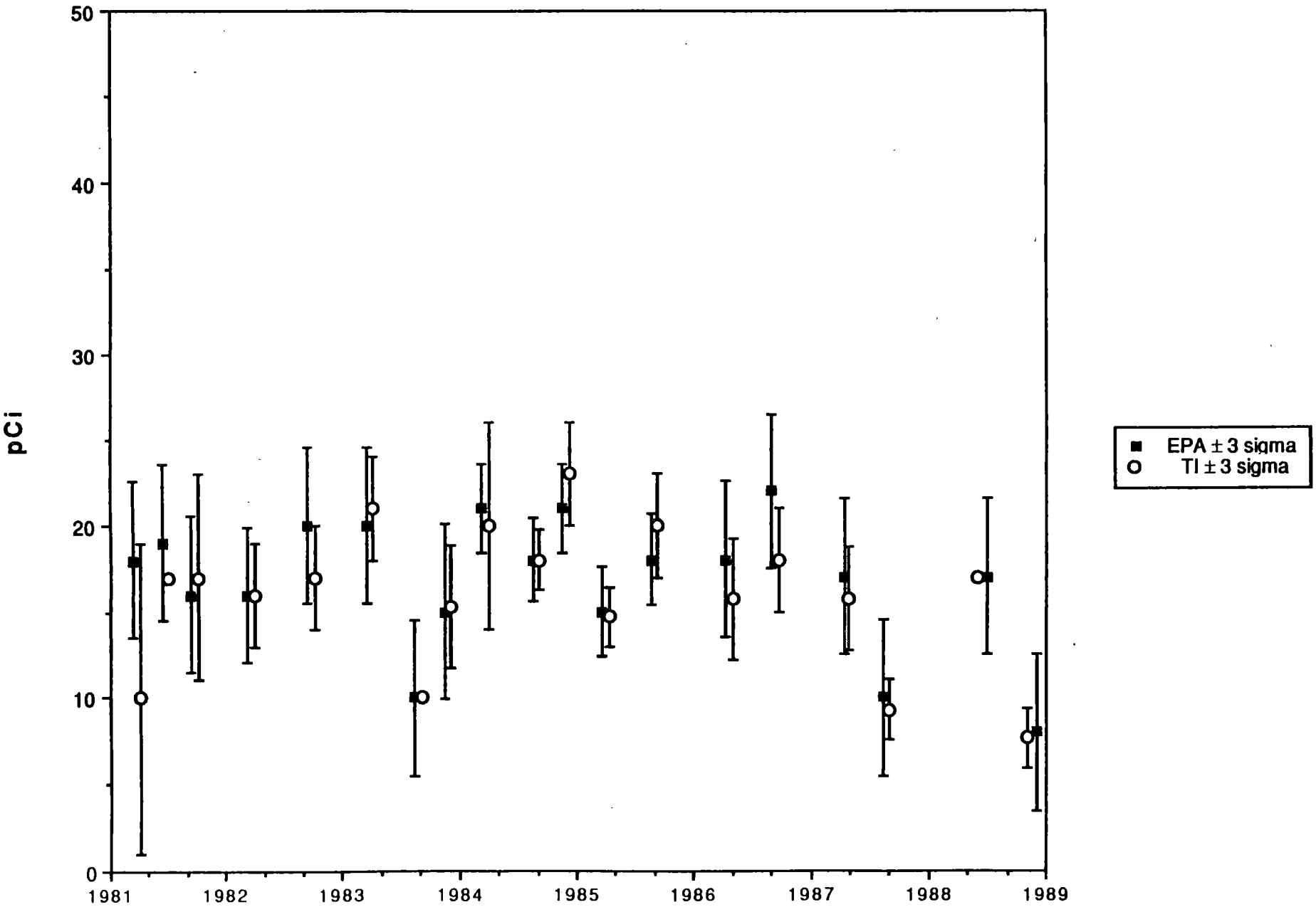
US EPA CROSS CHECK PROGRAM

CS-137 IN AIR PARTICULATES



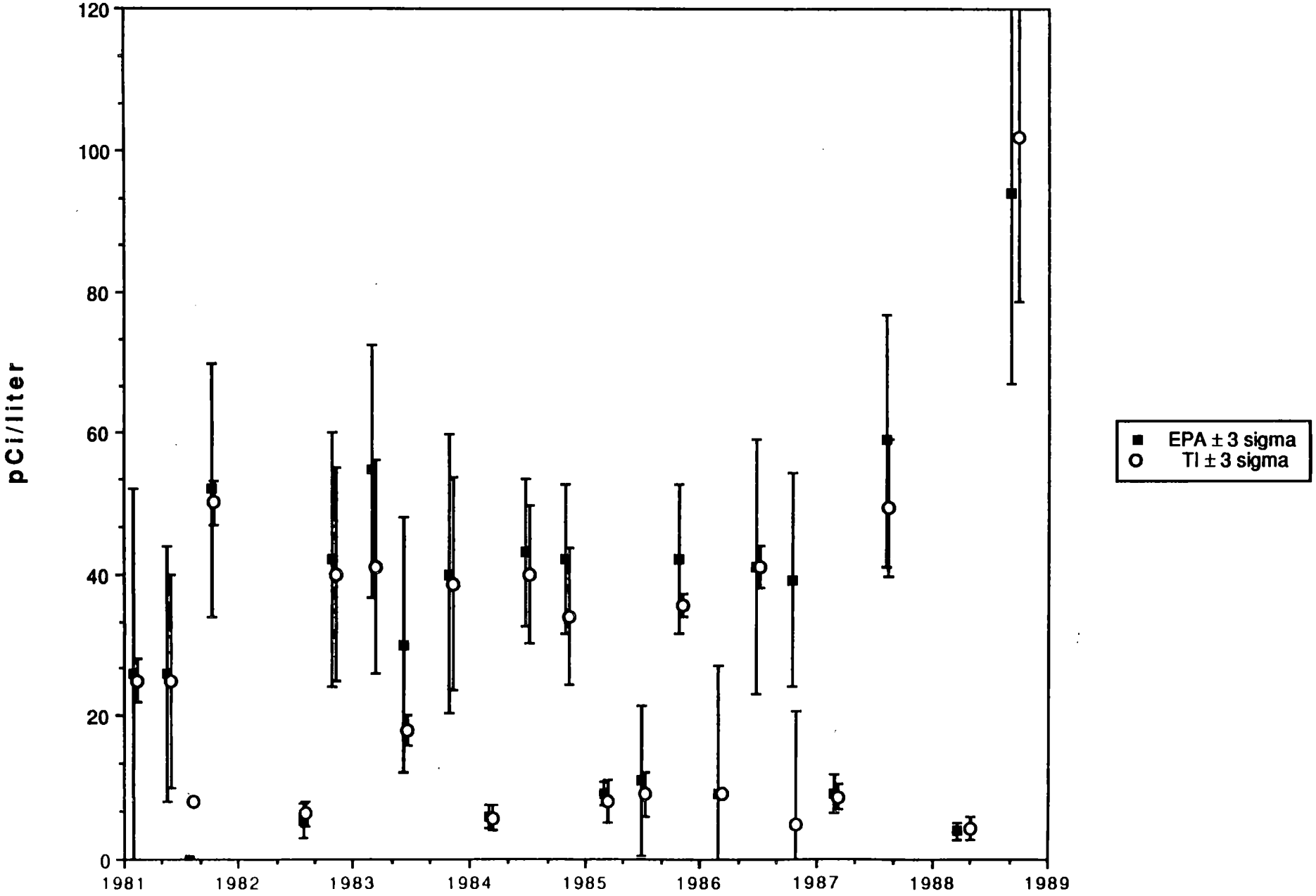
US EPA CROSS CHECK PROGRAM

SR-90 IN AIR PARTICULATES



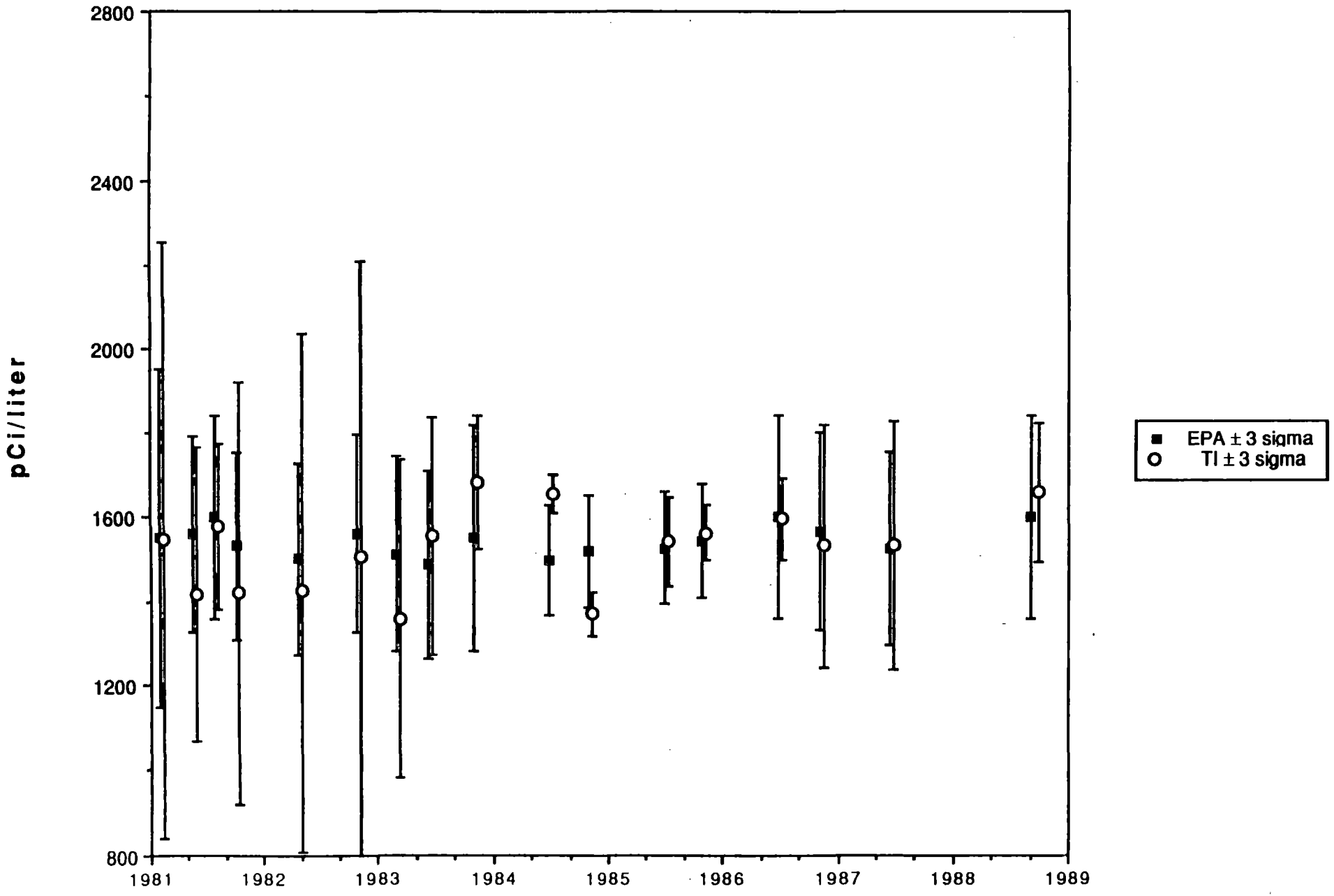
US EPA CROSS CHECK PROGRAM

I-131 IN MILK



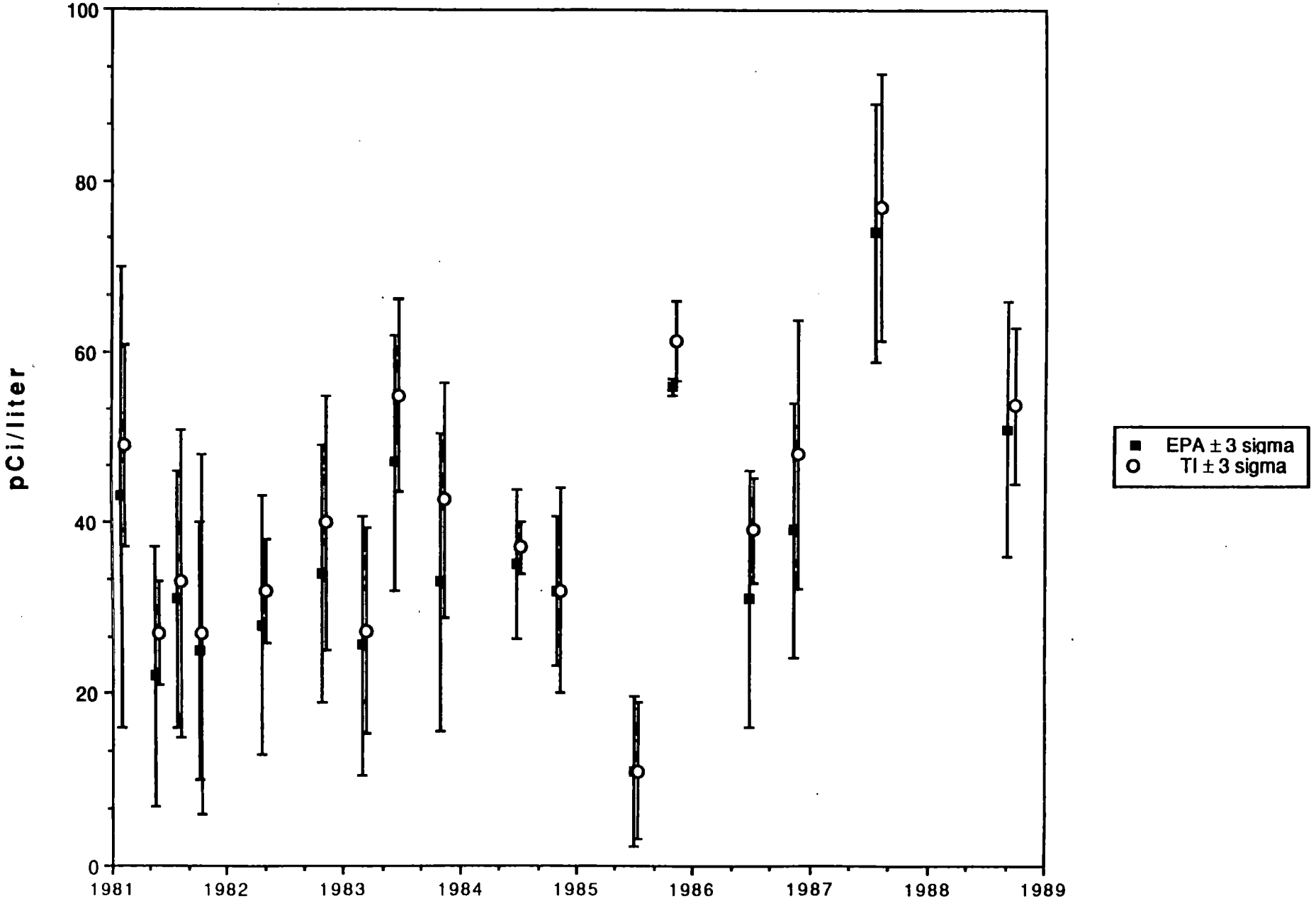
US EPA CROSS CHECK PROGRAM

K-40 IN MILK



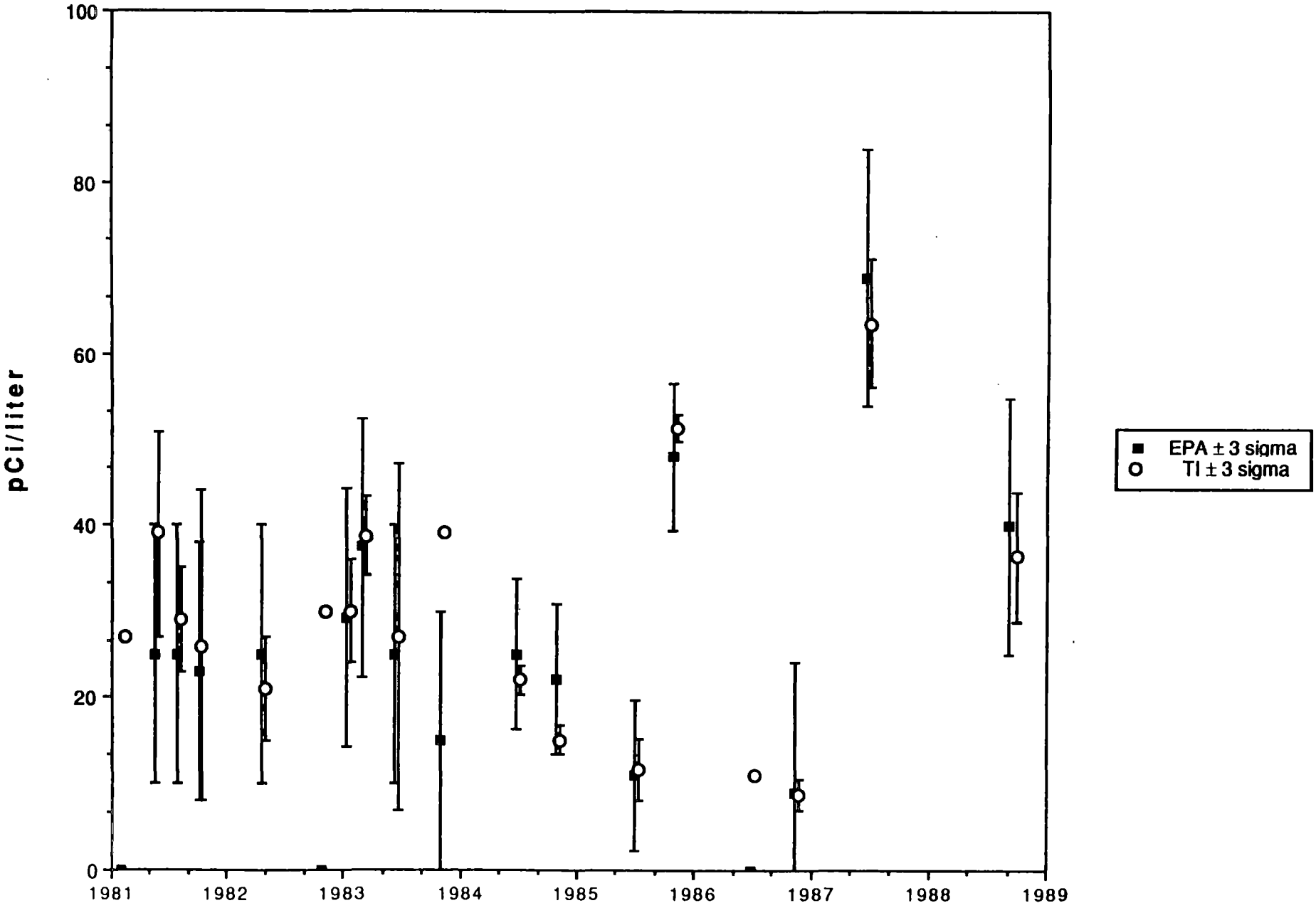
US EPA CROSS CHECK PROGRAM

CS-137 IN MILK



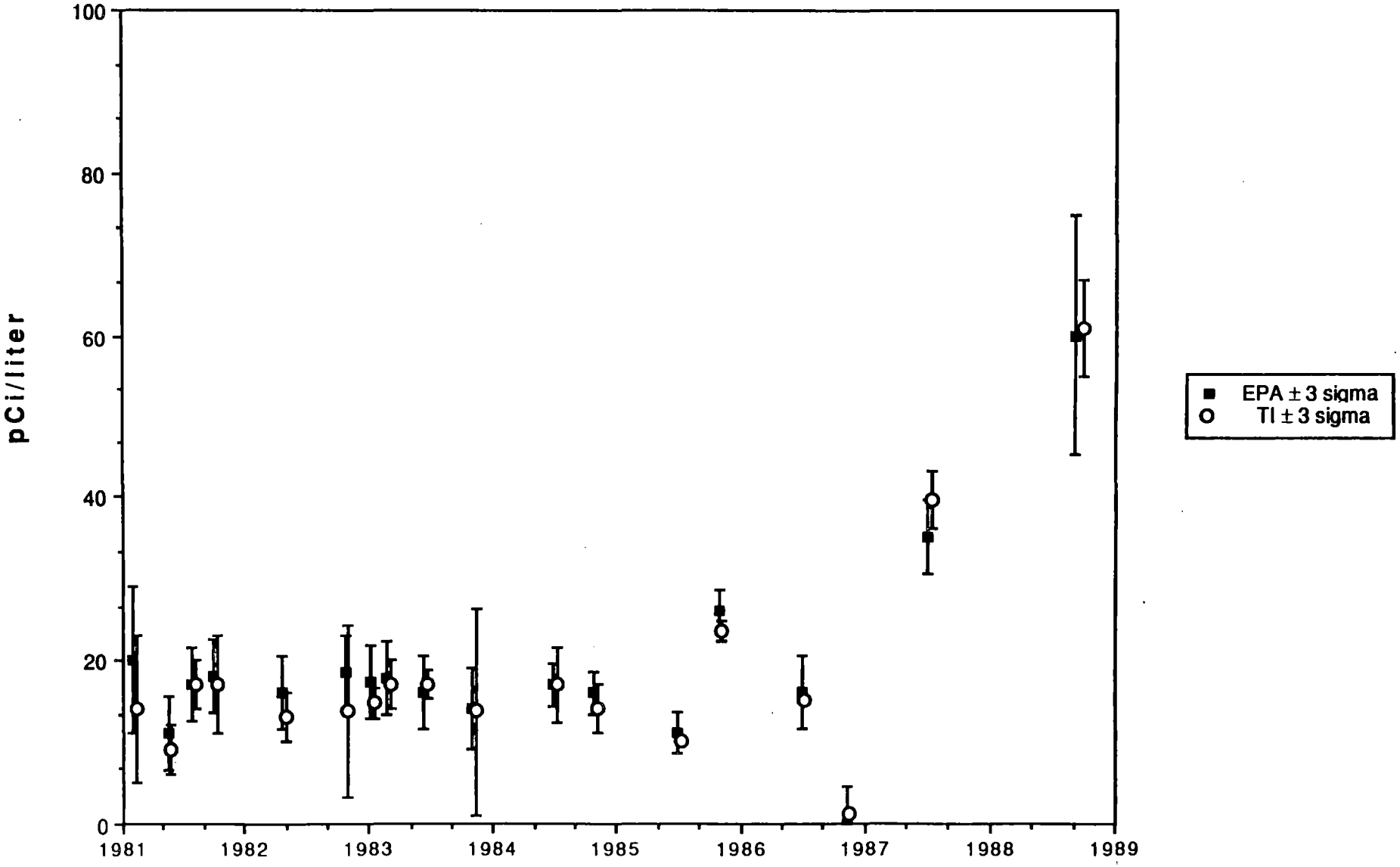
US EPA CROSS CHECK PROGRAM

SR-89 IN MILK



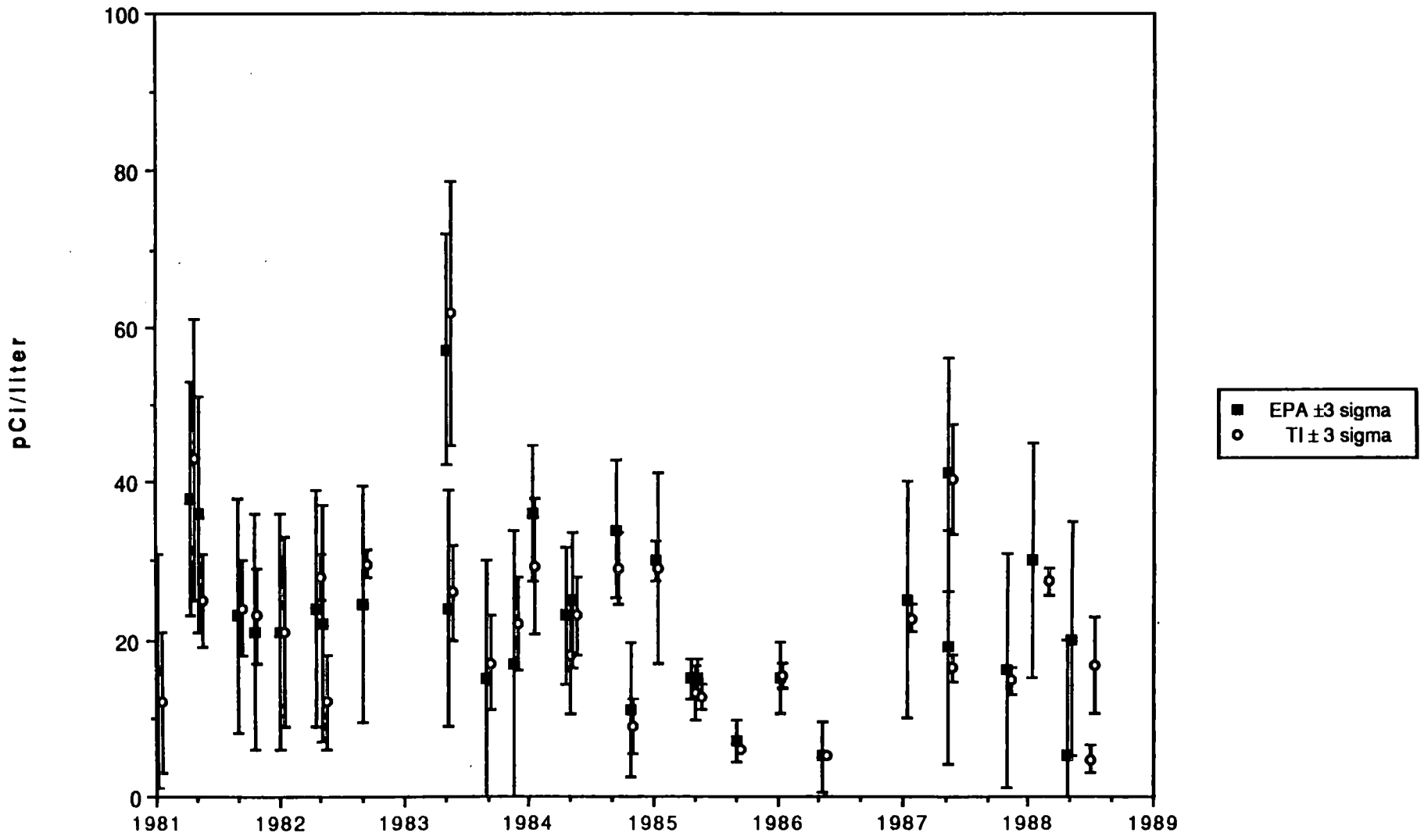
US EPA CROSS CHECK PROGRAM

SR-90 IN MILK



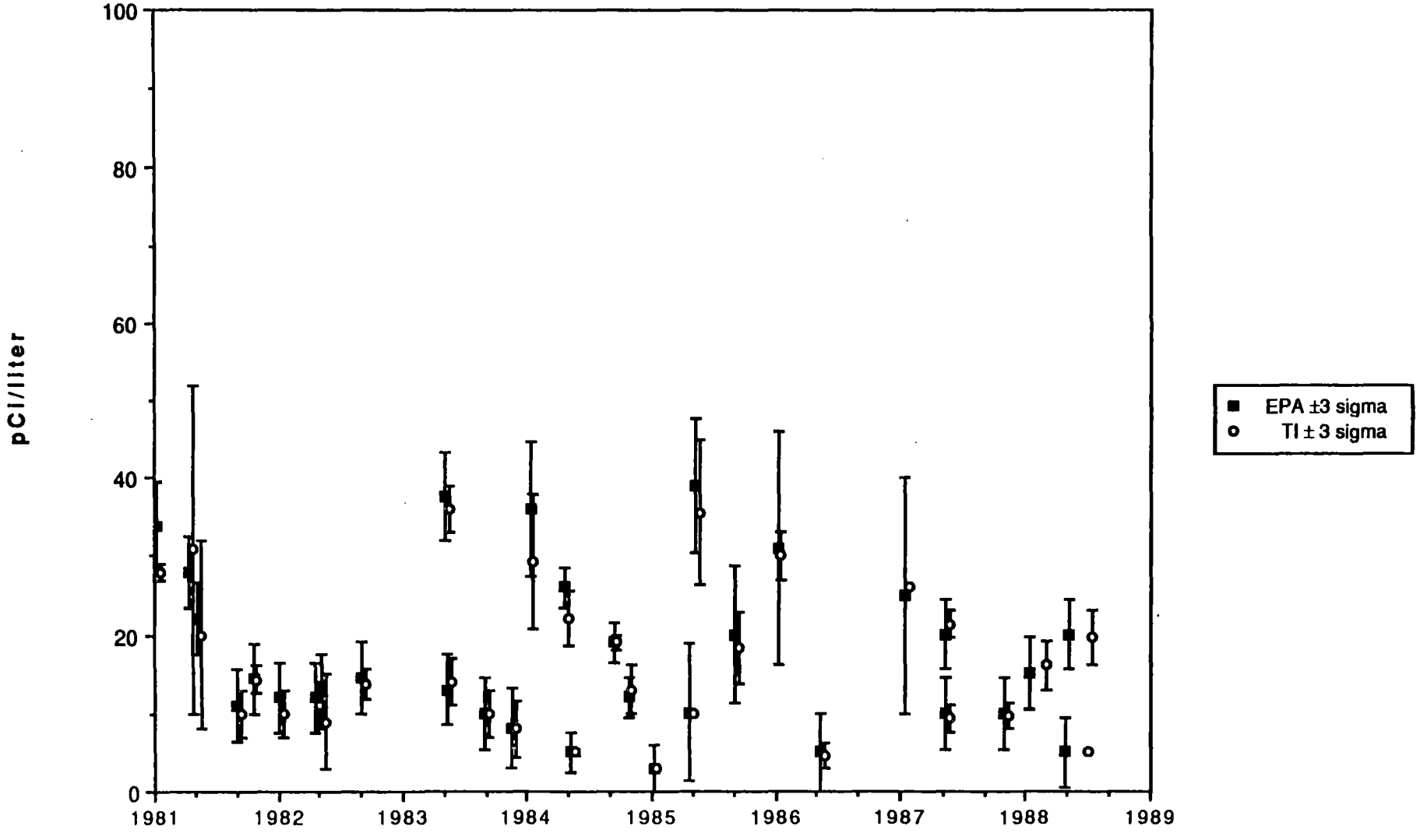
US EPA CROSS CHECK PROGRAM

SR-89 IN WATER



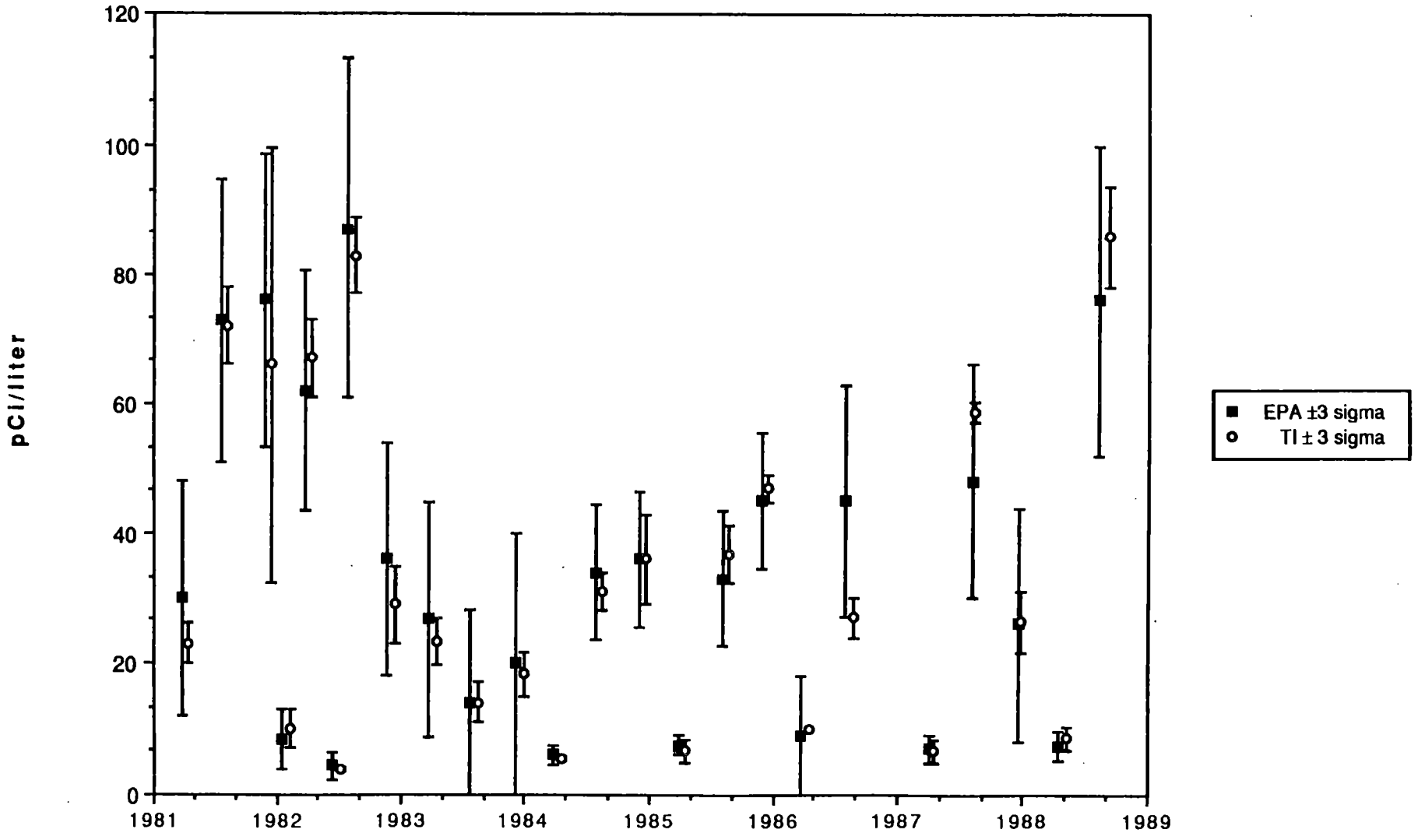
US EPA CROSS CHECK PROGRAM

SR-90 IN WATER



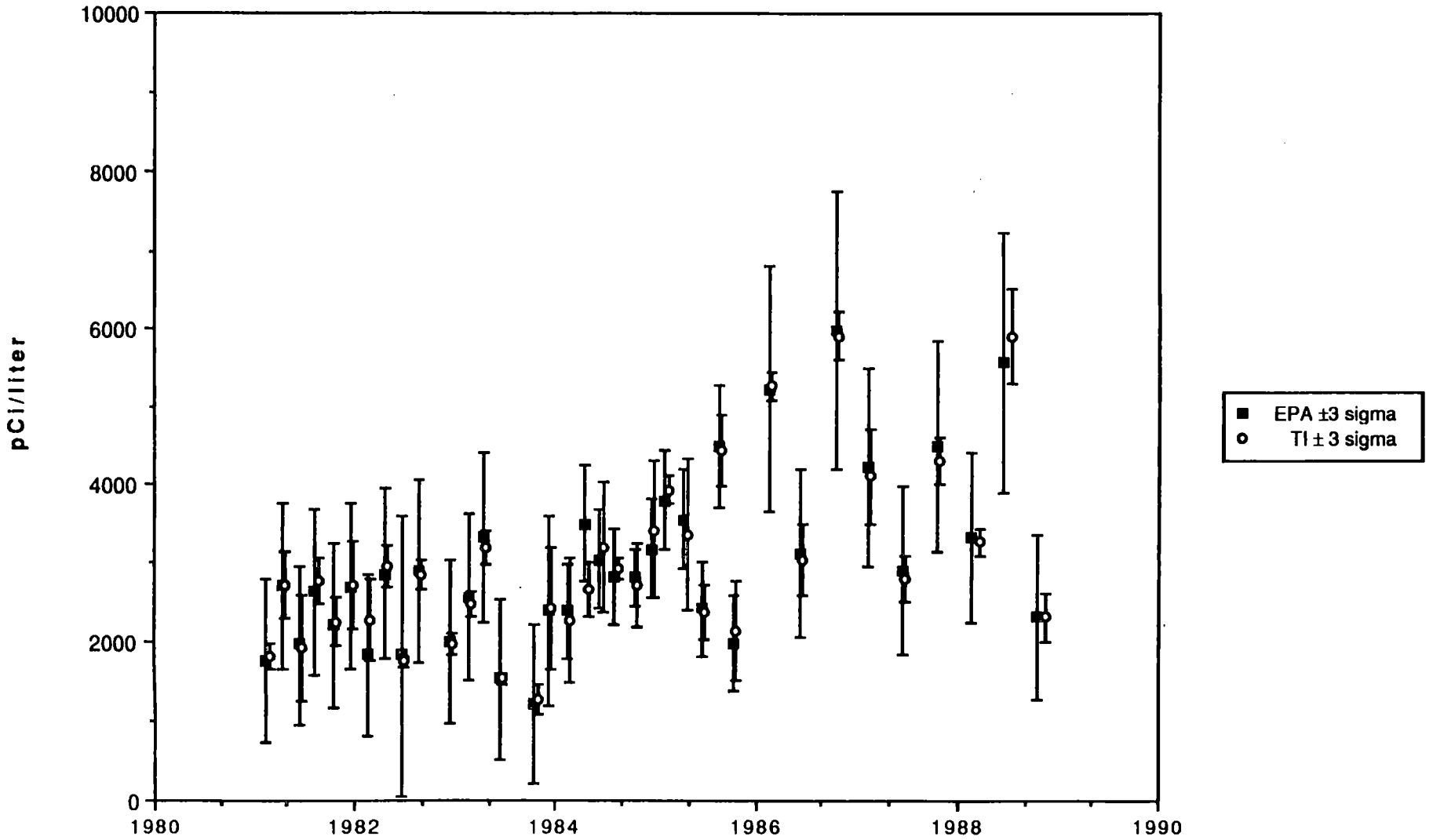
US EPA CROSS CHECK PROGRAM

I-131 IN WATER



US EPA CROSS CHECK PROGRAM

H-3 IN WATER



US EPA INTERLABORATORY COMPARISON PROGRAM 1988

VEPCO - SURRY

EPA PREPARATION	Date TI Mailed Results	Date EPA Issued Results	Media	Nuclide	EPA Results(a)	TI Results(b)	Norm Dev. (Known)	** Warning *** Action
12/11/87	01/28/88	02/23/88	Water	Ra-226	4.80 ± 0.72	5.20 ± 0.35	0.96	
				Ra-228	5.30 ± 0.80	4.93 ± 0.49	-0.79	
01/08/88	02/29/88	04/11/88	Water	Sr-89	30.00 ± 5.00	27.33 ± 0.58	-0.92	
				Sr-90	15.00 ± 1.50	16.00 ± 1.00	1.15	
01/22/88	02/19/88	03/07/88	Water	Gr-Alpha	4.00 ± 5.00	3.67 ± 0.58	-0.12	
				Gr-Beta	8.00 ± 5.00	8.33 ± 0.58	0.12	
01/29/88	04/05/88	05/03/88	Food	Sr-89	46.00 ± 5.00	40.67 ± 2.52	-1.85	
				Sr-90	55.00 ± 2.75	54.33 ± 3.79	-0.42	
				I-131	102.00 ± 10.20	85.67 ± 5.13	-2.77	** (c)
				Cs-137	91.00 ± 5.00	98.67 ± 7.64	2.66	** (d)
				K	1230.00 ± 61.50	1210.00 ±151.00	-0.56	
02/05/88	03/14/88	04/11/88	Water	Co-60	69.00 ± 5.00	65.00 ± 2.65	-1.39	
				Zn-65	94.00 ± 9.40	91.00 ± 4.36	-0.55	
				Ru-106	105.00 ± 10.50	89.00 ± 7.94	-2.64	** (e)
				Cs-134	64.00 ± 5.00	55.00 ± 5.29	-3.12	*** (f)
				Cs-137	94.00 ± 5.00	91.00 ± 3.61	-1.04	
02/12/88	03/18/88	04/04/88	Water	H-3	3327.00 ±362.00	3266.67 ± 57.73	-0.29	
02/26/88	03/18/88	04/29/88	Milk	I-131	4.00 ± 0.40	4.33 ± 0.58	1.44	
03/18/88	04/12/88	05/16/88	Water	Gr-Alpha	6.00 ± 5.00	4.00 ± 0.00	-0.69	
				Gr-Beta	13.00 ± 5.00	15.67 ± 0.58	0.92	
03/25/88	06/02/88	06/28/88	Air Filter	Gr-Alpha	20.00 ± 5.00	24.00 ± 0.00	1.39	
				Gr-Beta	50.00 ± 5.00	46.33 ± 1.15	-1.27	
				Sr-90	17.00 ± 1.50	17.00 ± 0.00	0.00	
				Cs-137	16.00 ± 5.00	16.33 ± 0.58	0.12	
03/31/88	05/06/88	05/31/88	Water	Ra-226	7.60 ± 1.14	7.30 ± 0.17	-0.46	
				Ra-228	7.70 ± 1.16	12.00 ± 0.00	6.42	*** (g)
04/08/88	05/06/88	06/06/88	Water	I-131	7.50 ± 0.75	8.67 ± 0.58	2.69	** (h)

EPA PREPARATION	Date TI Mailed Results	Date EPA Issued Results	Media	Nuclide	EPA Results(a)	TI Results(b)	Norm Dev. (Known)	** Warning *** Action
04/24/88	06/29/88	08/01/88	Lab Perf.	Gr-Alpha	46.00 ± 11.00	70.67 ± 0.58	3.88	*** (i)
			(Sample A)	Ra-226	6.40 ± 0.96	6.63 ± 0.12	0.42	
				Ra-228	5.60 ± 0.84	6.10 ± 0.20	1.03	
			(Sample B)	Gr-Beta	57.00 ± 5.00	67.67 ± 2.08	3.70	*** (j)
				Sr-89	5.00 ± 5.00	4.67 ± 0.58	-0.12	
				Sr-90	5.00 ± 1.50	5.00 ± 0.00	-0.00	
				Co-60	50.00 ± 5.00	53.00 ± 2.00	1.04	
				Cs-134	7.00 ± 5.00	8.33 ± 1.15	0.46	
				Cs-137	7.00 ± 5.00	9.00 ± 1.00	0.69	
05/06/88	07/13/88	08/05/88	Water	Sr-89	20.00 ± 5.00	16.67 ± 2.08	-1.15	
				Sr-90	20.00 ± 1.50	19.67 ± 1.15	-0.38	
05/20/88	06/17/88	07/19/88	Water	Gr-Alpha	11.00 ± 5.00	4.67 ± 0.58	-2.19	** (k)
				Gr-Beta	11.00 ± 5.00	13.67 ± 0.58	0.92	
06/03/88	07/12/88	08/08/88	Water	Cr-51	302.00 ± 30.00	313.67 ± 20.31	0.67	
				Co-60	15.00 ± 5.00	18.00 ± 2.00	1.04	
				Zn-65	101.00 ± 10.00	109.33 ± 10.50	1.44	
				Ru-106	195.00 ± 20.00	184.67 ± 20.03	-0.89	
				Cs-134	20.00 ± 5.00	19.33 ± 2.08	-0.23	
				Cs-137	25.00 ± 5.00	30.33 ± 7.55	1.73	
06/10/88	07/08/88	08/01/88	Water	H-3	5565.00 ±557.00	5900.00 ±199.99	1.04	
06/17/88	08/11/88	09/08/88	Water	Ra-226	10.00 ± 1.51	10.60 ± 0.40	0.69	
				Ra-228	12.40 ± 1.86	9.97 ± 0.06	-2.27	** (l)
06/24/88	09/02/88	09/26/88	Milk	Sr-89	40.00 ± 5.00	36.33 ± 2.52	-1.27	
				Sr-90	60.00 ± 3.00	61.00 ± 2.00	0.58	
				I-131	94.00 ± 9.00	101.67 ± 7.64	1.48	
				Cs-137	51.00 ± 5.00	53.67 ± 3.06	0.92	
				K	1600.00 ± 80.00	1656.67 ± 55.07	1.23	
07/22/88	08/19/88	09/08/88	Water	Gr-Alpha	15.00 ± 5.00	8.33 ± 0.58	-2.31	** (m)
				Gr-Beta	4.00 ± 5.00	6.00 ± 0.00	0.69	
07/29/88	10/07/88	11/10/88	Food	I-131	107.00 ± 11.00	103.33 ± 11.55	-0.58	
				Cs-137	49.00 ± 5.00	51.33 ± 2.52	0.81	
				K	1240.00 ± 62.00	1220.00 ± 34.64	-0.56	
08/05/88	09/07/88	10/12/88	Water	I-131	76.00 ± 8.00	86.00 ± 2.65	2.17	** (n)

US EPA INTERLABORATORY COMPARISON PROGRAM 1988

VEPCO - SURRY

EPA PREPARATION	Date TI Mailed Results	Date EPA Issued Results	Media	Nuclide	EPA Results(a)	TI Results(b)	Norm Dev. (Known)	** Warning *** Action
08/26/88	11/04/88	12/02/88	Air Filter	Gr-Alpha	8.00 ± 5.00	9.33 ± 0.58	0.46	
				Gr-Beta	29.00 ± 5.00	25.67 ± 1.53	-1.15	
				Sr-90	8.00 ± 1.50	7.67 ± 0.58	-0.38	
				Cs-137	12.00 ± 5.00	11.00 ± 1.00	-0.35	
09/16/88	11/10/88	12/02/88	Water	Ra-226	8.40 ± 1.30	8.70 ± 0.26	0.40	
				Ra-228	5.40 ± 0.80	5.83 ± 0.32	0.94	
09/23/88	10/21/88	11/21/88	Water	Gr-Alpha	8.00 ± 5.00	9.00 ± 0.00	0.35	
				Gr-Beta	10.00 ± 5.00	11.33 ± 0.58	0.46	
10/07/88	11/17/88	12/12/88	Water	Cr-51	251.00 ± 25.00	236.00 ± 29.21	-1.04	
				Co-60	25.00 ± 5.00	28.00 ± 0.00	1.04	
				Zn-65	151.00 ± 15.00	165.67 ± 5.51	1.69	
				Ru-106	152.00 ± 15.00	169.67 ± 12.22	0.89	
				Cs-134	25.00 ± 5.00	27.67 ± 1.53	0.92	
				Cs-137	15.00 ± 5.00	17.33 ± 3.06	0.81	
10/14/88	11/10/88	12/01/88	Water	H-3	2316.00 ±350.00	2300.00 ±100.00	-0.08	
10/18/88	12/23/88	02/06/89	Lab Perf.	Gr-Alpha	41.00 ± 10.00	38.67 ± 1.15	-0.40	
			(Sample A)	Ra-226	5.00 ± 0.80	5.67 ± 0.15	1.44	
				Ra-228	5.20 ± 0.80	5.27 ± 0.06	0.14	
			(Sample B)	Gr-Beta	54.00 ± 5.00	53.33 ± 2.52	-0.23	
				Sr-89	11.00 ± 5.00	8.67 ± 0.58	-0.81	
				Sr-90	10.00 ± 1.50	9.00 ± 0.00	-1.15	
				Cs-134	15.00 ± 5.00	15.67 ± 1.15	0.23	
				Cs-137	15.00 ± 5.00	16.33 ± 3.21	0.46	
11/25/88	12/23/88	01/23/89	Water	Gr-Alpha	9.00 ± 5.00	10.00 ± 0.00	0.35	
				Gr-Beta	9.00 ± 5.00	11.00 ± 1.00	0.69	
10/28/88	01/06/89	12/13/88	Milk	Sr-89	40.00 ± 5.00	28.33 ± 0.58	-4.04	*** (o)
				Sr-90	60.00 ± 3.00	52.00 ± 3.56	-4.62	*** (o)
				I-131	91.00 ± 9.00	87.67 ± 1.15	-0.64	
				Cs-137	50.00 ± 5.00	51.33 ± 1.53	0.46	
				K	1600.00 ± 80.00	1578.33 ± 23.63	-0.47	
12/09/88	01/10/89	02/09/89	Water	I-131	115.00 ± 12.00	106.67 ± 5.77	-1.20	

Footnotes:

(a) Average ± experimental sigma.

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

(c) The average result of 86 pCi/kg was lowered by one analysis of 80 pCi/kg, in which I-131 may have been lost in processing. If this analysis is discarded and the higher results of the other 2 aliquots are taken, the average becomes 94 pCi/kg which is more favorable (-1.1 sigma for 2 determinations). Our investigations revealed no systemic reason for the low (-2.77) sigma for 3 determinations). Moreover, our previous performance for this analysis shows no systematic bias.

(d) There is no apparent reason for the deviation. Although there is a bias high, the bias does not appear to be changing significantly. Starting with the 01/13/86 data, the ratio of the average TI results to the EPA result is 1.27, 1.10, 1.08 and 1.15.

(e) The ruthenium-106 results (as well as other isotopes in the EPA sample) for the February 5, 1988 EPA sample were based on a new standard (Amersham) used in the December 1987 annual calibrations. A calculation using the previous NBS standard efficiencies gave an average of 98.0 pCi/liter having a normalized deviation of -1.15. A second Amersham standard in a marinelli was prepared and agreed with the NBS standard. These efficiencies are in use currently.

(f) The cesium-134 results (as well as the other isotopes in the EPA sample) for February 5, 1988 EPA sample were based on a new standard (Amersham) used in the December 1987 annual calibrations. A calculation using the previous NBS standard efficiencies gave an average of 60.2 pCi/liter having a normalized deviation of -1.80. A second Amersham standard in a Marinelli was prepared and agreed with the NBS standard. These efficiencies are is use currently.

(g) The samples were analyzed for Ra-228 by PRO-032-67. A new procedure (PRO-032-97) has been formalized and is currently in use for all samples. The results using the new procedure gave 6.2 ± 1.4 pCi/liter.

(h) An investigation was conducted and there is no apparent reason for the deviation. The samples contained an unusually high concentration of stable iodide (3.6 mg/liter) as determined by electrode readings which was verified at that time. The chemical yields were properly calculated taking these readings into account. No corrective action is necessary since these results fall within the EPA 3 sigma control limits and no trends on previous I-131 intercomparison results are evident.

(i) Dr. Frank Novielli of the EPA states that the EPA takes energy correction into account. He mailed us a document which indicates how this is achieved. Teledyne Isotopes has implemented the EPA method for energy correction.

(j) High concentration of Co-60 in the sample (50 pCi/ℓ) resulted in false beta counts on the Tennelec counters from Co-60 gamma. Dr. Frank Novielli of the EPA stated that the EPA will discontinue using Co-60 in Performance Evaluation samples (effective October 1988) because of this problem.

(k) Low alpha caused by the presence of chlorides in the sample reside which increases self-absorption. Samples are now being evaporated with more nitric acid to convert chlorides to niturates. These reported results fall within the EPA 3 sigma control limits.

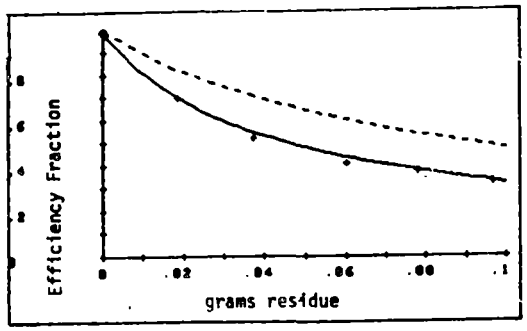
(l) The investigation revealed no apparent reason for the reported low value; the result is within the EPA 3-sigma acceptance region. The new rapid extraction method for Ra-228 has provided acceptable results for all of the last 7 EPA tests.

Footnotes: (Cont.)

(m) The deviation noted is due to unusually high self-absorption characteristics of EPA water spikes. Our results and the midwest laboratory, each independently calibrated with Am-241, obtained low results by the same margin. Corrective action involves applying the self-absorption curve derived by our analysis of EPA water in 1976 Collaborative Study (solid line) instead of the usual curve (dashed line) when calculating EPA cross-check samples.

(n) Faulty stable iodide yield correction, probably caused by a chemical in the sample which interferes with the iodide electrode. The high electrode reading was verified by repeating several times. Without yield correction our average result would have been 77pCi/l. This is in the EPA 3 sigma acceptance region.

(o) Possible loss of radiostrontium in the initial TCA separation step. Another possibility, the presence of calcium on the final strontium mount, has been ruled out by an experiment in which the strontium mounts were repurified and recounted, giving the same results as originally found. An experiement with direct ashing (EML method) and with ion exchange (EPA method) as alternatives to the TCA separation step is being explored. This study includes an experiment in which spiked milk samples are stored for several weeks before analysis in order to determine whether radiostrontium becomes bound to the protein or fat components of the milk.



IX. REFERENCES

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

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

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

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