DUQUESNE LIGHT COMPANY
BEAVER VALLEY POWER STATION
UNITS 1 AND 2
LICENSES DPR-66 AND NPF-73

1993 ANNUAL ENVIRONMENTAL REPORT
RADIOLOGICAL

EXECUTIVE SUMMARY

This report describes the Radiological Environmental Monitoring Program conducted during 1993 in the vicinity of the Beaver Valley Power Station Units 1 and 2. The Radiological Environmental Program consists of off-site monitoring of water, air, river sediments, soils, food pathway samples, and radiation levels in the vicinity of the site. This report discusses the results of this monitoring during 1993.

Duquesne Light Company operates the Beaver Valley Power Station Units 1 and 2 pressurized water reactors as part of the Central Area Power Coordination Group.

The Beaver Valley Power Station Unit 1 operated throughout 1993 except during the nineth refueling outage March 26, 1993 through June 18, 1993 and during plant maintenance October 12, 1993 through November 17, 1993. The high average daily output generated during the year, 821 megawatts net was reached in both October and November, 1993 and the total net electrical generation during the year was 4,353,580 megawatt-hours.

Beaver Valley Power Station Unit 2 operated throughout the year except during the fourth refueling outage which began September 17, 1993 and was extended by plant maintenance until December 7, 1993. The highest average daily output generated during the year was 842 megawatts net in December, 1993, and the total net electrical generation during the year was 5,200,472 megawatt-hours.

In 1993, samples were taken from over 60 sites around Beaver Valley Power Station that included the aquatic, atmospheric and terrestrial environments. More than 3,000 analyses were performed on these samples.

During the year, the radioactive releases from BVPS Units 1 and 2 did not exceed the Technical Specification Environmental Limits identified in the Beaver Valley Power Station Operating License Technical Specifications for Units 1 and 2. Based upon the estimated dose to individuals from the natural background radiation exposure, the incremental increase in total body dose to the 50-mile population (4 million people), from the operation of Beaver Valley Power Station - Unit No. 1 and No. 2, is less than 0.00012% of the annual background. See Section V.I for specific details. The National Academy of Sciences 1990 BEIR Report shows that the typical dose to an individual from background (natural radiation exposure including radon) is 296 mrem per year.

The environmental monitoring program outlined in the Beaver Valley Power Station Units 1 and 2 Technical Specifications was followed throughout 1993. The results for each media are contained in Section V of this report. Examination of effluents and environmental media show that the Beaver Valley Power Station Units 1 and 2 operations have not adversely affected the surrounding environment.

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Section 1. INTRODUCTION

A. Scope and Objectives of the Program

The environmental program consists of environmental monitoring for radioactivity in the vicinity of the Beaver Valley Power Station. Environmental sampling and analyses included air, water, milk, vegetation, river sediments, fish, and ambient radiation levels in areas surrounding the site. The results of these media are assessed to determine impacts of the plant operation on the environment. The Annual Radiological Environmental Report for the Beaver Valley Power Station summarizes the radiological environmental program conducted by the Duquesne Light Company in 1993.

B. Description of the Beaver Valley Site

The Beaver Valley Power Station is located on the south bank of the Ohio River in the Borough of Shippingport, Beaver County, Pennsylvania, on a 501 acre tract of land. Figure 1-1 is a view of the Beaver Valley Power Station. The site is approximately one mile from Midland, Pennsylvania; 5 miles from East Liverpool, Ohio; and 25 miles from Pittsburgh, Pennsylvania. Figure 1-2 shows the site location in relation to the principal population centers. Population density in the immediate vicinity of the site is relatively low. The population within a 5 mile radius of the plant is approximately 18,000 and the only area within the radius of concentrated population is the Borough of Midland, Pennsylvania, with a population of approximately 3,300.

The site lies in a valley along the Ohio River. It extends from the river (elevation 665 feet above sea level) to a ridge along the border south of the Beaver Valley Power Station at an elevation of 1,160 feet. Plant ground level is approximately 735 feet above sea level.

The Beaver Valley Power Station is on the Ohio River at river mile 34.8, at a location on the New Cumberland Pool that is 3.3 river miles downstream from Montgomery Lock and Dam, and 19.4 miles upstream from New Cumberland Lock and Dam. The Pennsylvania-Ohio-West Virginia border is located 5.2 river miles downstream from the site. The river flow is regulated by a series of dams and reservoirs on the Beaver, Allegheny, Monongahela and Ohio Rivers and their tributaries. Flow ranges from a minimum of approximately 5000 cubic feet per second (CFS) to a maximum of approximately 100,000 CFS. The mean annual flow is approximately 25,000 CFS.

Water temperature of the Ohio River varies from 32°F to 84°F, the minimum temperatures occur in January and/or February and maximum temperatures in July and August. Water quality in the Ohio River at the site location is affected primarily by the water quality of the Allegheny, Monongahela, and Beaver rivers.

The climate of the area may be classified as humid continental. Annual precipitation is approximately 36 inches, typical yearly temperatures vary from approximately - 3°F to 95°F with an annual average temperature of 52.3°F. The predominant wind direction is typically from the southwest in summer and from the northwest in winter.

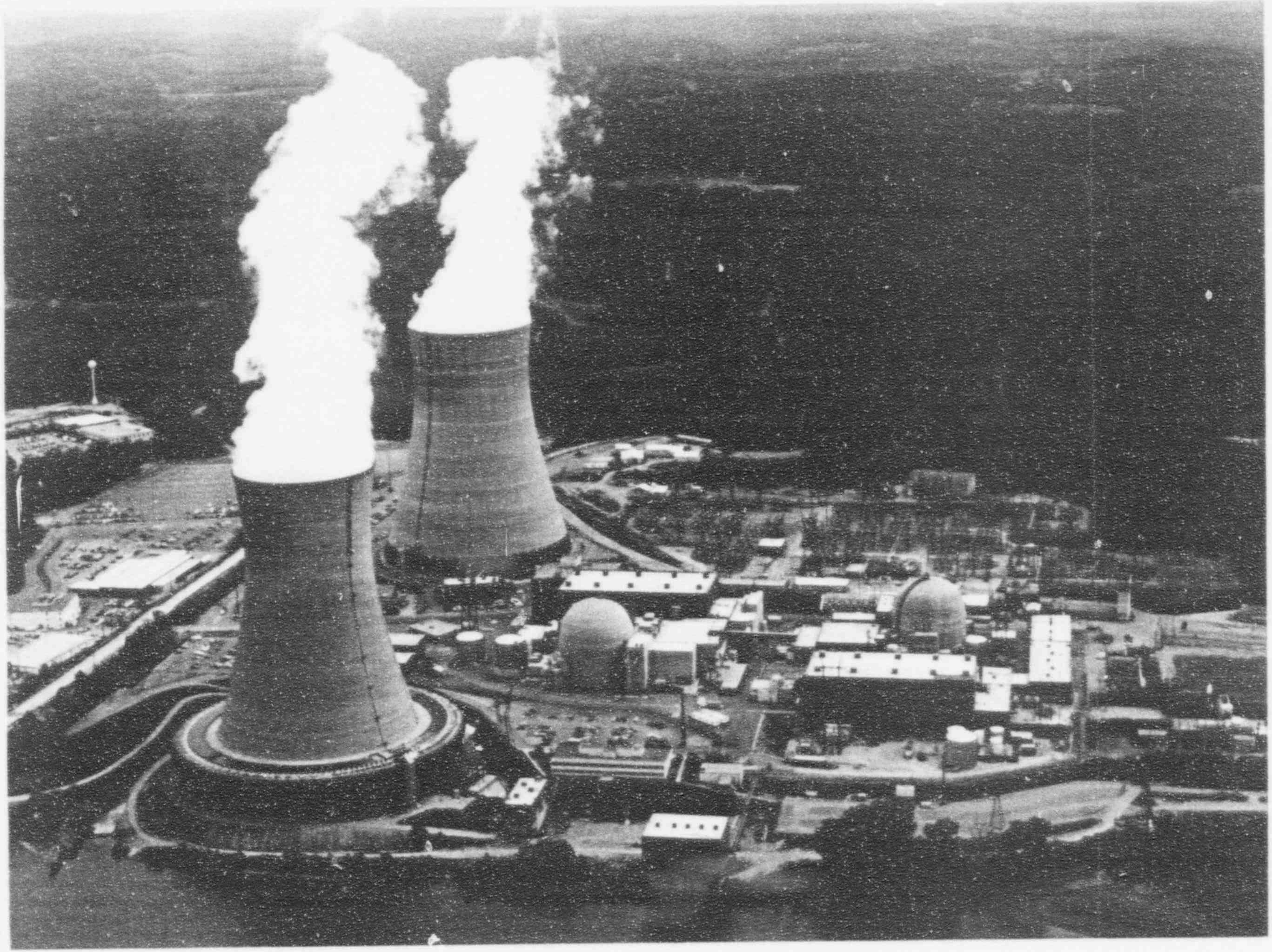
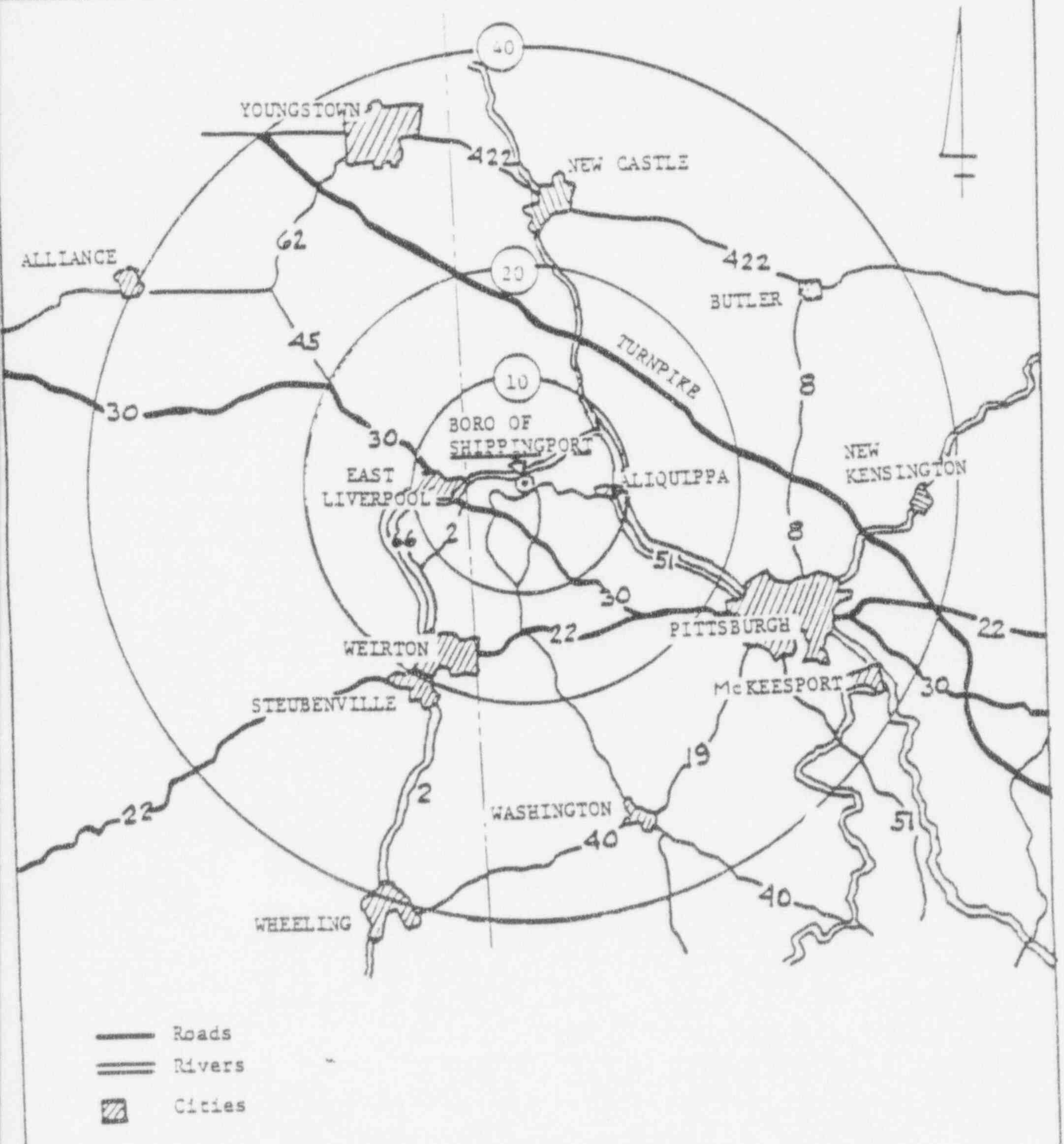


FIGURE 1-1
VIEW OF THE BEAVER VALLEY POWER STATION
BVPS

Figure 1-2 Geographical Map and Principal Communities in 40-mile Radius of the Beaver Valley Power Station



GEOGRAPHICAL MAP AND PRINCIPAL COMMUNITIES IN 40-MILE RADIUS OF THE BEAVER VALLEY POWER STATION

FIGURE 1-2

The design ratings and basic features of the Beaver Valley Power Station Units 1 and 2 are tabulated below:

	Beaver Valley Unit 1	Beaver Valley Unit 2
Thermal & Elec. Rating (Net MW_e)	2660 MW_t 835 MW_e	2660 MW_t 836 MW_e
Type of Power	PWR	PWR
No. of Reactor Coolant Loops	3	3
No. of Steam Generators & Type	3 - Vertical	3 - Vertical
Steam Used by Main Turbine	Saturated	Saturated

The units utilize two separate systems (primary and secondary) for transferring heat from the source (the reactor) to the receiving component (turbine-generator). Because the two systems are isolated from each other, primary and secondary waters do not mix; therefore, radioactivity in the primary system water is normally isolated from the secondary system. Reactor coolant in the primary system is pumped through the reactor core and steam generators by means of reactor coolant pumps. Heat is given up from the primary system to the secondary system in the steam generators, where steam is formed and delivered to the main unit turbine, which drives the electrical generator. The steam is condensed after passing through the turbine, and returned to the steam generators to begin another steam/water cycle.

NOTE: MW_t - megawatts thermal

MW_e - megawatts electrical

Section 2. RESULTS AND CONCLUSIONS

Plant operations at the Beaver Valley Power Station had no adverse effects on the environment as a result of activity at the station during 1993.

The Beaver Valley Power Station Unit 1 operated throughout 1993, except during the ninth refueling outage March 26, 1993 through June 18, 1993 and during plant maintenance October 12, 1993 through November 17, 1993. Unit 2 operated throughout the year except during the fourth refueling outage which began September 17, 1993 and was extended by plant maintenance until December 7, 1993. During the year, the radioactive releases were below the limits of 10 CFR Part 50, Appendix I. The releases at Beaver Valley Power Station Units 1 and 2 did not exceed the limiting conditions identified in the Beaver Valley Power Station Units 1 and 2 Operating License Technical Specifications.

The environmental program for 1993 was the same as in 1992 except several changes in dairy locations which were revised as required by the Beaver Valley Technical Specifications. (Refer to Table 5-1 for the 1993 Radiological Monitoring Program Outline.)

The Beaver Valley Power Station Technical Specifications require sampling of three (3) dairies which have the highest calculated milk pathway potential and one large local dairy. The three dairies are determined from calculations based on the meteorological data and the latest milch animal survey. However, these dairies are frequently small, consisting of as few as one cow or goat. The availability of milk from single cow dairies and revisions due to updated calculations and surveys normally result in sampling of several additional dairies during the year in different sampling periods.

The Environmental Monitoring Program also includes two larger dairies in order to provide continuity in the sampling/analyses program and a control location. Samples from each of these dairies are obtained in addition to the four dairies required by the Environmental Technical Specifications. The collection periods associated with each of the locations are provided in the detailed summary of the milk monitoring program of this report (Section 5-E).

Activity detected was attributable to naturally occurring radionuclides, BVPS effluents, previous nuclear weapons tests, medical procedures or to the normal statistical fluctuation for activities near the lower limit of detection (LLD). The positive results attributable to the Beaver Valley Power Station were consistent with station data of authorized radioactive discharges and were within limits permitted by the NRC license.

The results and conclusions for each media of the 1993 Radiological Environmental Monitoring Program are contained in Section 5 of this report. A summary of the 1993 operational environmental data is found in Table 5-2 and a summary of preoperational data (1974-1975) environmental data is found in Table 5-3.

Evaluation of effluent release data from the Beaver Valley Power Station and environmental media demcnstrated compliance with regulations and Station Technical Specifications.

Section 3. ENVIRONMENTAL MONITORING CONSIDERATIONS

A. Environmental Quality Control Program

The Quality Control (QC) Program used for the Beaver Valley Environmental Radioactivity Monitoring Program consisted of seven (7) elements. It should be noted that the comparisons made were at very low levels of radioactivity and consequently, the activities at these levels are difficult to measure. See Section 3-B for discussion of comparison criteria. Values in Table 3-1 through Table 3-12 identified with an asterisk (*) do not meet comparison criteria. However, acceptable correlation was achieved in most instances as outlined in the discussions and tables which follow.

1. TLD Monitoring (Duquesne Light Company (DLC) Contractor Laboratory and QC Laboratory)

   Thirteen (13) TLDs from the Contractor Laboratory and QC Laboratory are co-located, replaced quarterly and results compared. The average of the contractor laboratory and the average of the quality control laboratory agree within ± 11.0% of the mean of all results. This is within the precision of typical TLD Systems. Summary data of the TLD Monitoring Program is provided in Table 3-1.

2. Split Sample Program (DLC Contractor Laboratory - DLC QC Laboratory)

   Samples of surface (river) water and drinking water were routinely split and analyzed by the DLC Contractor Laboratory and the DLC QC Laboratory. In addition, samples of other media, such as milk, soil, sediment and feedcrop were also split with the DLC QC Laboratory.

   A summary of results of split water samples is provided in Table 3-2 and Table 3-3. The only non-comparison in all of the surface and drinking water analysis was one gross beta analysis of a surface water sample. The one non-comparison of surface water gross beta is believed due to variation in the presence of small amounts of sediment which can affect comparison at low levels of activity. All gross beta analysis of drinking water (which are relatively free of sediment) compared.

   Summaries of milk, sediment and feed/food crop split samples is provided in Table 3-4 and Table 3-5. Good overall agreement was obtained with only one non-comparison observed of K-40 in feed and one non-comparison of Co-60 in sediment. Some variation may be expected due to small variations in duplicate samples, variations in analytical procedures and in calibration, source type, etc.

Table 3-1. Quality Control Data - Contractor/Quality Control Laboratory Comparison Thermoluminescent Dosimeters - mR/day

TABLE 3-1

QUALITY CONTROL DATA - CONTRACTOR/QUALITY CONTROL LABORATORY COMPARISON THERMOLUMINESCENT DOSIMETERS - mR/day

1ST QUARTER		
Location No.	DLC Contractor ($CaSO_4$:Dy)	DLC - QC Lab ($CaSO_4$:Dy)
10	0.14	0.18
13	0.13	0.16
14	0.14	0.20
15	0.11	0.15
27	0.15	0.18
28	0.15	0.18
29B	0.18	0.20
32	0.17	0.20
45	0.16	0.18
46	0.13	0.16
47	0.17	0.20
48	0.15	0.18
51	0.17	0.17

2ND QUARTER		
Location No.	DLC Contractor ($CaSO_4$:Dy)	DLC - QC Lab ($CaSO_4$:Dy)
10	0.15	0.17
13	0.16	0.17
14	0.16	0.18
15	0.14	0.15
27	0.17	0.19
28	0.17	0.19
29B	0.24	0.21
32	0.14	0.19
45	0.17	0.19
46	0.16	0.16
47	0.16	0.21
48	0.15	0.19
51	0.17	0.18

3RD QUARTER		
Location No.	DLC Contractor ($CaSO_4$:Dy)	DLC - QC Lab ($CaSO_4$:Dy)
0	0.16	0.19
13	0.15	0.18
14	0.15	0.18
15	0.12	0.14
27	0.16	0.18
28	0.16	0.18
29B	0.20	0.23
32	0.17	0.20
45	0.16	0.19
46	0.14	0.16
47	0.18	0.20
48	0.17	0.20
51	0.17	0.20

4TH QUARTER		
Location No.	DLC Contractor ($CaSO_4$:Dy)	DLC - QC Lab ($CaSO_4$:Dy)
10	0.16	0.16
13	0.14	0.16
14	0.15	0.17
15	0.14	0.14
27	0.17	0.17
28	0.14	0.17
29B	0.20	0.21
32	0.19	0.17
45	0.16	0.17
46	0.14	0.14
47	0.19	0.18
48	0.16	0.18
51	0.16	0.17

ANNUAL		
Location No.	DLC Contractor ($CaSO_4$:Dy)	DLC - QC Lab ($CaSO_4$:Dy)
10	0.14	0.16
13	0.14	0.16
14	0.14	0.16
15	0.11	0.14
27	0.14	0.16
28	0.14	0.16
29B	0.17	0.19
32	0.15	0.17
45	0.14	0.17
46	0.12	0.15
47	0.16	0.19
48	0.15	0.16
51	0.15	0.16

Table 3-2. Quality Control Data - Contractor/Quality Control Laboratory Comparison Split Surface Water Samples

TABLE 3-2

QUALITY CONTROL DATA
CONTRACTOR/QUALITY CONTROL LABORATORY COMPARISON SPLIT SURFACE WATER SAMPLES

Media	Analysis	Sampling Period	DLC Contractor Lab (1)	DLC - QC Lab (1)	Units
Surface Water	Gross Alpha	January	< 1.7	< 0.6	pCi/l
		April	< 1.6	< 0.6	pCi/l
		July	< 1.6	< 1.1	pCi/l
		October	< 1.4	< 1.0	pCi/l
Surface Water	Gross Beta	January	6.2 ± 1.8	3.8 ± 0.4	pCi/l
		April	7.9 ± 1.2*	2.5 ± 0.4	pCi/l
		July	8.7 ± 1.8	5.8 ± 0.5	pCi/l
		October	4.9 ± 0.8	3.9 ± 0.5	pCi/l
Surface Water	Co-60	January	< 3.0	< 1.9	pCi/l
		April	< 3.0	< 2.0	pCi/l
		July	< 3.0	< 1.8	pCi/l
		October	< 3.0	< 1.6	pCi/l
Surface Water	Cs-134	January	< 3.0	< 1.4	pCi/l
		April	< 3.0	< 1.9	pCi/l
		July	< 4.0	< 1.9	pCi/l
		October	< 3.0	< 2.2	pCi/l
Surface Water	Cs-137	January	< 3.0	< 1.6	pCi/l
		April	< 3.0	< 1.9	pCi/l
		July	< 3.0	< 2.6	pCi/l
		October	< 3.0	< 1.9	pCi/l
Surface Water	Tritium	1st Quarter Composite	29000 ± 1000	33985 ± 505	pCi/l
		3rd Quarter Composite	25000 ± 1000	25670 ± 447	pCi/l
Surface Water	Sr-89	2nd Quarter Composite	< 1.0	< 1.0	pCi/l
		4th Quarter Composite	< 0.8	< 0.7	pCi/l
Surface Water	Sr-90	2nd Quarter Composite	< 0.24	< 0.7	pCi/l
		4th Quarter Composite	< 0.16	< 0.6	pCi/l
Surface Water	Co-60 (high sensitivity anaylsis)	2nd Quarter Composite	< 0.8	< 1.6	pCi/l
		4th Quarter Composite	< 0.8	< 2.1	pCi/l

(1) Uncertainties are based on counting statistics and are specified at the 95% confidence coefficient.

* See Section 3-A.2

Table 3-3. Quality Control Data - Contractor/Quality Control Laboratory Comparison Split Drinking Water Samples

TABLE 3-3

QUALITY CONTROL DATA
CONTRACTOR/QUALITY CONTROL LABORATORY COMPARISON SPLIT DRINKING WATER SAMPLES

Media	Analysis	Sampling Period	DLC Contractor Lab (1)	DLC - QC Lab (1)	Units
Drinking Water (weekly split)	Cs-137	February	< 5.0	< 1.7	pCi/l
		May	< 4.0	< 1.5	pCi/l
		August	< 4.0	< 1.4	pCi/l
		November	< 3.0	< 1.9	pCi/l
Drinking Water (weekly split)	Cs-134	February	< 3.0	< 1.4	pCi/l
		May	< 4.0	< 1.4	pCi/l
		August	< 3.0	< 1.8	pCi/l
		November	< 3.0	< 1.7	pCi/l
Drinking Water (weekly split)	Co-60	February	< 3.0	< 1.8	pCi/l
		May	< 4.0	< 1.6	pCi/l
		August	< 3.0	< 2.1	pCi/l
		November	< 3.0	< 1.3	pCi/l
Drinking Water (monthly composite)	Gross Alpha	March	< 1.0	< 0.9	pCi/l
		June	< 1.5	< 1.2	pCi/l
		August	< 1.9	< 1.4	pCi/l
		November	< 1.6	< 2.3	pCi/l
Drinking Water (monthly composite)	Gross Beta	March	4.6 ± 0.8	2.4 ± 0.5	pCi/l
		June	6.7 ± 1.3	5.0 ± 0.8	pCi/l
		August	6.2 ± 1.0	4.1 ± 0.6	pCi/l
		November	5.1 ± 1.3	2.8 ± 1.1	pCi/l
Drinking Water	Tritium	2nd Quarter	< 200	< 173	pCi/l
		4th Quarter	< 200	< 190	pCi/l

(1) Uncertainties are based on counting statistics and are specified at the 95% confidence coefficient

Table 3-4. Quality Control Data - Contractor/Quality Control Laboratory Comparison Split Milk Samples

TABLE 3-4

QUALITY CONTROL DATA
CONTRACTOR/QUALITY CONTROL LABORATORY COMPARISON SPLIT MILK SAMPLES

Media	Sampling Period	Analysis	DLC Contractor Lab (1)	DLC - QC Lab (1)	Units
Milk (25)	3-24-93	Sr-89	< 1.2	< 0.7	pCi/l
		Sr-90	2.4 ± 0.2	2.9 ± 0.5	pCi/l
		Co-60	< 4.0	< 2.6	pCi/l
		I-131	< 0.1	< 0.4	pCi/l
		Cs-134	< 5.0	< 2.1	pCi/l
		Cs-137	< 5.0	< 2.3	pCi/l
		K-40	1320 ± 130	1300 ± 90	pCi/l
Milk (25)	6-16-93	Co-60	< 4.0	< 1.7	pCi/l
		I-131	< 0.15	< 0.4	pCi/l
		Cs-134	< 4.0	< 1.4	pCi/l
		Cs-137	< 4.0	< 1.7	pCi/l
		K-40	1360 ± 140	990 ± 110	pCi/l
Milk (25)	9-20-93	Sr-89	< 0.64	< 0.7	pCi/l
		Sr-90	2.6 ± 0.2	3.2 ± 0.6	pCi/l
		Co-60	< 4.0	< 2.1	pCi/l
		I-131	< C.17	< 0.3	pCi/l
		Cs-134	< 4.0	< 3.3	pCi/l
		Cs-137	< 4.0	< 3.0	pCi/l
		K-40	1450 ± 140	1230 ± 57	pCi/l
Milk (25)	12-14-93	Co-60	< 5.0	< 2.4	pCi/l
		I-131	< 0.16	< 0.2	pCi/l
		Cs-134	< 4.0	< 2.4	pCi/l
		Cs-137	< 4.0	< 2.2	pCi/l
		K-40	1550 ± 150	1420 ± 50	pCi/l

(1) Uncertainties are based on counting statistics and are specified at the 95% confidence coefficient.

Table 3-5. Quality Control Data - Contractor/Quality Control Laboratory Comparison Split Feed, Food and Sediment Samples

TABLE 3-5

QUALITY CONTROL DATA
CONTRACTOR/QUALITY CONTROL LABORATORY
COMPARISON SPLIT FEED, FOOD AND SEDIMENT SAMPLES

Media	Sampling Period	Analysis	DLC Contractor Lab (1)	DLC - QC Lab (1)	Units
Feed (25)	6-16-93	Be-7	1.63 ± 0.26	1.14 ± 0.15	pCi/gm (dry)
		K-40	16.1 ± 1.6*	9.63 ± 0.50	pCi/gm (dry)
		Co-60	< 0.03	< 0.020	pCi/gm (dry)
		I-131	< 0.006	< 0.021	pCi/gm (dry)
		Cs-134	< 0.03	< 0.014	pCi/gm (dry)
		Cs-137	< 0.03	< 0.016	pCi/gm (dry)
Feed (25)	6-14-93	Sr-90	0.041 ± .011	< 0.011	pCi/gm (dry)
Food (10)	8-24-93	K-40	1.56 ± 0.16	2.33 ± 0.34	pCi/gm (wet)
		Co-60	< 0.005	< 0.018	pCi/gm (wet)
		I-131	< 0.35	< 0.025	pCi/gm (wet)
		Cs-134	< 0.006	< 0.012	pCi/gm (wet)
		Cs-137	< 0.005	< 0.014	pCi/gm (wet)
Sediment (2A)	10-7-93	Gross Alpha	18 ± 0.6	12.8 ± 4.2	pCi/gm (dry)
		Gross Beta	38 ± 3.0	22.0 ± 3.1	pCi/gm (dry)
		Sr-89	< 0.16	< 0.041	pCi/gm (dry)
		Sr-90	< 0.38	< 0.014	pCi/gm (dry)
		Co-58	0.325 ± 0.062	2.44 ± 0.06	pCi/gm (dry)
		Co-60	1.52 ± 0.15*	3.25 ± 0.08	pCi/gm (dry)
		Cs-134	< 0.07	< 0.037	pCi/gm (dry)
		Cs-137	0.232 ± 0.040	0.23 ± 0.04	pCi/gm (dry)
		Ra-226	0.232 ± 0.04	2.24 ± 0.56	pCi/gm (dry)
		Th-228	1.18 ± 0.12	1.14 ± 0.16	pCi/gm (dry)
		K-40	11.7 ± 1.2	14.1 ± 0.77	pCi/gm (dry)

(1) Uncertainties are based on counting statistics and are specified at the 95% confidence coefficient.

* See Section 3.A.2 and 3-B.

3. DLC QC Laboratory Program

Spiked samples prepared by DLC QC Laboratory were routinely submitted to the Contractor Laboratory for analysis. Table 3-6 (water) and Table 3-7 (milk) provide data from this portion of the QC Program. See Section 3-B for evaluation of the data.

4. Comparisons of Similar Samples (DLC Contractor Laboratory - DLC QC Laboratory)

Duplicate air particulate and charcoal filters (radioiodine) samples were collected at Location #30 and compared during the year on a weekly basis. Comparison of particulate and charcoal samples alternated from week to week. Duplicate monthly air particulate filters, composited from the weekly air particulate filters, were analyzed 6 months out of the year for gamma activity. Duplicate quarterly air particulate filters, composited from the weekly air particulate filters, were analyzed for Sr-89 and Sr-90 activity for each quarter of the year. Table 3-8, Table 3-9 and Table 3-10 provides data for this portion of the QC program.

5. Contractor and QC Laboratory - Internal QC Program

The Contractor and QC Laboratory maintained their own QC Program which included participation in the Environmental Protection Agency - Environmental Monitoring Safety Laboratory (EPA - EMSL) Interlaboratory Cross Check Program. This cross check program indicated that the Contractor and QC Laboratory results were in agreement with EPA EMSL. See Appendix I and II.

6. Special QC Program (DLC Contractor Laboratory - Independent Laboratory - DLC QC Laboratory)

Low level spiked water and milk samples are prepared by a vendor noted for supplying quality primary standards with NIST traceability. The "spiked to" values are used for calculating comparison acceptance criteria. The prepared spiked samples are then split 3 ways between an Independent Laboratory (a laboratory qualified to perform analysis for REMP programs), the DLC Contractor Laboratory, and the DLC QC Laboratory. A summary of results of this portion of the QC program is provided in Table 3-11 and Table 3-12. See Section 3-B for evaluation of this data.

Table 3-6. Quality Control Data - Contractor/Quality Control Laboratory Comparison Spiked Water Samples

TABLE 3-6

**QUALITY CONTROL DATA
CONTRACTOR/QUALITY CONTROL
LABORATORY COMPARISON SPIKED WATER SAMPLES**

Sample Date	Identification No.	Sample Analysis	DLC Contractor Lab (1)	DLC - QC Lab (1)	Units
3-31-93	W-98	Sr-89 Sr-90	14.0 ± 1.0 15.0 ± 1.0	18.2 ± 5.0 20.1 ± 1.8	pCi/l pCi/l
4-30-93	W-99	H-3	4900 ± 200	5464 ± 219	pCi/l
4-30-93	W-100	I-131	160 ± 10	149.8 ± 1.9	pCi/l
4-30-93	W-101	Co-60 Cs-134 Cs-137	20.5 ± 4.3 26.1 ± 3.9 30.8 ± 3.9	24.8 ± 2.3 26.4 ± 1.9 34.0 ± 2.6	pCi/l pCi/l pCi/l
6-30-93	W-102	Gross Alpha Gross Beta	23 ± 2.0 34.0 ± 2.0	21.9 ± 1.6 33.6 ± 1.1	pCi/l pCi/l
9-28-93	W-103	Sr-89 Sr-90	32.0 ± 2.0 18.0 ± 1.0	21.9 ± 3.9 19.5 ± 1.8	pCi/l pCi/l
10-7-93	W-104	H-3	17000 ± 1000	16900 ± 368	pCi/l
10-8-93	W-105	I-131	92.0 ± 2.0	95.2 ± 10.6	pCi/l
10-8-93	W-106	Co-60 Cs-134 Cs-137	19.4 ± 2.9 33.2 ± 3.3 47.8 ± 4.8	19.3 ± 3.1 31.5 ± 3.3 44.4 ± 3.6	pCi/l pCi/l pCi/l
12-30-93	W-107	Gross Alpha Gross Beta	38.0 ± 8.0 45.0 ± 7.0	35.0 ± 2.0 32.0 ± 2.0	pCi/l pCi/l
12-30-93	W-108 *	Gross Alpha Gross Beta	79.0 ± 12.0 75.0 ± 9.0	66.8 ± 2.1 63.8 ± 1.5	pCi/l pCi/l

(1) Uncertainties are based on counting statistics and are specified at the 95% confidence coefficient.

* See Section 3-B.

Table 3-7. Quality Control Data - Contractor/Quality Control Laboratory Comparison Spiked Milk Samples

TABLE 3-7

**QUALITY CONTROL DATA
CONTRACTOR/QUALITY CONTROL
LABORATORY COMPARISON SPIKED MILK SAMPLES**

Sample Date	Identification No.	Sample Analysis	DLC Contractor Lab (1)	DLC - QC Lab (1)	Units
1-25-93	MI-45	Sr-89	13.0 ± 1.0*	6.7 ± 3.1	pCi/l
		Sr-90	15.0 ± 1.0	20.0 ± 1.2	pCi/l
		Cs-134	21.1 ± 3.9	17.1 ± 2.0	pCi/l
		Cs-137	26.1 ± 4.4	21.4 ± 2.2	pCi/l
		K-40	1470 ± 150	1390 ± 60	pCi/l
2-2-93	MI-46	I-131	81.0 ± 2.0	72.5 ± 8.4	pCi/l
4-30-93	MI-47	I-131	150.0 ± 10	139.8 ± 1.6	pCi/l
		Cs-134	55.2 ± 5.5	48.8 ± 2.9	pCi/l
		Cs-137	68.5 ± 6.9	65.2 ± 3.1	pCi/l
		K-40	1470 ± 150	1406 ± 50	pCi/l
8-20-93	MI-48	Sr-89	43.0 ± 2.0	29.1 ± 4.9	pCi/l
		Sr-90	21.0 ± 1.0	18.3 ± 1.3	pCi/l
		Cs-134	23.4 ± 3.0	31.4 ± 7.2	pCi/l
		Cs-137	33.8 ± 3.6	32.3 ± 7.5	pCi/l
		K-40	1340 ± 130	1310 ± 150	pCi/l
9-28-93	MI-49	I-131	48.0 ± 1.0	40.2 ± 0.8	pCi/l
10-8-93	MI-50	I-131	45.0 ± 1.0	49.7 ± 8.6	pCi/l
		Cs-134	33.3 ± 3.8	30.8 ± 4.5	pCi/l
		Cs-137	54.9 ± 5.5	43.4 ± 6.0	pCi/l

(1) Uncertainties are based on counting statistics and are specified at the 95% confidence coefficient.

* See Section 3-B

TABLE 3-8

QUALITY CONTROL DATA
CONTRACTOR/QUALITY CONTROL LABORATORY COMPARISON
SPLIT AIR PARTICULATE AND CHARCOAL FILTER SAMPLES

Air Particulates pCi/Cu. Meter (Beta)			Air Iodine pCi/Cu. Meter		
Sample Date	* DLC Contractor Lab (1)	DLC - QC Lab (1)	Sample Date	DLC Contractor Lab (1)	DLC - QC Lab (1)
1/4 - 1/11	0.015 ± 0.003*	0.026 ± 0.003	12/28 - 1/4	< 0.02	< 0.01
1/18 - 1/25	0.013 ± 0.003	0.014 ± 0.003	1/11 - 1/18	< 0.02	< 0.01
2/1 - 2/8	0.017 ± 0.003	0.021 ± 0.003	1/25 - 2/1	< 0.01	< 0.01
2/16 - 2/22	0.013 ± 0.003	0.019 ± 0.003	2/8 - 2/16	< 0.01	< 0.01
3/1 - 3/8	0.017 ± 0.003	0.021 ± 0.003	2/22 - 3/1	< 0.01	< 0.01
3/15 - 3/22	0.014 ± 0.003	0.019 ± 0.003	3/8 - 3/15	< 0.02	< 0.01
3/29 - 4/5	0.009 ± 0.002	0.012 ± 0.002	3/22 - 3/29	< 0.02	< 0.01
4/12 - 4/19	0.010 ± 0.003	0.012 ± 0.003	4/5 - 4/12	< 0.02	< 0.01
4/26 - 5/3	0.015 ± 0.003	0.019 ± 0.003	4/19 - 4/26	< 0.01	< 0.02
5/10 - 5/17	0.009 ± 0.003	0.014 ± 0.003	5/3 - 5/10	< 0.01	< 0.01
5/24 - 6/1	0.009 ± 0.002	0.014 ± 0.003	5/17 - 5/24	< 0.01	< 0.01
6/7 - 6/14	0.011 ± 0.003	0.017 ± 0.003	6/1 - 6/7	< 0.01	< 0.01
6/21 - 6/28	0.009 ± 0.003	0.016 ± 0.003	6/14 - 6/21	< 0.01	< 0.01

(1) Uncertainties are based on counting statistics and are specified at the 95% confidence coefficient.

* See Section 3-B.

TABLE 3-8

QUALITY CONTROL DATA
CONTRACTOR/QUALITY CONTROL LABORATORY COMPARISON
SPLIT AIR PARTICULATE AND CHARCOAL FILTER SAMPLES

Air Particulates pCi/Cu. Meter (Beta)			Air Iodine pCi/Cu. Meter		
Sample Date	DLC Contractor Lab (1)	DLC - QC Lab (1)	Sample Date	DLC Contractor Lab (1)	DLC - QC Lab (1)
7/6 - 7/12	0.017 ± 0.003	0.019 ± 0.003	6/28 - 7/6	< 0.01	< 0.01
7/19 - 7/26	0.013 ± 0.003*	0.010 ± 0.003	7/12 - 7/19	< 0.02	< 0.01
8/2 - 8/9	0.013 ± 0.003	0.014 ± 0.003	7/26 - 8/2	< 0.02	< 0.01
8/16 - 8/23	0.019 ± 0.003	0.022 ± 0.003	8/9 - 8/16	< 0.01	< 0.01
8/30 - 9/7	0.018 ± 0.003	0.014 ± 0.003	8/23 - 8/30	< 0.02	< 0.01
9/13 - 9/20	0.016 ± 0.003	0.019 ± 0.003	9/7 - 9/13	< 0.01	< 0.01
9/27 - 10/4	0.012 ± 0.003	0.017 ± 0.003	9/20 - 9/27	< 0.02	< 0.01
10/11 - 10/18	0.024 ± 0.004	0.023 ± 0.003	10/4 - 10/11	< 0.01	< 0.01
10/25 - 11/1	0.016 ± 0.003	0.018 ± 0.003	10/18 - 10/25	< 0.01	< 0.01
11/8 - 11/15	0.034 ± 0.004	0.033 ± 0.004	11/1 - 11/8	< 0.02	< 0.01
11/22 - 11/29	0.019 ± 0.003	0.022 ± 0.003	11/15 - 11/22	< 0.02	< 0.01
12/6 - 12/13	0.020 ± 0.003	0.022 ± 0.003	11/29 - 12/6	< 0.02	< 0.01
12/20 - 12/27	0.021 ± 0.004	0.026 ± 0.003	12/13 - 12/20	< 0.01	< 0.01

(1) Uncertainties are based on counting statistics and are specified at the 95% confidence coeficient.

* See Section 3-B.

Table 3-9. Quality Control Data - Contractor/Quality Control Laboratory Comparison Split Air Particulate Samples (gamma) (pCi/m³)

TABLE 3-9

QUALITY CONTROL DATA
CONTRACTOR/QUALITY CONTROL LABORATORY
COMPARISON SPLIT AIR PARTICULATE SAMPLES (GAMMA) (pCi/m³)

Sample Date	Nuclide	DLC - Contractor Lab (1)	DLC - QC Lab (1)
January	Be-7	0.080 ± 0.01	0.095 ± 0.03
	K-40	0.015 ± 0.006	LLD
	Others	LLD	LLD
March	Be-7	0.092 ± 0.01	0.070 ± 0.03
	Others	LLD	LLD
May	Be-7	0.124 ± 0.01	0.130 ± 0.03
	Others	LLD	LLD
July	Be-7	0.126 ± 0.01	0.088 ± 0.04
	Others	LLD	LLD
September	Be-7	0.131 ± 0.01	0.041 ± 0.02
	Others	LLD	LLD
November	Be-7	0.120 ± 0.01	0.085 ± 0.04
	Others	LLD	LLD

(1) Uncertainties are based on counting statistics and are specified at the 95% confidence coefficient.

LLD - Lower Limit of Detection

Table 3-10 Quality Control Data - Contractor/Quality Control Laboratory Composite Samples Comparison Split for Sr-89 and Sr-90 (pCi/m³)

TABLE 3-10

QUALITY CONTROL DATA
CONTRACTOR/QUALITY CONTROL LABORATORY
COMPOSITE SAMPLES COMPARISON SPLIT FOR Sr-89, 90 (pCi/m³)

Sample Date	Nuclide	DLC - Contractor Lab (1)	DLC - QC Lab (1)
1st Quarter Composite	Sr-89	< 1.2 E-3	< 3.0 E-4
	Sr-90	< 2.1 E-4	< 3.0 E-4
2nd Quarter Composite	Sr-89	< 6.2 E-4	< 2.0 E-4
	Sr-90	< 1.2 E-4	< 2.0 E-4
3rd Quarter Composite	Sr-89	< 1.2 E-3	< 4.0 E-4
	Sr-90	< 1.8 E-4	< 3.0 E-4
4th Quarter Composite	Sr-89	< 7.1 E-4	< 3.0 E-4
	Sr-90	< 1.1 E-4	< 3.0 E-4

(1) Uncertainties are based on counting statistics and are specified at the 95% confidence coefficient.

Table 3-11. Quality Control Data - Independent Laboratory/Contractor/Quality Control Laboratory Comparison Spiked Water Samples (pCi/l)

TABLE 3-11

QUALITY CONTROL DATA
INDEPENDENT LABORATORY/CONTRACTOR/QUALITY CONTROL LABORATORY COMPARISON SPIKED WATER SAMPLES (pCi/l)

Sample Date	Identification No.	Sample Type and Analyses	Independent Lab (1)	DLC CONTRACTOR LAB (1)	DLC - QC Lab (1)
2-28-93	Water 53-327	Sr-89	24.2 ± 5.4	24.0 ± 2.0	26.3 ± 4.3
		Sr-90	15.1 ± 5.7	11.0 ± 1.0	11.3 ± 1.4
		I-131	18.1 ± 1.8	16.5 ± 1.0	17.0 ± 0.5
		Cs-134	14.8 ± 5.4	15.1 ± 3.3	18.0 ± 1.9
		Cs-137	22.0 ± 6.6	25.0 ± 3.7	19.6 ± 2.9
2-8-93	Water 53-328	H-3	1050 ± 330	940 ± 110	960 ± 116
4-30-93	Water 53-329	Sr-89	10.2 ± 4.8	10.0 ± 2.0	5.4 ± 2.1*
		Sr-90	11.8 ± 6.0	15.5 ± 1.0	14.3 ± 1.0
		Co-60	9.7 ± 7.0	11.3 ± 1.0	10.1 ± 1.7
		I-131	16.8 ± 1.5	14.0 ± 1.0	19.9 ± 0.3*
		Cs-137	20.1 ± 7.2*	13.8 ± 2.9	14.0 ± 1.3
4-30-93	Water 53-330	H-3	860 ± 300	790 ± 130	972 ± 70
8-6-93	Water 53-331	Sr-89	14.0 ± 3.9	14.0 ± 1.0	12.6 ± 5.6
		Sr-90	9.5 ± 3.6	10.2 ± 0.8	9.1 ± 1.7
		Mn-54	22.4 ± 4.0	24.0 ± 3.0	22.5 ± 2.4
		I-131	21.0 ± 2.7	23.0 ± 1.0	18.4 ± 0.7
		Cs-137	15.4 ± 5.0	16.2 ± 3.4	17.1 ± 2.3
8-6-93	Water 53-332	H-3	1100 ± 300	840 ± 130	956 ± 130
10-29-93	Water 53-333	Sr-89	11.7 ± 7.2	17.0 ± 1.0	12.4 ± 4.1
		Sr-90	9.4 ± 5.4	10.5 ± 1.5	9.5 ± 1.3
		Co-58	22.0 ± 4.5	23.6 ± 4.1	25.8 ± 5.0
		Co-60	12.6 ± 5.8	12.3 ± 3.4	14.0 ± 3.5
		I-131	20.3 ± 1.7	29.0 ± 1.0*	14.9 ± 0.3*
10-29-93	Water 53-334	H-3	884 ± 291	690 ± 120	958 ± 129

(1) Uncertainties are based on counting statistics and are reported at the 95% confidence coefficient.

* See Section 3-B.

Table 3-12. Quality Control Data - Independent Laboratory/Contractor/Quality Control Laboratory Comparison Spiked Milk Samples (pCi/l)

TABLE 3-12

**QUALITY CONTROL DATA
INDEPENDENT LABORATORY/CONTRACTOR/QUALITY
CONTROL LABORATORY COMPARISON SPIKED MILK SAMPLES (pCi/l)**

Sample Date	Identification No.	Sample Type and Analyses	Independent Lab (1)	DLC CONTRACTOR LAB (1)	DLC - QC Lab (1)
2-8-93	Milk 52-266	Sr-89	30.7 ± 4.5	23.5 ± 2.0**	24.2 ± 3.2
		Sr-90	20.0 ± 4.5	21.0 ± 1.0	20.4 ± 1.3
		I-131	29.8 ± 2.4	26.0 ± 1.0	28.2 ± 0.7
		Cs-134	15.6 ± 5.0	14.4 ± 3.6	13.4 ± 1.4
		Cs-137	13.8 ± 4.0	16.1 ± 3.7	13.6 ± 2.4
4-30-93	Milk 52-267	Sr-89	16.6 ± 6.9	13.5 ± 3.0	10.0 ± 2.3*
		Sr-90	14.8 ± 6.6	21.0 ± 1.0	19.2 ± 1.0
		I-131	16.7 ± 1.6	14.5 ± 1.0	18.9 ± 0.3
		Cs-134	10.6 ± 4.0	9.7 ± 3.4	9.5 ± 1.3
		Cs-137	22.6 ± 5.4	21.3 ± 3.6	21.5 ± 1.9
8-6-93	Milk 52-268	Sr-89	12.3 ± 5.4	14.0 ± 1.0	8.9 ± 4.4*
		Sr-90	18.0 ± 3.9	18.5 ± 1.0	18.6 ± 1.3
		I-131	21.9 ± 3.3	25.5 ± 1.0	21.9 ± 1.7
		Cs-134	15.5 ± 5.5	15.6 ± 3.0	15.3 ± 5.6
		Cs-137	18.5 ± 3.9	16.4 ± 3.1	18.2 ± 6.3
10-29-93	Milk 52-269	Sr-89	10.1 ± 5.4*	16.0 ± 2.0	9.5 ± 5.3*
		Sr-90	14.4 ± 5.4*	12.0 ± 1.0	12.1 ± 0.9
		I-131	21.4 ± 1.8	27.0 ± 1.0**	21.8 ± 0.5
		Cs-134	10.0 ± 5.1	12.5 ± 2.9	9.5 ± 1.4
		Cs-137	11.5 ± 4.8	11.0 ± 2.7	13.7 ± 2.9

(1) Uncertainties are based on counting statistics and are based on the 95% confidence coefficient.

* See Section 3-B.

** One sample of duplicate analysis compared

7. Pennsylvania Department of Environmental Resources Program

   The Pennsylvania Department of Environmental Resources (PDER) also conducted a surveillance program in the vicinity of the site. Samples of air, river water, drinking water, sediment, milk, vegetation, fish and radiation monitoring are included in their program. Results were compared quarterly in 1993.

B. Evaluation of the Quality Control Program Data

The split and spiked sample program indicates that the Contractor and QC Laboratory are generally performing satisfactorily in accordance with "Criteria for Comparing Analytical Measurements from NRC Compliance Office." In addition, an Independent laboratory is used to supplement the regular program. Comparisons between the independent, QC and Contractor laboratories are generally acceptable and demonstrate a satisfactory performance by the DLC contractor. All media were found to be in agreement in accordance with NRC criteria as listed in Inspection Guidance 84750-03 dated 12/04/90 with the exception of those media in Table 3-1 through Table 3-12 identified with an asterisk (*).

The QC Laboratory was noted to have a slightly low bias for strontium 89 in milk as indicated by three non-comparisons in the Independent Laboratory Program data shown in Table 3-12. This bias may also have contributed to a non-comparison for strontium 89 in Table 3-7 for the QC sample spike program with the Contractor. The QC Laboratory bias has been addressed by a strontium in milk procedure revision. The corrective action will be followed by the ongoing QC program in 1994.

The Contractor had minor non-comparisons within the Independent Laboratory Program. One sample out of a duplicate set for strontium 89 was slightly low, one sample out of a duplicate set for iodine 131 in milk was slightly high, and there was one non-comparison for iodine 131 in water, which was slightly high.

The remainder of the Quality Control Program non-comparisons are random in nature. Comparison samples for feed and sediment are particularly subject to sample variability. Single non-comparisons were noted for potassium 40 in feed and cobalt 60 in sediment, however, overall these samples compared in other isotopes. Several air sample gross beta's did not compare, but comparison was demonstrated on the whole.

In the QC Laboratory spike program, agreement was reached for W-102 gross alpha and beta after re-analysis by the QC Laboratory. Agreement was reached for W-107 gross alpha and beta after re-analysis by both laboratories. These areas will be followed by the ongoing QC program in 1994.

Based on all available QC program data, the data from the Contractor and QC Laboratory's internal EPA Interlaboratory Cross Check Program, and comparisons with the PDER, the Environmental Monitoring Program for 1993 is acceptable with respect to both accuracy and measurement.

C. Standard Requirements and Limitations for Radiological and Other Effluents

The Beaver Valley Power Station is governed by rules and regulations of the Federal Government and the Commonwealth of Pennsylvania. Effluent releases are controlled to ensure that limits set by Federal or State governments are not exceeded. In addition, self-imposed limits have been established to further limit discharges to the environment.

Beaver Valley Power Station is subject to regulations which include the Code of Federal Regulations 10 CFR (Energy), Pennsylvania Department of Environmental Resources (PDER) Industrial Waste Permit #0473211, Gaseous Discharge Permit #04-306-001, PA Code - Title 24, Part I, Ohio River Valley Water Sanitation Commission (ORSANCO) Standards No. 1-70 and 2-70, Environmental Protection Agency (EPA), National Pollution Discharge Elimination (NPDES) Permit #0025615, and the Beaver Valley Power Station Technical Specifications.

D. Reporting Levels

A report is required to be submitted to the Nuclear Regulatory Commission when the level of radioactivity in an environmental sampling medium exceeds the limits specified in the Beaver Valley Power Station Technical Specifications when averaged over any calendar quarter. Also, when more than one of the radionuclides are detected in the sampling medium, this report shall be submitted if:

$$\frac{\textit{Concentration}\,(1)}{\textit{Limit Level}\,(1)} + \frac{\textit{Concentration}\,(2)}{\textit{Limit Level}\,(2)} + \ldots \geq 1.0$$

There were no analytical results of environmental samples during 1993 which exceeded Beaver Valley Power Station reporting levels.

Section 4. MONITORING EFFLUENTS

A. Monitoring of Liquid Effluents

1. Description of Liquid Effluents at the Beaver Valley Power Station.

   Most of the water required for the operation of the Beaver Valley station is taken from the Ohio River, and returned to the river, used for makeup to various plant systems, consumed by station personnel, or discharged via a sanitary waste system. In addition, small amounts of well water and liquid effluents are discharged to the Ohio River using discharge points shown in Figure 4-1. Schematic diagrams of liquid flow paths for the Beaver Valley Power Station are shown in Figure 4-2, Figure 4-3, Figure 4-4 and Figure 4-5

2. Radioactive Liquid Waste Sampling and Analysis Program

   See Table 4-1.

3. Results of Liquid Effluent Discharge to the Environment

   See Table 4-2.

Figure 4-1. Liquid Discharge Points to Ohio River

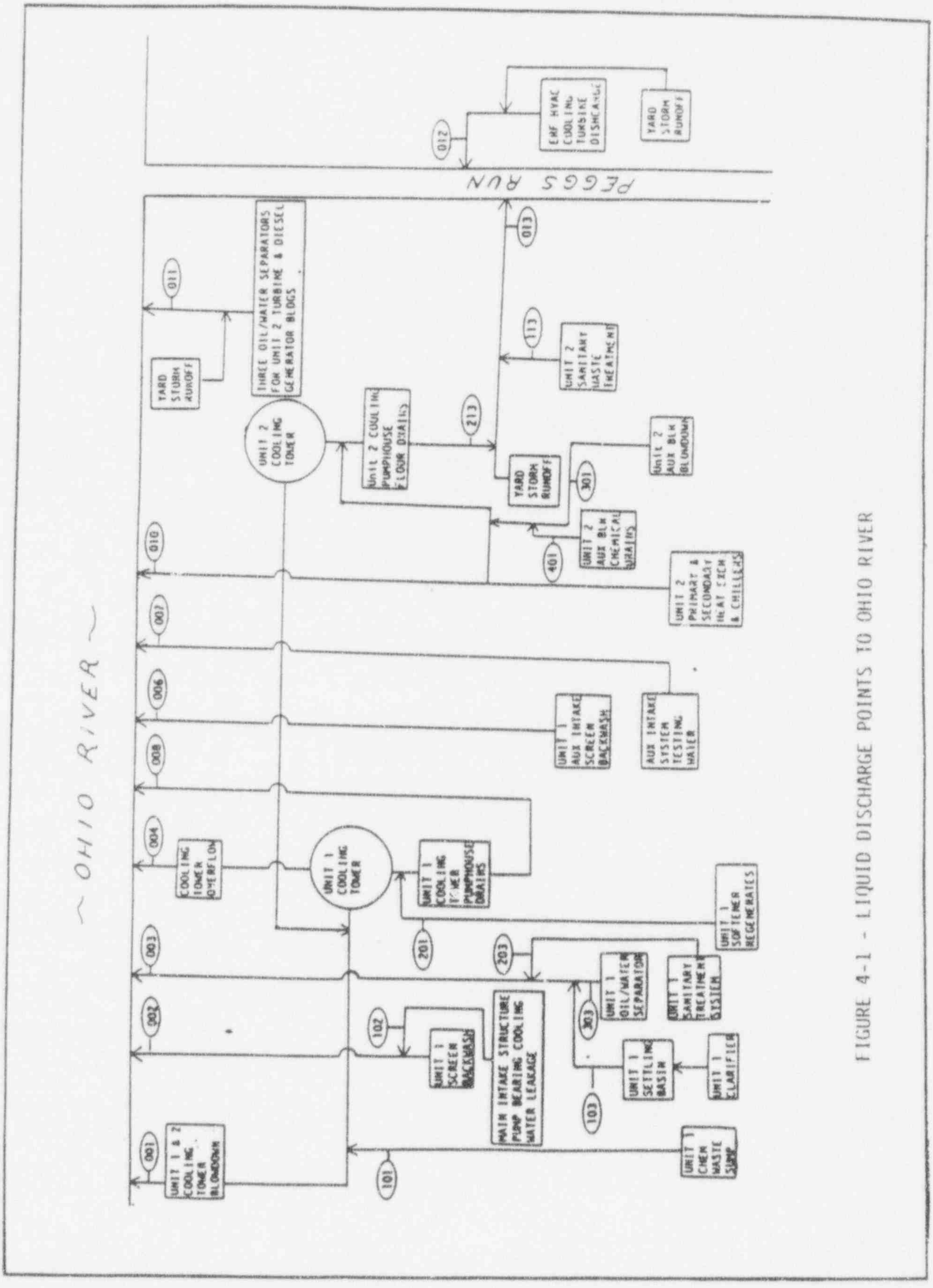


FIGURE 4-1 - LIQUID DISCHARGE POINTS TO OHIO RIVER

Figure 4-2. Unit 1 Water Flow Schematic

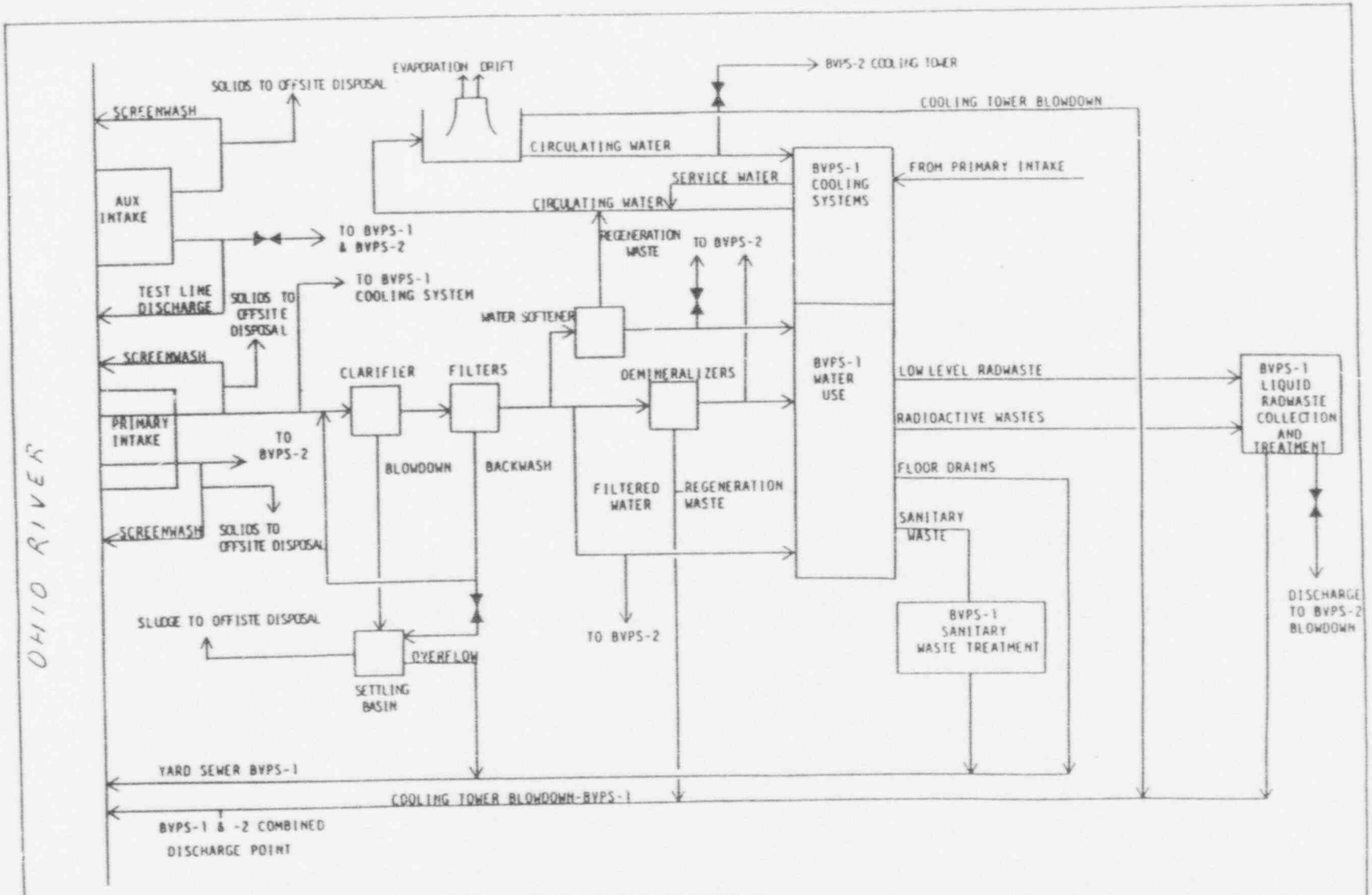


FIGURE 4-2 - UNIT 1 WATER FLOW SCHEMATIC

Figure 4-3. Unit 2 Water Flow Schematic

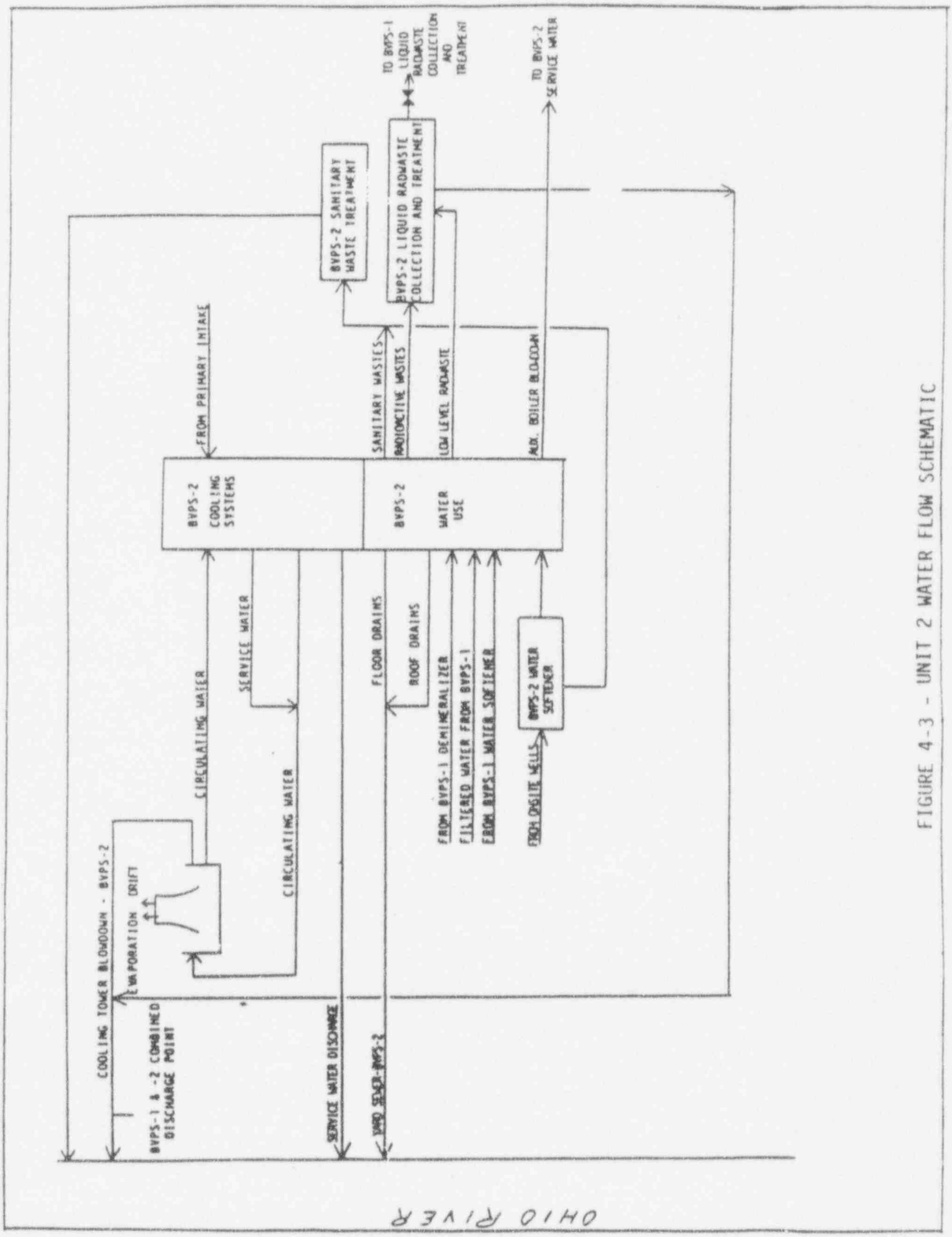


Figure 4-4 Unit 1 Liquid Waste System

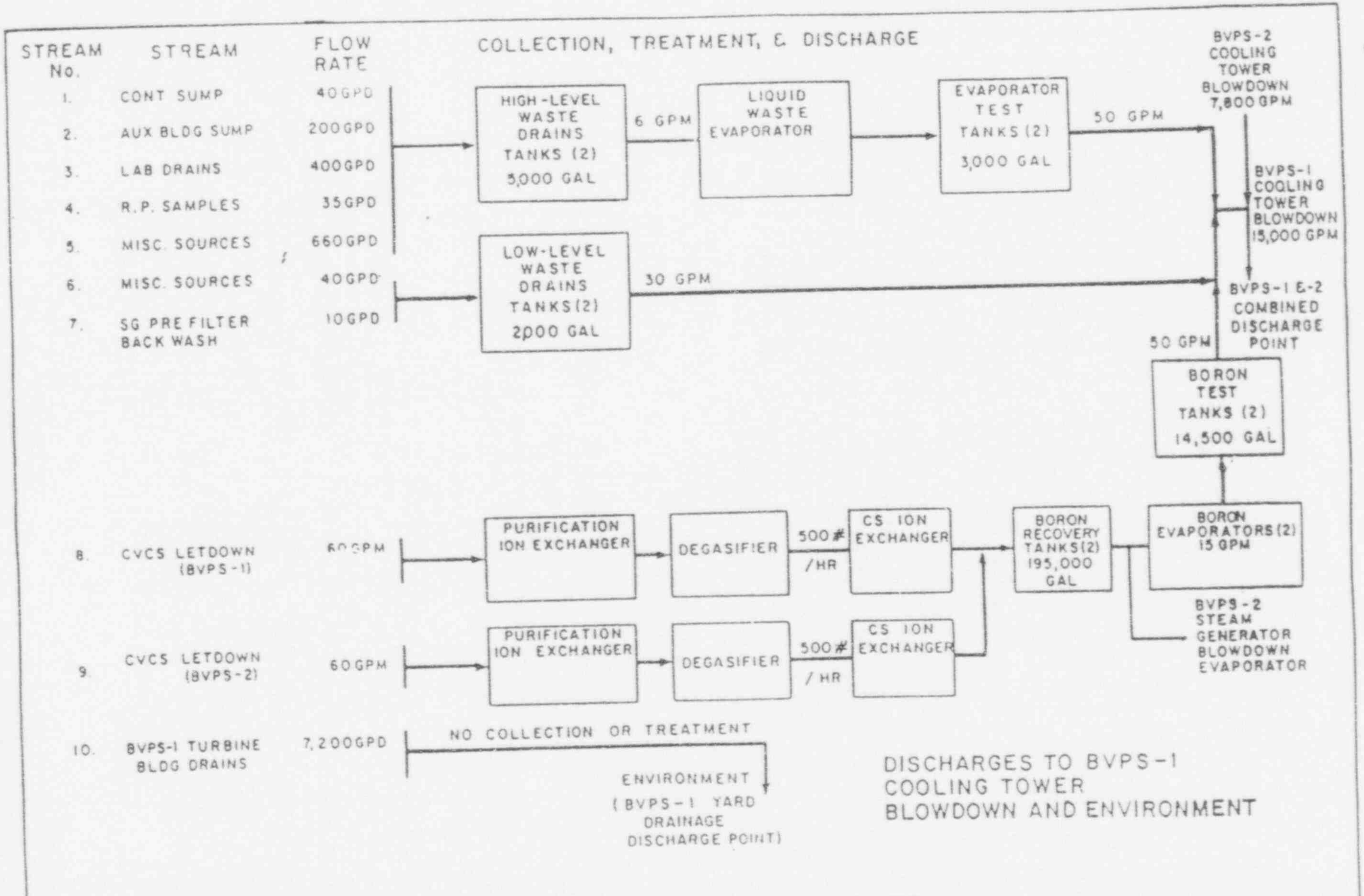


FIGURE 4-4 - UNIT 1 LIQUID WASTE SYSTEM

Figure 4-5. Unit 2 Liquid Waste System

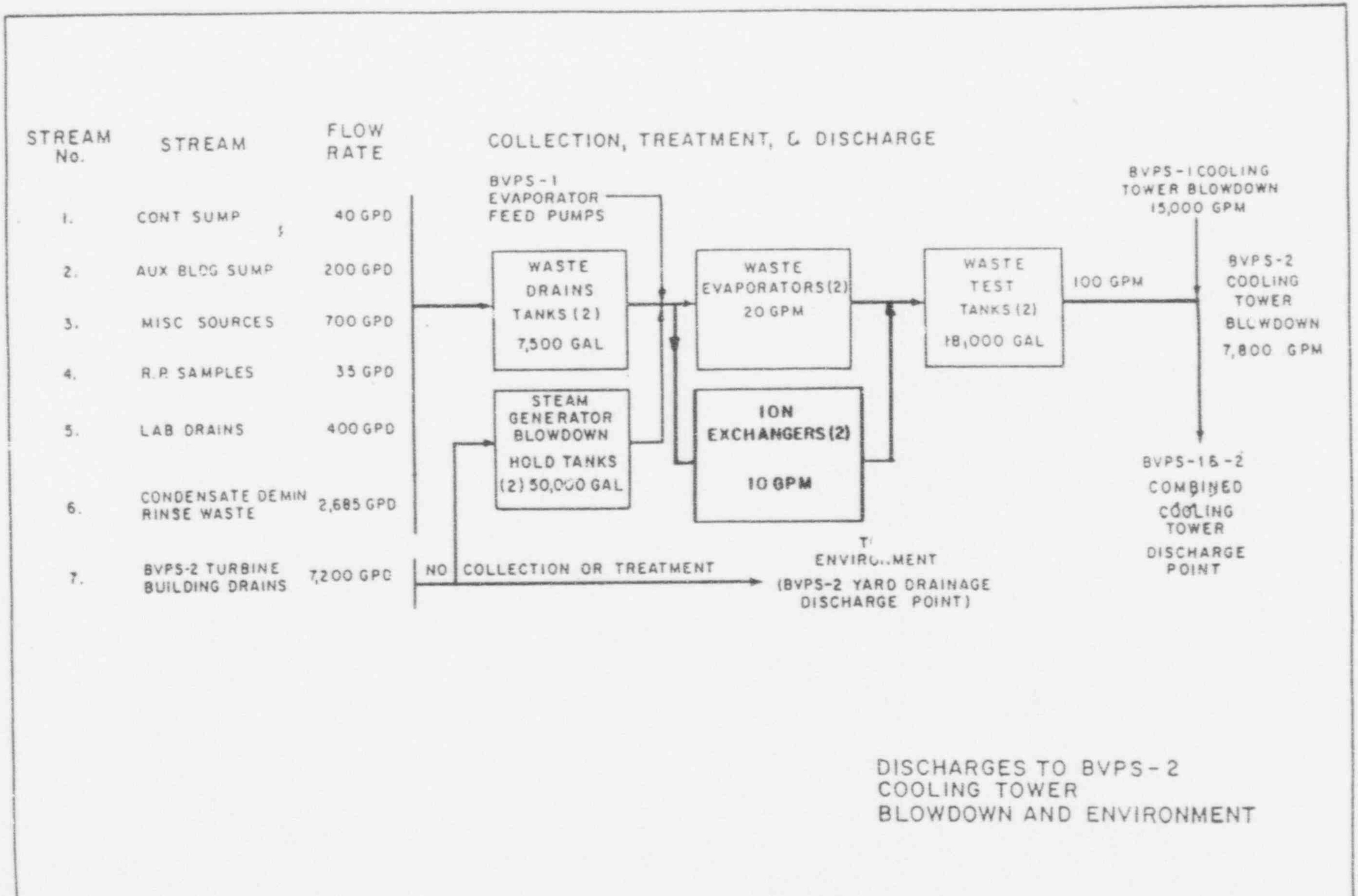


FIGURE 4-5 - UNIT 2 LIQUID WASTE SYSTEM

Table 4-1. Radioactive Liquid Waste Sampling and Analysis Program

TABLE 4-1

Radioactive Liquid Waste Sampling and Analysis Program

LIQUID RELEASE TYPE	SAMPLING FREQUENCY	MINIMUM ANALYSIS FREQUENCY	TYPE OF ACTIVITY ANALYSIS	LOWER LIMIT OF DETECTION (LLD) (μCi/ml)[a]
Batch Waste Release Tanks[d]	P Each Batch[h]	P Each Batch[h]	Principal Gamma Emitters[f]	5E-7
			I-131	1E-6
	P One Batch/M[h]	M	Dissolved and Entrained Gases (Gamma Emitters)	1E-5
	P Each Batch[h]	M Composite[b]	H-3	1E-5
			Gross Alpha	1E-7
	P Each Batch[h]	Q Composite[b]	Sr-89, Sr-90	5E-8
			Fe-55	1E-6
B. Continuous Releases[e,g]	Grab Sample[g]	W Composite[c]	Principal Gamma Emitters[f]	5E-7
			I-131	1E-6
	Grab Sample[g]	M	Dissolved and Entrained Gases (Gamma Emitters)	1E-5
	Grab Sample[g]	M Composite[c]	H-3	1E-5
			Gross Alpha	1E-7
	Grab Sample[g]	Q Composite[c]	Sr-89, Sr-90	5E-8
			Fe-55	1E-6

W - At least once per 7 days
M - At least once per 31 days
Q - At least once per 92 days
P - Completed prior to each release

TABLE 4-1 NOTATION

a. The Lower Limit of Detection (LLD).

b. A composite sample is one in which the quantity of liquid sampled is proportional to the quantity of liquid waste discharged and in which the method of sampling employed results in a specimen which is representative of the liquids released.

c. To be representative of the quantities and concentrations of radioactive materials in liquid effluents, samples shall be collected continuously in proportion to the rate of flow of the effluent stream. Prior to analyses, all samples taken for the composite shall be thoroughly mixed in order for the composite sample to be representative of the effluent release.

d. A batch release exists when the discharge of liquid wastes is from a discrete volume. Prior to sampling for analyses, each batch shall be isolated, and then thoroughly mixed to assure representative sampling.

e. A continuous release exists when the discharge of liquid wastes is from a non-discrete volume; e.g., from a volume of a system having an input flow during the continuous release. For BV-1, this is applicable to the Turbine Building drains and the AFW Pump Bay Drain System and chemical waste sump, when the secondary coolant gross radioactivity (beta and gamma) is greater than 1E-5 μCi/ml. For BV-2, this is applicable to the Turbine Building drains when the secondary coolant gross radioactivity (beta and gamma) is greater than 1E-5 μCi/ml.

f. The principal gamma emitters for which the LLD specification will apply are exclusively the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141 and Ce-144. This list does not mean that only these nuclides are to be detected and reported. Other peaks which are measurable and identifiable, together with the above nuclides, shall also be identified and reported. Nuclides which are below the LLD for the analyses should be reported as "less than" the nuclide's LLD, and should not be reported as being present at the LLD level for that nuclide. The "less than" values should not be used in the required dose calculations. When unusual circumstances result in LLD's higher than required, the reasons shall be documented in the Semi-Annual Radioactive Effluent Release Report.

g. Whenever there is primary to secondary leakage, sampling is done for Turbine Building drain effluents by means of grab samples taken every four hours during the period of discharge and analyzed for gross radioactivity (beta and gamma) at a senstivity of at least 1E-7 μCi/ml and recorded in the plant records, along with the flow rate. Primary to secondary leakage is considered to be occurring whenever measurements indicate that secondary coolant gross radioactivity (beta and gamma) is greater than 1E-5 μCi/ml. In addition, two (2) plant personnel shall check release calculations to verify that the limits of Technical Specifications 3.11.1.1 and 3.11.1.2 are not exceeded

h. Whenever the BV-2 Recirculation Drain Pump(s) are discharging to catch basin 16, sampling will be performed by means of a grab sample taken every 4 hours during pump operation.

Table 4-2. Results of Liquid Effluent Discharges to the Environment

TABLE 4-2

RESULTS OF LIQUID EFFLUENT DISCHARGES TO THE ENVIRONMENT

Effluent Type	Results for 1993
Steam System Blowdown	The Steam System Blowdown was recycled when practicable.
Batch Radioactive Waste Liquids	Routine planned releases of liquid effluents from the Beaver Valley Power Station were released in accordance with conditions noted in Section 3/4.11.1 of the Technical Specifications and Section 1 of the Offsite Dose Calculation Manual. No limits were exceeded. These values have been reported in the Beaver Valley Power Station Semi-annual Radioactive Effluent Release Reports for 1993.
Continuous Radioactive Waste Liquids	Radioactive waste liquids were not discharged in a continuous mode during 1993.

B. Monitoring of Atmospheric Effluents

1. Description of Atmospheric Effluent Sources

Beaver Valley Power Station (Units 1 and 2)

The Beaver Valley Power Station identifies isotopes according to the Technical Specifications and Regulatory Guide 1.21. Prior to waste gas decay tank batch releases and containment purge releases, an analysis of the principal gamma emitters is performed. The principal gamma emitters include noble gases, iodines, and particulates. Figure 4-6 shows the gaseous radwaste system at Beaver Valley Power Station.

The environmental gaseous release points also require specific nuclide identification. These points include:

a. Unit 1 Release Points:

1) The Ventilation Vent located on top of the Unit 1 Primary Auxiliary Building.

2) The Supplementary Leak Collection and Release System (SLCRS) Vent located on top of the Unit 1 Containment Building.

b. Unit 2 Release Points;

1) The Ventilation Vent located on top of the Unit 2 Primary Auxiliary Building.

2) The Supplementary Leak Collection and Release System (SLCRS) Vent located on top of the Unit 2 Containment Building.

3) The Condensate Polishing Building Vent located on top of the Unit 2 Condensate Polishing Building.

4) The Waste Gas Storage Vault Vent located on top of the Unit 2 Decontamination Building.

5) The Decontamination Building Vent located on top of the Unit 2 Decontamination Building.

c. Unit 1 and Unit 2 shared release point;

1) The Process Vent located on top of the Unit 1 Cooling Tower.

These points are continuously monitored for particulates and gases. Grab samples are obtained on a weekly basis and are analyzed for noble gas gamma emitting isotopes and tritium. Weekly continuous samples are obtained on filter paper and charcoal cartridges. The filter papers are analyzed for particulate gamma emitting isotopes and gross alpha. Composites of the filter papers are analyzed monthly for Sr-89 and Sr-90. The charcoal cartridges are analyzed for I-131, I-133 and I-135.

Figure 4-7 shows these gaseous release points.

Figure 4-6. Units 1 and 2 Gaseous Radwaste System

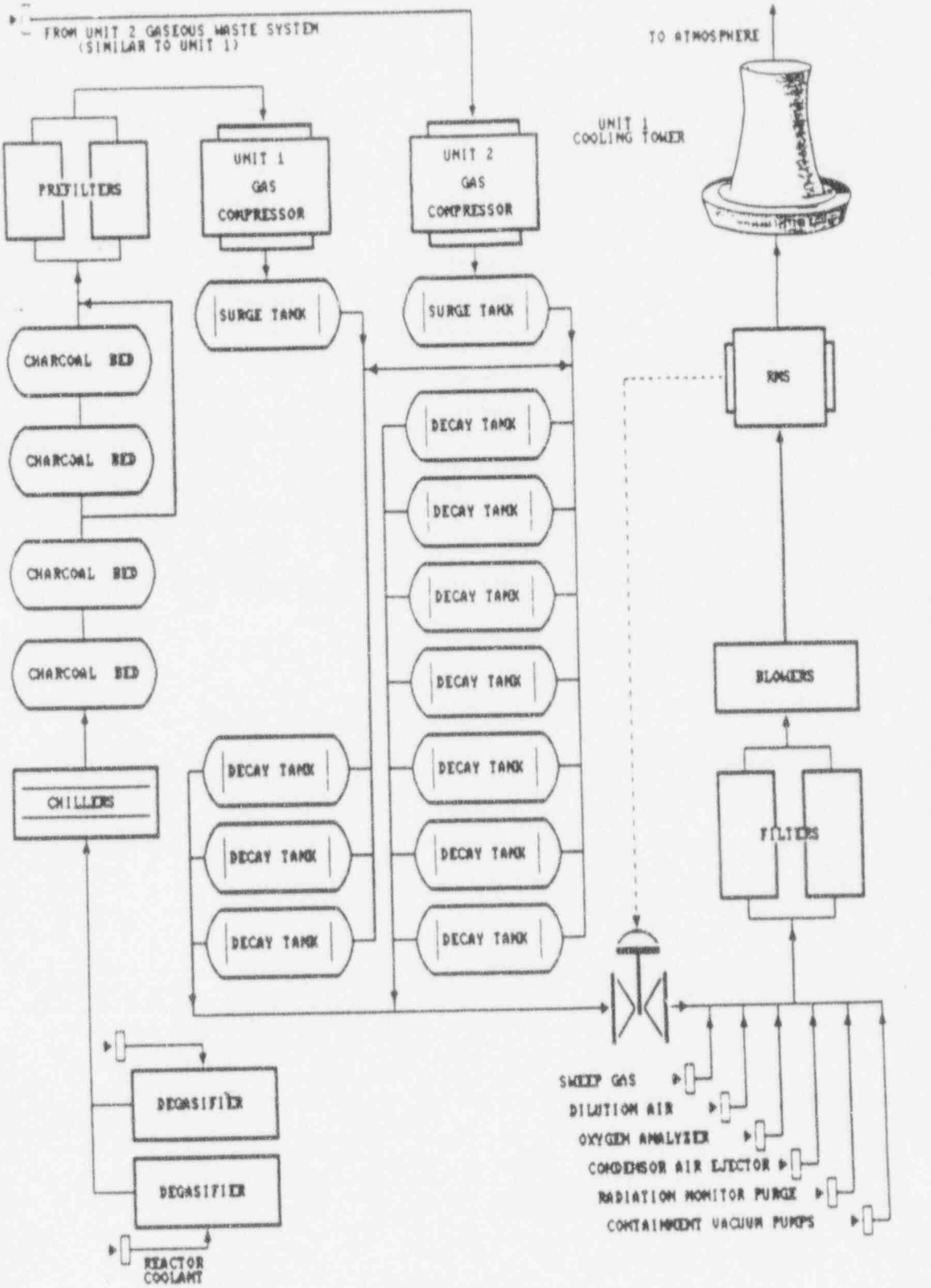


FIGURE 4-6 - UNITS 1 AND 2 GASEOUS RADWASTE SYSTEM

Figure 4-7. Units 1 and 2 Gaseous Release Points

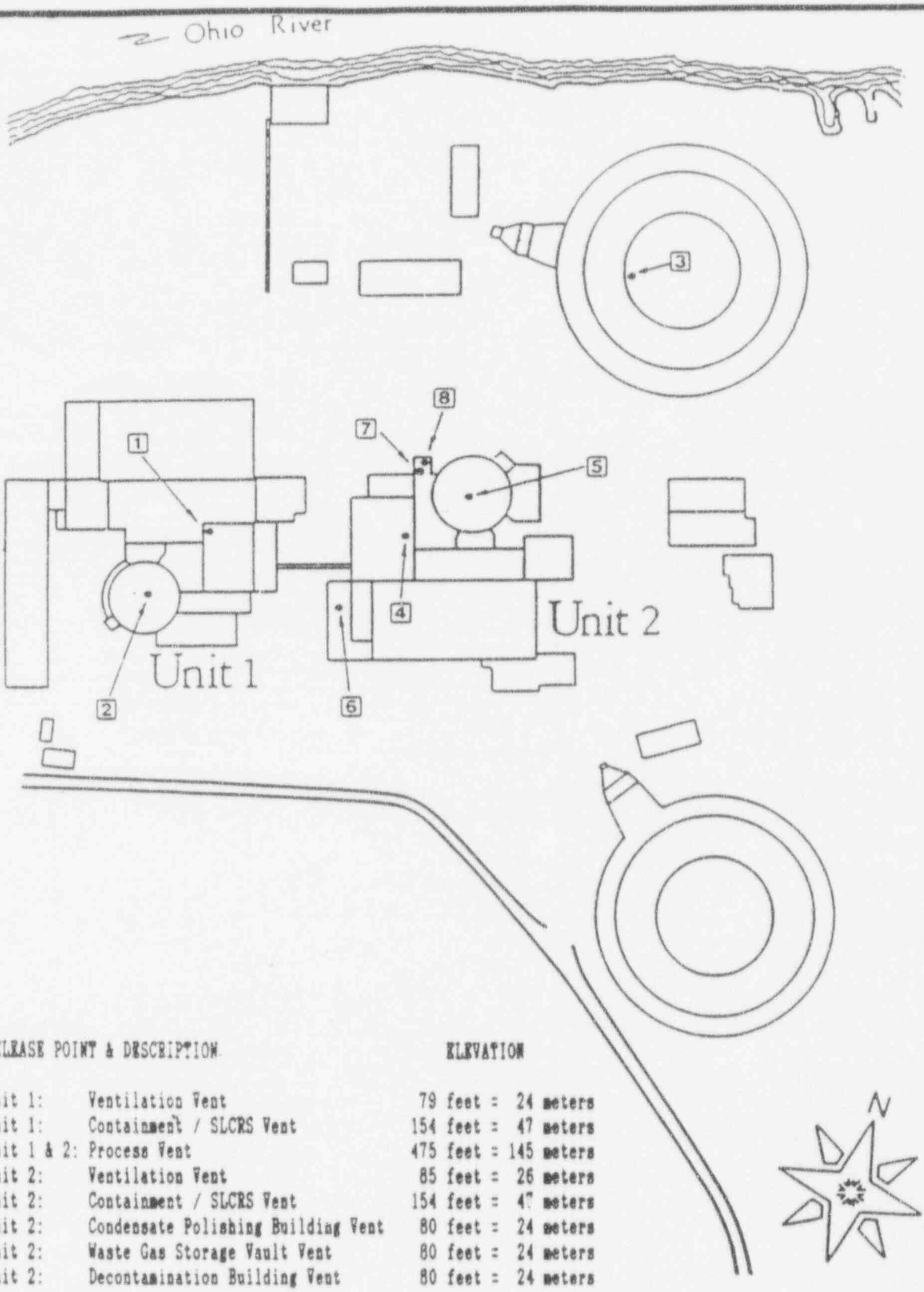


FIGURE 4-7 - UNITS 1 AND 2 GASEOUS RELEASE POINTS

2. Atmospheric Effluent Treatment and Sampling

Beaver Valley Power Station (Units 1 and 2)

Radioactive gases enter the gaseous waste disposal system from the degasifier vent chiller of the boron recovery system, and are directed to the gaseous waste charcoal delay subsystem upstream of the overhead gas compressor where the gas is chilled to condense most of the water vapor. Gases from the degasifier vent chillers contain primarily hydrogen and water vapor. A small amount of nitrogen and radioisotopes consisting of noble gases, particulates and radioiodines are also present in this system.

The overhead gas compressor directs the radioactive gas stream to a gas surge tank. Gas is periodically transferred from the Unit 1 or Unit 2 surge tank to one of the three (3) decay tanks at Unit 1 or one of the seven (7) decay tanks at Unit 2. After the decay tanks are sampled and authorization obtained for discharge, the flow of the waste gases from the decay tanks (2 scfm) is rapidly diluted with about 1000 scfm of air in order to dilute hydrogen and radioactive effluent concentration. The gases are then combined with nitrogen purge from the oxygen analyzers, calibration gas from the oxygen analyzers, the main condenser air ejector exhaust, the containment vacuum system exhaust, aerated vents of the vent and drain system, discharge of the overhead gas compressor and the purge from the multi sample point radiation monitor. The mixture is then filtered through one of the gaseous waste disposal filters, each of which consists of a charcoal bed and a high efficiency filter. The filtered gases are then discharged by one of the gaseous waste disposal blowers to the atmosphere via the process vent on the top of the Unit 1 cooling tower. The radioactivity levels of the stream are monitored continuously.

Should the radioactivity release concentration of the stream go above the allowable setpoint, a signal from the radiation monitor will stop all flow from the Unit 1 or Unit 2 decay tanks being discharged.

During a shutdown period after the Unit 1 or Unit 2 containment has been sampled and the activity levels determined, purging may commence through the Ventilation Vent located on top of the Auxiliary Building or the Supplementary Leak Collection and Release System (SLCRS) Vent located on top of the Reactor Containment Building or the Process Vent located on top of the Cooling Tower.

Areas in the Unit 1 Auxiliary Building (subject to radioactive contamination) are monitored for radioactivity prior to entering the common Ventilation Vent. These individual radiation monitors aid in identifying any sources of contaminated air. The Ventilation Vent is also monitored continuously by several redundant channels of the Radiation Monitoring System (RMS) and is sampled periodically. Upon a high activity alarm, automatic dampers divert the system's exhaust air stream through one of the main filter banks in the Supplementary Leak Collection and Release System (SLCRS) and to the SLCRS Vent.

Areas in the Unit 2 Auxiliary Building (subject to radioactive contamination) are monitored for radioactivity prior to entering the filter banks for the Supplementary Leak Collection and Release System (SLCRS) Vent. This system is sampled periodically for determination of radioactive material and is monitored continuously by other channels of the Digital Radiation Monitoring System (DRMS).

Each Unit 1 and Unit 2 filter bank consists of roughing filters, charcoal filters,and pleated glass fiber type HEPA filters. The roughing filters remove large particulates to prevent excessive pressure drop buildup on the charcoal and HEPA filters. The charcoal filters are effective for radioactive iodine removal and the HEPA filters remove particulates and charcoal fines.

Release points for Unit 1 and Unit 2 of the Beaver Valley Power Station are shown in Figure 4-7. Some of these release points discharge small amounts of radioisotopes consisting of noble gases, particulates and radioiodines.

See Table 4-3 for Radioactive Gaseous Waste Sampling and Analysis Program.

Table 4-3. Radioactive Gaseous Waste Sampling and Analysis Program

TABLE 4-3

Radioactive Gaseous Waste Sampling and Analysis Program

GASEOUS RELEASE TYPE	SAMPLING FREQUENCY	MINIMUM ANALYSIS FREQUENCY	TYPE OF ACTIVITY ANALYSIS	LOWER LIMIT OF DETECTION (LLD) (μCi/cc)
1. Waste Gas Storage Tank	P Each Tank Grab Sample	P Each Tank	Principal Gamma Emitters[g]	1×10^{-4}
			H-3	1×10^{-6}
2. Containment Purge	P Each Purge[b] Grab Sample	P Each Purge[b]	Principal Gamma Emitters[g]	1×10^{-4}
			H-3	1×10^{-6}
3. Ventilation Systems[h] a. Process Vent b. Containment Vents c. Aux. Bldg. Vents d. Cond. Polish. Bldg. Vent e. Decon. Bldg. Vent f. Waste Gas Vault Vent	M[b,c,e] Grab Sample	M[b]	Principal Gamma Emitters[g]	1×10^{-4}
			H-3	1×10^{-6}
	Continuous[f]	W[d] Charcoal Sample	I-131	1×10^{-12}
			I-133	1×10^{-10}
	Continuous[f]	W[d] Particulate Sample	Principal Gamma Emitters[g] (I-131, Others)	1×10^{-11}
	Continuous[f]	M Composite Particulate Sample	Gross alpha	1×10^{-11}
	Continuous[f]	Q Composite Particulate Sample	Sr-89, Sr-90	1×10^{-11}
	Continuous[f]	Noble Gas Monitor	Noble Gases Gross Beta and Gamma	1×10^{-6}

W - At least once per 7 days
M - At least once per 31 days
Q - At least once per 92 days
P - Completed prior to each release

TABLE 4-3 NOTATION

a. The Lower Limit of Detection (LLD).

b. When reactor coolant system activity exceeds the limits stated in the BVPS Technical Specification, analyses shall be performed once every 24 hours during startup, shutdown and 25% load changes and 72 hours after achieving the maximum steady state power operation unless continuous monitoring is provided.

c. Tritium grab samples shall be taken at least once per 24 hours (from the appropriate ventilation release path) when the refueling canal is flooded.

d. Samples shall be changed at least once per 7 days and analyses shall be completed within 48 hours after changing (or after removal from sampler). Sampling and analyses shall also be performed at least once per 24 hours, during startup, shutdown and 25% load changes and 72 hours after achieving the maximum steady state power operation when RCS activity exceeds the limits stated in the Technical Specification unless continuous monitoring is provided. When samples collected for 24 hours are analyzed, the corresponding LLD's may be increased by a factor of 10.

e. Tritium grab samples shall be taken at least once per 7 days from the ventilation exhaust from the spent fuel pool area, whenever spent fuel is in the spent fuel pool.

f. The average ratio of the sample flow rate to the sampled stream flow rate shall be known for the time period covered by each dose or dose rate calculation made in accordance with the BVPS Technical Specification.

g. The principal gamma emitters for which the LLD specification will apply are exclusively the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, and Xe-138 for gaseous emissions and Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141, and Ce-144 for particulate emissions. This list does not mean that only these nuclides are to be detected and reported. Other peaks which are measurable and identifiable, together with the above nuclides, shall also be identified and reported. Nuclides which are below the LLD for the analyses should not be reported as being present at the LLD level for that nuclide. When unusual circumstances result in LLD's higher than required, the reasons shall be documented in the Semi-Annual Effluent Release Report.

h. Only when release path is in use.

3. Results

Gaseous effluents from the Beaver Valley Power Station were released in accordance with conditions noted in Section 3/4.11.2 of the Technical Specifications and Section 2 of the Offsite Dose Calculation Manual. No limits were exceeded. These values have been reported in the Beaver Valley Power Station Semi-Annual Radioactive Effluent Release Reports for 1993.

C. Solid Waste Disposal

During Beaver Valley Power Station normal operations and periodic maintenance, small quantities of solid radioactive waste materials were generated such as contaminated rags, paper, plastics, filters, spent ion-exchange resins, and miscellaneous tools and equipment. These were disposed of as solid radioactive waste.

The services of offsite vendors were used to segregate, incinerate, and super-compact the waste. The waste is shipped for disposal at a commercial radioactive material burial site licensed by the Nuclear Regulatory Commission (NRC) or a state under agreement with the NRC. No radioactive waste material is buried at the Beaver Valley Power Station site.

All containers used for packaging, transport, and disposal of radioactive materials met the requirements of the United States Department of Transportation (DOT) and the Nuclear Regulatory Commission (NRC). Shipments offsite were made in accordance with DOT and NRC regulations. Figure 4-8 depicts solid waste handling at the site.

At Beaver Valley Power Station approximately 5,174 cubic feet of radioactive solid waste was buried offsite in 1993. The forty-seven (47) shipments contained a total activity of 1,371 curies.

Industrial solid wastes were collected in portable bins, and removed to an approved offsite burial ground. No burning or burial of wastes was conducted at the Beaver Valley Power Station site.

Figure 4-8. Solid Waste Disposal Diagram

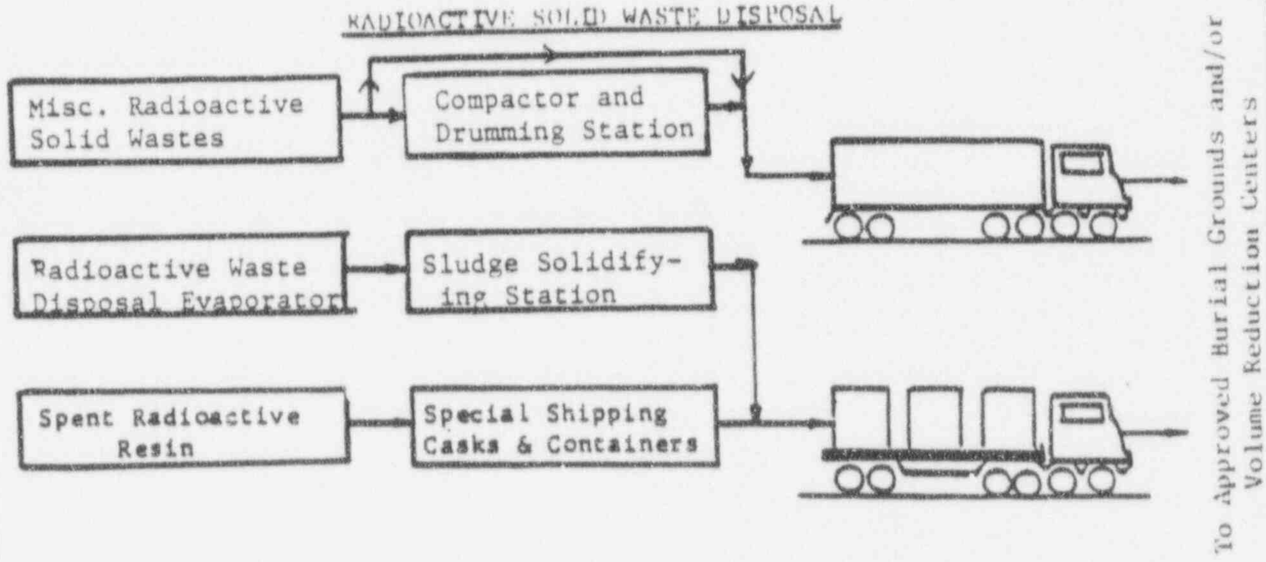


FIGURE 4-8 - SOLID WASTE DISPOSAL DIAGRAM

Section 5. ENVIRONMENTAL MONITORING PROGRAM

A. Environmental Radioactivity Monitoring Program

1. Program Description

The program consists of monitoring water, air, soil, river bottoms, vegetation and foodcrops, cows milk, ambient radiation levels in areas surrounding the site, and aquatic life as summarized in Table 5-1. Further description of each portion of the program (Sampling Methods of Sample Analysis, Discussion and Results) are included in parts 5-B through 5-I of this report.

5-B - Air Monitoring

5-C - Sediments and Soils Monitoring

5-D - Vegetation and Foodcrops

5-E - Cows Milk

5-F - Environmental Radiation Monitoring

5-G - Fish

5-H - Surface, Drinking, Well Waters and Precipitation

5-I - Estimates of Radiation Dose to Man

Table 5-1. Radiological Environmental Monitoring Program

TABLE 5-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

	Type of Sample	DLC Sample Points	Sector	Miles	Sample Point Description	Sample Frequency	Sample Preparation	Analysis(b)
1	Air Particulate and Radioiodine	13	11	1.6	Meyer's Farm	Continuous Sampling with sample collection at least weekly	Weekly Composite(d) Monthly Composite(d) Quarterly Composite(d)	Gross Beta, (c) I-131 Gamma -scan Sr-89,90
		30	4	0.6	Shippingport, PA (S.S.)			
		46.1	3	2.4	Industry, PA			
		32	15	0.8	Midland, PA (S.S.)			
		48(a)	10	16.5	Weirton, WV (a)			
		51	5	8.0	Aliquippa, PA (S.S.)			
		47	14	4.8	East Liverpool, OH			
		27	7	6.2	Brunton's Farm			
		28	1	8.7	Sherman's Farm			
		29B	3	8.1	Beaver County Hospital			
2	Direct Radiation	30	4	0.6	Shippingport, PA (S.S.)	Continuous (TLD)	Quarterly(k) Annually(k)	Gamma-Dose
		13	11	1.6	Meyer's Farm			
		46	3	2.5	Industry, PA (Church)			
		32	15	0.8	Midland, PA (S.S.)			
		48(a)	10	16.5	Weirton, WV (a)			
		45.1	6	2.0	Raccoon Twp, PA Kennedy's Crnrs			
		51	5	8.0	Aliquippa, PA (S.S.)			
		47	14	4.8	East Liverpool, OH			
		70	1	3.0	West Bvr. School			
		80	9	8.4	Raccoon Park			
		81	9	3.9	Southside School			
		82	9	7.1	Hanover Municipal Bldg			
		83	10	4.5	Mill Creek Rd			
		14	11	2.6	Hookstown			
		84	11	8.5	Hancock Co. Children Home			
		85	12	5.8	Rts. 8 & 30 Intersection			
		86	13	6.5	E. Liverpool Cahills House			
		92	12	3.0	Georgetown Rd			
		87	14	7.0	Calcutta Road			
		88	15	3.1	Midland Heights			
		89	15	4.7	Ohioville			
		90	16	5.2	Fairview School			
		10	4	0.8	Shippingport Boro, PA			
		45	5	2.2	Mt. Pleasant Church			
		60	13	3.7	Haney's Farm			
		93	16	1.3	Sunset Hills, Midland			

TABLE 5-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Type of Sample		DLC Sample Points	Sector	Miles	Sample Point Description	Sample Frequency	Sample Preparation	Analysis[b]
2	Direct Radiation (continued)	95	10	2.4	McCleary Rd, Hollie Williams	Continuous (TLD)	Quarterly[k] Annually[k]	Gamma-Dose
		28	1	8.7	Sherman's Farm			
		71	2	5.6	Brighton Twp. School			
		72	3	3.2	Logan School			
		29B	3	8.1	Beaver County Hospital			
		73	4	2.2	Potter Twp. School			
		74	4	6.8	Comm. Col-Center Twp			
		75	5	4.3	Holt Road			
		76	6	3.8	Raccoon Twp. School			
		77	6	5.8	Green Garden Rd (Wayne's)			
		59	7	1.1	Irons			
		78	7	2.3	Raccoon Mun. Bldg			
		27	7	6.2	Brunton's Farm			
		79	8	4.6	Rt. 18 & Rt. 151			
		15	14	3.3	Georgetown			
		46.1	3	2.1	Industry, PA			
		91	2	3.7	Pine Grove Rd and Doyle Rd			
		94	8	2.4	McCleary Rd, Wilson			
3	Surface Water	49.1(a)	4	5.0	Arco Polymers	Weekly, Intermittent Composite Samples[j] Collected Weekly	Weekly Sample from Arco only	I-131
		2.1	14	1.3	Downstream (Midland) J&L	Weekly Grab Samples Only	Monthly composite of Weekly Sample (d)	Gross Beta Gross Alpha Gamma-scan
		2.0	3	3.2	Station Discharge BVPS		Quarterly Composite	Co-60, H-3 Sr-89, Sr-90
		2A	13	0.2	Downstream BVPS Outfall			
		5	14	4.8	East Liverpool (raw water)	Daily Grab Sample Only - Collected Weekly[j]		
4	Groundwater	13	11	1.6	Meyer's Farm	Quarterly	Quarterly	Gamma-scan, Gross Beta, Gross Alpha, H-3
		14	11	2.6	Hookstown, PA			
		15	15	3.3	Georgetown, PA			
		11	3	0.8	Shippingport Boro			
5	Drinking	4	14	1.3	Midland, PA (Midland Water Treatment Plant)	Intermittent[e] Sample Collected Weekly	Weekly Composite of Daily Sample (d) Mnth. Composite (d)	Gamma-scan, I-131 Gross Alpha, Gross Beta
		5	14	4.8	East Liverpool, OH (East Liverpool Water Treatment Plant)		Quart. Composite (d)	H-3, Co-60, Sr-89, 90
		6	5	0.5	DLC Training Bldg	Weekly Grab Sample		

TABLE 5-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Type of Sample		DLC Sample Points	Sector	Miles	Sample Point Description	Sample Frequency	Sample Preparation	Analysis(b)
6	Shoreline Sediment	2A	13	0.2	Downstream BVPS Outfall	Semiannual	Semiannual	Gamma-scan, Gross Beta, Gross Alpha, Uranium Isotopic, Sr-89, 90
		3	13	0.2	Vicinity SAPS Discharge			
		49	3	3.2	Upstream Side of Montgomery Dam(a)			
		50	13	8.2	Upstream side of New Cumberland Dam			
7	Milk	25	10	2.1	Searight's Dairy	Weekly(f)	Weekly sample from Searight's only	I-131
		*				Biweekly(g) when animals are on pasture, monthly at other times	Biweekly (grazing) Monthly (indoors)	Gamma-scan Sr-89, 90 I-131, Cs-137
		*						
		*						
		96(a)	10	10.3	Windsheimer			
		27	7	6.2	Brunton's Dairy(h)	Monthly	Monthly	Gamma-scan Sr-89, 90, I-131, Cs-137
		29	3	8.3	Nicol's Dairy(h)			
*	BVPS Technical Specification Table 3.12-1 requires three (3) dairies to be selected on basis of highest potential thyroid dose using milch census data. See Section 5-E for specific locations sampled.							
8	Fish	2A	13	0.2	Vicinity of BVPS #1 Station Discharge	Semiannual	Composite of edible parts by species(i)	Gamma-scan on edible portions
		49(a)	3	4.7	Upstream Side of Montgomery Dam			
9	Food Crops					Annual at harvest if available	Composite of each sample species	Gamma-scan I-131 on green leafy vegetables
	(Shipp.)	10	4	0.8	(Three locations within 5 miles Selected by Company)			
	(Georg.)	15	14	3.3				
	(Indus.)	46	3	2.5				
		48(a)	10	16.5	Weirton, WV			
10	Feedstuff and Summer Forage	25	10	2.1	Searight's Dairy Farm	Monthly Quarterly	Monthly Quarterly Composite	Gamma-scan Sr-90
11	Soil	13	11	1.6	Meyer's Farm	Every 3 years (1991, 1994, etc.)	12 Core Samples 3" Deep (3" Dia at each location (approx. 10' radius)	Gamma-scan Sr-90 Gross Beta Gross Alpha Uranium Isotopic
		30	4	0.6	Shippingport, PA			
		46	3	2.6	Industry, PA			
		32	15	0.8	(North of Site) Midland			
		48(a)	10	16.5	Weirton, WV			
		51	5	8.0	Aliquippa, PA			
		47	14	4.8	E. Liverpool, OH			
		27	7	6.2	Brunton's Dairy			
		22	8	0.3	South of BVPS Site			
		29A	3	8.3	Nicol's Dairy			
12	Precipitation	30	4	0.6	Shippingport, PA	Weekly grab samples when available	Monthly Composite of grab samples Quarterly Composite	Gross β γ-scan H-3, Sr-89, Sr-90
		47	14	4.8	East Liverpool, OH			
		48	10	16.5	Weirton, WV			

TABLE 5-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (continued)

Notes:

(a) Control sample station: These are locations which are presumed to be outside the influence of plant effluents.

(b) Typical LLD's for gamma spectrometry are shown in Table 5-4.

(c) Particulate samples are not counted for ≥ 24 hours after filter change. Perform gamma isotopic analysis on each sample when gross beta is > 10 times the yearly mean of control samples.

(d) Analysis composites are well mixed actual samples prepared of equal portions from each shorter term samples from each location.

(e) Composite samples are collected at intervals not exceeding 2 hours.

(f) Weekly milk sample from Searight's Dairy is analyzed for I-131 only.

(g) Milk samples are collected bi-weekly when animals are in pasture and monthly at other times. [Assume April - October for grazing season (pasture).]

(h) The milk samples from Brunton's and Nicol's are collected once per month.

(i). The fish samples will contain whatever species are available. If the available sample size permits, then the sample will be separated according to species and compositing will provide one sample of each species. If the available size is too small to make separation by species practical, then edible parts of all fish in the sample will be mixed to give one sample.

(j) Composite samples are collected at intervals not exceeding 2 hours at locations 49.1 and 2.1. Weekly grab samples are obtained at locations 49 and 2A. A weekly grab sample is also obtained from daily composited grab samples obtained by the water treatment plant operator at location 5.

(k) Two (2) TLDs are collected quarterly and annually from each monitoring location.

Additional Notes:

- Sample points correspond to site numbers shown on maps.
- All I-131 analyses are performed within 40 hours of sample collection if possible.
- All air samples are decayed for 72 hours before analyzing for Gross Beta.

2. Summary of Results

All results of this monitoring program are summarized in Table 5-2. This table is prepared in the format specified by NRC Regulatory Guide 4.8 and in accordance with Beaver Valley Power Station Operating License, (Appendix A, Technical Specifications). Summaries of results of analysis of each media are discussed in Sections 5-B through 5-H and an assessment of radiation doses are found in Section 5-I. Table 5-3 summarizes Beaver Valley Power Station preoperational ranges for the various sampling media during the years 1974 and 1975. Comparisons of preoperational data with operational data indicate the ranges of values are generally in good agreement for both periods of time.

Activity detected was attributed to naturally occurring radionuclides, BVPS effluents, medical procedures, previous nuclear weapons tests or to the normal statistical fluctuation for activities near the lower limit of detection (LLD).

The conclusion from all program data is that the operation of the Beaver Valley Power Station has resulted in insignificant changes to the environment.

3. Quality Control Program

The Quality Control Program implemented by Duquesne Light Company to assure reliable performance by the DLC contractor and the supporting QC data are presented and discussed in Section 3 of this report. The lower limits of detection for various analysis for each media monitored by this program by the DLC Contractor Laboratory are provided in Table 5-2 and in Table 5-4.

Table 5-2

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

Name of Facility Beaver Valley Power Station Unit 1 and 2 Docket No. 50-334/50-412

Location of Facility Beaver, Pennsylvania (County, State) Reporting Period Annual 1993

Medium of Pathway Sampled (Unit of Measurement)	Analysis and Total Number of Analysis Performed	Lower Limit of Detection (LLD)	All Indicator Locations ** Mean (f) **Range	Location with Highest Annual Mean Name Distance and Directions	**Mean (f) **Range	Control Locations **Mean (f) **Range	Number of Nonroutine Reported Measurements***
	*					Weirton, WV No. 48	
Air Particulate and Radioiodine	Gross (520) Beta	2.5	16(520/520) (6.0-36)	32, Midland, PA 0.8 mi NW	16(52/52) (6.8-32)	15(52/52) (6.6-31)	0
($X10^{-3}$ pCi/Cu.M.)	Sr-89 (40)	5	LLD	--	--	--	-
	Sr-90 (40)	0.2	LLD	--	--	--	-
	I-131(520)	40	LLD	--	--	--	-
	Gamma (120)						
	Be-7	40	117(120/120) (63-171)	32, Midland, PA 0.8 mi NW	128(12/12) (95-165)	111(12/12) (63-150)	0
	K-40	20	14(13/120) (8.2-35)	48, Weirton, WV 16.05 mi SSW	35([illegible]2) --	Same as High Location	0
	Others	Table V.A.	LLD	-- --	--		

* Nominal Lower Limit of Detection (LLD)
** Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parentheses (f)
*** Nonroutine reported measurements are defined in Regulatory Guide 4.8 (December 1975) and the Beaver Valley Power Station Specifications

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

Name of Facility Beaver Valley Power Station Unit 1 and 2 Docket No. 50-334/50-412

Location of Facility Beaver, Pennsylvania (County, State) Reporting Period Annual 1993

Medium of Pathway Sampled (Unit of Measurement)	Analysis and Total Number of Analysis Performed	Lower Limit of Detection (LLD)*	All Indicator Locations ** Mean (f) **Range	Location with Highest Annual Mean Name Distance and Directions	Location with Highest Annual Mean **Mean (f) **Range	Control Locations **Mean (f) **Range	Number of Nonroutine Reported Measurements***
						Weirton, WV No. 48	
External Radiation (mR/day)	Gamma (44) (175 quarterly)	0.05	0.16(175/175) (0.12-0.29)	84, Hancock County Children's Home 8.5 mi SW	0.20(4/4) (0.18-0.24)	0.15(4/4) (0.14-0.17)	0
	Gamma (44 annual)	0.05	0.14(44/44) (0.07-0.19)	84, Hancock County Children's Home 8.5 mi SW	0.19(1/1) --	0.15(1/1) --	0
Feed and Forage (pCi/g) (dry weight)	I-131 (12)	0.01	LLD	--	--	One Sample Location	-
	Sr-90 (4)	0.003	0.030(4/4) (0.005-0.056)	--	-	--	0
	Gamma (12)						
	Be-7	0.3	1.1(7/12) (0.36-1.7)	-	--	--	0
	K-40	0.5	18(12/12) (12-29)	--	--	--	0
	Th-228	0.08	0.08(2/12) (0.078-0.089)	--	--	--	0
	Others	Table V.A.	LLD	--	--	--	-

* Nominal Lower Limit of Detection (LLD)
** Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parentheses (f)
*** Nonroutine reported measurements are defined in Regulatory Guide 4.8 (December 1975) and the Beaver Valley Power Station Specifications.

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

Name of Facility Beaver Valley Power Station Unit 1 and 2 Docket No. 50-334/50-412

Location of Facility Beaver, Pennsylvania (County, State) Reporting Period Annual 1993

Medium of Pathway Sampled (Unit of Measurement)	Analysis and Total Number of Analysis Performed	Lower Limit of Detection (LLD)	All Indicator Locations ** Mean (f) **Range	Location with Highest Annual Mean Name Distance and Directions	**Mean (f) **Range	Control Locations **Mean (f) **Range Montgomery Dam No. 49	Number of Nonroutine Reported Measurements***
Fish (pCi/g) (wet weight)	Gamma (8) K 40	0.05	3.0(8/8) (2.4-4.1)	49, Upstream Montgomery Dam 4.7 mi NE	3.3(4/4) (2.5-4.1)	Same as high location	0
	Cs-137	0.006	0.0066(1/8) --	02A, BVPS Discharge 0.2 mi W	0.0066(1/4) --	LLD	0
	Others	Table V.A.	LLD	-- --	--		-

* Nominal Lower Limit of Detection (LLD)
** Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parentheses (f)
*** Nonroutine reported measurements are defined in Regulatory Guide 4.8 (December 1975) and the Beaver Valley Power Station Specifications.

Table 5-2

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

Name of Facility Beaver Valley Power Station Unit 1 and 2 Docket No. 50-334/50-412

Location of Facility Beaver, Pennsylvania (County, State) Reporting Period Annual 1993

Medium of Pathway Sampled (Unit of Measurement)	Analysis and Total Number of Analysis Performed	Lower Limit of Detection (LLD)	All Indicator Locations ** Mean (f) **Range	Location with Highest Annual Mean Name Distance and Directions	Location with Highest Annual Mean **Mean (f) **Range	Control Locations **Mean (f) **Range	Number of Nonroutine Reported Measurements***
Food and Garden Crops (pCi/g) (wet weight)	I-131 (5)	* 0.006	LLD	--	--	Weirton, WV No. 48 --	-
	Gamma (5)						
	K-40	0.5	1.9(5/5) (1.6-2.6)	10, Shippingport, PA 0.8 mi ENE	2.1(2/2) (1.6-2.6)	1.6(1/1) --	0
	Others	Table V.A	LLD	--	--	--	-

* Nominal Lower Limit of Detection (LLD)
** Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parentheses (f)
*** Nonroutine reported measurements are defined in Regulatory Guide 4.8 (MARCH 1975) and the Beaver Valley Power Station Specifications.

Table 5-2

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

Name of Facility Beaver Valley Power Station Unit 1 and 2 Docket No. 50-334/50-412

Location of Facility Beaver, Pennsylvania (County, State) Reporting Period Annual 1993

Medium of Pathway Sampled (Unit of Measurement)	Analysis and Total Number of Analysis Performed	Lower Limit of Detection (LLD)	All Indicator Locations ** Mean (f) **Range	Location with Highest Annual Mean Name Distance and Directions	**Mean (f) **Range	Control Locations **Mean (f) **Range	Number of Nonroutine Reported Measurements***
						Brunton Dairy No. 27	
Milk (pCi/l)	I-131 (166) *	0.2	LLD	--	--	--	-
	Sr-89 (133)	2	LLD	--	--	--	-
	Sr-90 (133)	1	2.5(133/133) (0.93-9.0)	102. Ferry Dairy (a)	7.2(5/5) (6.0-9.0)	1.8(19/19) (0.94-3.1)	0
	Gamma (133)						
	K-40	100	1451(133/133) (1220-2140)	110. Darnley Dairy (a)	1768(18/18) (1370-2140)	1367(19/19) (1290-1490)	0
	Others	Table V.A.	LLD	--	--	--	-

(a) Goat Dairy

* Nominal Lower Limit of Detection (LLD)
** Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parentheses (f)
*** Nonroutine reported measurements are defined in Regulatory Guide 4.8 (December 1975) and the Beaver Valley Power Station Specifications

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

Name of Facility Beaver Valley Power Station Unit 1 and 2 Docket No. 50-334/50-412

Location of Facility Beaver, Pennsylvania (County, State) Reporting Period Annual 1993

Medium of Pathway Sampled (Unit of Measurement)	Analysis and Total Number of Analysis Performed	Lower Limit of Detection (LLD)	All Indicator Locations ** Mean (f) **Range	Location with Highest Annual Mean Name Distance and Directions	**Mean (f) **Range	Control Locations **Mean (f) **Range Montgomery Dam No. 49	Number of Nonroutine Reported Measurements***
Sediment (pCi/g) (dry weight)	Gross (6) Alpha	0.3	14(6/6) (9.2-20)	2A, BVPS Discharge 0.2 mi. W	19(2/2) (18-20)	13(2/2) (11-14)	0
	Gross (6) Beta	0.1	35(6/6) (26-48)	2A, BVPS Discharge 0.2 mi. W	43(2/2) (38-48)	36(2/2) (32-39)	0
	Sr-89 (6)	0.2	LLD	--	--	--	-
	Sr-90 (6)	0.04	LLD	--	--	--	0
	Gamma (6) Be-7	0.2	1.2(3/6) (0.74-2.2)	2A, BVPS Discharge 0.2 mi. W	2.2(1/2) --	0.82(1/2) --	0
	K-40	0.5	12(6/6) (8.1-16)	2A, BVPS Discharge 0.2 mi. W	14(2/2) (12-16)	12(2/2) (11-13)	0
	Co-58	0.2	0.26(2/6) (0.18-0.33)	2A, BVPS Discharge 0.2 mi. W	0.26(2/2) (0.18-0.33)	LLD	0
	Co-60	0.2	0.84(2/6) (0.15-1.5)	2A, BVPS Discharge 0.2 mi. W	0.84(2/2) (0.15-1.5)	LLD	0
	Cs-137	0.02	0.18(5/6) (0.15-0.23)	2A, BVPS Discharge 0.2 mi. W	0.23(1/2) --	0.19((2/2) (0.17-0.20)	0
	Ra-226	0.1	2.1(6/6) (1.6-2.7)	2A, BVPS Discharge 0.2 mi. W	2.2(2/2) (1..8-2.7)	1..9(2/2) (1.8-2.0)	0
	Th-228	0.02	1.1(6/6) (1.0-1.6)	2A, BVPS Discharge 0.2 mi. W	1.4(2/2) (1.2-1.6)	1.0(2/2) (0.87-1.0)	0
	Others	Table V.A.	LLD	--	--	--	-

* Nominal Lower Limit of Detection (LLD)
** Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parentheses (f)
*** Nonroutine reported measurements are defined in Regulatory Guide 4.8 (December 1975) and the Beaver Valley Power Station Specifications.

Table 5-2

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

Name of Facility Beaver Valley Power Station Unit 1 and 2 Docket No. 50-334/50-412

Location of Facility Beaver, Pennsylvania (County, State) Reporting Period Annual 1993

Medium of Pathway Sampled (Unit of Measurement)	Analysis and Total Number of Analysis Performed	Lower Limit of Detection (LLD)	All Indicator Locations ** Mean (f) **Range	Location with Highest Annual Mean Name Distance and Directions	Location with Highest Annual Mean **Mean (f) **Range	Control Locations **Mean (f) **Range	Number of Nonroutine Reported Measurements***
Drinking Water (pCi/l)	I-131 (156)	0.5	0.63(46/156) (0.22-1.5)	04. Midland, PA 1.3 mi WNW	0.68(25/52) (0.22-1.5)	--	0
	Gross (36) Alpha	0.6	LLD	-- --	--		-
	Gross (36) Beta	1	4.7(36/36) (2.8-6.7)	04. Midland, PA 1.3 mi WNW	4.9(12/12) (3.6-6.7)	--	0
	Gamma (156)						
	Others Table V.A.		LLD	-- --	--		-
	Sr-89 (12)	1.5	LLD	-- --	--		-
	Sr-90 (12)	0.5	LLD	-- --	--		-
	Co-60 (12) (a)	1	LLD	-- --	--		-
	H-3 (12)	100	150(2/12) (150-150)	04. Midland, PA 1.3 mi WNW	150(1/4) --	--	0

(a) Co-60 analyzed by high sensitivity method.

* Nominal Lower Limit of Detection (LLD)
** Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parentheses (f)
*** Nonroutine reported measurements are defined in Regulatory Guide 4.8 (December 1975) and the Beaver Valley Power Station Specifications.

Table 5-2

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

Name of Facility Beaver Valley Power Station Unit 1 and 2 Docket No. 50-334/50-412

Location of Facility Beaver, Pennsylvania (County, State) Reporting Period Annual 1993

Medium of Pathway Sampled (Unit of Measurement)	Analysis and Total Number of Analysis Performed	Lower Limit of Detection (LLD)	All Indicator Locations ** Mean (f) **Range	Location with Highest Annual Mean Name Distance and Directions	Location with Highest Annual Mean **Mean (f) **Range	Control Locations **Mean (f) **Range Georgetown, PA No. 15	Number of Nonroutine Reported Measurements***
Groundwater (pCi/l)	Gross (16) Alpha	2	3.6(1/16) --	11, Shippingport Boro 0.8 mi NE	3.6(1/4) --	LLD	
	Gross (16) Beta	1	4.7(13/16) (1.0-10)	14, Hookstown, PA 2.6 mi SW	6.4(4/4) (4.3-8.4)	4.3(4/4) (1.0-10)	0
	Gamma (16)						
	K-40	100	43(1/16) --	14, Hookstown, PA 2.6 mi SW	43(1/4) --	LLD	0
	Others	TableV.A.	LLD	--	--	--	
	H-3 (16)	90	LLD	--	--	--	

* Nominal Lower Limit of Detection (LLD)
** Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parentheses (f).
*** Nonroutine reported measurements are defined in Regulatory Guide 4.8 (December 1975) and the Beaver Valley Power Station Specifications.

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

Name of Facility Beaver Valley Power Station Unit 1 and 2 Docket No. 50-334/50-412

Location of Facility Beaver, Pennsylvania (County, State) Reporting Period Annual 1993

Medium of Pathway Sampled (Unit of Measurement)	Analysis and Total Number of Analysis Performed	Lower Limit of Detection (LLD)*	All Indicator Locations ** Mean (f) **Range	Location with Highest Annual Mean Name Distance and Directions	Location with Highest Annual Mean **Mean (f) **Range	Control Locations **Mean (f) **Range Weirton, WV No.48	Number of Nonroutine Reported Measurements***
Water Precipitation (pCi/l)	Gross (34) Beta	1	12(34/34) (2.3-51)	47, E. Liverpool, OH 4.8 mi WNW	13(12/12) (2.3-51)	12(11/11) (4.8-22)	0
	Gamma (34)						
	Be-7	40	92(28/34) (52-205)	48, Weirton, WV 16.05 mi SSW	95(11/11) (53-143)	Same as high location	0
	Others	Table V.A.	LLD	--	--	--	-
	Sr-89 (12)	2	LLD	--	--	--	-
	Sr-90 (12)	0.5	LLD	--	--	--	-
	H-3 (12)	100	280(5/12) (130-670)	20, Shippingport, PA 0.6 mi ENE	318(4/4) (190-670)	LLD	0

* Nominal Lower Limit of Detection (LLD)
** Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parentheses (f)
*** Nonroutine reported measurements are defined in Regulatory Guide 4.8 (December 1975) and the Beaver Valley Power Station Specifications .

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

Name of Facility Beaver Valley Power Station Unit 1 and 2 Docket No. 50-334/50-412

Location of Facility Beaver, Pennsylvania (County, State) Reporting Period Annual 1993

Medium of Pathway Sampled (Unit of Measurement)	Analysis and Total Number of Analysis Performed	Lower Limit of Detection (LLD)	All Indicator Locations ** Mean (f) **Range	Location with Highest Annual Mean: Name, Distance and Directions	Location with Highest Annual Mean: **Mean (f) **Range	Control Locations **Mean (f) **Range (Upstream - ARCO Chemical No. 49.1)	Number of Nonroutine Reported Measurements***
Surface Water (pCi/l)	I-131 (52)	0.5	0.53(20/52) (0.23-1.4)	49.1, Upstream, ARCO Chemical 5.0 mi ENE		one sample location	0
	Gross (48) Alpha	2	1.6(1/48) --	05, E. Liverpool, OH 4.8 mi WNW	1.6(1/12) --	LLD	0
	Gross (48) Beta	1	5.8(48/48) (2.9-16)	02A, BVPS Discharge 0.2 mi W	7.2(12/12) (4.7-9.9)	4.7(12/12) (2.9-8.5)	0
	Gamma (48)						
	Others Table V.A.		LLD	--	--	--	-
	Sr-89 (16)	2	LLD	--	--	--	-
	Sr-90 (16)	0.5	LLD	--	--	--	-
	Co-60 (16) (a)	2	LLD	--	--	--	-
	H-3 (16)	100	11202(5/16) (130-29000)	02A, BVPS Discharge 0.2 mi W	18567(3/4) (1700-29000)	130(1/4) --	0

(a) Co-60 analyzed by high sensitivity method.

* Nominal Lower Limit of Detection (LLD)
** Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parentheses (f)
*** Nonroutine reported measurements are defined in Regulatory Guide 4.8 (December 1975) and the Beaver Valley Power Station Specifications.

Table 5-3. Pre-operational Environmental Radiological Monitoring Program Summary

TABLE 5-3

PRE-OPERATIONAL ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

Name of Facility Beaver Valley Power Station **Docket No.** 50-334

Location of Facility Beaver, Pennsylvania **Reporting Level** CY 1974 - 1975

(County, State)

PRE-OPERATIONAL PROGRAM SUMMARY (COMBINED 1974 - 1975)

Medium or Pathway Sampled (Unit of Measurement)	Analysis and Total Number of Analysis Performed		Lower Limit of Detection LLD	All Indicator Locations Mean, (f) Range		
Sediments pCi/g (dry)	Gross Alpha	(0)	–		–	
	Gross Beta	(33)	1	18	33/33	5 - 30
	Sr-90	(0)	–		–	
	U-234, 235, 238	(0)	–		–	
	Gamma	(33)	–	13	33/33	2 - 30
	K-40		1.5	13	33/33	2 - 30
	Cs-137		0.1	0.4	21/33	0.1 - 0.6
	ZrNb-95		0.05	0.8	12/33	0.2 - 3.2
	Ce-144		0.3	0.5	3/33	0.4 - 0.7
	Ru-106(b)		0.3	1.5	3/33	1.3 - 1.8
	Others		–		< LLD	
Foodstuff pCi/g (dry)	Gamma	(8)	–		–	
	K-40		1	33	8/8	10 - 53
	Cs-137		0.1	0.2	1/8	–
	ZrNb-95		0.05	0.2	1/8	–
	Ru-106(b)		0.3	0.8	1/8	–
	Others		–		< LLD	
Feedstuff pCi/g (dry)	Gross Beta	(80)	0.05	19	80/80	8 - 50
	Sr-89	(81)	0.025	0.2	33/81	0.04 - 0.93
	Sr-90	(81)	0.005	0.4	78/81	0.02 - 0.81
	Gamma	(81)	–		–	
	K-40		1	19	75/81	5 - 46
	Cs-137		0.1	0.5	6/81	0.2 - 1.6
	Ce-144		0.3	1.5	5/81	0.9 - 2.6
	ZrNb-95		0.05	0.8	13/81	0.2 - 1.8
	Ru-106(b)		0.3	1.4	12/81	0.6 - 2.3
	Others		–		< LLD	
Soil pCi/g (dry) (Template Samples)	Gross Alpha	(0)	–		–	
	Gross Beta	(64)	1	22	64/64	14 - 32
	Sr-89	(64)	0.25	0.4	1/64	–
	Sr-90	(64)	0.05	0.3	48/64	0.1 - 1.3
	U-234, 235, 238	(0)	–		–	
	Gamma	(64)	–		–	
	K-40		1.5	13	63/64	5 - 24
	Cs-137		0.1	1.5	56/64	0.1 - 6.8
	Ce-144		0.3	1.1	7/64	0.2 - 3
	ZrNb-95		0.05	0.3	13/64	0.1 - 2
	Ru-106(b)		0.3	1.1	3/64	0.5 - 2
	Others		–		< LLD	

TABLE 5-3

PRE-OPERATIONAL ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

Name of Facility Beaver Valley Power Station **Docket No.** 50-334

Location of Facility Beaver, Pennsylvania **Reporting Level** CY 1974 - 1975

(County, State)

PRE-OPERATIONAL PROGRAM SUMMARY (COMBINED 1974 - 1975)

Medium or Pathway Sampled (Unit of Measurement)	Analysis and Total Number of Analysis Performed		Lower Limit of Detection LLD	All Indicator Locations Mean, (f) Range		
Soil pCi/g (dry) (Core Samples)	Gross Alpha	(0)	–		–	
	Gross Beta	(8)	1	21	8/8	16 - 28
	Sr-89	(8)	0.25		< LLD	
	Sr-90	(8)	0.05	0.2	5/8	0.08 - 0.5
	Gamma	(8)	–		–	
	K-40		1.5	13	8/8	7 - 20
	Cs-137		0.1	1.2	7/8	0.2 - 2.4
	Co-60		0.1	0.2	1/8	–
	Others		–		< LLD	
Surface Water pCi/l	Gross Alpha	(40)	0.3	0.75	5/40	0.6 - 1.1
	Gross Beta	(120)	0.6	4.4	120/120	2.5 - 11.4
	Gamma	(1)	10 - 60		< LLD	
	Tritium	(121)	100	300	120/121	180 - 800
	Sr-89	(0)	–		–	
	Sr-90	(0)	–		–	
	C-14	(0)	–		–	
Drinking Water pCi/l	I-131	(0)	–		–	
	Gross Alpha	(50)	0.3	0.6	4/50	0.4 - 0.8
	Gross Beta	(208)	0.6	3.8	208/208	2.3 - 6.4
	Gamma	(0)	–		–	
	Tritium	(211)	100	310	211/211	130 - 1000
	C-14	(0)	–		–	
	Sr-89	(0)	–		–	
	Sr-90	(0)	–		–	
Ground Water pCi/l	Gross Alpha	(19)	0.3		< LLD	
	Gross Beta	(76)	0.6	2.9	73/75(a)	1.3 - 8.0
	Tritium	(81)	100	440	77/81	80 - 800
	Gamma	(1)	10 - 60		< LLD	
Air Particulates and Gaseous pCi/m^3	Gross Alpha	(188)	0.001	0.003	35/188	0.002 - 0.004
	Gross Beta	(927)	0.006	0.07	927/927	0.02 - 0.32
	Sr-89	(0)	–		–	
	Sr-90	(0)	–		–	
	I-131	(816)	0.04	0.08	2/816	0.07 - 0.08
	Gamma	(197)	–		–	
	ZrNb-95		0.005	0.04	122/197	0.01 - 0.16
	Ru-106		0.010	0.04	50/197	0.02 - 0.09
	Ce-141		0.010	0.02	3/197	0.01 - 0.04
	Ce-144		0.010	0.02	44/197	0.01 - 0.04
	Others				< LLD	

TABLE 5-3

PRE-OPERATIONAL ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

Name of Facility Beaver Valley Power Station **Docket No.** 50-334

Location of Facility Beaver, Pennsylvania **Reporting Level** CY 1974 - 1975

(County, State)

PRE-OPERATIONAL PROGRAM SUMMARY (COMBINED 1974 - 1975)

Medium or Pathway Sampled (Unit of Measurement)	Analysis and Total Number of Analysis Performed		Lower Limit of Detection LLD	All Indicator Locations Mean, (f) Range		
Milk pCi/l	I-131	(91)	0.25	0.6	4/91	0.3 - 0.8
	Sr-89	(134)	5	7	4/134	6 - 11
	Sr-90	(134)	1	5.3	132/134	1.5 - 12.8
	Gamma	(134)	--		--	
	Cs-137		10	13	19/134	11 - 16
	Others				< LLD	
External Radiation mR/day	γ - Monthly	(599)	0.5 mR*	0.20	599/599	0.08 - 0.51
	γ - Quarterly	(195)	0.5 mR*	0.20	195/195	0.11 - 0.38
	γ - Annual	(48)	0.5 mR*	0.19	48/48	0.11 - 0.30
Fish pCi/g (wet)	Gross Beta	(17)	0.01	1.9	15/17	1.0 - 3.2
	Sr-90	(17)	0.005	0.14	17/17	0.02 - 0.50
	Gamma	(17)	0.5			
	K-40		--	2.4	17/17	1.0 - 3.7
	Others		--		< LLD	

* LLD in units of MR - Lower end of useful integrated exposure detectability range for a passive radiation detector (TLD).

(a) One outlier not included in mean. (Water taken from dried-up spring with high sediment and potassium content. Not considered typical groundwater sample).

(b). may include Ru-106, Ru-103, Be-7.

Table 5-4. Typical LLDs For Gamma Spectrometry

TABLE 5-4

TYPICAL LLDs * FOR GAMMA SPECTROSCOPY

Nuclide	Milk Water (pCi/liter)	Air Particulates (pCi)	Vegetation (pCi/kg dry)	Sediment & Soil (pCi/g dry)	Fish (pCi/g wet)
Be-7	50	20	200	0.2	0.02
K-40	80	50	400	0.4	0.4
Cr-51	50	20	200	0.2	0.2
Mn-54	5	2	20	0.02	0.02
Co-58	5	2	20	0.02	0.02
Fe-59	10	3	40	0.04	0.04
Co-60	5	2	20	0.02	0.02
Zn-65	10	5	40	0.04	0.04
Zr/Nb-95	5	3	40	0.04	0.04
Ru-103	5	3	30	0.03	0.03
Ru-106	50	20	200	0.2	0.2
Ag-110M	10	5	50	0.05	0.05
I-131	15	4	200	0.2	0.2
Te-132	8	4	20	0.02	0.02
I-133	8	4	20	0.02	0.02
Cs-134	5	2	20	0.02	0.02
Cs-136	8	4	50	0.05	0.05
Cs-137	5	2	20	0.02	0.02
Ba-La-140	10	3	200	0.2	0.02
Ce-141	10	20	100	0.1	0.1
Ce-144	40	10	200	0.2	0.2
Ra-226	80	10	100	0.1	0.1
Th-228	10	10	20	0.02	0.02

* At time of analysis (DLC Contractor Lab).

NOTE: Lower Level of Detection is defined in Beaver Valley Power Station Technical Specifications.

B. Air Monitoring

1. Characterization of Air and Meteorology

The air in the vicinity of the site contains pollutants typical for an industrial area. Air flow is generally from the Southwest in summer and from the Northwest in the winter.

2. Air Sampling Program and Analytical Techniques

a. Program

The air is sampled for gaseous radioiodine and radioactive particulates at each of ten (1) offsite air sampling stations. The locations of these stations are listed in Table 5-1 and shown on a map in Figure 5-1.

Samples are collected at each of these stations by continuously drawing one cubic foot per minute of atmosphere air through a glass fiber filter and through a charcoal cartridge. The former collects airborne particulates; the latter is for radioiodine sampling. Samples are collected for analysis on a weekly basis.

The charcoal is used in the weekly analysis of airborne I-131. The filters are analyzed each week for gross beta, then composited by station for monthly analysis by gamma spectrometry. They are further composited in a quarterly sample from each station for Sr-89 and Sr-90 analysis. In order to reduce interference from natural radon and thoron radioactivities, all filters are allowed to decay for a few days after collection prior to counting for beta in a low background counting system.

b. Procedures

Gross Beta analysis is performed by placing the filter paper from the weekly air sample in a 2" x 1/4" planchet and counting it in a low background, gas flow proportional counter.

Gamma emitters are determined by stacking all the filter papers from each monitoring station collected during the month and scanning this composite on a high resolution germanium gamma spectrometer.

Radioiodine (I-131) analysis is performed by a gamma scan of the charcoal in a weekly charcoal cartridge. The activity is referenced to the mid-collection time.

Figure 5-1. Air Sampling Stations

FIGURE 5-1 - AIR SAMPLING STATIONS

Strontium-89 and Strontium-90 activities are determined in quarterly composited air particulate filters.. 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. Half of the filtrate is taken for strontium analysis and is reduced in volume by evaporation. Strontium is precipitated as $Sr(NO_3)_2$ using fuming (90%) nitric acid. A barium scavenge is performed to remove radium and other natural nuclides. An iron (ferric hydroxide) scavenge is 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. Sr-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 low level beta counting.

3. Results and Conclusions

A summary of data is presented in Table 5-2.

a. Airborne Radioactive Particulates

A total of five hundred twenty (520) weekly samples from ten (10) locations were analyzed for gross beta. Results were comparable to previous years. Figure 5-2 illustrates the average concentration of gross beta in air particulates.

The weekly air particulate samples were composited to one hundred twenty (120) monthly samples which were analyzed by gamma spectrometry. Naturally occurring Be-7 was present in every sample. Naturally occurring K-40 was detected in thirteen (13) of the one hundred twenty (120) monthly samples. Results are listed in the summary Table 5-2.

A total of forty (40) quarterly samples were each analyzed for Sr-89 and Sr-90. No Sr-89 or Sr-90 was detected.

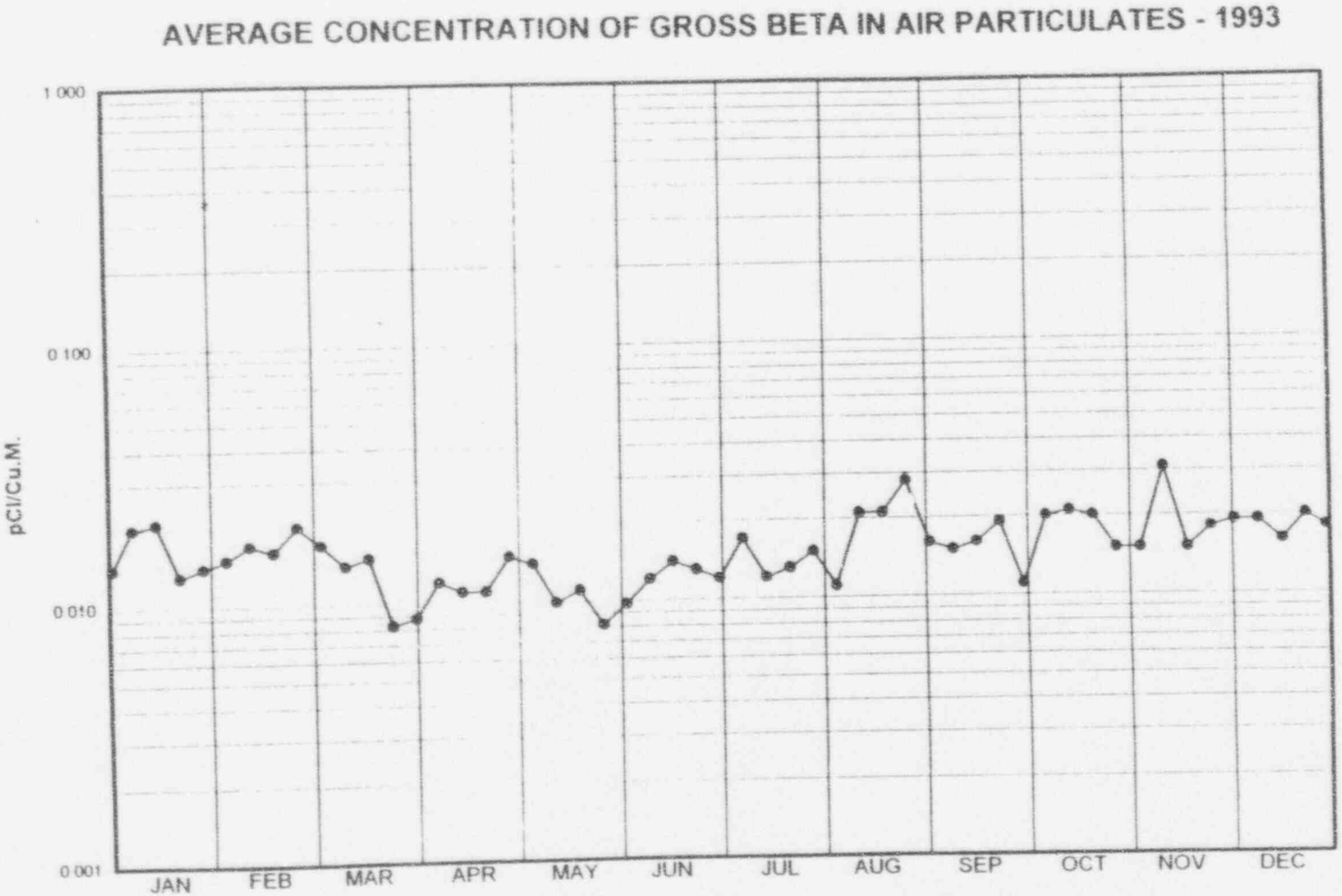
Based on the analytical results, the operation of Beaver Valley Power Station did not contribute to any increase in air particulate radioactivity during 1993.

b. Radioiodine

A total of five hundred twenty (520) weekly charcoal filter samples were analyzed for I-131. No detectable concentrations were found at any locations.

Based on analytical results, the operation of Beaver Valley Power Station did not contribute to any increase in airborne radioiodine during 1993.

Figure 5-2. Average Concentration of Gross Beta in Air Particulates



C. Monitoring of Sediments and Soils

(Soil Monitoring is required every 3 years and was required in 1991)

1. Characterization of Stream Sediments and Soils

The stream sediments consist largely of sand and silt. Soil samples may vary from sand and silt to a heavy clay with variable amounts of organic material.

2. Sampling Program and Analytical Techniques

a. Program

River bottom sediments were collected semi-annually above the Montgomery Dam in the vicinities of the Beaver Valley discharge and above the New Cumberland Dam. A Ponar or Eckman dredge is used to collect the sample. The sampling locations are also listed in Table 5-1 and are shown in Figure 5-3.

Soil samples were not collected during 1993. The next set of samples will be taken in 1994. Sampling locations are listed in Table 5-1 and are shown in Figure 5-3.

Bottom sediments and soils are analyzed for gross alpha and beta activity, strontium, and the gamma-emitting radionuclides.

b. Analytical Procedures

Gross beta - sediments and soils are analyzed for gross beta by mounting a 1 gram portion of dried sediment in a 2" planchet. The sample is counted in a low background, gas flow proportional counter. Self absorption corrections are made on the basis of sample weight.

Gross alpha activity of sediment or soil is analyzed in the same manner as gross beta except that the counter is set up to count only alpha.

Gamma analysis of sediment or soil is performed in a 300 ml plastic bottle which is counted by a gamma spectrometer.

Figure 5-3. Environmental Monitoring Locations - Shoreline Sediments and Soil

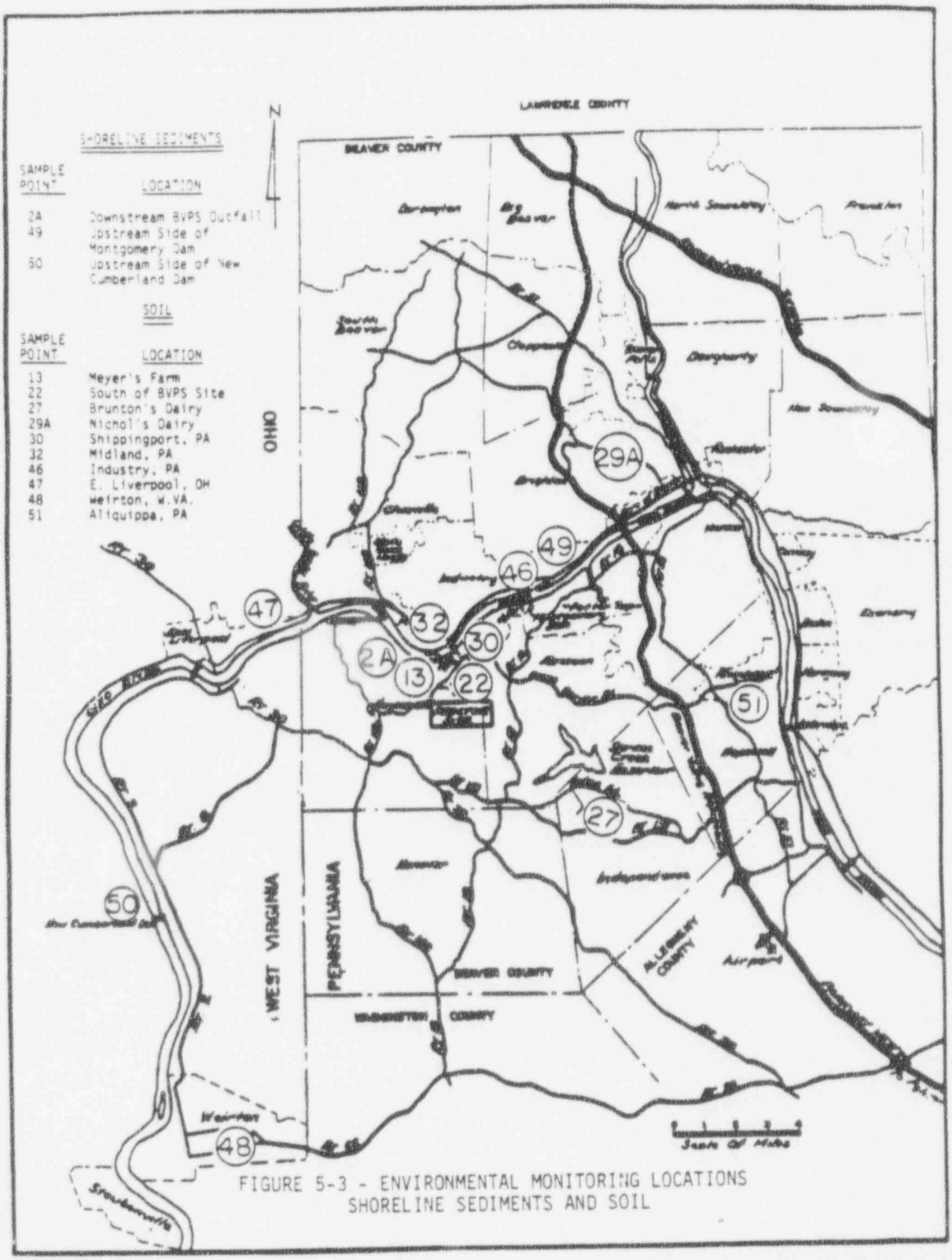


FIGURE 5-3 - ENVIRONMENTAL MONITORING LOCATIONS
SHORELINE SEDIMENTS AND SOIL

Strontium 89 and 90 are determined by radiochemistry. The sample is first dried and weighed. Stable strontium and calcium carriers are added and the sample is leached in hydrochloric acid. The sample is filtered. Calcium and strontium are precipitated as phosphates, collected by vacuum filtration, then dissolved in nitric acid. Strontium is separated by precipitating $Sr(NO_3)_2$ using nitric acid. A barium scavenge is performed to remove radium and other natural nuclides. Final purification of strontium is accomplished by precipitating $SrSO_4$ An iron scavenge is performed, followed by addition of stable yttrium carrier and a minimum 5-day period for Y-90 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. Sr-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.

3. Results and Conclusions

A summary of sediment and soil analysis is presented in Table 5-2.

a. Sediment

A total of six (6) samples were analyzed for gross alpha and gross beta. Results were comparable to previous years.

A total of six (6) samples were analyzed for Sr-89 and Sr-90. No Sr-89 or Sr-90 was detected.

A total of six (6) sample were analyzed by gamma spectrometry. Naturally occurring K-40, Ra-226 and Th-228 was found in every sample. Be-7 was found in three samples. Small amounts of Cs-137 from previous nuclear weapons test were found in five river sediment samples including two upstream above Montgomery Dam, which are unaffected by plant effluents. Small amounts of Co-58, Co-60 and Cs-137 were detected in the Beaver Valley Power Station discharge area and are attributable to station releases. The activity found in the station discharge area is consistent with station data of authorized radioactive discharges which were within limits permitted by the NRC license.

The analyses demonstrate that the Beaver Valley Power Station did not contribute a significant increase of radioactivity in the Ohio River sediment. The positive results detected are attributable to authorized releases from the Beaver Valley Power Station and are characteristic of the effluent. These results confirm that the station assessments, prior to authorizing radioactive discharges, are adequate and that the environmental monitoring program is sufficiently sensitive.

D. Monitoring of Feedcrops and Foodcrops

1. Characterization of Vegetation and Foodcrops

According to the 1992 statistical summary of the Pennsylvania Department of Agriculture, there were approximately 570 farms in Beaver County. The total value of farm crops and livestock was $17,929,000. The principal source of revenue was in dairy products which were estimated at $7,969,000. Revenues from other farm products were estimated as follows:

Field Crops	$1,536,000
Fruits	$373,000
Horticulture and Mushrooms	$3,521,000
Meat and Animal Products	$3,839,000
Vegetables and Potatoes	$468,000
Poultry Products	$78,000

The total land in Beaver County is 279,020 acres. Approximately 147,900 acres are forested land and 59,063 acres are pasture and crop land.

2. Sampling Program and Analytical Techniques

a. Program

Representative samples of cattle feed are collected monthly from the nearest dairy (Searight). See Figure 5-4. Each sample is analyzed by gamma spectrometry. The monthly samples are composited into a quarterly sample which is analyzed for Sr-90.

A land use census was performed July 1993 to locate the nearest residence and nearest garden of greater than 500 square feet producing fresh leafy vegetables within a five (5) mile radius of the site. See Table 5-5 for results.

Foodcrops (vegetables) were collected at garden locations during the summer of 1993. Leafy vegetables, i.e., cabbage were obtained from Shippingport, Georgetown, Industry, PA and Weirton, WV. All samples were analyzed for gamma emitters (including I-131 by gamma spectroscopy).

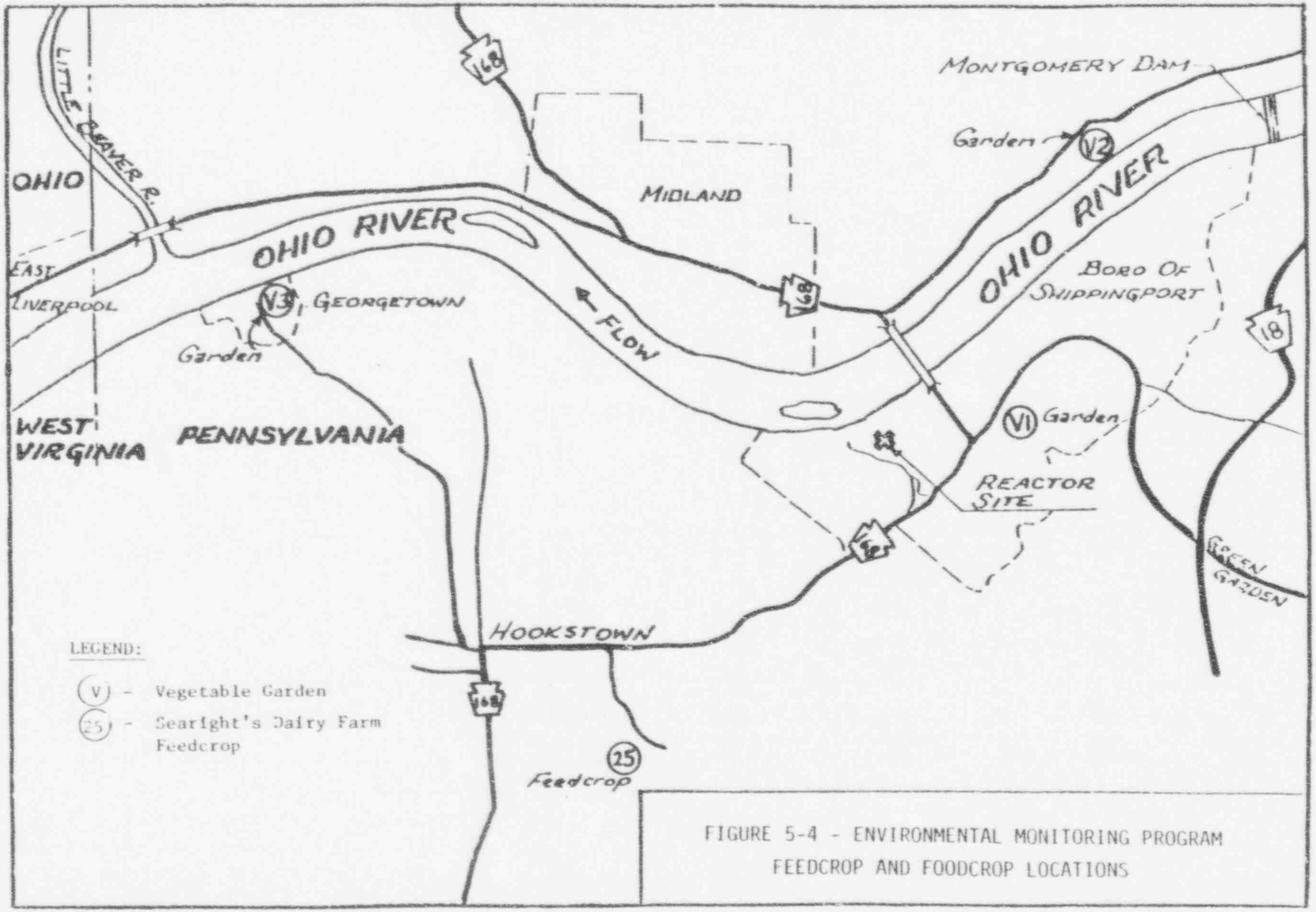


FIGURE 5-4 - ENVIRONMENTAL MONITORING PROGRAM FEEDCROP AND FOODCROP LOCATIONS

Table 5-5. Closest Residence and Garden in Each Sector

TABLE 5-5

Closest Residence and Garden in Each Sector

Sector	Closest Residence*	Closest Garden*
1	1.55 mi N	1.55 mi N
2	1.59 mi NNE	1.61 mi NNE
3	0.42 mi NE	2.53 mi NE
4	0.38 mi ENE	0.98 mi ENE
5	0.42 mi E	2.16 mi E
6	0.87 mi ESE	1.74 mi ESE
7	1.10 mi SE	1.25 mi SE
8	1.10 mi SSE	2.84 mi SSE
9	1.40 mi S	2.16 mi S
10	0.80 mi SSW	1.53 mi SSW
11	1.46 mi SW	1.67 mi SW
12	1.46 mi WSW	1.46 mi WSW
13	2.27 mi W	2.27 mi W
14	2.77 mi WNW	2.77 mi WNW
15	0.91 mi NW	0.92 mi NW
16	0.91 mi NNW	1.10 mi NNW

*Direction and Distance from Midpoint between Reactors

b. Procedures

Gamma emitters, including I-131, are determined by scanning a dried, homogenized sample with the gamma spectroscopy system. A high resolution germanium detector is utilized with this system.

Strontium 90 analysis for feedstuff is performed by a procedure similar to that described in 5-C.2 after drying, weighing and ashing the sample.

Radioiodine (I-131) is determined by radiochemistry. Stable iodide carrier is first added to a chopped sample which is then leached with sodium hydroxide solution, evaporated to dryness and fused in a muffle furnace. The melt is dissolved in water, filtered and treated with sodium hypochlorite. The iodate is then reduced to iodine with hydroxylamine hydrochloride and is extracted into chloroform. 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.

3. Results and Conclusions

A summary of data is presented in Table 5-2.

a. Feed

A total twelve (12) samples were analyzed for I-131. No detectable concentrations were found.

A total of four (4) samples were analyzed for Sr-90. Small amounts of Sr-90 from previous nuclear weapons tests were found in all samples.

A total of twelve (12) samples were analyzed by gamma spectroscopy. Naturally occurring K-40 was found in all samples and Be-7 was detected in seven (7) samples.

b. Food

A total of five (5) samples were analyzed for I-131. No detectable concentrations were found.

A total of five (5) samples were analyzed by gamma spectrometry. Naturally occurring K-40 was found in all samples.

c. The data from food and feed analyses were consistent with previous data. These data confirm that the Beaver Valley Power Station did not contribute to radioactivity in foods and feeds in the vicinity of the site.

E. Monitoring of Local Cows Milk

1. Description - Milch Animal Locations

During the seasons that animals producing milk (milch animals) for human consumption are on pasture, samples of fresh milk are obtained from these animals at locations and frequencies noted in Table 5-1. This milk is analyzed for its radioiodine content calculated as Iodine-131. The analyses are performed within eight (8) days of sampling.

Detailed field surveys are performed during the grazing season to locate and enumerate milch animals within a five (5) mile radius of the site. Goat herd locations out to fifteen (15) miles are identified. Survey data for the most recent survey conducted in is shown in Figure 5-5.

2. Sampling Program and Analytical Techniques

a. Program

Milk was collected from these (3) reference dairy farms (Searight's, Brunton's and Nicol's) within a 10-mile radius of the site and from one (1) control location (Windsheimer's) outside of the 10-mile radius. Additional dairies, which represent the highest potential milk pathway for radioiodine based on milch animal surveys and meteorological data were selected and sampled. These dairies are subject to change based upon availability of milk or when more recent data (milch animal census) indicate other locations are more appropriate. The location of each is shown in Figure 5-6 and described below.

Site	Dairy	Number of Milch Animals	Direction and Distance from Midpoint between Reactors	Collection Period
25	Searight	43 Cows	2.2 miles SSW	Jan. - Dec.
27	Brunton	93 Cows	7.3 miles SE	Jan. - Dec.
29A	Nicol	73 Cows	8.0 miles NE	Jan. - Dec.
96	Windsheimer	46 Cows	10.3 miles SSW	Jan. - Dec.
109**	Soissen	36 Cows	3.83 miles WSW	Jan. - Dec.
110**	Darnley	6 Goats	4.24 miles WSW	Jan. - Feb. Mar. - Dec.
102**	Ferry	3 Goats*	3.3 miles SE	Aug. - Oct.
105**	Ambrose	30 Cows	3.86 miles WSW	March
106**	Conkle	29 Cows	3.75 miles WSW	Jan. - Dec.

* Milk Usage - Home Only.

** Highest potential pathway dairies.

Figure 5-5. Beaver Valley Power Station Milch Animal Census

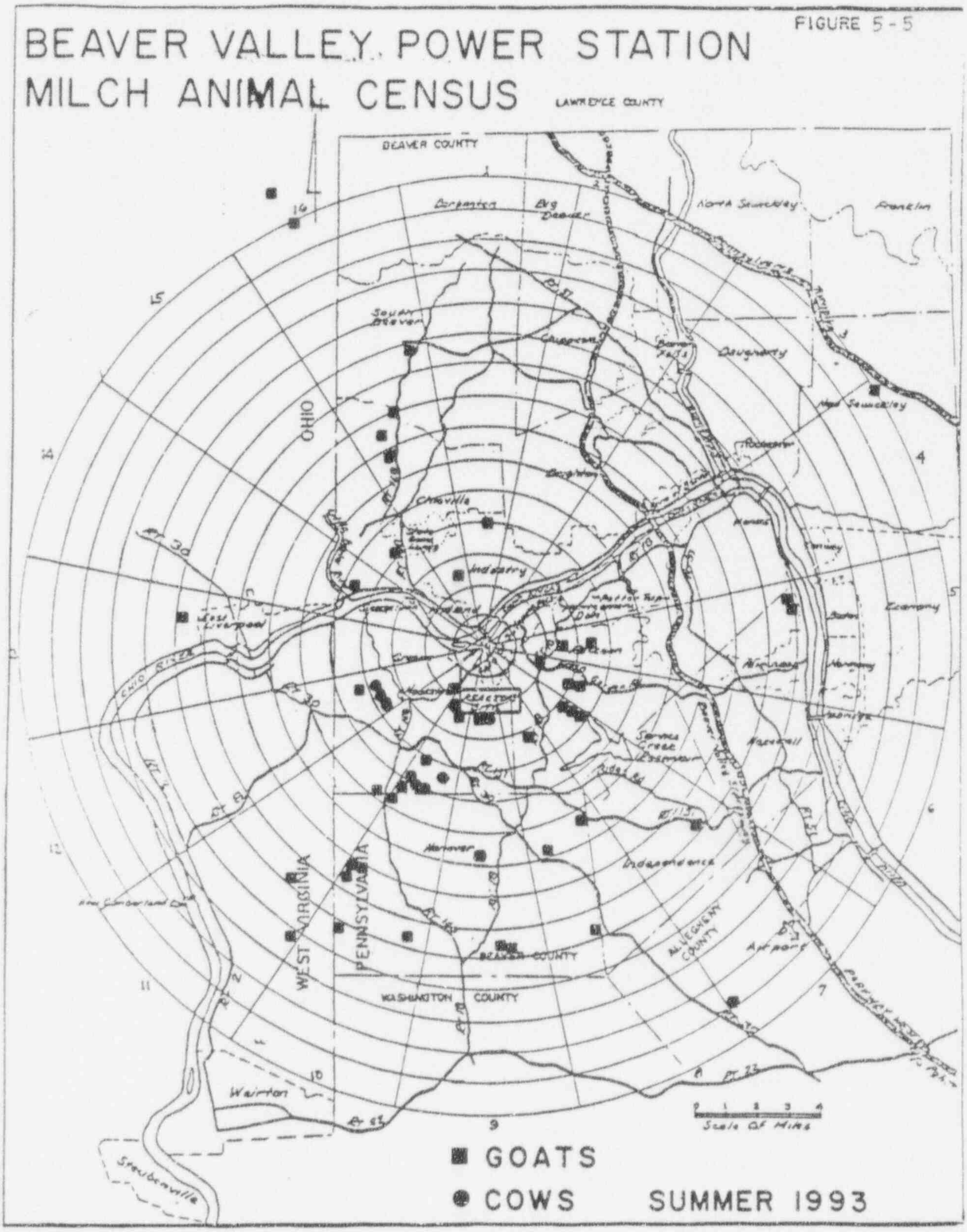


Figure 5-6. Environmental Monitoring Locations - Milk

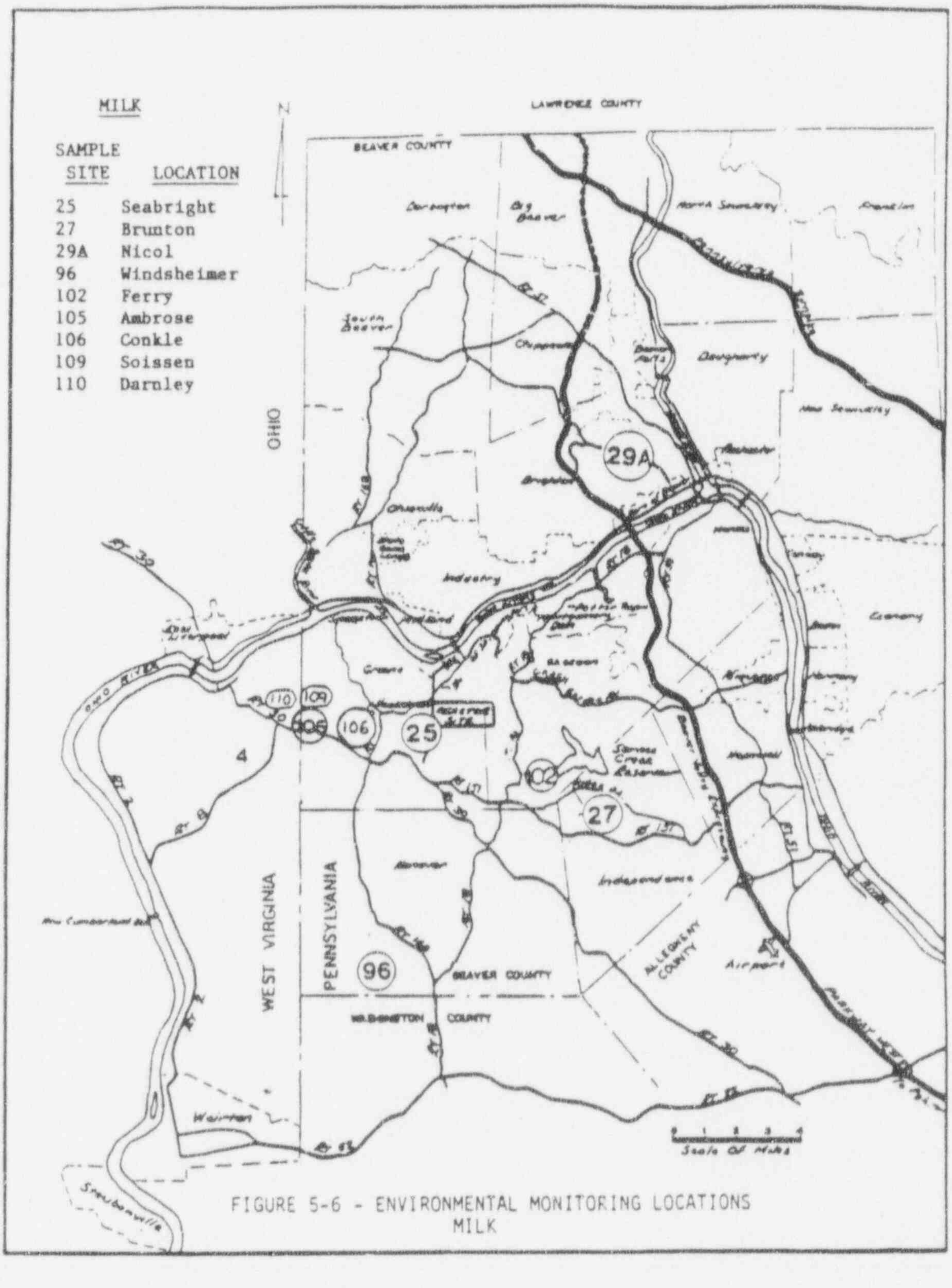


FIGURE 5-6 - ENVIRONMENTAL MONITORING LOCATIONS
MILK

The sample from Searight Dairy was collected and analyzed weekly for radioiodine using a procedure with a high sensitivity. Samples from each of the other selected dairies were collected monthly when cows are indoors, and bi-weekly when cows are grazing. This monthly or bi-weekly sample is analyzed for Sr-89, Sr-90, gamma emitters including Cs-137 (by high resolution germanium gamma spectroscopy) and I-131 (high sensitivity analysis).

b. Procedure

Radioiodine (I-131) analysis in milk was normally performed using chemically prepared samples and analyzed with a low-level beta counting system.

Gamma emitters are determined by gamma spectroscopy of a one liter Marinelli container of milk.

Strontium milk samples are prepared by adding stable strontium carrier and evaporating to dryness, then ashing in a muffle furnace, followed by precipitating phosphates. Strontium is purified in all samples in a chromatographic column. Stable yttrium carrier is added and the sample is allowed to stand for a minimum of 5 days for the ingrowth of Y-90. 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. Chemical yields of strontium and yttrium are determined gravimetrically.

3. Results and Conclusions

A summary of data is presented in Table 5-2.

A total of one hundred sixty-six (166) samples were analyzed for I-131 during 1993. All I-131 activities in milk were below the minimum detectable level.

A total of one hundred thirty-three (133) samples were analyzed for Sr-89 and Sr-90. No Sr-89 was detected. Sr-90 levels attributable to previous nuclear weapons tests were detected in all samples and were within the normally expected range.

A total of one hundred thirty-three (133) samples were analyzed by gamma spectroscopy. Naturally occurring K-40 was found in all samples.

It was noted that the dairies with the highest annual mean activities were goat dairies, which are known to concentrate activities over a factor of two compared to a cow dairy.

All results were consistent with (or lower than) those obtained in the preoperational program. These data confirm that the Beaver Valley Power Station did not contribute to radioactivity in milk in the vicinity of the site.

F. Environmental Radiation Monitoring

1. Description of Regional Background Radiation and Sources

The terrain in the vicinity of the Beaver Valley Power Station generally consists of rough hills with altitude variations of 300-400 feet. Most of the land is wooded.

The principal geologic features of the region are nearly flat-laying sedimentary beds of the Pennsylvania Age. Beds of limestone alternate with sandstone and shale with abundant interbedded coal layers. Pleistocene glacial deposits partially cover the older sedimentary deposits in the northwest. Most of the region is underlain by shale, sandstone, and some coal beds of the Conemaugh Formation. Outcrops of sandstone, shale, and limestone of the Allegheny Formation exist within the Ohio River Valley and along major tributary streams.

Based on surveys reported in previous annual reports, exposure rates ranged from 6-12 μR/hr. Results for 1993 indicated that background radiation continued in this range.

2. Locations and Analytical Procedures

Ambient external radiation levels around the site were measured using thermoluminescent dosimeters (TLDs).

In 1993 there were a total of forty-four (44) off-site environmental TLD locations. The locations of the TLDs are shown in Figure 5-7 through Figure 5-10. Thirteen (13) locations also have QC Laboratory TLDs. Both laboratories use calcium sulfate dysprosium, ($CaSO_4$:Dy) in Teflon matrix.

The calcium sulfate ($CaSO_4$:Dy) TLDs were annealed shortly before placing the TLDs in their field locations. The radiation dose accumulated in-transit between the field location and the laboratory was corrected by annealing control dosimeters shortly before the field dosimeters were removed from the field location, when shipping the freshly annealed control dosimeters with the exposed field dosimeters to the laboratory for readout at the same time. All dosimeters were exposed in the field in a special environmental holder. The dosimetry system was calibrated by reading calcium sulfate dosimeters which have been exposed in an accurately known gamma radiation field.

3. Results and Conclusions

Data obtained with the contractor TLD ($CaSO_4$:Dy in Teflon) during 1993 are summarized in Table 5-2, and the quality control TLD results are listed in Table 3-1.

The annual exposure rate of all off-site TLDs averaged 0.154 mR/day in 1993. As in previous years, there was some variation among locations and seasons as would be expected. Two TLDs were lost in the field during the year.

In 1993, ionizing radiation dose determinations from TLDs averaged approximately 56.2 mR for the year. This is comparable to previous years. There was no evidence of anomalies that could be attributed to the operation of the Beaver Valley Power Station. The TLDs confirm that changes from natural radiation levels, if any, are negligible.

Figure 5-7. TLD Locations - Northwest Quadrant

Figure 5-8. TLD Locations Northeast Quadrant Beaver Valley Power Station

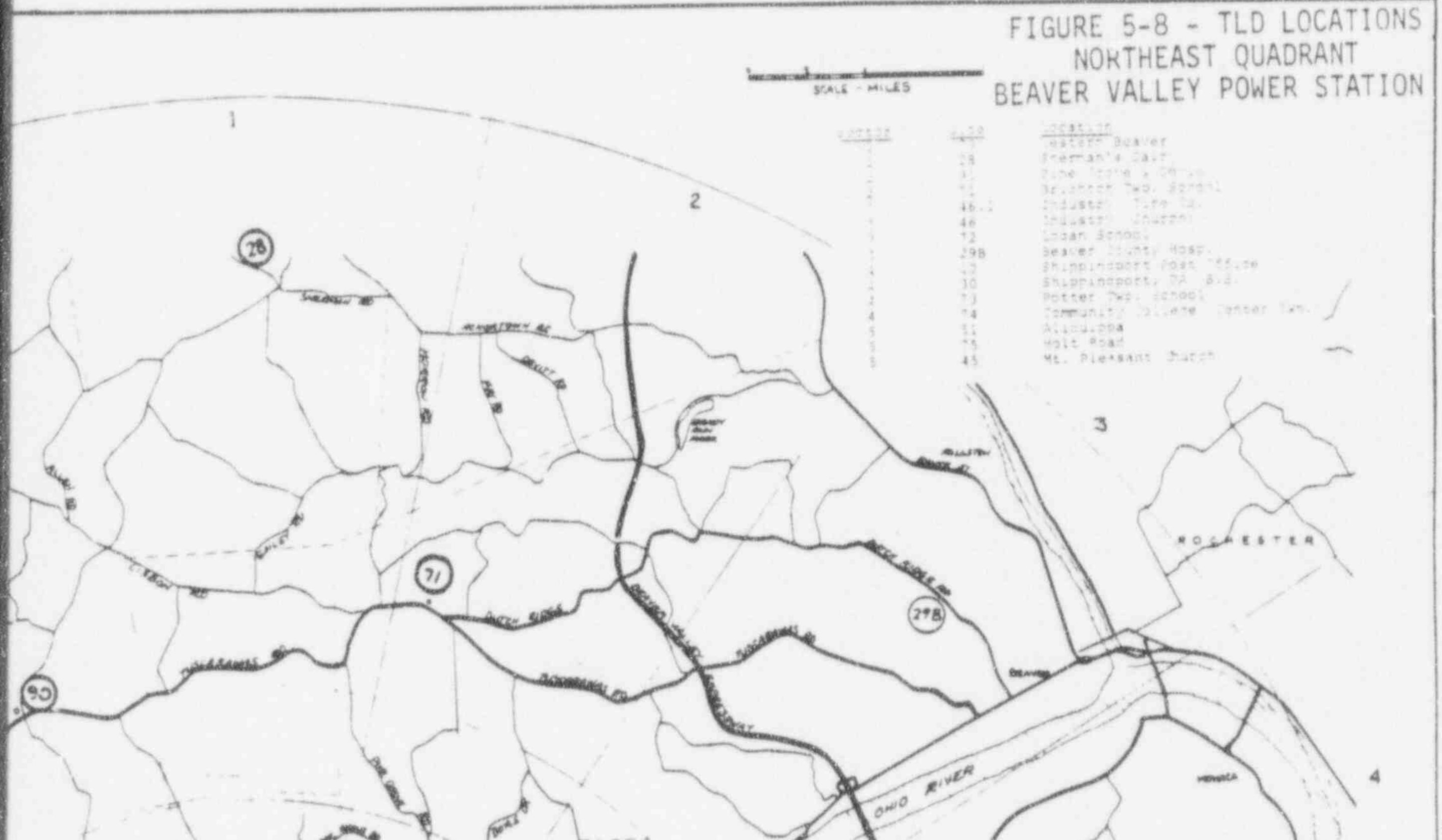


Figure 5-9. TLD Locations - Southeast Quadrant

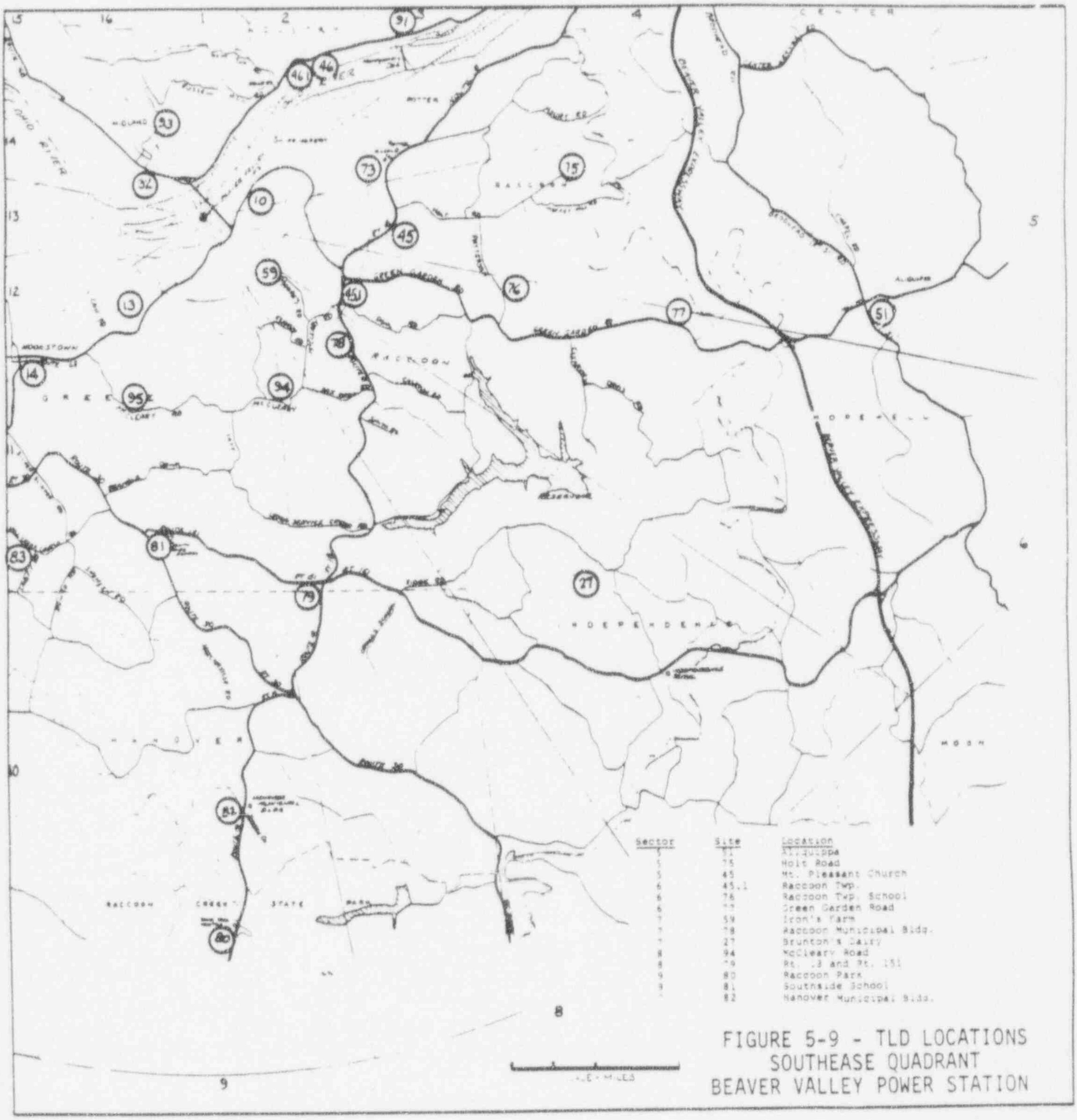
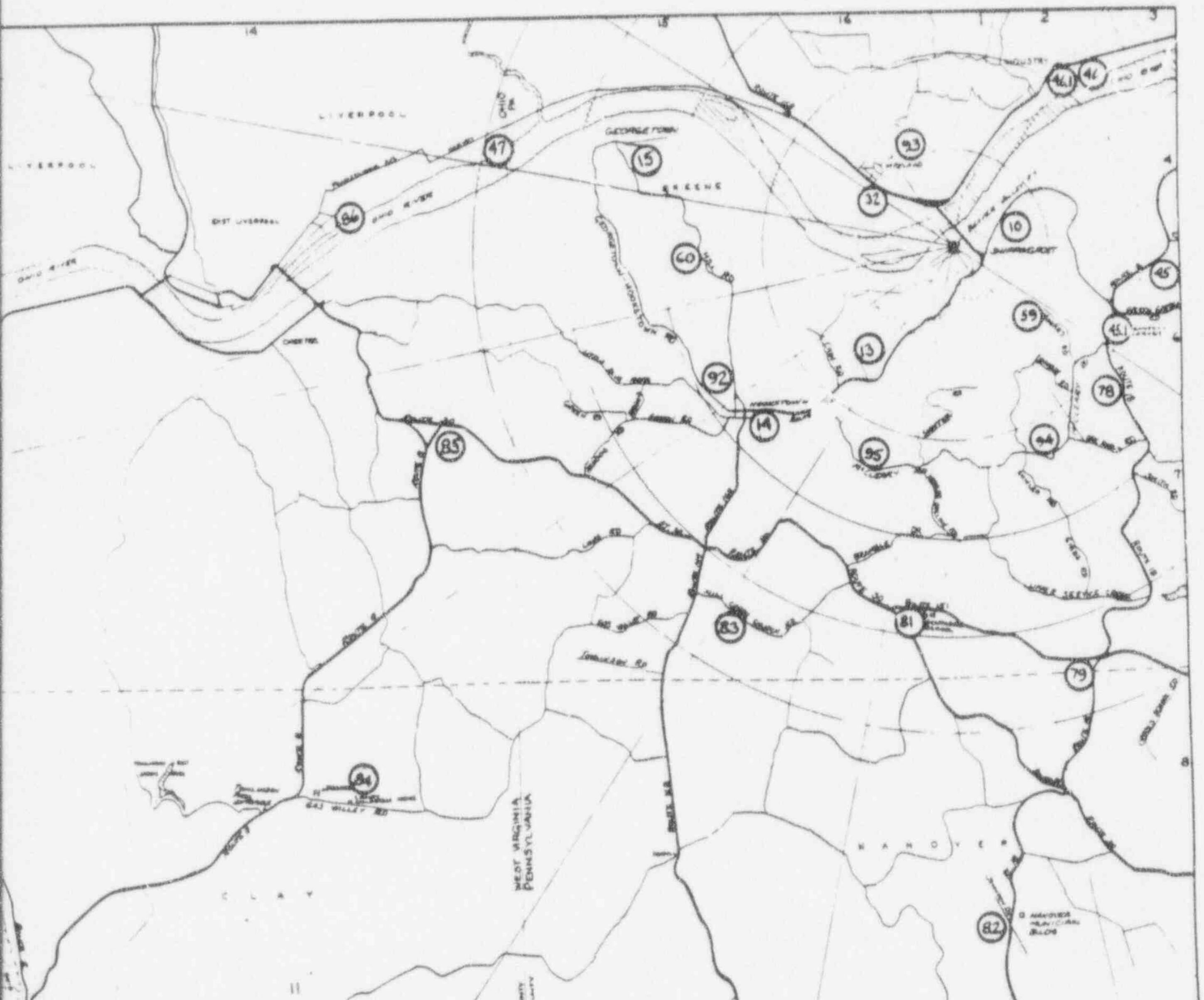


Figure 5-10. TLD Locations Southwest Quadrant Beaver Valley Power Station



Sector	Site	Location
9	80	Racoon Park
9	81	Southside School
9	82	Hanover Municipal Bldg.
10	48	Weirton Water Company
10	83	Mill Creek Road
10	95	McCleary Road
11	13	Meyer's Farm
11	14	Hookstown
11	84	Hancock Children's Home
12	92	Georgetown Road
12	85	Rt. 8 and Rt. 30
13	86	E. Liverpool
13	60	Haney's Farm

FIGURE 5-10 - TLD LOCATIONS
SOUTHWEST QUADRANT
BEAVER VALLEY POWER STATION

G. Monitoring of Fish

1. Description

During 1993, fish collected for the radiological monitoring program included carp, catfish, sucker and freshwater drum.

2. Sampling Program and Analytical Techniques

a. Program

Fish samples are collected semi-annually in the New Cumberland pool of the Ohio River at the Beaver Valley effluent discharge point and upstream of the Montgomery Dam. The edible portion of each different species caught is analyzed by gamma spectroscopy. Fish sampling locations are shown in Figure 5-11.

b. Procedure

A sample is prepared in a standard tared 300 ml plastic bottle and scanned for gamma emitting nuclides with gamma spectrometry system which utilizes a high resolution germanium detector.

3. Results and Conclusions

A summary of the results of the fish monitoring data is provided in Table 5-2.

A total of eight (8) samples were analyzed by gamma spectroscopy. Naturally occurring K-40 was found in all samples. One of four fish samples at the Beaver Valley discharge indicated Cs-137 near the lower limit of detection.

The analyses demonstrate that the Beaver Valley Power Station did not contribute a significant increase of radioactivity in the Ohio River fish population.

Figure 5-11. Environmental Monitoring Program - Fish Sampling Locations

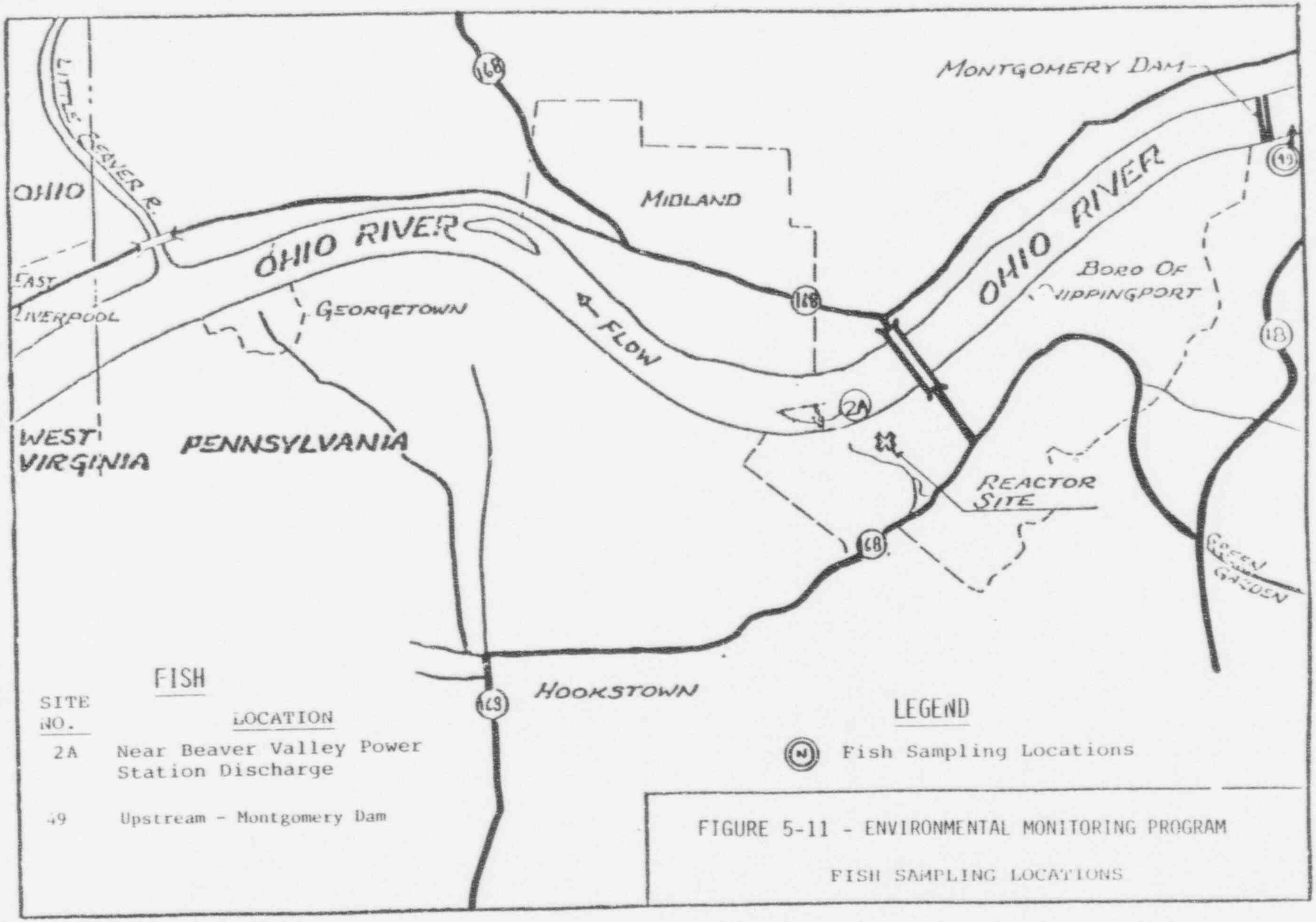


FIGURE 5-11 - ENVIRONMENTAL MONITORING PROGRAM

FISH SAMPLING LOCATIONS

H. Monitoring of Surface, Drinking, Well Waters and Precipitation

1. Description of Water Sources

The Ohio River is the main body of water in the area. It is used by the Beaver Valley Power Station for plant make-up for the cooling tower and for receiving plant liquid effluents.

Ohio River water is a source of water for some towns both upstream and downstream of the Beaver Valley Power Station site. It is used by several municipalities and industries downstream of the site. The nearest user of the Ohio River as a potable water source is Midland Borough Municipal Water Authority. The intake of the treatment plant is approximately 1.5 miles downstream and on the opposite side of the river. The next downstream user is East Liverpool, Ohio which is approximately 6 miles downstream. The heavy industries in Midland, as well as others downstream use river water for cooling purposes. Some of these plants also have private treatment facilities for plant sanitary water.

Ground water occurs in large volumes in the gravel terraces which lie along the river, and diminishes considerably in the bedrock underlying the site. Normal well yields in the bedrock are less than 10 gallons per minute (gpm) with occasional wells yielding up to 60 gpm.

In general, the BVPS site experiences cool winters and moderately warm summers with ample annual precipitation evenly distributed throughout the year. The record mean annual precipitation for the area is 36.40 inches based on 1972 to 1990 data collected at the Pittsburgh International Airport.

2. Sampling and Analytical Techniques

a. Surface (Raw River) Water

The sampling program of river water includes five (5) sampling points along the Ohio River. Raw water samples are normally collected at the East Liverpool (Ohio) Water Treatment Plant [River Mile 41.2] daily and composited into a monthly sample. Weekly grab samples are taken from the Ohio River at the following locations: upstream of Montgomery Dam [River Mile 31.8]; and near the discharge from the Beaver Valley Power Station [River Mile 35.0]. Two automatic river water samplers are at the following locations: Upstream of Montgomery Dam [River Mile 29.6]; and at J&L Steel's river water intake [River Mile 36.2]. The automatic sampler takes a 20-40 ml sample every 15 minutes and samples are collected on a weekly basis. The weekly grab samples and automatic water samples are composited into monthly samples from each location. In addition, a quarterly composite sample is prepared for each sample point.

The weekly composites from the automatic river water sampler upstream at Montgomery Dam are analyzed for I-131.

The monthly composites are analyzed for gross alpha, gross beta, and gamma emitters. The quarterly composites are analyzed for H-3, Sr-89, Sr-90, and Co-60 (high sensitivity).

Locations of each sample point are shown in Figure 5-12.

b. Drinking Water (Public Supplies)

Drinking (treated) water is collected at both Midland (PA) and East Liverpool (OH) Water Treating Plants. An automatic sampler at each location collects 20-40 ml every 20 minutes. These intermittent samples are then composited into a weekly sample. A weekly grab sample is also taken at the DLC Training Building in Shippingport, PA. The weekly sample from each location is analyzed by gamma spectroscopy. The weekly samples are also analyzed for I-131.

Monthly composites of the weekly samples are analyzed for gross alpha, gross beta, and by gamma spectrometry. Quarterly composites are analyzed for H-3, Sr-89, Sr-90 and Co-60 (high sensitivity). Locations of each sample point are shown in Figure 5-12.

c. Ground Water

Grab samples were collected each quarter from each of four (4) well locations (see Figure 5-12) within four (4) miles of the site. These locations are:

One (1) well at Shippingport, PA

One (1) well at Meyer's Farm (Hookstown, PA)

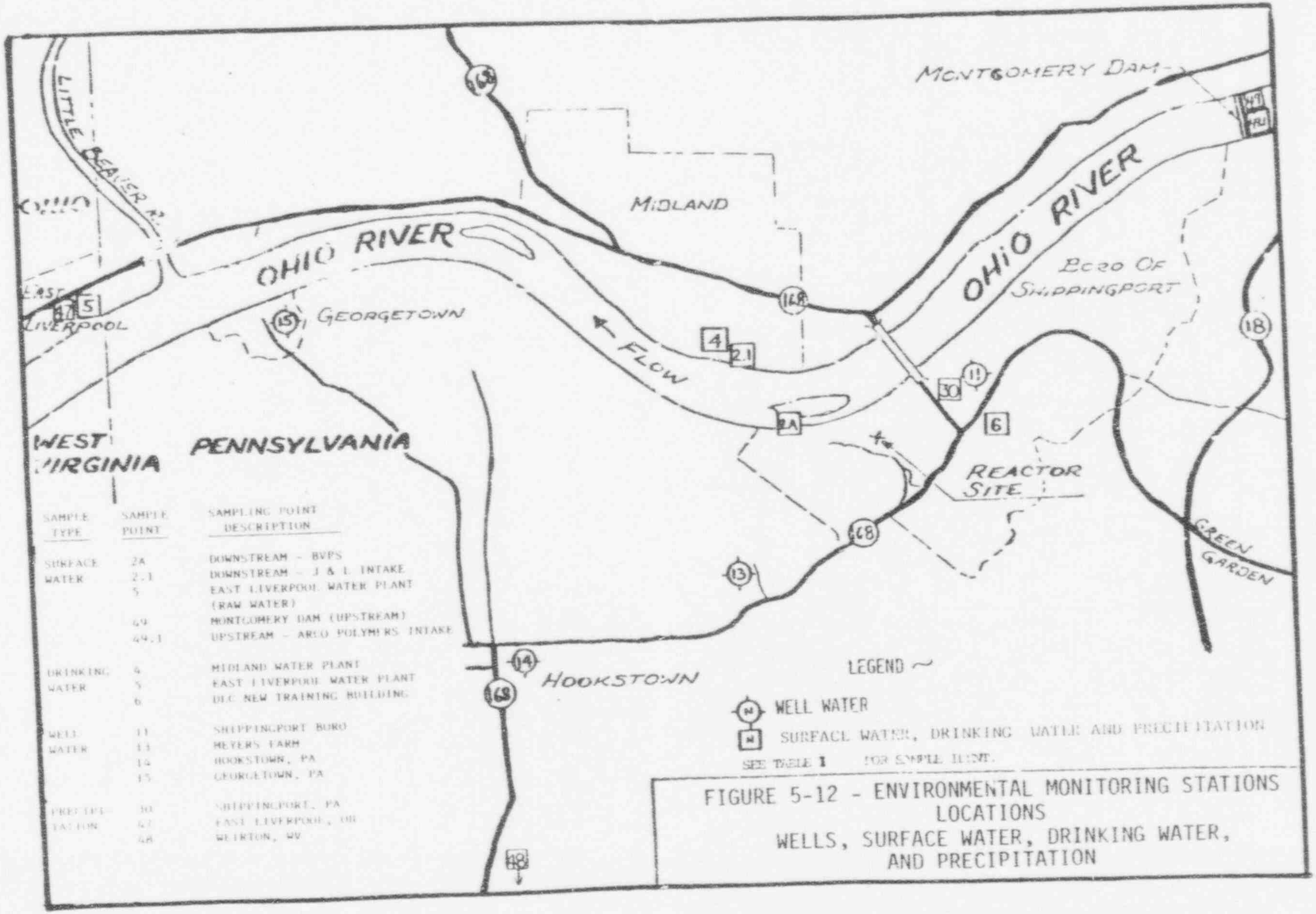
One (1) well in Hookstown, PA

One (1) well in Georgetown, PA

Each ground water sample is analyzed for gross alpha, gross beta, tritium, and by gamma spectroscopy.

d. Precipitation

Precipitation is collected at Shippingport, PA, East Liverpool, OH and Weirton, WV. Precipitation when available is collected each week and then composited into monthly and quarterly samples. The monthly samples are analyzed for gross beta and gamma emitters and the quarterly composites are analyzed for H-3, Sr-89 and Sr-90. Locations of each sample point are shown in Figure 5-12.



SAMPLE TYPE	SAMPLE POINT	SAMPLING POINT DESCRIPTION
SURFACE WATER	2A	DOWNSTREAM - BVPS
	2.1	DOWNSTREAM - J & L INTAKE
	5	EAST LIVERPOOL WATER PLANT (RAW WATER)
	49	MONTGOMERY DAM (UPSTREAM)
	49.1	UPSTREAM - ARCO POLYMERS INTAKE
DRINKING WATER	4	MIDLAND WATER PLANT
	5	EAST LIVERPOOL WATER PLANT
	6	DLC NEW TRAINING BUILDING
WELL WATER	11	SHIPPINGPORT BURO
	13	MEYERS FARM
	14	HOOKSTOWN, PA
	15	GEORGETOWN, PA
PRECIPITATION	30	SHIPPINGPORT, PA
	47	EAST LIVERPOOL, OH
	48	WEIRTON, WV

Figure 5-12. Environmental Monitoring Stations Locations - Wells, Surface Water, Drinking Water and Precipitation

e. Procedures

Gross alpha and gross beta activities are determined first by evaporating one liter of the sample on a hotplate. The residue is mounted and dried on a 2-inch stainless steel planchet. The sample is counted in a low background, gas flow proportional counter. Self-absorption corrections are made on the basis of sample weight.

Gamma analysis is performed on water sample by loading one liter of sample into a one liter Marinelli container and counting a high resolution germanium gamma spectrometry system.

Strontium-89 and 90 are determined on water samples by a procedure similar to that described in 5-C.2 except that the leaching step is eliminated.

Cobalt-60 is determined with a sensitivity of 1 pCi/liter by evaporating 2 liters of sample on a hotplate and transferring the residue to a 2-inch planchet. The planchet is counted on a high resolution germanium gamma spectrometry system.

Tritium is determined in water samples by liquid scintillation counting.

Radioiodine (I-131) analysis in water was normally performed using chemically prepared samples and analyzed with a low-level beta counting system.

3. Results and Conclusions

A summary of results of all analyses of water samples (surface, drinking, ground and precipitation) are provided by sample type and analysis in Table 5-2. These are discussed below.

a. Surface Water

A total of forty-eight (48) samples were analyzed for gross alpha and gross beta. Alpha activity was detected in one of the samples at a level comparable to preoperational values. Positive beta results above preoperational levels were detected in the BVPS discharge area and are attributable to station releases. The beta activity found in the station discharge area is consistent with station data of authorized radioactive discharges and were within limits permitted by the NRC license.

A total of sixteen (16) samples were analyzed for H-3, Sr-89 and Sr-90 as well as a high sensitivity analysis for Co-58 and Co-60. Positive tritium results were detected in the BVPS discharge area and are attributable to station releases. The highest tritium results were noted, however, to correspond to shore samples taken when mixing zone sampling by boat was not possible. All other samples taken upstream and downstream were within preoperational levels. The activity found in the station discharge area is consistent with station data of authorized radioactive discharges and were within limits permitted by the NRC license.

A total of forty-eight (48) samples were analyzed by gamma spectrometry. No gamma emitting radionuclides were detected.

A total of fifty-two (52) samples were analyzed for I-131 using a highly sensitive technique. Trace levels of I-131 were measured in twenty (20) of the weekly samples. The results were slightly above the minimum detectable activity. The positive results were detected at a control location above the BVPS discharge and could not be attributed to plant releases. The results may be attributed to medical procedures and the expected variability in the analyses results of very low levels of activity.

b. Drinking Water

A total of thirty-six (36) samples were analyzed for gross alpha and gross beta. All results were within a normal range.

A total of twelve (12) samples were analyzed for H-3, Sr-89 and Sr-90 as well as a high sensitivity analysis for Co-60. No Sr-89, Sr-90, or Co-60 were detected. The H-3 data were within the preoperational range indicative of normal environmental levels.

A total of another one hundred fifty-six (156) samples were analyzed by gamma spectrometry.

A total of one hundred fifty-six (156) samples were analyzed for I-131 using a highly sensitive technique. Trace levels of I-131 were measured in forty-six (46) of the weekly samples. The results were slightly above the minimum detectable activity. The positive results were detected at Midland and East Liverpool and could not be attributed to plant releases. As noted under Surface Water above, I-131 has been observed upstream of the site. The results may be attributed to medical procedures and the expected variability in the analyses results of very low levels of activity.

c. Ground Water

A total of sixteen (16) samples were each analyzed for gross alpha, gross beta, H-3 and by gamma spectrometry. One sample had alpha activity near the detection limit. No H-3 activity was detected in any of the samples. The gross beta results are comparable to preoperational ranges. No gamma emitting radionuclides were detected.

d. Precipitation

A total of thirty-four (34) samples were analyzed for gross beta. All results were within a normal range.

A total of twelve (12) samples were analyzed for H-3, Sr-89 and Sr-90. Five (5) positive tritium results detected were within normal levels. No Sr-89 or Sr-90 was detected.

A total of thirty-four (34) samples were analyzed by gamma spectrometry. Naturally occurring Be-7 was detected in twenty-eight (28) samples.

e. Summary

The data from water analyses demonstrates that the Beaver Valley Power Station did not contribute a significant increase of radioactivity in local river, drinking, well waters or precipitation. The few positive results which could be attributable to authorized releases from the Beaver Valley Power Station are characteristic of the effluent. These results confirm that the station assessments, prior to authorizing radioactive discharges, are adequate and that the environmental monitoring program is sufficiently sensitive.

Further, the actual detected concentration (averaged over the total batch discharge period during the year) attributable to Beaver Valley Power Station, was only 0.40% of the Maximum Permissible Concentration allowed by the Federal Regulations for water discharged to the Ohio River. The Ohio River further reduced this concentration by a factor of ~ 600 prior to its potential use by members of the public.

I. Estimates of Radiation Dose to Man

1. Pathways to Man - Calculational Models

The radiation doses to man as a result of Beaver Valley operations were calculated for both gaseous and liquid effluent pathways using codes for the ARERAS/MIDAS computer system equivalent to NRC computer codes XOQDOQ2, GASPAR, and LADTAP. Dose factors listed in the ODCM were used to calculate doses to maximum individuals from radioactive noble gases in discharge plumes. Beaver Valley effluent data, based on sample analysis in accordance with the schedule set forth in Appendix A of the BVPS license, were used as the radionuclide activity input.

Each radionuclide contained in the Semi-Annual Radioactive Effluent Release Report (noble gases, particulates, radioiodines and tritium) were included as source terms when they were detected above the LLD values. All LLD values reported by Beaver Valley Power Station are equal to or lower than those required by the Technical Specifications.

All gaseous effluent releases, including Auxiliary Building Ventilation, were included in dose assessments. The release activities are based on laboratory analysis. When the activity of noble gas was below detection sensitivity, either the inventory based on its MDL or an appropriate but conservative ratio to either measured activity of Kr-85 or Xe-133 was used. Meteorological data collected by the Beaver Valley Power Station Meteorology System was used as input to code equivalent to XOQDOQ2 which in turn provided input for the GASPAR equivalent. Except when more recent or specific data was available, all inputs were the same as used in the Beaver Valley Power Station Environmental Statements or in Regulatory Guide 1.109. The airborne pathways evaluated were beta and gamma doses from noble gas plumes inhalation, the "cow-milk-child", and other ingestion pathways.

All potentially radioactive liquid effluents, including steam generator blowdown, are released by batch mode after analysis by gamma spectrometry using Intrinsic Germanium detectors. Each batch is diluted by cooling tower blowdown water prior to discharge into the Ohio River at the Beaver Valley Power Station outfall (River Mile 35.0). The actual data from these analyses are tabulated and used as the radionuclide activity input term in code equivalent to LADTAP. A hypothetical real individual for liquid pathways is located at Midland. Except when more recent or specific data for the period is available, all other input are obtained from the Beaver Valley Power Station Environmental Statement or Regulatory Guide 1.109. Pathways, which were evaluated, are drinking water, fish consumption, shoreline recreation, swimming, and boating.

2. Results of Calculated Radiation Dose to Man - Liquid Releases

a. Individual Dose

The doses which are calculated by the model described above are to a hypothetical real individual located at Midland since this is the nearest location where significant exposure of a member of the public could potentially occur; therefore, this location is use to calculate the maximum exposure. A breakdown of doses by pathway and organ is provided in Table 5-6 for the maximum individual. Included in this table is a breakdown of a typical dose to individuals from natural radiation exposure. The results of calculated radiation dose to the hypothetical real individual are compared to BVPS annual limits in Table 5-7.

b. Upon implementation of the Unit 2 Technical Specifications and inception of the liquid discharge procedures at Unit 2 on July 24, 1987, the discharge limits were clarified to be reactor specific; i.e., Unit 1 and Unit 2 have reactor specific dose limits that are equal to the limits in 10 CFR Part 50, Appendix I. Therefore, the annual site limits listed in Table 5-8 are specific to this report only, and were derived by multiplying the individual Technical Specification reactor limits by a factor of two (2).

Table 5-6. Radiation Dose to Maximum Individual, mrem/yr - Liquid Releases

TABLE 5-6

Radiation Dose to Maximum Individual[a], mrem/yr - Liquid Releases[b]

PATHWAY	SKIN	ORGAN	THYROID	BONE	WHOLE BODY
Fish Consumption	N/A	0.000659 (Teen) (Liver)	0.0000582 (Adult)	0.000508 (Child)	0.000473 (Adult)
Drinking Water	N/A	0.00194 (Child) (Thyroid)	0.00194 (Child)	0.0000528 (Child)	0.00186 (Child)
Shoreline Activities	0.000039 (Teen)	0.000039 (Teen) (Skin)	0.000033 (Teen)	0.000033 (Teen)	0.000033 (Teen)
MREM MAXIMUM INDIVIDUAL	0.000039 (Teen)	0.00246 (Child) (Liver)	0.00199 (Child)	0.000568 (Child)	0.00200 (Child)

TYPICAL DOSE TO INDIVIDUALS FROM NATURAL RADIATION EXPOSURE[c]

Ambient Gamma Radiation	:	58
Radionuclides in Body	:	40
Global Fallout	:	<1
Radon	:	198
TOTAL mrem	:	296

a Located at Midland Drinking Water Intake

b Total liquid releases are from Site (combined Units 1 and 2)

c National Academy of Sciences, "The Effects on Populations of Exposure to Low Levels of Ionizing Radiation", BEIR Report, 1990

Table 5-7. Results of Calculated Radiation Dose to Man - Liquid Releases

TABLE 5-7

Results of Calculated Radiation
Dose to Man - Liquid Releases

Organ	Maximum Exposure Hypothetical Real Individual mrem	BVPS Annual Limits mrem	Percent of Annual Limit
TOTAL BODY			
Adult	0.00185	6.0	0.031
Teen	0.00128	6.0	0.021
Child	0.00200	6.0	0.033
Infant	0.00182	6.0	0.030
ANY ORGAN			
Adult	0.00203 (Liver)	20.0	0.0102
Teen	0.00167 (Liver)	20.0	0.0083
Child	0.00246 (Liver)	20.0	0.0123
Infant	0.00198 (Thyroid)	20.0	0.0099

Maximum Total Body Dose - Capsule Summary

	mrem
1993 Calculated	0.00200
Final Environmental Statement	3.5

Highest Organ Dose

1993 Calculated	0.00246
Final Environmental Statement	4.7

c. Population Dose

The 1993 calculated dose to the entire population of almost 4 million people within 50 miles of the plant was:

Organ	Man-Millirems	Largest Isotope Contributor
TOTAL BODY	135	H-3 132 mrem
THYROID	138	H-3 132 mrem

3. Results of Calculated Radiation Dose to Man - Atmospheric Releases

The results of calculated radiation dose to the maximum exposed individuals for BVPS airborne radioactive effluents during 1993 are provided in Table 5-8. The doses include the contribution of all pathways. A 50-mile population dose is also calculated and provided in Table 5-8. H-3 is the primary radionuclide contributions to these doses.

The results are compared to the BVPS annual limits in Table 5-8. As in the liquid discharge limits, the gaseous effluent limits are reactor specific; i.e., Unit 1 and Unit 2 have reactor specific dose limits that are equal to the limits in 10 CFR Part 50, Appendix I. Therefore, the annual limits listed in Table 5-8 are specific to this report only, and were derived by multiplying the individual Technical Specification reactor limits by a factor of two (2). The results show compliance with the BVPS annual limits.

4. Conclusions

Based upon the estimated dose to individuals from the natural background radiation exposure in Table 5-6, the incremental increase in total body dose to the 50-mile population (4 million people), from the operation of Beaver Valley Power Station - Unit 1 and 2, is less than 0.00012% of the annual background.

The calculated doses to the public from the operation of Beaver Valley Power Station - Unit 1 and 2, are below BVPS annual limits and resulted in only a small incremental dose to that which area residents already received as a result of natural background. The doses constituted no meaningful risk to the public.

Table 5-8. Results of Calculated Radiation Dose to Man - Atmospheric Releases

TABLE 5-8

Results of Calculated Radiation Dose to Man - Atmospheric Releases

ORGAN	MAXIMUM EXPOSURE INDIVIDUAL mrem	BVPS ANNUAL LIMIT mrem	PERCENT OF ANNUAL LIMIT	50-MILE POPULATION DOSE man rem
TOTAL BODY	0.488	30	1.63	1.241
SKIN	0.488	30	1.63	0.687
LUNG	0.488	30	1.63	1.263
THYROID	0.574	30	1.91	1.421

APPENDIX I

Contractor Laboratory

EPA Interlaboratory

Comparison Program

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 1993 data summary tables are presented for isotopes in the various sample media applicable to the Duquesne Light Company's Radiological Environmental Monitoring Program. The footnotes of the table discuss investigations of problems encountered in a few cases and the steps taken to prevent reoccurrence.

DUQUESNE LIGHT COMPANY

EPA INTERLABORATORY COMPARISON PROGRAM 1993

EPA Preparation	Date TI Mailed Re sults	Date EPA Issued Results	Media	Nuclide	EPA Results(a)		TI Results(b)		Norm Dev. (Known)	**Warning ***Action	
01/15/93	03/23/93	04/26/93	Water	Sr-89	15.0 ±	5.0	12.67 ±	1.15	-0.81		
				Sr-90	10.0 ±	5.0	8.33 ±	1.15	-0.58		
01/29/93	02/22/93 *	05/10/93	Water	Gr-Alpha	34.0 ±	9.0	17.33 ±	1.15	-3.21	***	(c)
				Gr-Beta	44.0 ±	5.0	52.00 ±	1.00	2.77	**	(d)
02/05/93	03/04/93	04/20/93	Water	I-131	100.0 ±	10.0	106.67 ±	5.77	1.15		
03/05/93	04/30/93	06/10/93	Water	Ra-226	9.8 ±	1.5	7.67 ±	0.12	-2.46	**	(e)
				Ra-228	18.5 ±	4.6	19.33 ±	2.31	0.31		
04/20/93	07/02/93	08/16/93	Water	Gr-Beta	177.0 ±	27.0	150.0 ±	0.00	-1.73		
				Sr-89	41.0 ±	5.0	35.33 ±	1.53	-1.96		
				Sr-90	29.0 ±	5.0	27.33 ±	0.58	-0.58		
				Co-60	39.0 ±	5.0	40.67 ±	3.51	0.58		
				Cs-134	27.0 ±	5.0	23.67 ±	1.53	-1.15		
				Cs-137	32.0 ±	5.0	34.33 ±	2.08	0.81		
				Gr-Alpha	95.0 ±	24.0	94.33 ±	1.15	-0.05		
				Ra-226	24.9 ±	3.7	19.00 ±	1.00	-2.76	**	(e)
				Ra-228	19.0 ±	4.8	18.33 ±	0.58	-0.24		
06/04/93	07/02/93	8/16/93	Water	H-3	9844.0 ±	984.0	9366.67 ±	152.75	-0.84		
06/11/93	07/23/93	08/27/93	Water	Co-60	15.0 ±	5.0	16.33 ±	1.53	0.46		
				Zn-65	103.0 ±	10.0	121.33 ±	2.08	3.18	***	(f)
				Ru-106	119.0 ±	12.0	106.33 ±	15.89	-1.83		
				Cs-134	5.0 ±	5.0	5.67 ±	0.58	0.23		
				Cs-137	5.0 ±	5.0	6.67 ±	0.58	0.58		
				Ba-133	99.0 ±	10.0	104.33 ±	9.29	0.92		
07/16/93	09/14/93	12/02/93	Water	Sr-89	34.0 ±	5.0	31.67 ±	2.52	-0.81		
				Sr-90	25.0 ±	5.0	24.00 ±	0.00	-0.35		
07/23/93	08/20/93	10/23/93	Water	Gr-Alpha	15.0 ±	5.0	18.67 ±	2.08	1.27		
				Gr-Beta	43.0 ±	6.9	42.67 ±	2.52	-0.08		
08/27/93	11/05/93	12/28/93	Air Filter	Gr-Alpha	19.0 ±	5.0	17.0 ±	0.00	-0.69		
				Gr-Beta	47.0 ±	5.0	49.00 ±	1.73	0.69		
				Sr-90	19.0 ±	5.0	17.67 ±	0.58	-0.46		
				Cs-137	9.0 ±	5.0	9.67 ±	0.58	0.23		

* Footnotes located at end of table.

DUQUESNE LIGHT COMPANY

EPA INTERLABORATORY COMPARISON PROGRAM 1993

EPA Preparation	Date TI Mailed Results	Date EPA Issued Results	Media	Nuclide	EPA Results(a)		TI Results(b)		Norm Dev. (Known)	**Warning ***Action	
09/09/93	11/12/93	12/21/93	Water	Ra-226	14.9 ±	2.2	15.33 ±	0.58	0.34		
				Ra-228	20.4 ±	5.1	20.67 ±	1.15	0.09		
09/24/93	11/24/93	01/24/94	Milk	Sr-89	30.0 ±	5.0	35.67 ±	3.51	1.96		
				Sr-90	25.00 ±	5.0	24.00 ±	1.73	-0.35		
				I-131	120.0 ±	12.0	126.67 ±	5.77	0.96		
				Cs-137	49.0 ±	5.0	50.67 ±	1.15	0.58		
				K	1679.0 ±	84.0	1620.00 ±	17.32	-1.22		
10/08/93	11/10/93	12/23/93	Water	I-131	117.0 ±	12.0	103.33 ±	5.77	-1.97		
10/19/93	12/29/93	02/14/94	Water	Gr-Alpha	40.0 ±	10.0	39.67 ±	0.58	-0.06		
				Ra-226	9.9 ±	1.5	10.10 ±	0.79	0.23		
				Ra-228	12.5 ±	3.1	14.67 ±	1.15	1.21		
				Gr-Beta	58.0 ±	10.0	51.33 ±	3.21	-1.15		
				Sr-89	15.0 ±	5.0	15.00 ±	1.00	0.00		
				Sr-90	10.0 ±	5.0	10.00 ±	0.00	0.00		
				Co-60	10.0 ±	5.0	12.00 ±	1.00	0.69		
				Cs-134	12.0 ±	5.0	9.00 ±	1.00	-1.04		
				Cs-137	10.0 ±	5.0	12.67 ±	2.52	0.92		
10/29/93	11/02/93	01/17/94	Water	Gr-Alpha	20.0 ±	5.0	20.33 ±	2.08	0.12		
				Gr-Beta	15.0 ±	5.0	15.67 ±	2.08	0.23		
11/05/93	11/02/93	01/17/94	Water	H-3	7398.0 ±	740.0	6900.00 ±	100.00	-1.17		
11/02/93	12/23/93	02/14/93	Water	Co-60	30.0 ±	5.0	28.67 ±	2.89	-0.46		
				Zn-65	150.0 ±	15.0	152.00 ±	9.17	0.23		
				Ru-106	201.0 ±	20.0	177.33 ±	5.51	-2.05	**	(g)
				Cs-134	59.0 ±	5.0	53.33 ±	4.93	-1.96		
				Cs-137	40.0 ±	5.0	41.33 ±	3.06	0.46		
				Ba-133	79.0 ±	8.0	69.33 ±	3.06	-2.09	**	(g)

DUQUESNE LIGHT COMPANY

EPA INTERLABORATORY COMPARISON PROGRAM 1993

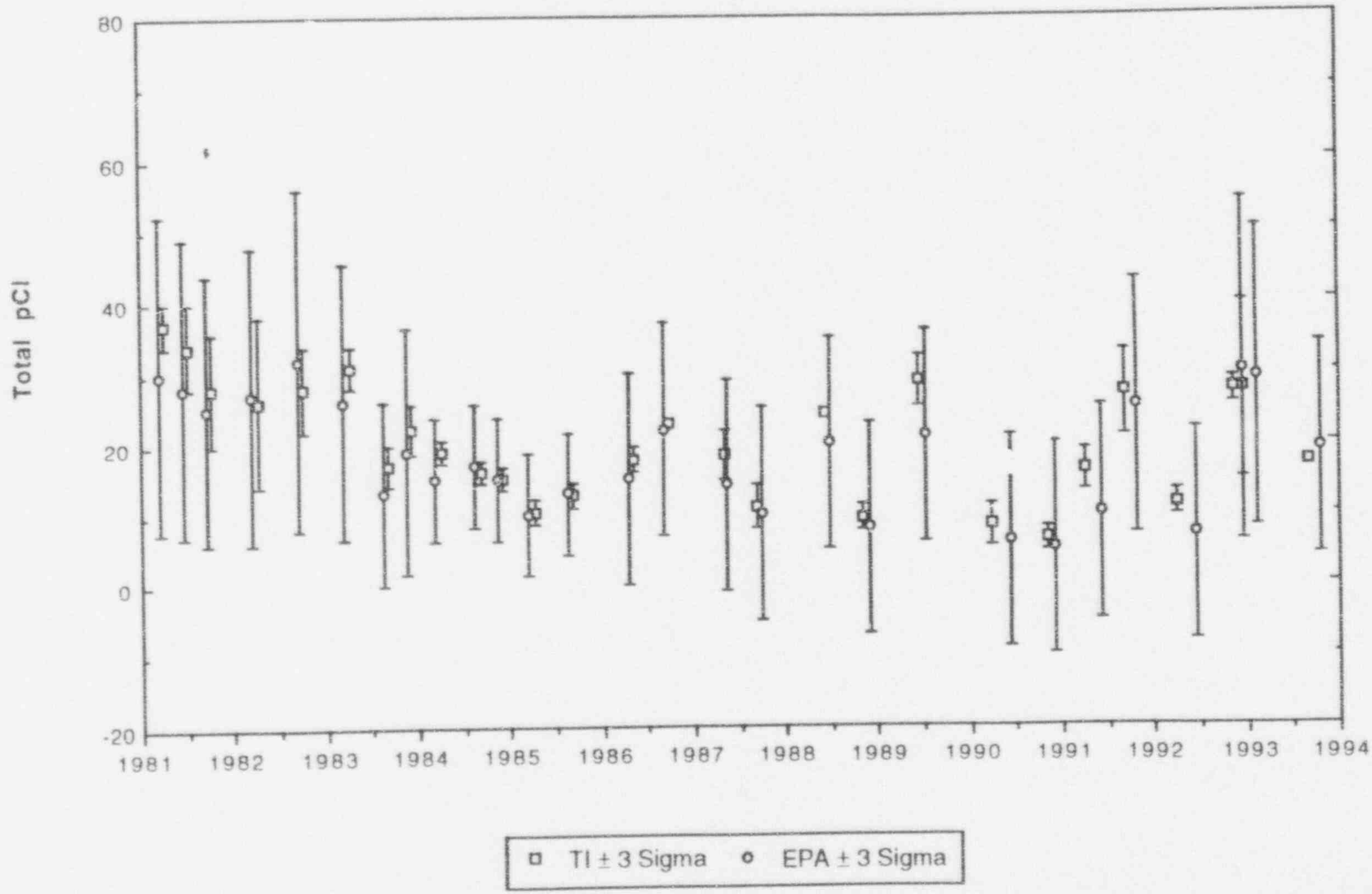
EPA Preparation	Date TI Mailed Re sults	Date EPA Issued Results	Media	Nuclide	EPA Results(a)	TI Results(b)	Norm Dev. (Known)	**Warning ***Action

Footnotes

(a) Average ± experimental sigma.
(b) Expected laboratory precision (1 sigma, 1 determination)
(c) The EPA switched from Am-241 to Th-230 alpha spike. We calibrated with Th-230, using sodium nitrate to generate a self-absorption curve. The EPA water, however has minerals which have greater self-absorption that the sodium nitrate matrix. The EPA has agreed to send us a gallon of their water which we can use to prepare a self-absorption curve with Th-230.
(d) By oversight, we did not use the special self-absorption curve which we had previously derived using EPA water and Cs-137 standard. We will use the EPA curve in the future. We may also re-derive this curve using a water sample which the EPA has agreed to send us.
(e) The counting data and backgrounds were verified. Possibly some efficiencies used were erroneously high, causing low values. A less likely cause is an error in dilution. New Ra-226 standards will be prepared. Closer monitoring of out of control efficiencies will be done and extra care in preparation of the sample will be maintained.
(f) The calculations were checked and found to be correct. The results of six gamma emitting isotopes were reported to the EPA. The results of four were within 1 normalized deviation; a fifth, within 2 normalized deviations. Only the Zn-65 average was outside the control limits. There is no obvious reason why one isotope should be outside the control limits, while five other isotopes were within control limits.
(g) An investigation is being conducted; results will be available shortly.

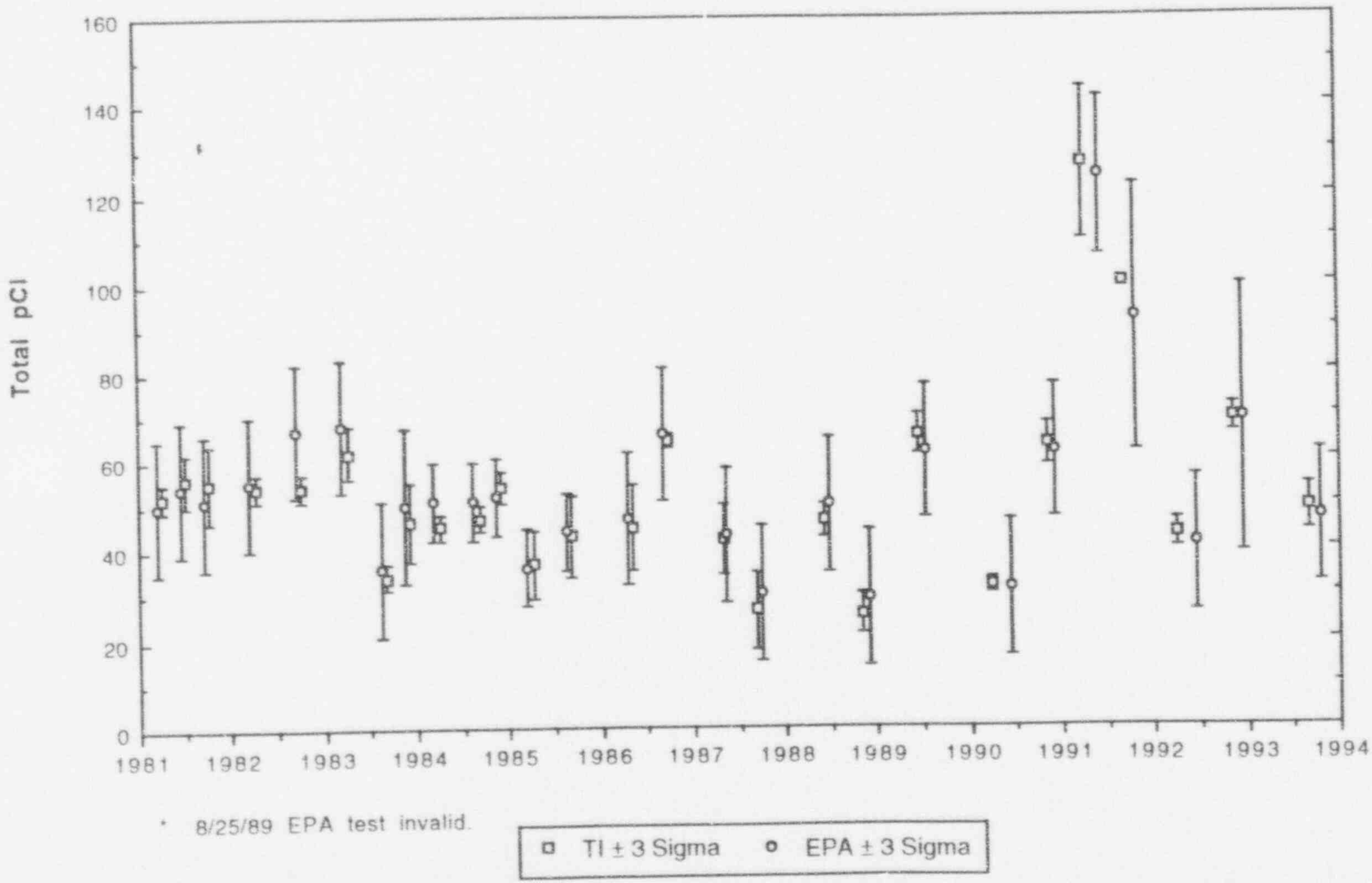
EPA CROSS CHECK PROGRAM

GROSS ALPHA IN AIR PARTICULATES (pg. 1 of 1)



EPA CROSS CHECK PROGRAM

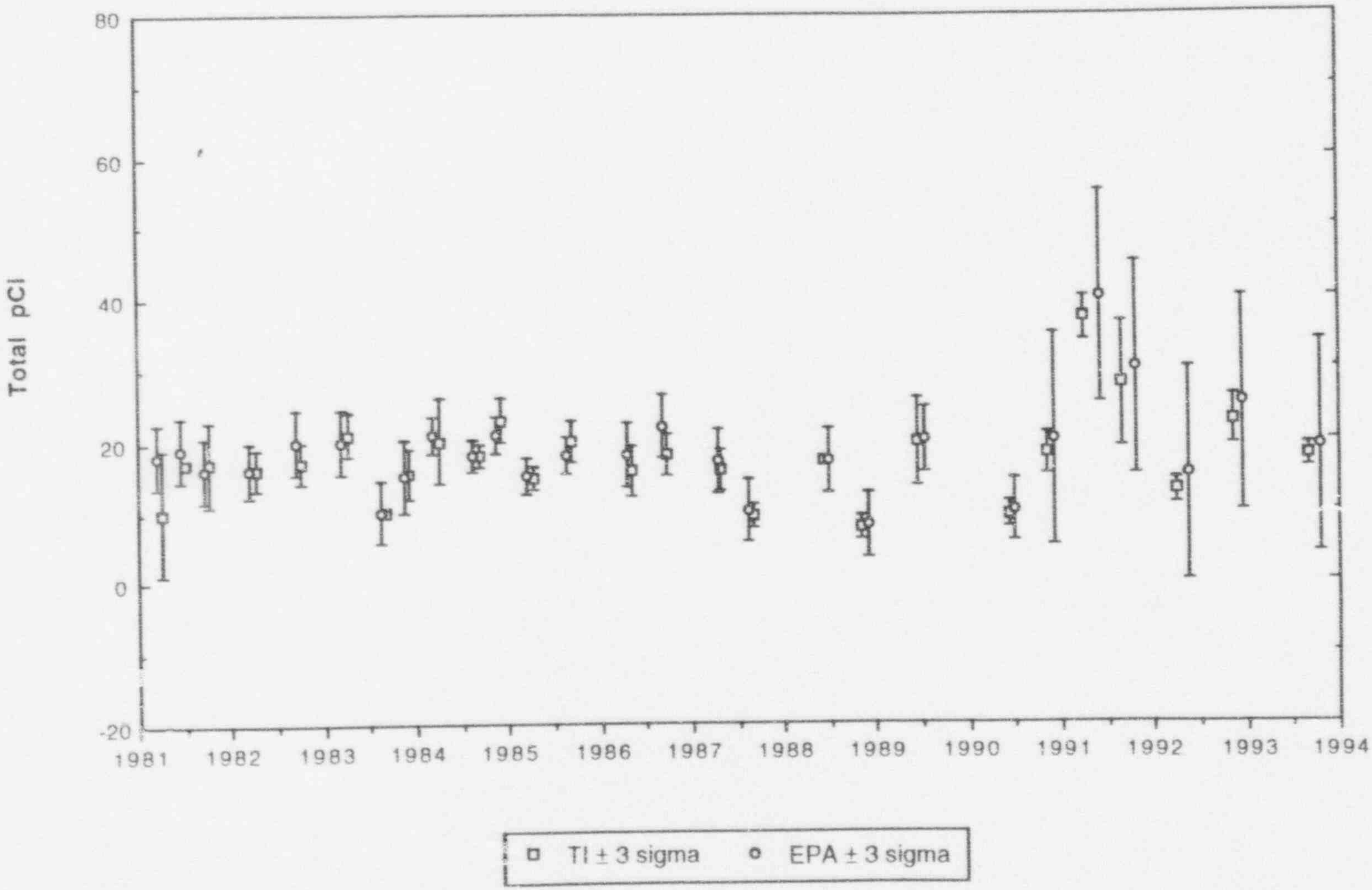
GROSS BETA IN AIR PARTICULATES (pg. 1 of 1)



* 8/25/89 EPA test invalid.

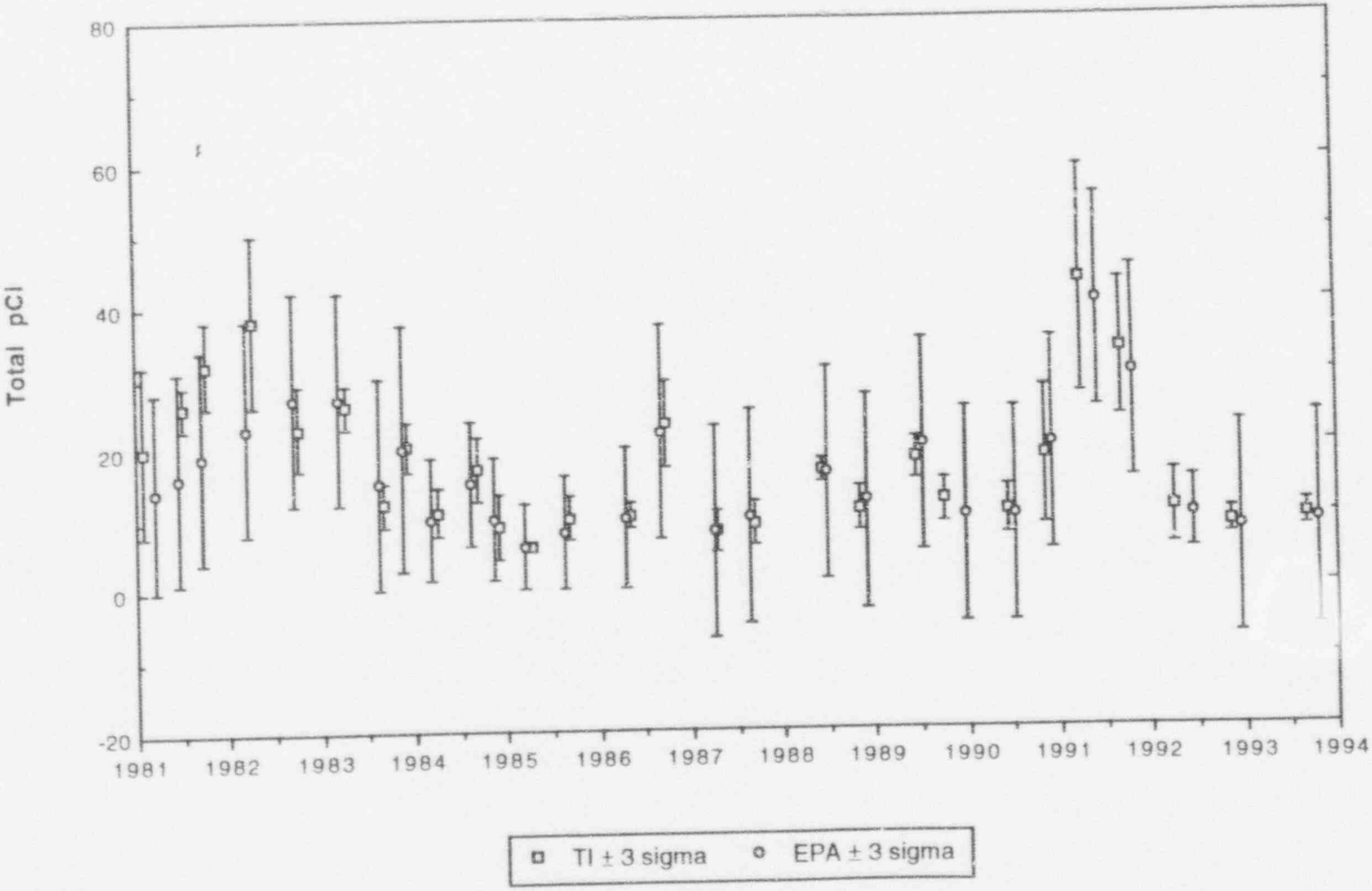
EPA CROSS CHECK PROGRAM

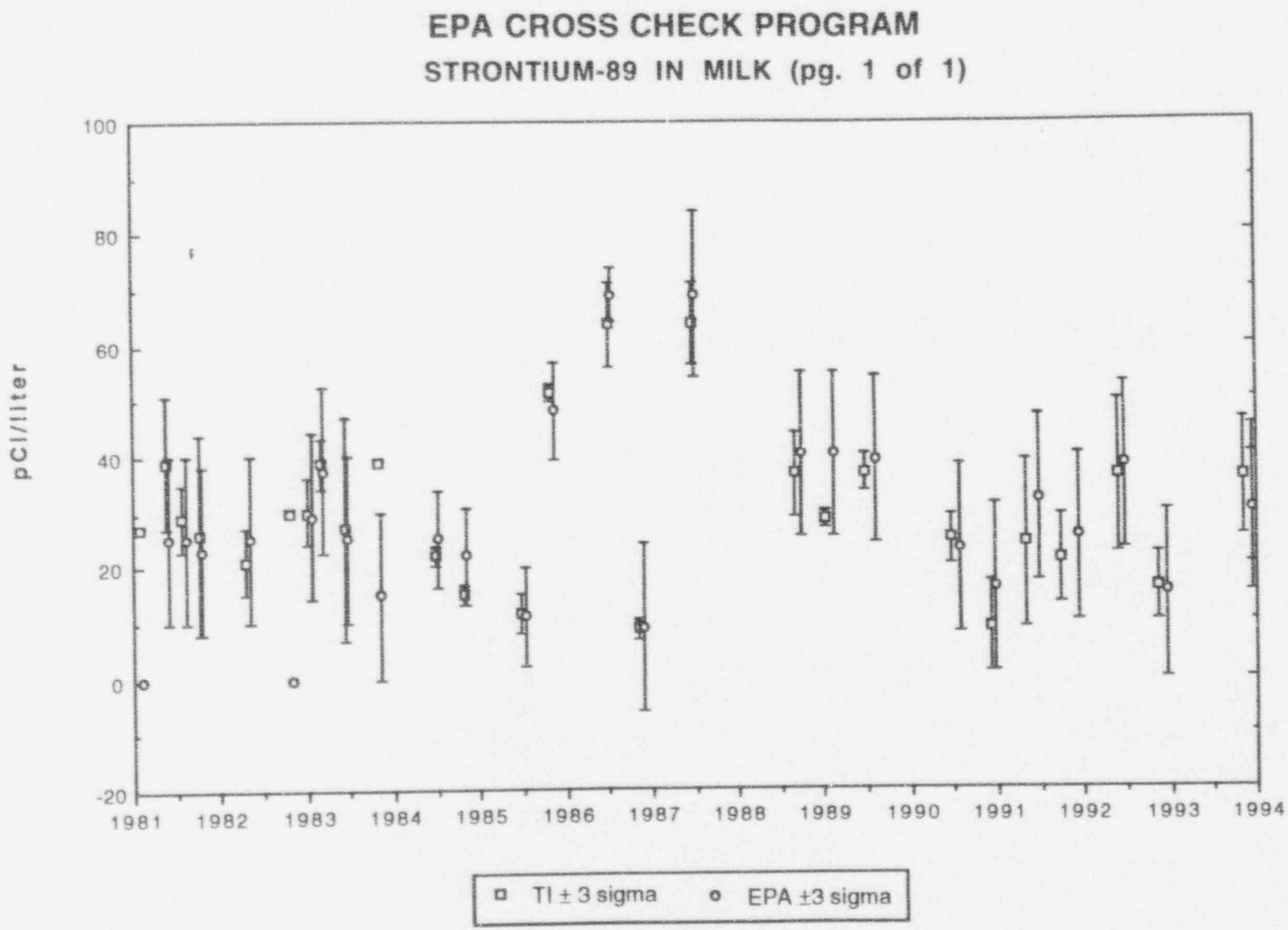
STRONTIUM-90 IN AIR PARTICULATES (pg. 1 of 1)



EPA CROSS CHECK PROGRAM

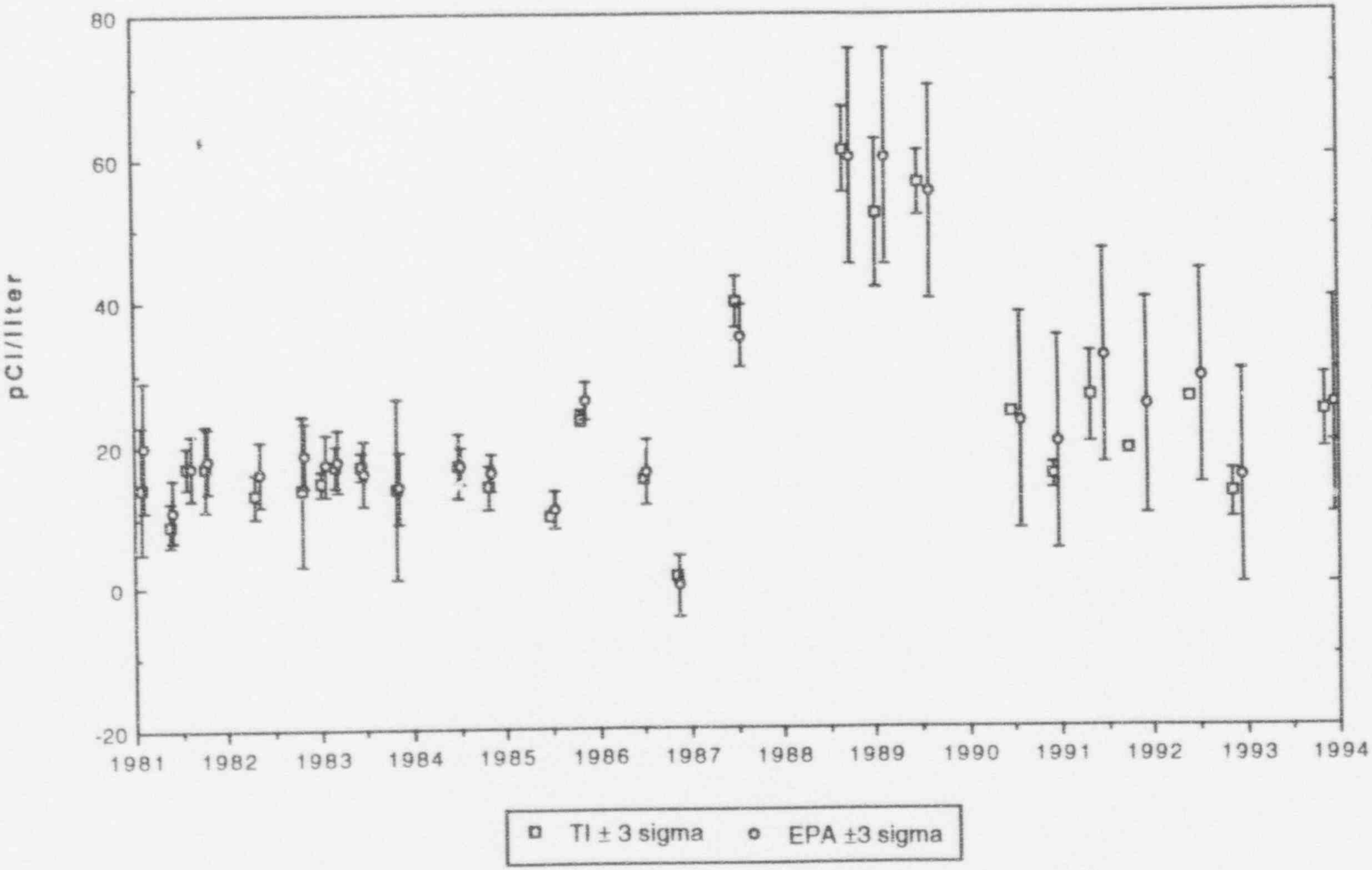
CESIUM-137 IN AIR PARTICULATES (pg. 1 of 1)




EPA CROSS CHECK PROGRAM
STRONTIUM-89 IN MILK (pg. 1 of 1)
pCi/liter
100
80
60
40
20
0
-20
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
TI ± 3 sigma
EPA ±3 sigma

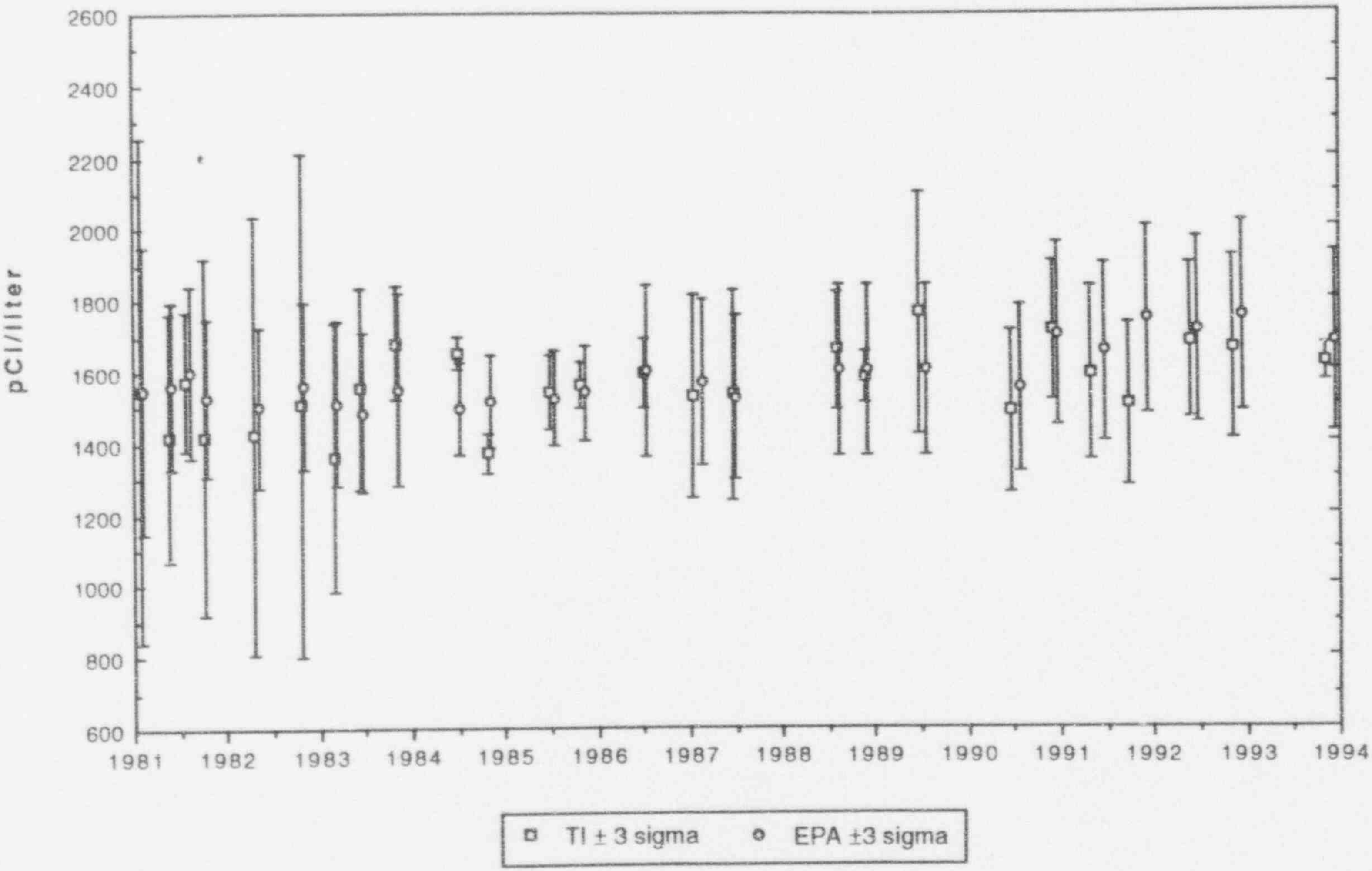
EPA CROSS CHECK PROGRAM

STRONTIUM-90 IN MILK (pg. 1 of 1)



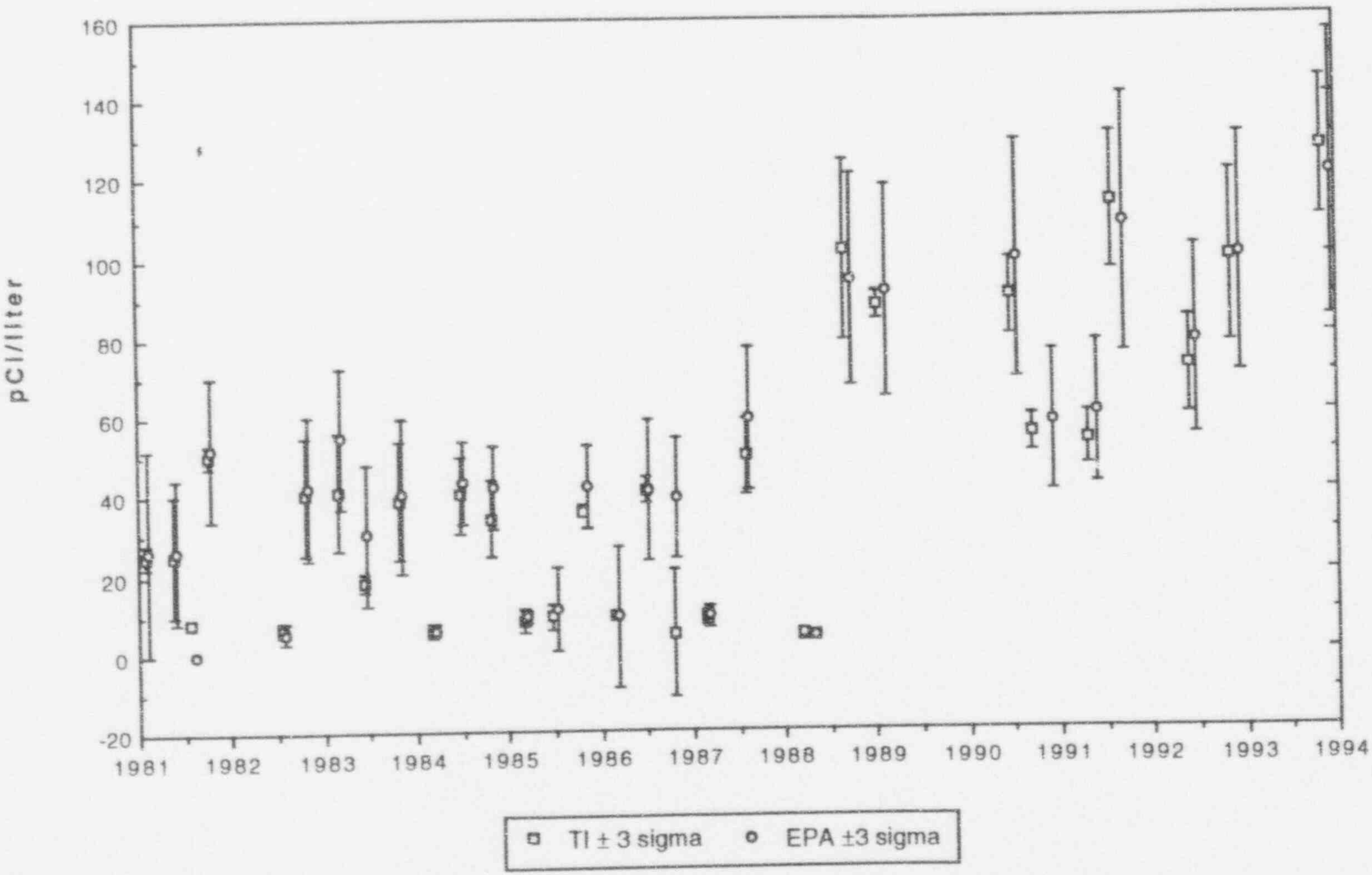
EPA CROSS CHECK PROGRAM

POTASSIUM-40 IN MILK (pg. 1 of 1)



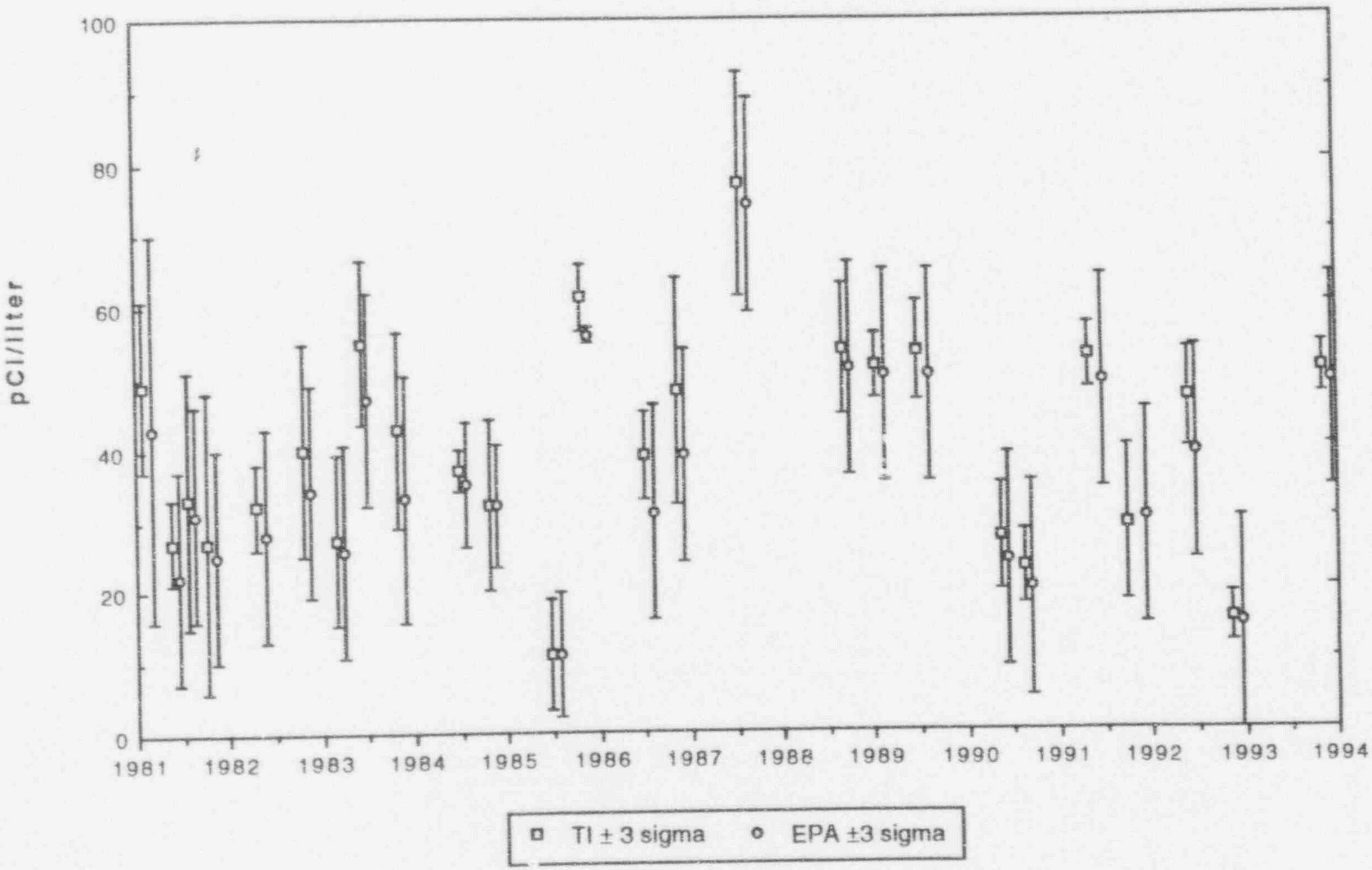
EPA CROSS CHECK PROGRAM

IODINE-131 IN MILK (pg. 1 of 1)



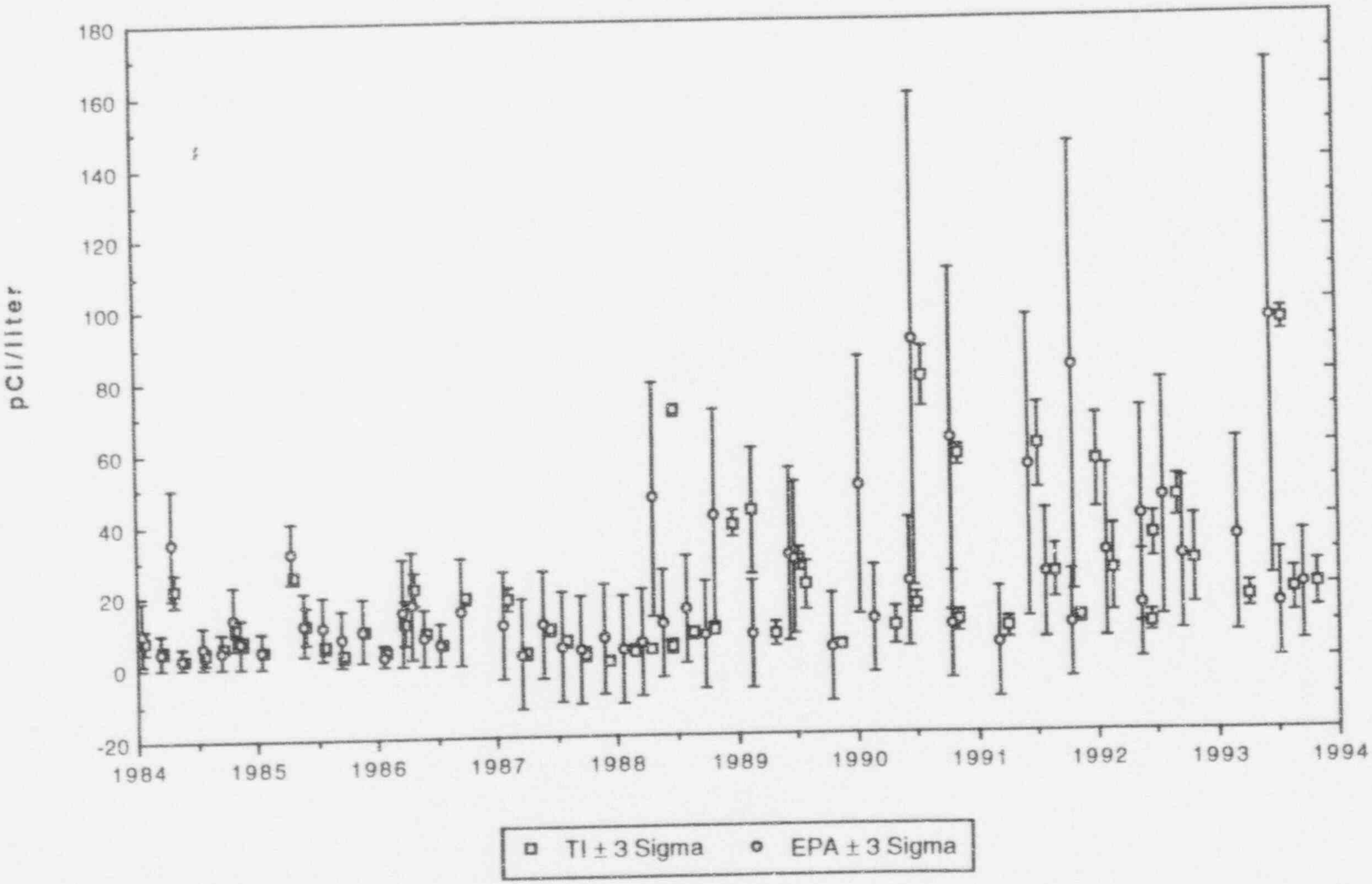
EPA CROSS CHECK PROGRAM

CESIUM-137 IN MILK (pg. 1 of 1)



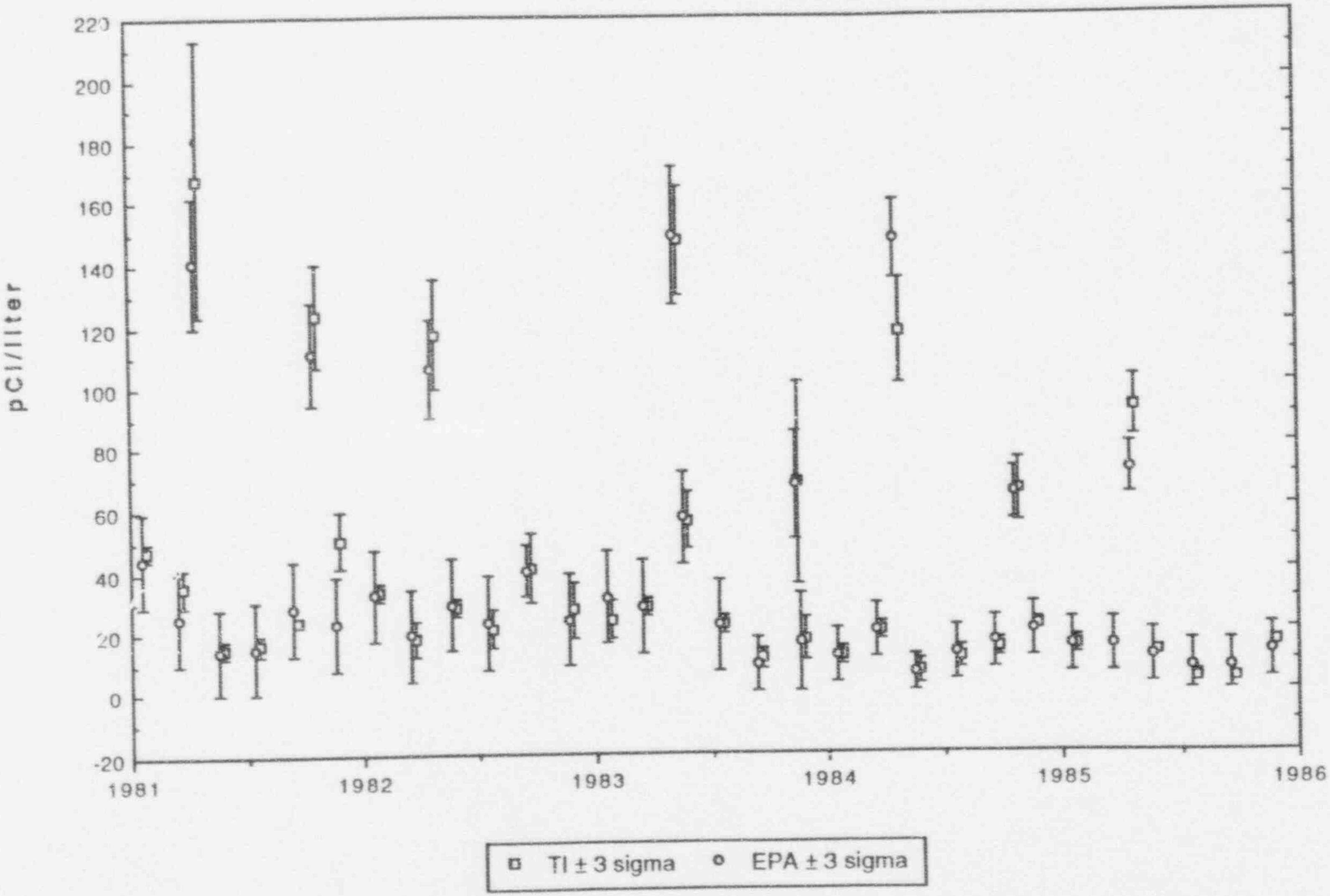
EPA CROSS CHECK PROGRAM

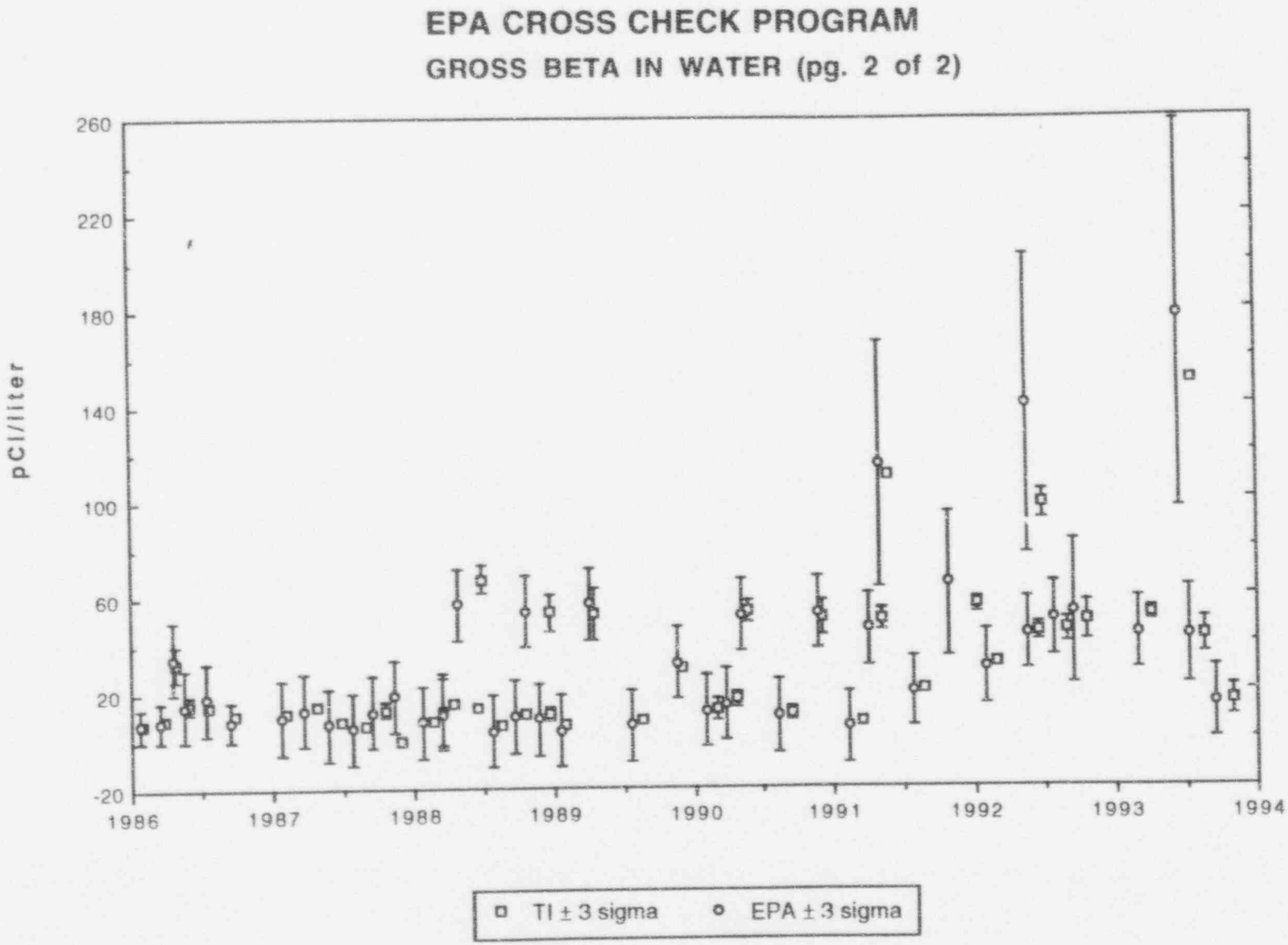
GROSS ALPHA IN WATER (pg. 1 of 1)



EPA CROSS CHECK PROGRAM

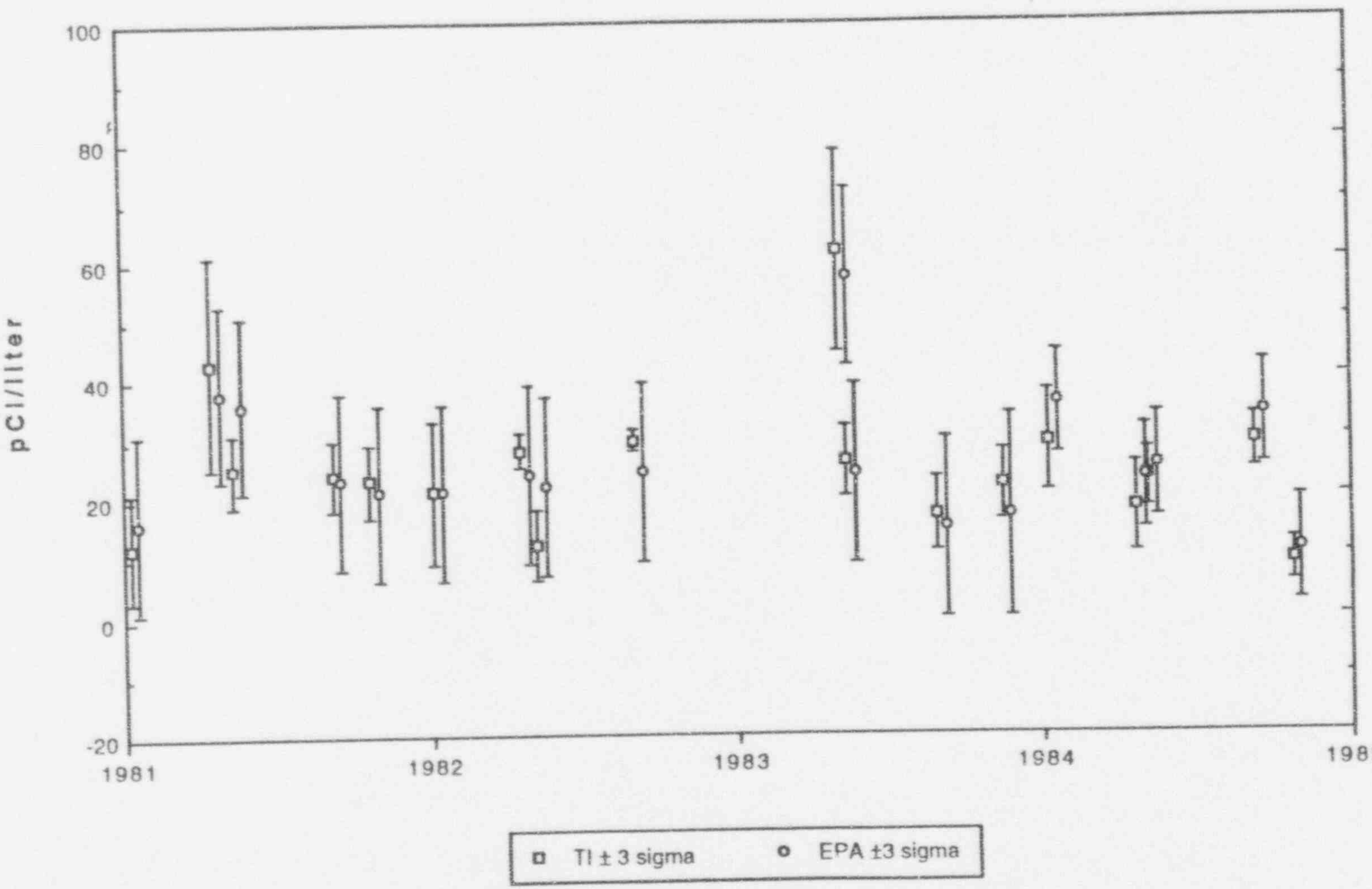
GROSS BETA IN WATER (pg. 1 of 2)




EPA CROSS CHECK PROGRAM
GROSS BETA IN WATER (pg. 2 of 2)
pCi/liter
260
220
180
140
100
60
20
-20
1986
1987
1988
1989
1990
1991
1992
1993
1994
TI ± 3 sigma
EPA ± 3 sigma

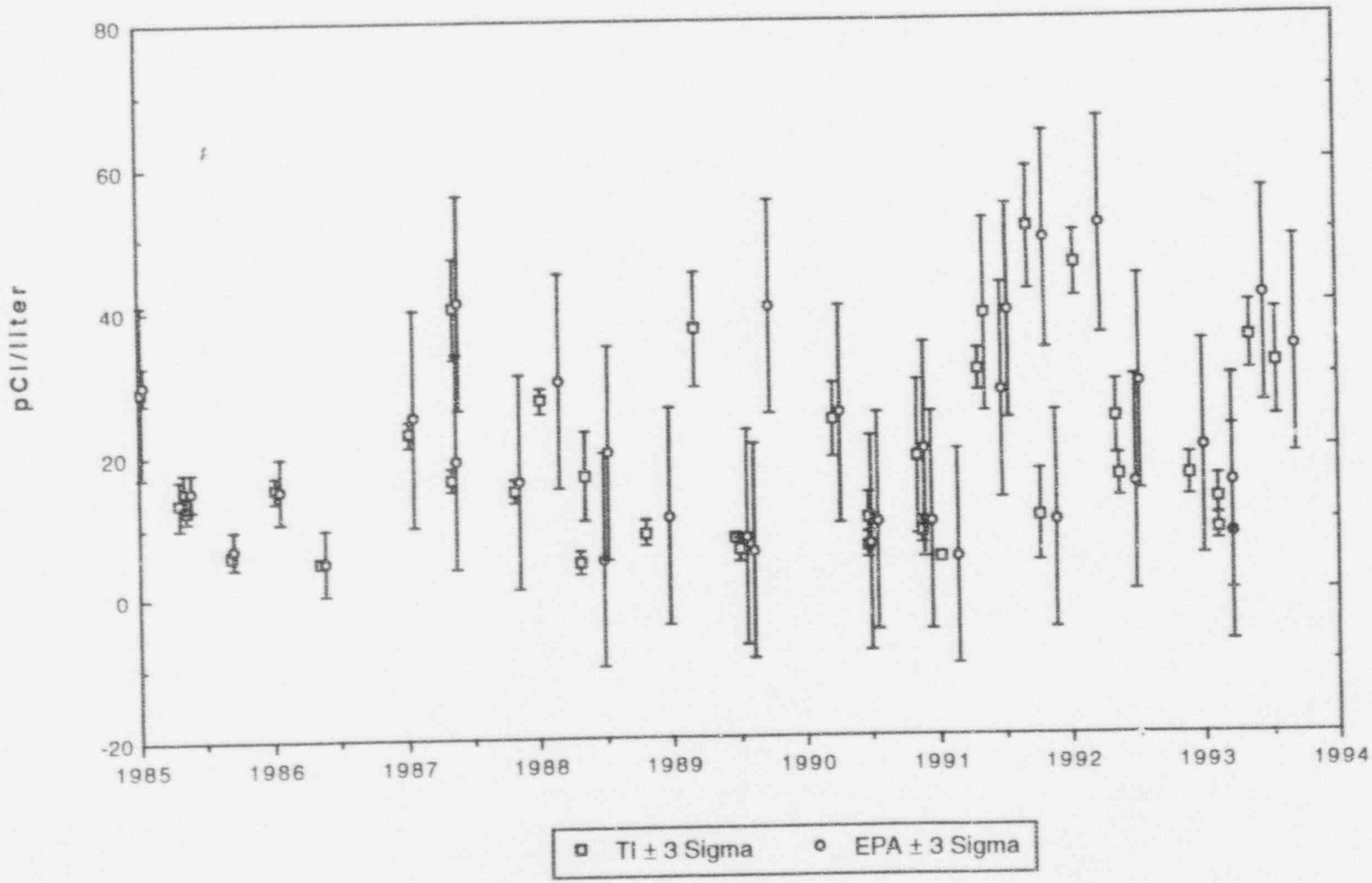
EPA CROSS CHECK PROGRAM

STRONTIUM-89 IN WATER (pg. 1 of 2)



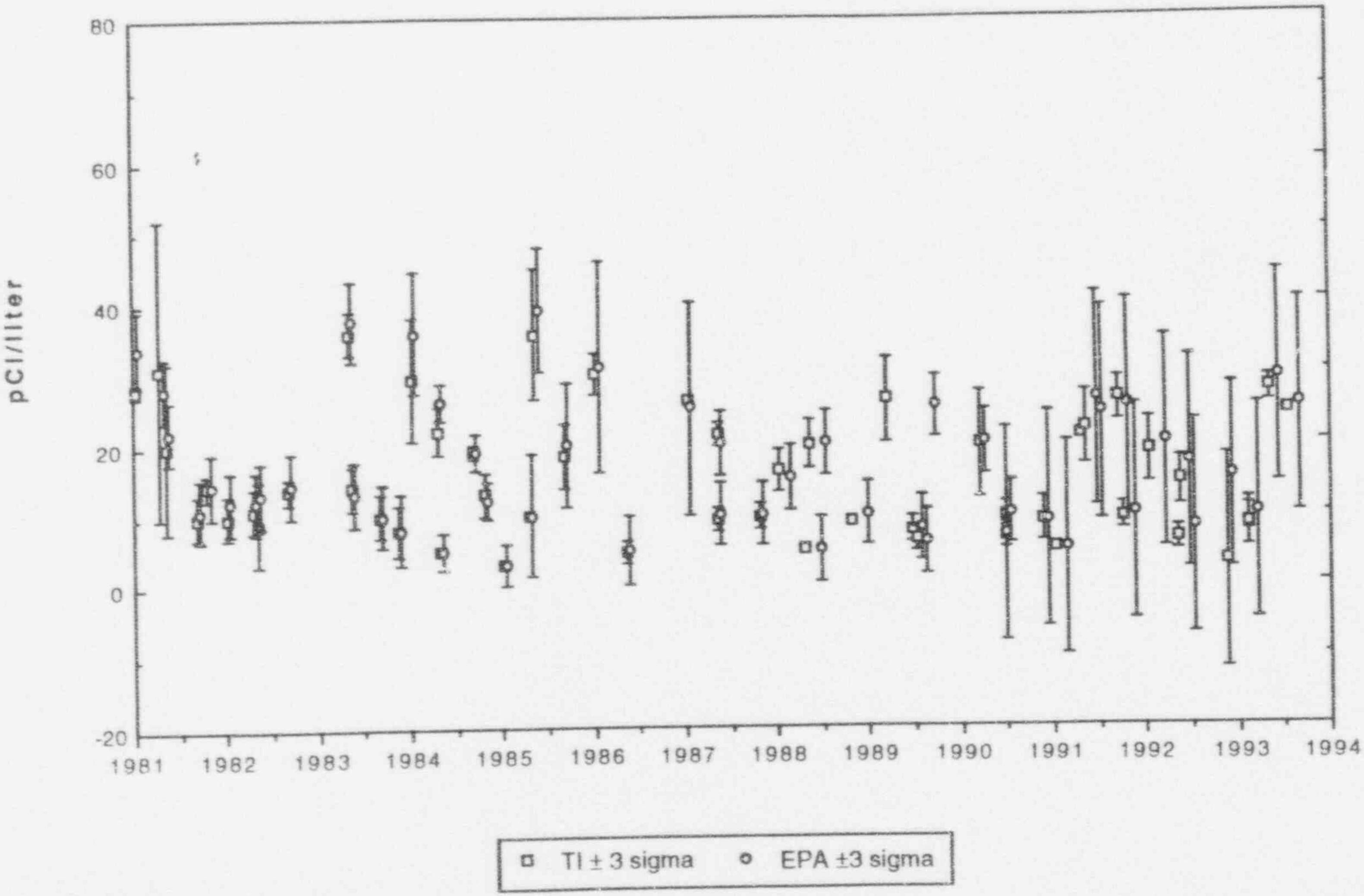
EPA CROSS CHECK PROGRAM

STRONTIUM-89 IN WATER (pg. 2 of 2)



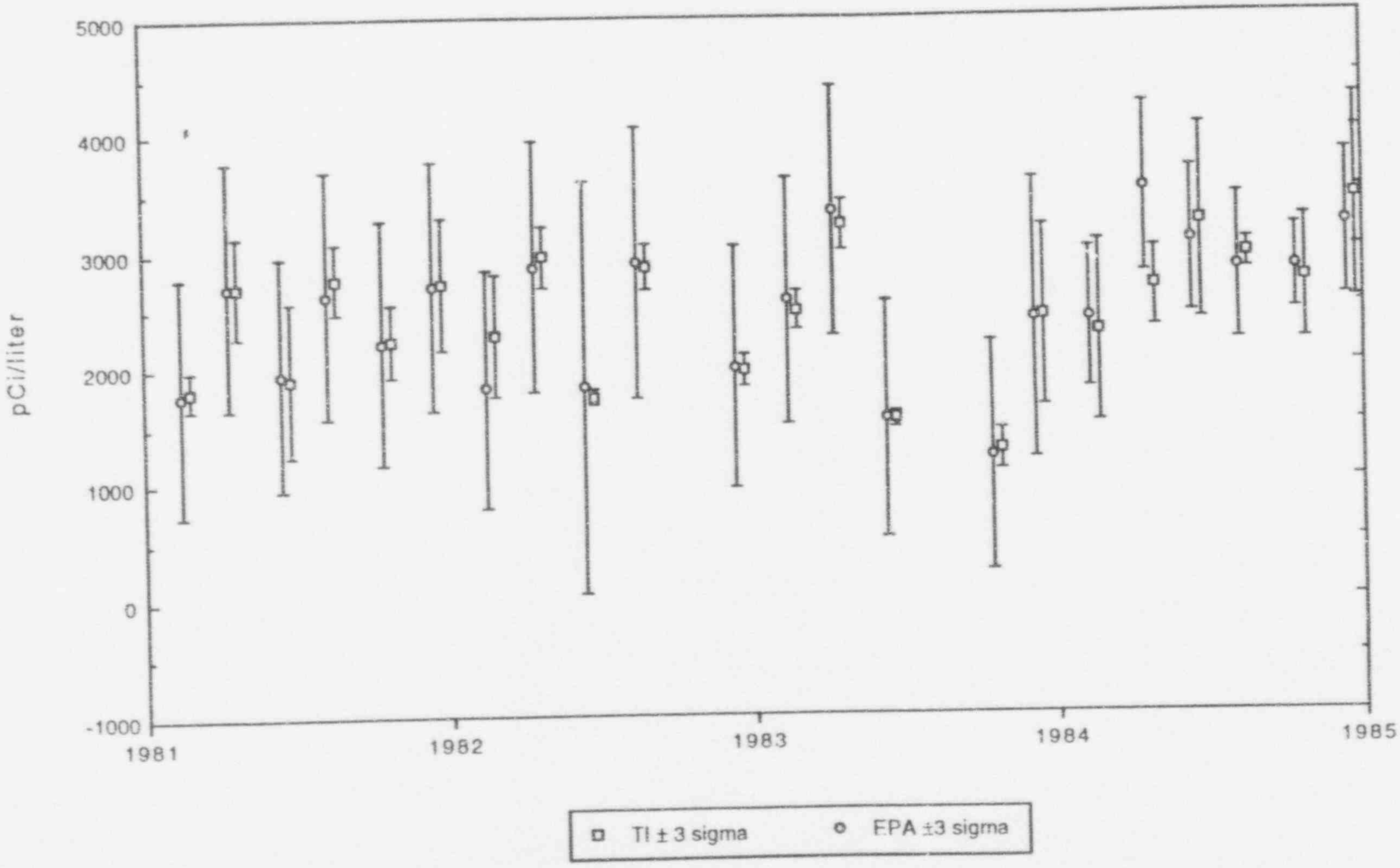
EPA CROSS CHECK PROGRAM

STRONTIUM-90 IN WATER (pg. 1 of 1)



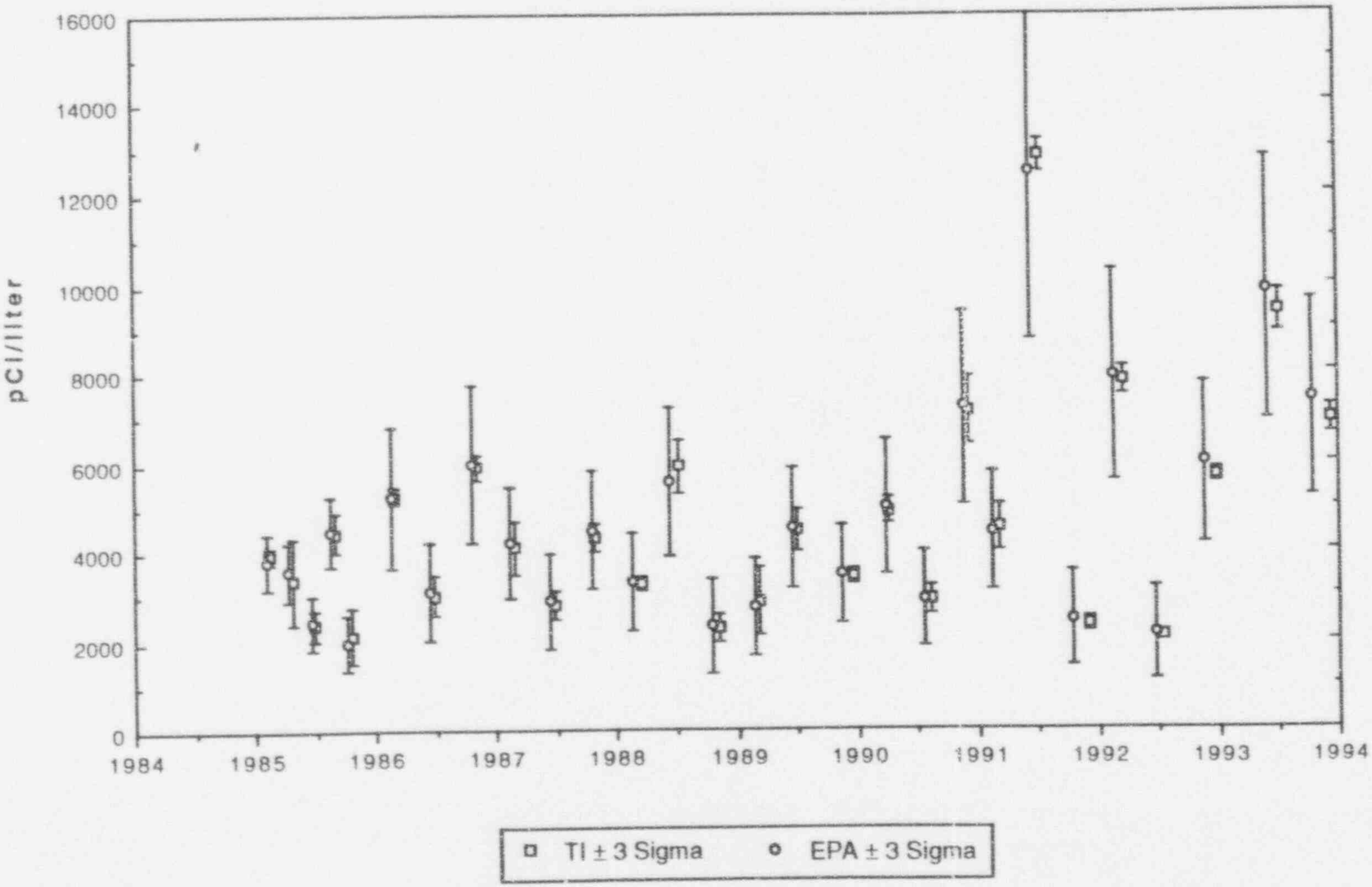
EPA CROSS CHECK PROGRAM

TRITIUM IN WATER (pg. 1 of 2)



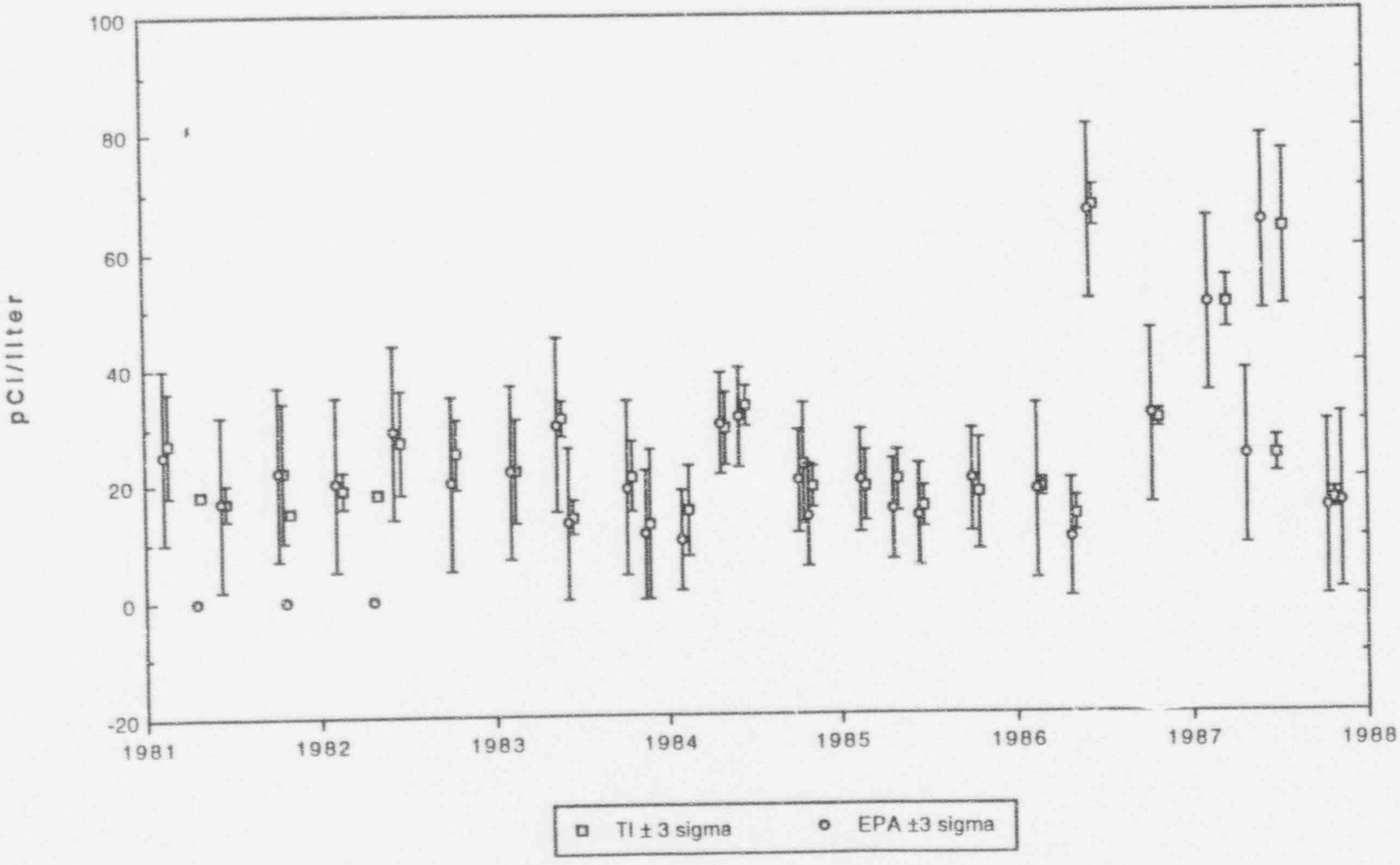
EPA CROSS CHECK PROGRAM

TRITIUM IN WATER (pg. 2 of 2)



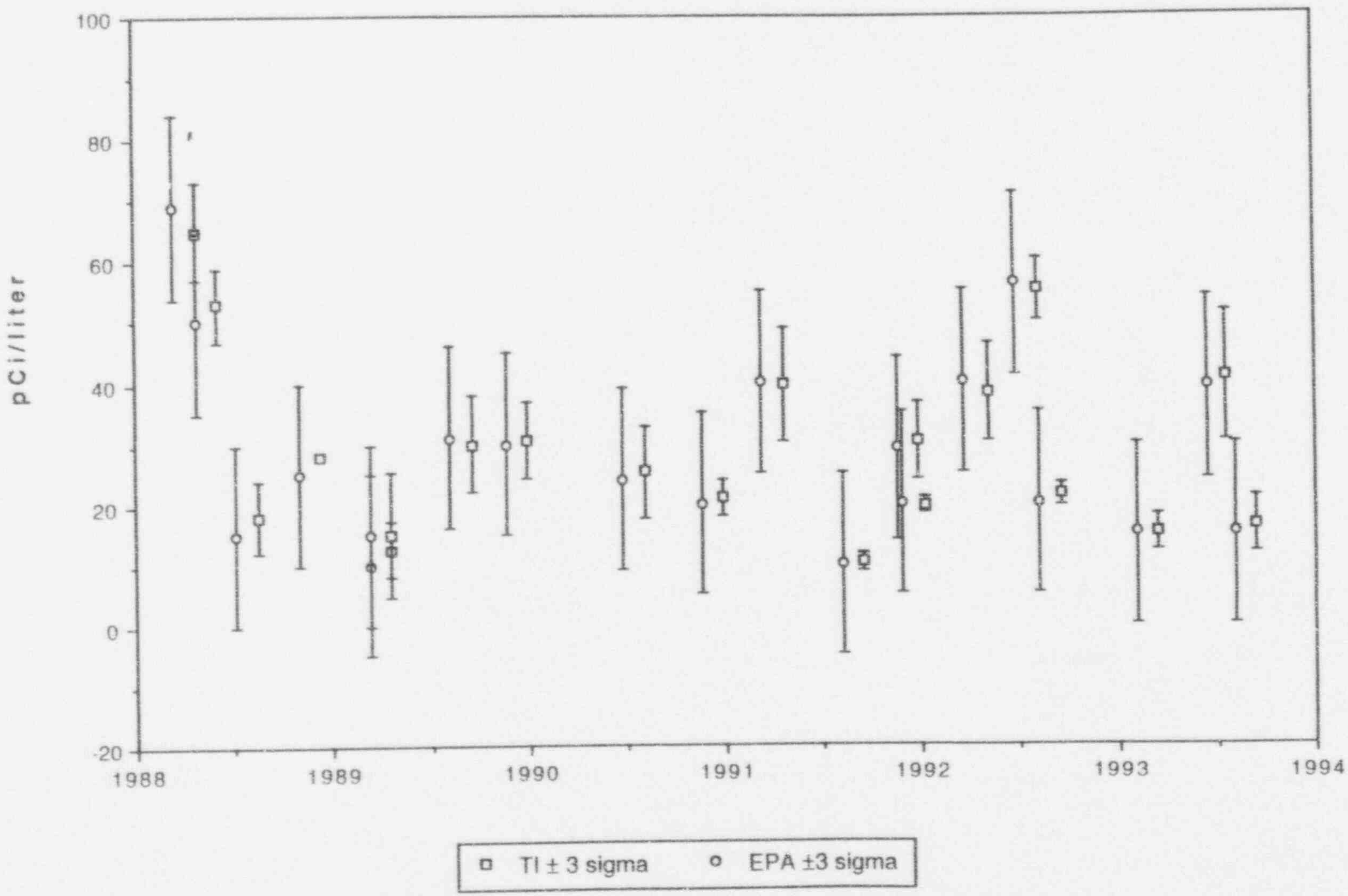
EPA CROSS CHECK PROGRAM

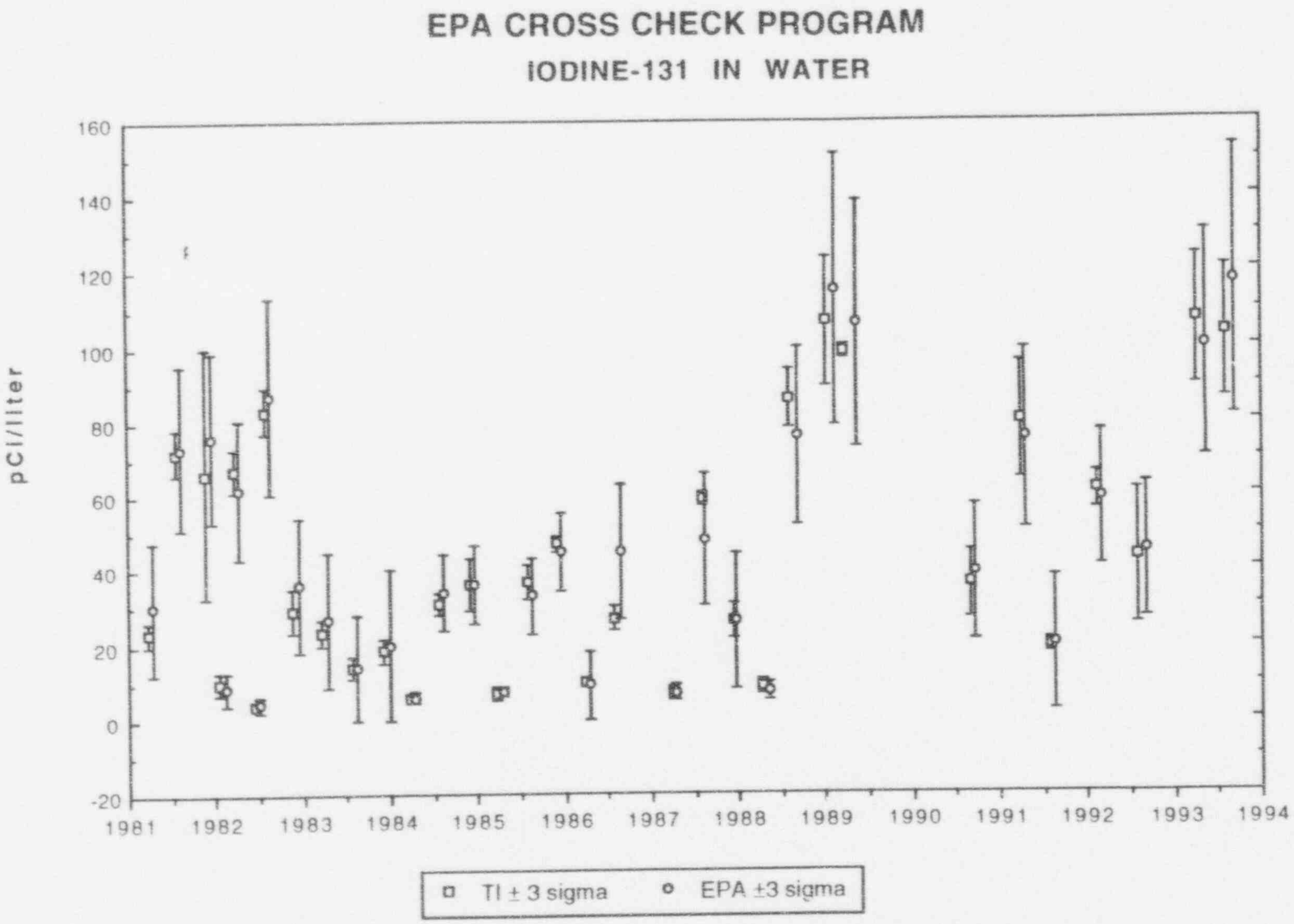
COBALT-60 IN WATER (pg 1 of 2)



EPA CROSS CHECK PROGRAM

COBALT-60 IN WATER (pg. 2 of 2)

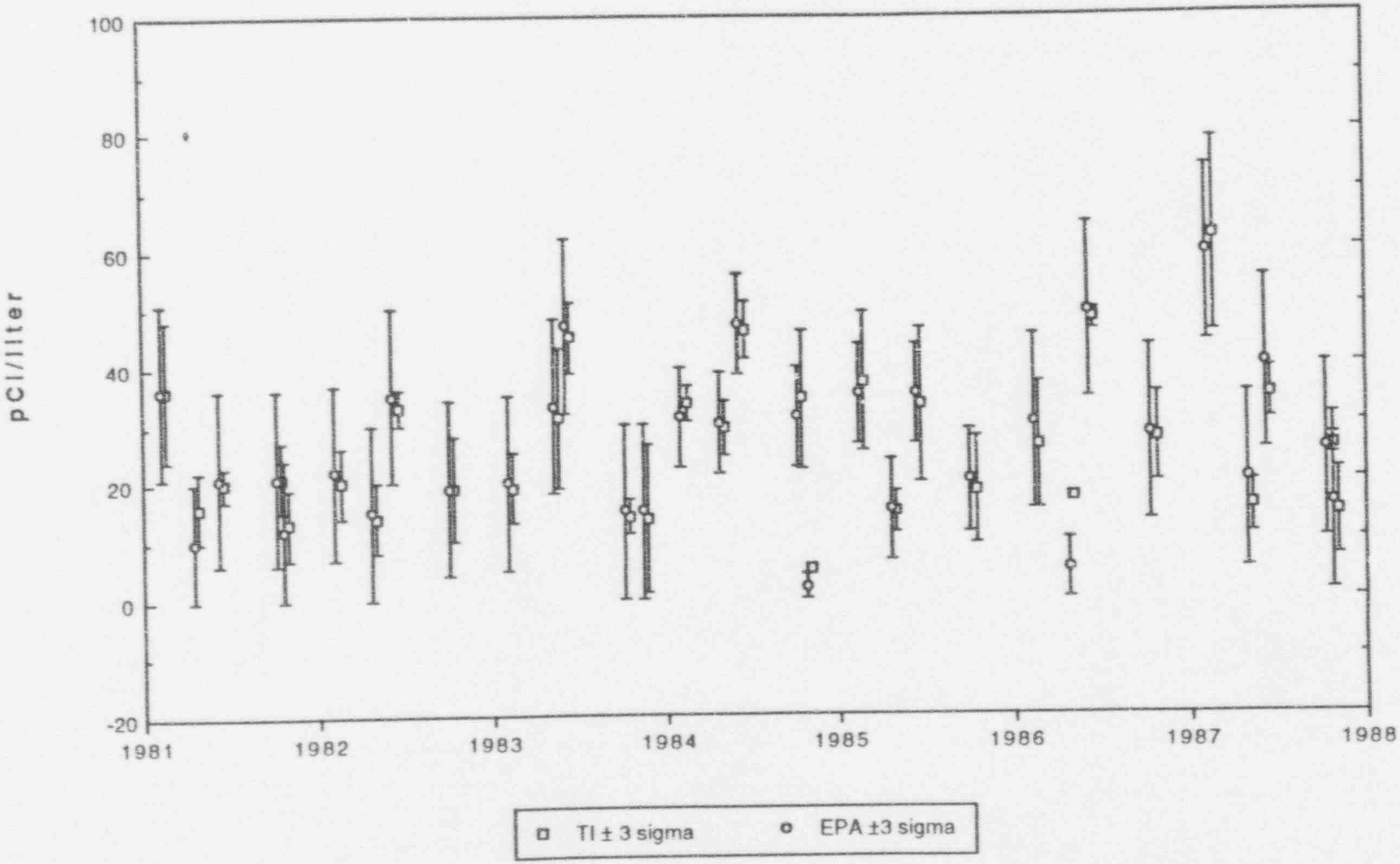




EPA CROSS CHECK PROGRAM
IODINE-131 IN WATER
160
140
120
100
80
60
40
20
0
-20
pCi/liter
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
TI ± 3 sigma
EPA ±3 sigma

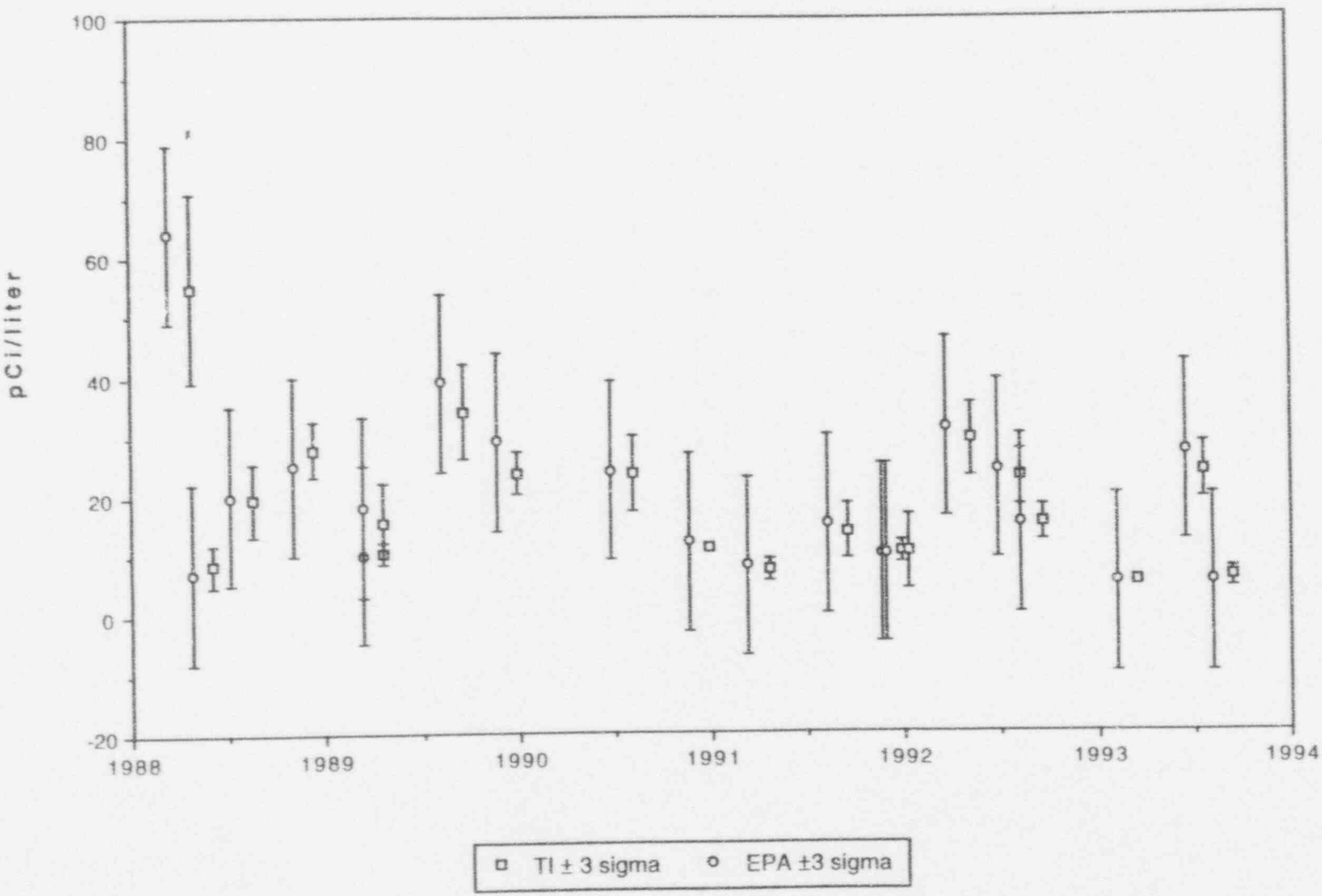
EPA CROSS CHECK PROGRAM

CESIUM-134 IN WATER (pg. 1 of 2)



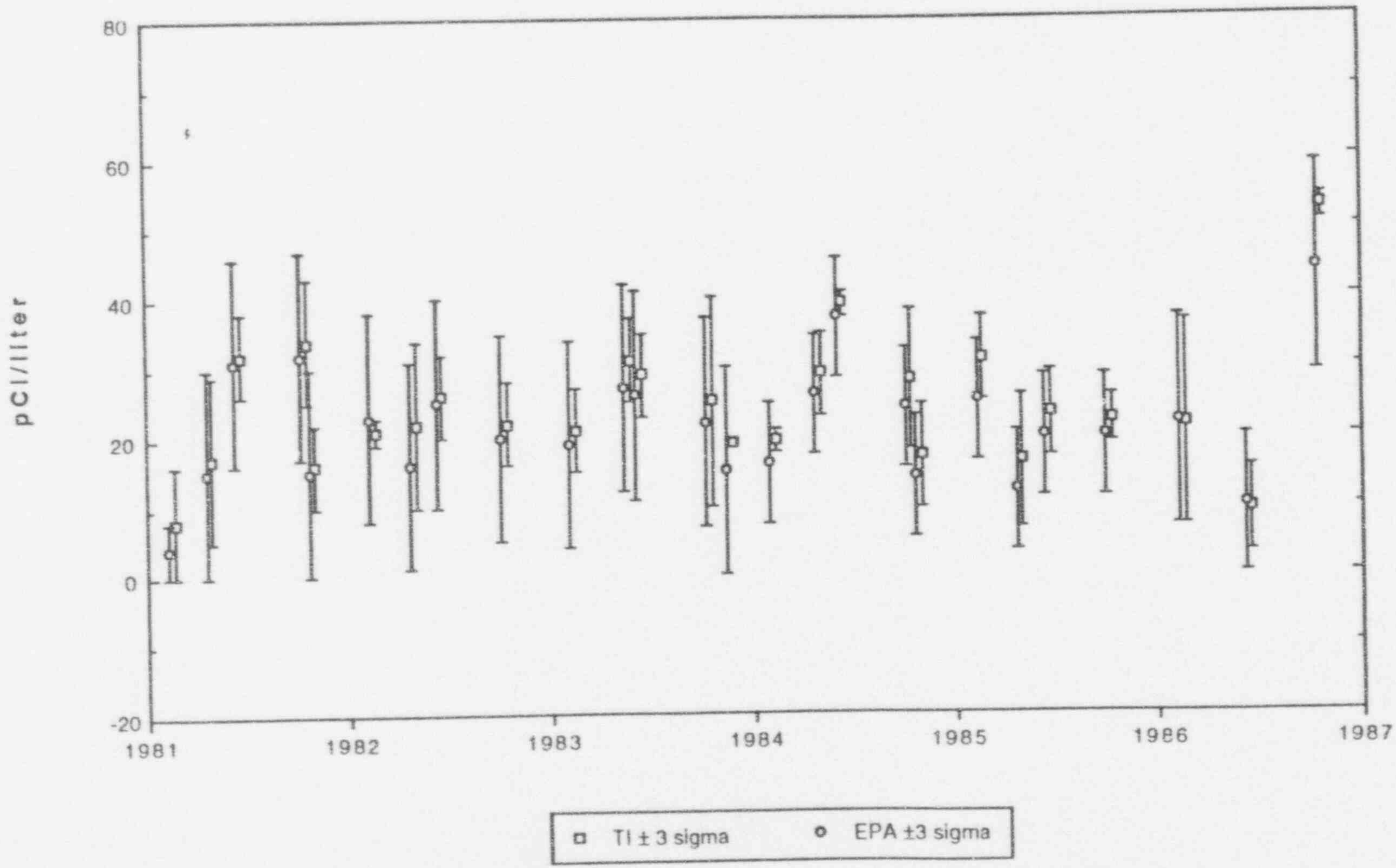
EPA CROSS CHECK PROGRAM

CESIUM-134 IN WATER (pg. 2 of 2)



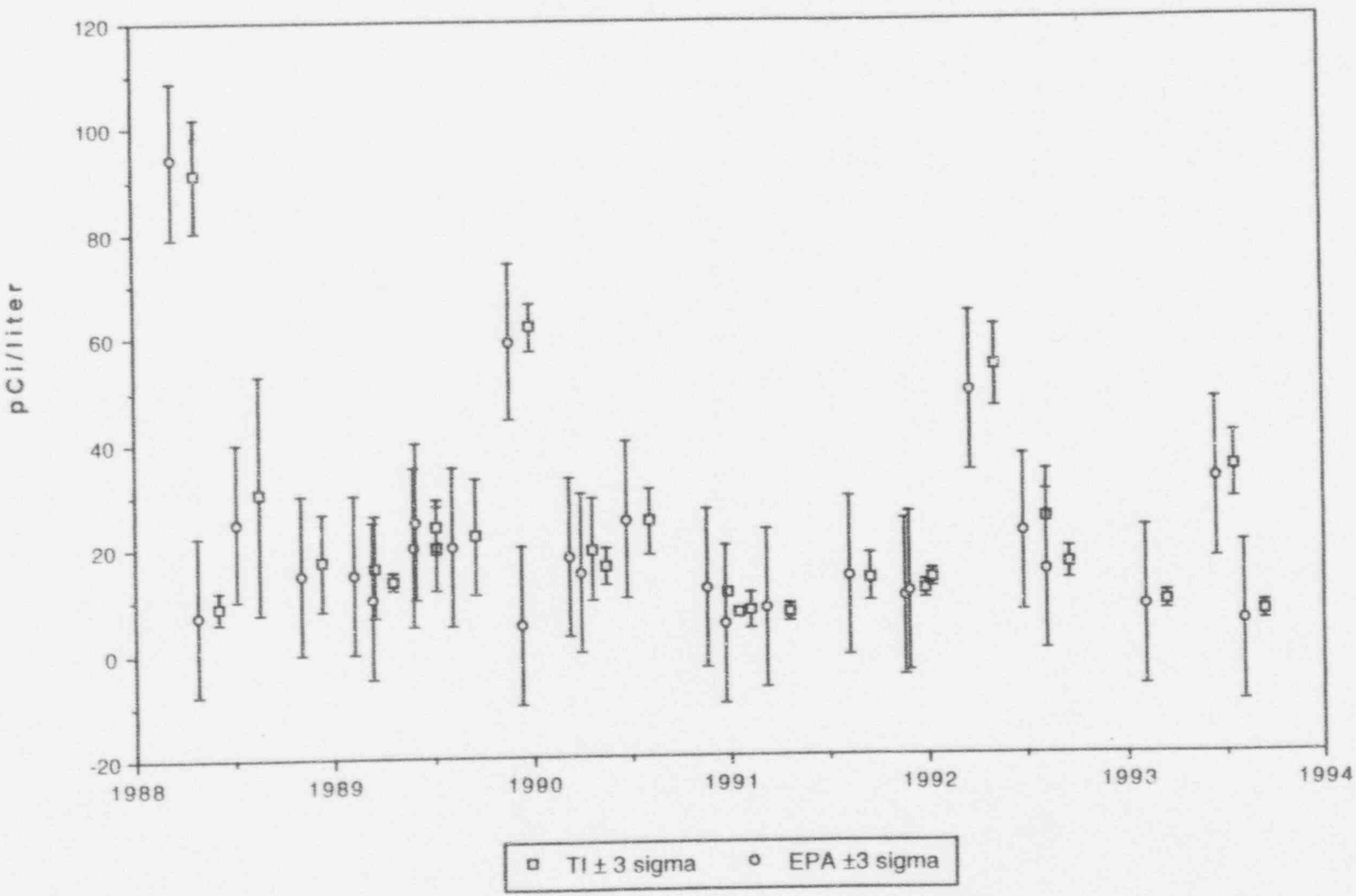
EPA CROSS CHECK PROGRAM

CESIUM-137 IN WATER (pg. 1 of 2)



EPA CROSS CHECK PROGRAM

CESIUM-137 IN WATER (pg. 2 of 2)



APPENDIX II

QC Laboratory

EPA Interlaboratory

Comparison Program

Appendix A

Interlaboratory Comparison Program Results

Teledyne Brown Engineering Environmental Services Midwest Laboratory (formerly Teledyne Isotopes and Hazleton Environmental Sciences) has participated in interlaboratory comparison (crosscheck) programs since the formulation of it's quality control program in December 1971. These programs are operated by agencies which supply environmental type samples (e.g., milk or water) containing concentrations of radionuclides know to the issuing agency but not to participant laboratories. The purpose of such a program is to provide an independent check on the laboratory's analytical procedures and to alert it to any possible problems.

Participant laboratories measure the concentration of specified radionuclides and report them to the issuing agency. Several months later, the agency reports the known values to the participant laboratories and specifies control limits. Results consistently higher or lower than the known values or outside the control limits indicate a need to check the instruments or procedures used.

The results in Table A-1 were obtained through participation in the environmental sample crosscheck program for milk, water, air filters, and food samples during the period 1990 - 1993. This program is conducted by the U.S. Environmental Protection Agency Intercomparison and Calibration Section, Quality Assurance Branch, Environmental Monitoring and Support Laboratory, Las Vegas, Nevada.

The results in Table A-2 were obtained for Thermoluminescent dosimenters (TLDs), since1976 via various International Intercomparisons of Environmental Dosimeters under the sponsorships listed in Table A-2. Also Teledyne testing results are listed.

Table A-3 lists results of the analyses on in-house "spiked" samples.

Table A-4 lists results of the analyses on in-house "blank" samples.

Attachment A lists acceptance criteria for "spiked" samples.

Out-of-limit results are explained directly below the result.

ATTACHMENT A

ACCEPTANCE CRITERIA FOR "SPIKED" SAMPLES

LABORATORY PRECISION: ONE STANDARD DEVIATION VALUES FOR VARIOUS ANALYSES[a]

Analysis	Level	One Standard Deviation for single determinations
Gamma Emitters	5 to 100 pCi/liter or kg >100 pCi/liter or kg	5.0 pCi/liter 5% of known value
Strontium-89[b]	5 to 50 pCi/liter or kg >50 pCi/liter or kg	5.0 pCi/liter 10% of known value
Strontium-90[b]	2 to 30 pCi/liter or kg >30 pCi/liter or kg	5.0 pCi/liter 10% of known value
Potassium	>0.1 g/liter or kg	5% of known value
Gross alpha	≤20 pCi/liter >20 pCi/liter	5.0 pCi/liter 25% of known value
Gross beta	≤100 pCi/liter >100 pCi/liter	5.0 pCi/liter 5% of known value
Tritium	≤4,000 pCi/liter >4,000 pCi/liter	1s = (pCi/liter) = $169.85 \times (\text{known})^{0.0933}$ 10% of known value
Radium-226,-228	<0.1 pCi/liter	15% of known value
Plutonium	0.1 pCi/liter, gram, or sample	10% of known value
Iodine-131, Iodine-129[b]	≤55 pCi/liter >55 pCi/liter	6.0 pCi/liter 10% of known value
Uranium-238, Nickel-64[b] Technetium-99[b]	≤35 pCi/liter >35 pCi/liter	6.0 pCi/liter 15% of known value
Iron-55[b]	50 to 100 pCi/liter >100 pCi/liter	10 pCi/liter 10% of known value
Others[b]	-	20% of known value

[a] From EPA publication, "Environmental Radioactivity Laboratory Intercomparison Studies Program, Fiscal Year, 1981-1982, EPA-600/4-81-004.

[b] TBEESML limit.

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne Brown Engineering Environmental Services, Midwest Laboratory results for various sample media[a].

				Concentration in pCi/L[b]		
Lab Code	Sample Type	Date Collected	Analyses	TBEESML Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
STW-589	WATER	Jan, 1990	Sr-89	22.7 ± 5.0	25.0 ± 5.0	16.3 - 33.7
			Sr-90	17.3 ± 1.2	20.0 ± 1.5	17.4 - 22.6
	The sample was reanalyzed in triplicate for Sr-90; results of reanalyses were 18.8±1.5 pCi/L. No further action is planned.					
STW-591	WATER	Jan, 1990	Gr. Alpha	10.3 ± 3.0	12.0 ± 5.0	3.3 - 20.7
			Gr. Beta	12.3 ± 1.2	12.0 ± 5.0	3.3 - 20.7
STW-592	WATER	Jan, 1990	Co-60	14.7 ± 2.3	15.0 ± 5.0	6.3 - 23.7
			Zn-65	135.0 ± 6.9	139.0 ± 14.0	114.8 - 163.2
			Ru-106	133.3 ± 13.4	139.0 ± 14.0	114.8 - 163.2
			Cs-134	17.3 ± 1.2	18.0 ± 5.0	9.3 - 26.7
			Cs-137	19.3 ± 1.2	18.0 ± 5.0	9.3 - 26.7
			Ba-133	78.0 ± 0.0	74.0 ± 7.0	61.9 - 86.1
STW-593	WATER	Feb, 1990	H-3	4827.0 ± 83.0	4976.0 ± 498.0	4113.0 - 5839.0
STW-594	WATER	Mar, 1990	Ra-226	5.0 ± 0.2	4.9 ± 0.7	4.1 - 5.7
			Ra-228	13.5 ± 0.7	12.7 ± 1.9	9.4 - 16.0
STW-595	WATER	Mar, 1990	Uranium	4.0 ± 0.0	4.0 ± 6.0	0.0 - 14.4
STAF-596	AIR FILTER	Mar, 1990	Gr. Alpha	7.3 ± 1.2	5.0 ± 5.0	0.0 - 13.7
			Gr. Beta	34.0 ± 0.0	31.0 ± 5.0	22.3 - 39.7
			Sr-90	10.0 ± 0.0	10.0 ± 1.5	7.4 - 12.6
			Cs-137	9.3 ± 1.2	10.0 ± 5.0	1.3 - 18.7
STW-597	WATER	Apr, 1990	Gr. Alpha	81.0 ± 3.5	90.0 ± 23.0	50.1 - 129.9
			Ra-226	4.9 ± 0.4	5.0 ± 0.8	3.6 - 6.4
			Ra-228	10.6 ± 0.3	10.2 ± 1.5	7.6 - 12.8
			U	18.7 ± 3.0	20.0 ± 6.0	9.6 - 30.4
STW-598	WATER	Apr, 1990	Gross Beta	51.0 ± 10.1	52.0 ± 5.0	43.3 - 60.7
			Sr-89	9.3 ± 1.2	10.0 ± 5.0	1.3 - 18.7
			Sr-90	10.3 ± 3.1	10.0 ± 1.5	8.3 - 11.7
			Cs-134	16.0 ± 0.0	15.0 ± 5.0	6.3 - 23.7
			Cs-137	19.0 ± 2.0	15.0 ± 5.0	6.3 - 23.7

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne Brown Engineering Environmental Services, Midwest Laboratory results for various sample media[a].

				Concentration in pCi/L[b]		
Lab Code	Sample Type	Date Collected	Analyses	TBEESML Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
STM-599	MILK	Apr, 1990	Sr-89	21.7 ± 3.1	23.0 ± 5.0	14.3 - 31.7
			Sr-90	21.0 ± 7.0	23.0 ± 5.0	14.3 - 31.7
			I-131	98.7 ± 1.2	99.0 ± 10.0	81.7 - 116.3
			Cs-137	26.0 ± 6.0	24.0 ± 5.0	15.3 - 32.7
			K	1300.0 ± 69.2	1550.0 ± 78.0	1414.7 - 1685.3

The K analysis was repeated in triplicate; result of reanalysis was 13.4±1.0 mg/L. No further action is planned.

STW-600	WATER	May, 1990	Sr-89	6.0 ± 2.0	7.0 ± 5.0	0.0 - 15.7
			Sr-90	6.7 ± 1.2	7.0 ± 5.0	0.0 - 15.7
STW-601	WATER	May, 1990	Gr. Alpha	11.0 ± 2.0	22.0 ± 6.0	11.6 - 32.4
			Gr. Beta	12.3 ± 1.2	15.0 ± 5.0	6.3 - 23.7

Gross Alpha analysis was repeated in triplicate; results of reanalyses were 13.4±1.0 pCi/L. No further action is planned.

STW-602	WATER	Jun, 1990	Co-60	25.3 ± 2.3	24.0 ± 5.0	15.3 - 32.7
			Zn-65	155.0 ± 10.6	148.0 ± 15.0	130.6 - 165.4
			Ru-106	202.7 ± 17.2	210.0 ± 21.0	173.6 - 246.4
			Cs-134	23.7 ± 1.2	24.0 ± 5.0	18.2 - 29.8
			Cs-137	27.7 ± 3.1	25.0 ± 5.0	16.3 - 33.7
			Ba-133	100.7 ± 8.1	99.0 ± 10.0	81.7 - 116.3
STW-603	WATER	Jun, 1990	H-3	2927.0 ± 306.0	2933.0 ± 358.0	2312.0 - 3554.0
STW-604	WATER	Jul, 1990	Ra-226	11.8 ± 0.9	12.1 ± 1.8	9.0 - 15.2
			Ra-228	4.1 ± 1.4	5.1 ± 1.3	2.8 - 7.4
STW-605	WATER	Jul, 1990	U	20.3 ± 1.7	20.8 ± 3.0	15.6 - 26.0
STW-606	WATER	Aug, 1990	I-131	43.0 ± 1.2	39.0 ± 6.0	28.6 - 49.4
STW-607	WATER	Aug, 1990	Pu-239	10.0 ± 1.7	9.1 ± 0.9	7.5 - 10.7
STAF-608	AIR FILTER	Aug, 1990	Gr. Alpha	14.0 ± 0.0	10.0 ± 5.0	1.3 - 18.7
			Gr. Beta	65.3 ± 1.2	62.0 ± 5.0	53.3 - 70.7
			Sr-90	19.0 ± 6.9	20.0 ± 5.0	11.3 - 28.7
			Cs-137	19.0 ± 2.0	20.0 ± 5.0	11.3 - 28.7
STW-609	WATER	Sep, 1990	Sr-89	9.0 ± 2.0	10.0 ± 5.0	1.3 - 18.7
			Sr-90	9.0 ± 2.0	9.0 ± 5.0	0.3 - 17.7
STW-610	WATER	Sep, 1990	Gr. Alpha	8.3 ± 1.2	10.0 ± 5.0	1.3 - 18.7
			Gr. Beta	10.3 ± 1.2	10.0 ± 5.0	1.3 - 18.7

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne Brown Engineering Environmental Services, Midwest Laboratory results for various sample media[a].

				Concentration in pCi/L[b]		
Lab Code	Sample Type	Date Collected	Analyses	TBEESML Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
STM-611	MILK	Sep, 1990	Sr-89	11.7 ± 3.1	16.0 ± 5.0	7.3 - 24.7
			Sr-90	15.0 ± 0.0	20.0 ± 5.0	11.3 - 28.7
			I-131	63.0 ± 6.0	58.0 ± 6.0	47.6 - 68.4
			Cs-137	20.0 ± 2.0	20.0 ± 5.0	11.3 - 28.7
			K-40	1673.3 ± 70.2	1700.0 ± 85.0	1552.5 - 1847.5
STW-612	WATER	Oct, 1990	Co-60	20.3 ± 3.1	20.0 ± 5.0	11.3 - 28.7
			Zn-65	115.3 ± 12.2	115.0 ± 12.0	94.2 - 135.8
			Ru-106	152.0 ± 8.0	151.0 ± 15.0	125.0 - 177.0
			Cs-134	11.0 ± 0.0	12.0 ± 5.0	3.3 - 20.7
			Cs-137	14.0 ± 2.0	12.0 ± 5.0	3.3 - 20.7
			Ba-133	116.7 ± 9.9	110.0 ± 11.0	90.9 - 129.0
STW-613	WATER	Oct, 1990	H-3	7167.0 ± 330.0	7203.0 ± 720.0	5954.0 - 8452.0
STW-614	WATER	Oct, 1990	Gr. Alpha	68.7 ± 7.2	62.0 ± 16.0	34.2 - 89.8
			Ra-226	12.9 ± 0.3	13.6 ± 2.0	10.1 - 17.1
			Ra-228	4.2 ± 0.6	5.0 ± 1.3	2.7 - 7.3
			U	10.4 ± 0.6	10.2 ± 3.0	5.0 - 15.4
STW-615	WATER	Oct, 1990	Gross Beta	55.0 ± 8.7	53.0 ± 5.0	44.3 - 61.7
			Sr-89	15.7 ± 2.9	20.0 ± 5.0	11.3 - 28.7
			Sr-90	12.0 ± 2.0	15.0 ± 5.0	6.0 - 23.7
			Cs-134	9.0 ± 1.7	7.0 ± 5.0	0.0 - 15.7
			Cs-137	7.7 ± 1.2	5.0 ± 5.0	0.0 - 13.7
STW-616	WATER	Nov, 1990	Ra-226	6.8 ± 1.0	7.4 ± 1.1	5.5 - 9.3
			Ra-228	5.3 ± 1.7	7.7 ± 1.9	4.4 - 11.0
STW-617	WATER	Nov, 1990	U	35.0 ± 0.4	35.5 ± 3.6	29.3 - 41.7
	Sample was analyzed but the results where not submitted to the EPA because the deadline was missed (all data on file).					
STW-618	WATER	Jan, 1991	Sr-89	4.3 ± 1.2	5.0 ± 5.0	0.0 - 13.7
			Sr-90	4.7 ± 1.2	5.0 ± 5.0	0.0 - 13.7
STW-619	WATER	Jan, 1991	Pu-239	3.6 ± 0.2	3.3 ± 0.3	2.8 - 3.8
STW-620	WATER	Jan, 1991	Gr. Alpha	6.7 ± 3.0	5.0 ± 5.0	0.0 - 13.7
			Gr. Beta	6.3 ± 1.2	5.0 ± 5.0	0.0 - 13.7

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne Brown Engineering Environmental Services, Midwest Laboratory results for various sample media[a].

				Concentration in pCi/L[b]		
Lab Code	Sample Type	Date Collected	Analyses	TBEESML Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
STW-621	WATER	Feb, 1991	Co-60	41.3 ± 8.4	40.0 ± 5.0	31.3 - 48.7
			Zn-65	166.7 ± 19.7	149.0 ± 15.0	123.0 - 175.0
			Ru-106	209.7 ± 18.6	186.0 ± 19.0	153.0 - 219.0
			Cs-134	9.0 ± 2.0	8.0 ± 5.0	0.0 - 16.7
			Cs-137	9.7 ± 1.2	8.0 ± 5.0	0.0 - 16.7
			Ba-133	85.7 ± 9.2	75.0 ± 8.0	61.1 - 88.9
STW-622	WATER	Feb, 1991	I-131	81.3 ± 6.1	75.0 ± 8.0	61.1 - 88.9
STW-623	WATER	Feb, 1991	H-3	4310.0 ± 144.2	4418.0 ± 442.0	3651.2 - 5184.8
STW-624	WATER	Mar, 1991	Ra-226	31.4 ± 3.2	31.8 ± 4.8	23.5 - 40.1
			Ra-228		21.1 ± 5.3	11.9 - 30.3
	No data for Ra-228 was reported; sample was lost during analysis.					
STW-625	WATER	Mar, 1991	U	6.7 ± 0.4	7.6 ± 3.0	2.4 - 12.8
STAF-626	AIR FILTER	Mar, 1991	Gr. Alpha	38.7 ± 1.2	25.0 ± 6.0	14.6 - 35.4
			Gr. Beta	130.0 ± 4.0	124.0 ± 6.0	113.6 - 134.4
			Sr-90	35.7 ± 1.2	40.0 ± 5.0	31.3 - 48.7
			Cs-137	33.7 ± 4.2	40.0 ± 5.0	31.3 - 48.7
	The cause of the high Gross Alpha result is the difference in geometry between the standard used in the TIML lab and the EPA filter.					
STW-627	WATER	Apr, 1991	Gr. Alpha	51.0 ± 6.0	54.0 ± 14.0	29.7 - 78.3
			Ra-226	7.0 ± 0.8	8.0 ± 1.2	5.9 - 10.1
			Ra-228	9.7 ± 1.9	15.2 ± 3.8	8.6 - 21.8
			U	27.7 ± 2.4	29.8 ± 3.0	24.6 - 35.0
STW-628	WATER	Apr, 1991	Gross Beta	93.3 ± 6.4	115.0 ± 17.0	85.5 - 144.5
			Sr-89	21.0 ± 3.5	28.0 ± 5.0	19.3 - 36.7
			Sr-90	23.0 ± 0.0	26.0 ± 5.0	17.3 - 34.7
			Cs-134	27.3 ± 1.2	24.0 ± 5.0	15.3 - 32.7
			Cs-137	29.0 ± 2.0	25.0 ± 5.0	16.3 - 33.7
STM-629	MILK	Apr, 1991	Sr-89	24.0 ± 8.7	32.0 ± 5.0	23.3 - 40.7
			Sr-90	28.0 ± 2.0	32.0 ± 5.0	23.3 - 40.7
			I-131	65.3 ± 14.7	60.0 ± 6.0	49.6 - 70.4
			Cs-137	54.7 ± 11.0	49.0 ± 5.0	40.3 - 57.7
			K-40	1591.7 ± 180.1	1650.0 ± 83.0	1506.0 - 1794.0
STW-630	WATER	May, 1991	Sr-89	40.7 ± 2.3	39.0 ± 5.0	30.3 - 47.7
			Sr-90	23.7 ± 1.2	24.0 ± 5.0	15.3 - 32.7

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne Brown Engineering Environmental Services, Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[b] TBEESML Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
STW-631	WATER	May, 1991	Gr. Alpha	27.7 ± 5.8	24.0 ± 6.0	13.6 - 34.4
			Gr. Beta	46.0 ± 0.0	46.0 ± 5.0	37.3 - 54.7
STW-632	WATER	Jun, 1991	Co-60	11.3 ± 1.2	10.0 ± 5.0	1.3 - 18.7
			Zn-65	119.3 ± 16.3	108.0 ± 11.0	88.9 - 127.1
			Ru-106	162.3 ± 19.0	149.0 ± 15.0	123.0 - 175.0
			Cs-134	15.3 ± 1.2	15.0 ± 5.0	6.3 - 23.7
			Cs-137	16.3 ± 1.2	14.0 ± 5.0	5.3 - 22.7
			Ba-133	74.0 ± 6.9	62.0 ± 6.0	51.6 - 72.4
	Sample was reanalyzed for Ba-133. Result of the reanalysis was 63.8±6.9 pCi/L; within the EPA control limits.					
STW-633	WATER	Jun, 1991	H-3	13470.0 ± 385.8	12480.0 ± 1248.0	10314.8 - 14645.2
STW-634	WATER	Jul, 1991	Ra-226	14.9 ± 0.4	15.9 ± 2.4	11.7 - 20.1
			Ra-228	17.6 ± 1.8	16.7 ± 4.2	9.4 - 24.0
STW-635	WATER	Jul, 1991	U	12.8 ± 0.1	[illegible]2 ± 3.0	9.0 - 19.4
STW-636	WATER	Aug, 1991	I-131	19.3 ± 1.2	20.0 ± 6.0	9.6 - 30.4
STW-637	WATER	Aug, 1991	Pu-239	21.4 ± 0.5	19.4 ± 1.9	16.1 - 22.7
STAF-638	AIR FILTER	Aug, 1991	Gr. Alpha	33.0 ± 2.0	25.0 ± 6.0	14.6 - 35.4
			Gr. Beta	88.7 ± 1.2	92.0 ± 10.0	80.4 - 103.6
			Sr-90	27.0 ± 4.0	30.0 ± 5.0	21.3 - 38.7
			Cs-137	26.3 ± 1.2	30.0 ± 5.0	21.3 - 38.7
STW-639	WATER	Sep, 1991	Sr-89	47.0 ± 10.4	49.0 ± 5.0	40.3 - 57.7
			Sr-90	24.0 ± 2.0	25.0 ± 5.0	16.3 - 33.7
STW-640	WATER	Sep, 1991	Gr. Alpha	12.0 ± 4.0	10.0 ± 5.0	1.3 - 18.7
			Gr. Beta	20.3 ± 1.2	20.0 ± 5.0	11.3 - 28.7
STM-641	MILK	Sep, 1991	Sr-89	20.3 ± 5.0	25.0 ± 5.0	16.3 - 33.7
			Sr-90	19.7 ± 3.1	25.0 ± 5.0	16.3 - 33.7
			I-131	130.7 ± 16.8	108.0 ± 11.0	88.9 - 127.1
			Cs-137	33.7 ± 3.2	30.0 ± 5.0	21.3 - 38.7
			K	1743.3 ± 340.8	1740.0 ± 87.0	1589.1 - 1890.9
	The cause of the high result for the I-131 analysis is unknown. An in-house spike sample was prepared with activity for I-131 of 68.3±6.8 pCi/L. Result of TIML's analysis of the in-house spike was 69.1±9.7 pCi/L.					

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne Brown Engineering Environmental Services, Midwest Laboratory results for various sample media[a].

				Concentration in pCi/L[b]		
Lab Code	Sample Type	Date Collected	Analyses	TBEESML Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
STW-642	WATER	Oct, 1991	Co-60	29.7 ± 1.2	29.0 ± 5.0	20.3 - 37.7
			Zn-65	75.7 ± 8.3	73.0 ± 7.0	60.9 - 85.1
			Ru-106	196.3 ± 15.1	199.0 ± 20.0	164.3 - 233.7
			Cs-134	9.7 ± 1.2	10.0 ± 5.0	1.3 - 18.7
			Cs-137	11.0 ± 2.0	10.0 ± 5.0	1.3 - 18.7
			Ba-133	94.7 ± 3.1	98.0 ± 10.0	80.7 - 115.3
STW-643	WATER	Oct, 1991	H-3	2640.0 ± 156.2	2454.0 ± 352.0	1843.3 - 3064.7
STW-644	WATER	Oct, 1991	Gr. Alpha	73.0 ± 13.1	82.0 ± 21.0	45.6 - 118.4
			Ra-226	20.9 ± 2.0	22.0 ± 3.3	16.3 - 27.7
			Ra-228	19.6 ± 2.3	22.2 ± 5.6	12.5 - 31.9
			U	13.5 ± 0.6	13.5 ± 3.0	8.3 - 18.7
STW-645	WATER	Oct, 1991	Gross Beta	55.3 ± 3.1	65.0 ± 10.0	47.7 - 82.3
			Sr-89	9.7 ± 3.1	10.0 ± 5.0	1.3 - 18.7
			Sr-90	8.7 ± 1.2	10.0 ± 5.0	1.3 - 18.7
			Co-60	20.3 ± 1.2	20.0 ± 5.0	11.3 - 28.7
			Cs-134	9.0 ± 5.3	10.0 ± 5.0	1.3 - 18.7
			Cs-137	14.7 ± 5.0	11.0 ± 5.0	2.3 - 19.7
STW-646	WATER	Nov, 1991	Ra-226	5.6 ± 1.2	6.5 ± 1.0	4.8 - 8.2
			Ra-228	9.6 ± 0.5	8.1 ± 2.0	4.6 - 11.6
STW-647	WATER	Nov, 1991	U	24.7 ± 2.3	24.9 ± 3.0	19.7 - 30.1
STW-648	WATER	Jan, 1992	Sr-89	42.7 ± 6.4	51.0 ± 5.0	42.3 - 59.7
			Sr-90	18.3 ± 3.1	20.7 ± 5.0	11.3 - 28.7
STW-649	WATER	Jan, 1992	Pu-239	16.1 ± 0.8	16.8 ± 1.7	13.9 - 19.7
STW-650	WATER	Jan, 1992	Gr. Alpha	23.7 ± 9.2	30.0 ± 8.0	16.1 - 43.9
			Gr. Beta	27.7 ± 4.2	30.0 ± 5.0	21.3 - 38.7
STW-651	WATER	Feb, 1992	I-131	60.3 ± 4.2	59.0 ± 6.0	48.6 - 69.4
STW-652	WATER	Feb, 1992	Co-60	40.3 ± 5.0	40.0 ± 5.0	31.3 - 48.7
			Zn-65	148.0 ± 15.0	150.7 ± 6.1	122.0 - 174.0
			Ru-106	188.7 ± 28.8	203.0 ± 20.0	168.3 - 237.7
			Cs-134	31.7 ± 4.2	31.0 ± 5.0	22.3 - 39.7
			Cs-137	51.0 ± 3.4	49.0 ± 5.0	40.3 - 57.7
			Ba-133	79.0 ± 3.4	76.0 ± 8.0	62.1 - 89.9
STW-653	WATER	Feb, 1992	H-3	7714.0 ± 119.6	7904.0 ± 790.0	6533.4 - 9274.6

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne Brown Engineering Environmental Services, Midwest Laboratory results for various sample media[a].

				Concentration in pCi/L[b]		
Lab Code	Sample Type	Date Collected	Analyses	TBEESML Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
STW-654	WATER	Mar, 1992	Ra-226	9.0 ± 0.4	10.1 ± 1.5	7.5 - 12.7
			Ra-228	18.8 ± 0.6	15.5 ± 3.9	8.7 - 22.3
STW-655	WATER	Mar, 1992	Rn-222	0.0	0.0	
	ND = No Data; Special EPA testing.					
STW-656	WATER	Mar, 1992	U	25.1 ± 1.9	25.3 ± 3.0	20.1 - 30.5
STW-657	WATER	Mar, 1992	Rn-222			
	No Data is available; Special EPA testing.					
STAF-658	AIR FILTER	Mar, 1992	Gr. Alpha	7.0 ± 0.0	7.0 ± 5.0	0.0 - 15.7
			Gr. Beta	39.3 ± 1.6	41.0 ± 5.0	32.3 - 49.7
			Sr-90	13.7 ± 1.6	15.0 ± 5.0	6.3 - 23.7
			Cs-137	10.0 ± 0.0	10.0 ± 5.0	1.3 - 18.7
STW-659	WATER	Apr, 1992	Gr. Alpha	35.7 ± 6.1	40.0 ± 10.0	22.7 - 57.3
			Ra-226	12.7 ± 1.2	14.9 ± 2.2	11.1 - 18.7
			Ra-228	14.5 ± 2.1	14.0 ± 3.5	7.9 - 20.1
			U	3.9 ± 0.2	4.0 ± 3.0	0.0 - 9.2
STW-660	WATER	Apr, 1992	Gross Beta	113.0 ± 7.2	140.0 ± 21.0	103.6 - 176.4
			Sr-89	12.3 ± 4.2	15.0 ± 5.0	6.3 - 23.7
			Sr-90	15.0 ± 1.2	17.0 ± 5.0	8.3 - 25.7
			Co-60	61.0 ± 4.0	56.0 ± 5.0	47.3 - 64.7
			Cs-134	24.3 ± 1.2	24.0 ± 5.0	15.3 - 32.7
			Cs-137	24.0 ± 2.0	22.0 ± 5.0	13.3 - 30.7
STM-661	MILK	Apr, 1992	Sr-89	25.3 ± 7.6	38.0 ± 5.0	29.3 - 46.7
			Sr-90	24.3 ± 3.1	29.0 ± 5.0	20.3 - 37.7
			I-131	78.7 ± 9.5	78.0 ± 8.0	64.1 - 91.9
			Cs-137	39.3 ± 2.3	39.0 ± 5.0	30.3 - 47.7
			K-40	1610.0 ± 72.1	1710.0 ± 86.0	1560.8 - 1859.2
	The cause of the low Sr-89 results is unknown. Data were checked for errors. An in-house spike sample was prepared with activity for Sr-89 of 41.0±10.0 pCi/L. Result of the analysis of the in-house spike sample for Sr-89 was 37.2±3.6 pCi/L.					
STW-662	WATER	May, 1992	Sr-89	24.0 ± 4.0	29.0 ± 5.0	20.3 - 37.7
			Sr-90	6.7 ± 1.2	8.0 ± 5.0	0.0 - 16.7
STW-663	WATER	May, 1992	Gr. Alpha	12.3 ± 2.1	15.0 ± 5.0	6.3 - 23.7
			Gr. Beta	46.0 ± 5.0	44.0 ± 5.0	35.3 - 52.7

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne Brown Engineering Environmental Services, Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[b] TBEESML Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
STW-664	WATER	Jun, 1992	Co-60	20.3 ± 1.2	20.0 ± 5.0	11.3 - 28.7
			Zn-65	103.3 ± 10.6	99.0 ± 10.0	81.7 - 116.3
			Ru-106	142.7 ± 23.7	141.0 ± 14.0	116.7 - 165.3
			Cs-134	14.3 ± 2.3	15.0 ± 5.0	6.3 - 23.7
			Cs-137	15.0 ± 2.0	15.0 ± 5.0	6.3 - 23.7
			Ba-133	92.7 ± 11.0	98.0 ± 10.0	80.7 - 115.3
STW-665	WATER	Jun, 1992	H-3	2153.3 ± 144.6	2125.0 ± 347.0	1523.0 - 2727.0
STW-666	WATER	Jul, 1992	Ra-226	22.3 ± 2.2	24.9 ± 3.7	18.5 - 31.3
			Ra-228	16.7 ± 3.1	16.7 ± 4.2	9.4 - 24.0
STW-667	WATER	Jul, 1992	Uranium	3.6 ± 0.3	4.0 ± 3.0	0.0 - 9.2
STW-668	WATER	Aug, 1992	I-131	47.0 ± 3.5	45.0 ± 6.0	34.6 - 55.4
STW-669	WATER	Aug, 1992	Pu-239	8.5 ± 0.9	9.0 ± 0.9	7.4 - 10.6
STAF-670	AIR FILTER	Aug, 1992	Alpha	25.7 ± 1.2	30.0 ± 8.0	16.1 - 43.9
			Beta	69.0 ± 2.0	69.0 ± 10.0	51.7 - 86.3
			Sr-90	26.0 ± 4.0	25.0 ± 5.0	16.3 - 33.7
			Cs-137	16.0 ± 0.0	18.0 ± 5.0	9.3 - 26.7
STW-671	WATER	Sep, 1992	Sr-89	16.0 ± 4.0	20.0 ± 5.0	11.3 - 28.7
			Sr-90	14.3 ± 3.1	15.0 ± 5.0	6.3 - 23.7
STW-672	WATER	Sep, 1992	Alpha	43.0 ± 13.1	45.0 ± 11.0	25.9 - 64.1
			Beta	41.3 ± 18.6	50.0 ± 5.0	14.3 - 58.7
STM-673	MILK	Sep, 1992	I-131(gamma	109.7 ± 19.4	100.0 ± 10.0	82.7 - 117.3
			Sr-89	11.0 ± 3.5	15.0 ± 5.0	6.3 - 23.7
			Sr-90	12.7 ± 1.6	15.0 ± 5.0	6.3 - 23.7
			Cs-137	14.0 ± 3.5	15.0 ± 5.0	6.3 - 23.7
			K	1540.0 ± 103.9	1750.0 ± 88.0	1597.3 - 1902.7
	The K activity was calculated using the wrong volume (3.5 L), instead of 3.25 L. Correction for volume resulted in a value of 1660.0±110.1; within EPA control limits.					
STW-674	WATER	Oct, 1992	Co-60	11.3 ± 2.3	10.0 ± 5.0	1.3 - 18.7
			Zn-65	169.7 ± 25.0	148.0 ± 15.0	122.0 - 174.0
			Ru-106	170.7 ± 2.3	175.0 ± 18.0	143.8 - 206.2
			Cs-134	9.7 ± 2.3	8.0 ± 5.0	0.0 - 16.7
			Cs-137	9.7 ± 1.2	8.0 ± 5.0	0.0 - 16.7
			Ba-133	80.3 ± 9.0	74.0 ± 7.0	61.9 - 86.1
STW-675	WATER	Oct, 1992	H-3	5896.7 ± 136.2	5962.0 ± 596.0	4928.0 - 6996.0

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne Brown Engineering Environmental Services, Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[b] TBEESML Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
STW-676	WATER	Oct, 1992	Gr. Alpha	24.7 ± 5.0	29.0 ± 7.0	16.9 - 41.1
			Ra-226	7.1 ± 0.4	7.4 ± 1.1	5.5 - 9.3
			Ra-228	11.5 ± 1.0	10.0 ± 2.5	5.7 - 14.3
			Uranium	9.7 ± 0.5	10.2 ± 3.0	5.0 - 15.4
STW-677	WATER	Oct, 1992	Gr. Beta	42.7 ± 8.1	53.0 ± 10.0	35.7 - 70.3
			Co-60	15.0 ± 2.0	15.0 ± 5.0	6.3 - 23.7
			Cs-134	5.7 ± 1.2	5.0 ± 5.0	0.0 - 13.7
			Cs-137	8.0 ± 2.0	8.0 ± 5.0	0.0 - 16.7
			Sr-89	6.7 ± 1.2	8.0 ± 5.0	0.0 - 16.7
			Sr-90	10.0 ± 2.0	110.0 ± 5.0	1.3 - 18.7
STW-678	WATER	Oct, 1992	Ra-226	7.5 ± 0.8	7.5 ± 1.1	5.6 - 9.4
			Ra-228	5.8 ± 0.7	5.0 ± 1.3	2.7 - 7.3
STW-679	WATER	Nov, 1992	Uranium	15.5 ± 1.1	15.2 ± 3.3	10.0 - 20.4
STW-680	WATER	Jan, 1993	Sr-89	15.0 ± 2.0	15.0 ± 5.0	6.3 - 23.7
			Sr-90	10.3 ± 1.2	10.0 ± 5.0	1.3 - 18.7
STW-681	WATER	Jan, 1993	Pu-239	17.5 ± 1.6	20.0 ± 2.0	16.5 - 23.5
STW-682	WATER	Jan, 1993	Alpha	17.1 ± 1.2	34.0 ± 9.0	18.4 - 49.6
			Beta	46.7 ± 3.2	44.0 ± 5.0	35.3 - 52.7
	Gross Alpha analysis was repeated with similar results. An investigation of possible causes for the deviation from the EPA was conducted with no cause discovered. The sample was spiked with Th-230; so Alpha Spec Analysis for Th-230 was performed in triplicate with results of 15.5±2.1, 13.4±1.4, and 14.8±2.0. It should be noted that 66% of all participants failed this analysis with a grand average of 17.1. This coupled with the support of the Alpha Spec results leaves TIML cause to believe that there may have been a dilution error at the EPA. It should be noted that on the next Gross Alpha EPA check, TIML reported results that where exactly the known value. Since no apparent cause can be found, and TIML had outstanding results on the following sample, it is felt that no further investigation is needed.					
STW-683	WATER	Feb, 1993	I-131	106.0 ± 10.0	100.0 ± 10.0	82.7 - 117.3
STW-684	WATER	Feb, 1993	Uranium	7.2 ± 0.5	7.6 ± 3.0	2.4 - 12.8
STW-685	WATER	Mar, 1993	Ra-226	9.3 ± 1.3	9.8 ± 1.5	7.2 - 12.4
			Ra-228	20.8 ± 2.2	18.5 ± 4.6	10.5 - 26.5
STW-686	WATER	Apr, 1993	Alpha	88.3 ± 8.1	95.0 ± 24.0	53.4 - 136.6
			Ra-226	25.4 ± 1.4	24.9 ± 3.7	18.5 - 31.3
			Ra-228	17.4 ± 1.2	19.0 ± 4.8	10.7 - 27.3
			Uranium	27.8 ± 2.2	28.9 ± 3.0	23.7 - 34.1

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne Brown Engineering Environmental Services, Midwest Laboratory results for various sample media[a].

				Concentration in pCi/L[b]		
Lab Code	Sample Type	Date Collected	Analyses	TBEESML Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
STW-687	WATER	Apr, 1993	Beta	141.7 ± 9.0	177.0 ± 27.0	130.2 - 223.8
			Sr-89	28.7 ± 9.4	41.0 ± 5.0	32.3 - 49.7
			Sr-90	28.0 ± 3.5	29.0 ± 5.0	20.3 - 37.7
			Co-60	41.3 ± 1.2	39.0 ± 5.0	30.3 - 47.7
			Cs-134	24.7 ± 1.2	27.0 ± 5.0	18.3 - 35.7
			Cs-137	30.0 ± 0.0	32.0 ± 5.0	23.3 - 40.7
	The EPA report was received 08-16-93. No cause for the low result for Sr-89 was found. The analyst has been observed performing this procedure with no noted descrepancies. Teledyne will continue to monitor this procedure in the future. No further action is anticipated unless conditions warrant.					
STW-688	WATER	Jun, 1993	H-3	9613.3 ± 46.2	9844.0 ± 984.0	8136.8 - 11551.2
STW-689	WATER	Jun, 1993	Co-60	17.3 ± 4.6	15.0 ± 5.0	6.3 - 23.7
			Zn-65	114.0 ± 13.2	103.0 ± 10.0	85.7 - 120.3
			Ru-106	108.0 ± 8.0	119.0 ± 12.0	98.2 - 139.8
			Cs-134	5.7 ± 1.2	5.0 ± 5.0	0.0 - 13.7
			Cs-137	6.0 ± 2.0	5.0 ± 5.0	0.0 - 13.7
			Ba-133	101.7 ± 10.3	99.0 ± 10.0	81.7 - 116.3
STW-690	WATER	Jul, 1993	Sr-89	28.3 ± 2.3	34.0 ± 5.0	25.3 - 42.7
			Sr-90	25.0 ± 1.0	25.0 ± 5.0	16.3 - 33.7
STW-691	WATER	Jul, 1993	Alpha	15.0 ± 2.7	15.0 ± 5.0	6.3 - 23.7
			Beta	41.3 ± 4.9	43.0 ± 6.9	31.0 - 55.0
STW-692	WATER	Aug, 1993	Uranium	24.9 ± 1.4	25.3 ± 3.0	20.1 - 30.5
STAF-693	AIR FILTER	Aug, 1993	Alpha	17.0 ± 1.0	19.0 ± 5.0	10.3 - 27.7
			Beta	47.3 ± 0.6	47.0 ± 5.0	38.3 - 55.7
			Sr-90	19.3 ± 0.6	19.0 ± 5.0	10.3 - 27.7
			Cs-137	10.0 ± 1.0	9.0 ± 5.0	0.3 - 17.7
STW-694	WATER	Sep, 1993	Ra-226	15.9 ± 0.7	14.9 ± 2.2	11.1 - 18.7
			Ra-228	21.0 ± 1.6	20.4 ± 5.1	11.6 - 29.2

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne Brown Engineering Environmental Services, Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[b] TBEESML Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
STM-695	MILK	Sep, 1993	I-131	125.3 ± 4.5	120.0 ± 12.0	99.2 - 140.8
			Sr-89	19.3 ± 1.5	30.0 ± 5.0	21.3 - 38.7
			Sr-90	22.0 ± 0.0	25.0 ± 5.0	16.3 - 33.7
			Cs-137	49.0 ± 3.0	49.0 ± 5.0	40.3 - 57.7
			K	1616.7 ± 37.9	1679.0 ± 84.0	1533.3 - 1824.7

Report was received 01-18-94; an investigation is underway as to the cause of the low Sr-89 results. In house spikes have been prepared and the analysis is in progress (see SPM-4848 and SPM-4849 in future reports). There is no apparent cause of the low Sr-89 results. In-house spikes have been prepared and the analysis is in progress. The analyst has been observed performing this procedure with no discrepancies noted. No further action is planned unless the results of the In-House spikes show a problem.

Lab Code	Sample Type	Date Collected	Analyses	TBEESML Results ±2 Sigma	EPA Result 1s, N=1	Control Limits
STW-696	WATER	Oct, 1993	I-131	116.7 ± 2.3	117.0 ± 12.0	96.2 - 137.8
STW-697	WATER	Oct, 1993	Gr. Alpha	39.7 ± 1.5	40.0 ± 10.0	22.7 - 57.3
			Ra-226	10.6 ± 0.5	9.9 ± 1.5	7.3 - 12.5
			Ra-228	13.2 ± 1.5	12.5 ± 3.1	7.1 - 17.9
			Uranium	15.3 ± 0.6	15.1 ± 3.0	9.9 - 20.3
STW-698	WATER	Oct, 1993	Beta	52.0 ± 1.0	58.0 ± 10.0	40.7 - 75.3
			Sr-89	11.3 ± 0.6	15.0 ± 5.0	6.3 - 23.7
			Sr-90	11.0 ± 0.0	10.0 ± 5.0	1.3 - 18.7
			Co-60	10.7 ± 0.6	10.0 ± 5.0	1.3 - 18.7
			Cs-134	10.0 ± 1.0	12.0 ± 5.0	3.3 - 20.7
			Cs-137	12.3 ± 1.2	10.0 ± 5.0	1.3 - 18.7
STW-699	WATER	Oct, 1993	Alpha	18.3 ± 2.5	20.0 ± 5.0	11.3 - 28.7
			Beta	13.7 ± 0.6	15.0 ± 5.0	6.3 - 23.7
STW-700	WATER	Nov, 1993	H-3	7310.0 ± 175.2	7398.0 ± 740.0	6114.1 - 8681.9
STW-701	WATER	Nov, 1993	Ba-133	75.7 ± 7.6	79.0 ± 8.0	65.1 - 92.9
			Co-60	30.7 ± 2.1	30.0 ± 5.0	21.3 - 38.7
			Cs-134	51.3 ± 5.9	59.0 ± 5.0	50.3 - 67.7
			Cs-137	41.7 ± 1.2	40.0 ± 5.0	31.3 - 48.7
			Ru-106	163.3 ± 3.2	201.0 ± 20.0	166.3 - 235.7
			Zn-65	157.0 ± 8.7	150.0 ± 15.0	124.0 - 176.0

The report was received on 02-14-94; the cause of the low Ru-106 is under investigation. It should be noted that the grand average of all participants in this analysis was 175.2 pCi/L, with 54% of the participants outside of limits.

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne Brown Engineering Environmental Services, Midwest Laboratory results for various sample media[a].

				Concentration in pCi/L[b]		
Lab Code	Sample Type	Date Collected	Analyses	TBEESML Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits

[a] Results obtained by Teledyne Brown Engineering Environmental Services Midwest Laboratory as a participant in the environmental sample crosscheck program operated by the Intercomparison and Calibration Section, Quality Assurance Branch, Environmental Monitoring and Support Laboratory, U.S. Environmental Protection Agency (EPA), Las Vegas, Neveda.

[b] All results are in pCi/L, except for elemental potassium (K) data in milk, which are in mg/L; air filter samples, which are in pCi/Filter; and food products, which are in mg/Kg.

[c] Unless otherwise indicated, the TBEESML results are given as the mean ± 2 standard deviations for three determinations.

[d] USEPA results are presented as the known values and expected laboratory precision (1s, 1 determination) and control limits as defined by the EPA.

Table A-2. Crosscheck program results; thermoluminescent dosimeters. (TLDs).

Lab Code	TLD Type		Measurement	mR TBEESML Results ± 2 Sigma	mR Known Value ± 2 Sigma	mR Average ± 2 Sigma (All Participants)
2nd International Intercomparison						
115-2	CaF_2: Mn Bulb	Apr, 1976	Field	17.0 ± 1.9	17.1	16.4 ± 7.7
			Lab	20.8 ± 4.1	21.3	18.8 ± 7.6
	Second International Intercomparison of Environmental Dosimeters conducted in April of 1976 by the Health and Safety Laboratory (HASL), New York, New York, and the School of Public Health of the University of Texas, Houston, Texas.					
3rd International Intercomparison						
115-3	CaF_2: Mn Bulb	Jun, 1977	Field	30.7 ± 3.2	34.9 ± 4.8	31.5 ± 3.0
			Lab	89.6 ± 6.4	91.7 ± 14.6	86.2 ± 24.0
	Third International Intercomparison of Environmental Dosimeters conducted in the summer of 1977 by Oak Ridge National Laboratory and the School of Public Health of the University of Texas, Houston, Texas.					
4th International Intercomparison						
115-4	CaF_2: Mn Bulb	Jun, 1979	Field	14.1 ± 1.1	14.1 ± 1.4	16.0 ± 9.0
			Lab, Low	9.8 ± 1.3	12.2 ± 2.4	12.0 ± 7.4
			Lab, High	40.4 ± 1.4	45.8 ± 9.2	43.9 ± 13.2
	Fourth International Intercomparison of Environmental Dosimeters conducted in the summer of 1979 by the School of Public Health of the University of Texas, Houston, Texas.					
5th International Intercomparison						
115-5A	CaF_2: Mn Bulb	Oct, 1980	Field	31.4 ± 1.8	30.0 ± 6.0	30.2 ± 14.6
			Lab, Start	77.4 ± 5.8	75.2 ± 7.6	75.8 ± 40.4
			Lab, End	96.6 ± 5.8	88.4 ± 8.8	90.7 ± 31.2
115-5B	LiF-100 Chips	Oct, 1980	Field	30.3 ± 4.8	30.0 ± 6.0	30.2 ± 14.6
			Lab, Start	81.1 ± 7.4	75.2 ± 7.6	75.8 ± 40.4
			Lab, End	85.4 ± 11.7	88.4 ± 8.8	90.7 ± 31.2
	Fifth International Intercomparison of Environmental Dosimeters conducted in the fall of 1980 at Idaho Falls, Idaho and sponsored by the School of Public Health of the University of Texas, Houston, Texas and Environmental Measurements Laboratory, New York, New York, U.S. Department of Energy.					
7th International Intercomparison						
115-7A	LiF-100 Chips	Jun, 1984	Field	75.4 ± 2.6	75.8 ± 6.0	75.1 ± 29.8
			Lab, Co-60	80.0 ± 3.5	79.9 ± 4.0	77.9 ± 27.6
			Lab, Cs-137	66.6 ± 2.5	75.0 ± 3.8	73.0 ± 22.2

Table A-2. Crosscheck program results; thermoluminescent dosimeters. (TLDs).

Lab Code	TLD Type	Measurement		mR TBEESML Results ± 2 Sigma	Known Value ± 2 Sigma	Average ± 2 Sigma (All Participants)
115-7B	CaF_2: Mn Bulb	Jun, 1984	Field	71.5 ± 2.6	75.8 ± 6.0	75.1 ± 29.8
			Lab, Co-60	84.8 ± 6.4	79.9 ± 4.0	77.9 ± 27.6
			Lab, Cs-137	78.8 ± 1.6	75.0 ± 3.8	73.0 ± 22.2
115-7C	$CaSO_4$:Dy Cards	Jun, 1984	Field	76.8 ± 2.7	75.8 ± 6.0	75.1 ± 29.8
			Lab, Co-60	82.5 ± 3.7	79.9 ± 4.0	77.9 ± 27.6
			Lab, Cs-137	79.0 ± 3.2	75.0 ± 3.8	73.0 ± 22.2

Seventh International Intercomparison of Environmental Dosimeters conducted in the spring and summer of 1984 at Las Vegas, Neveda, and sponsored by the U.S. Department of Energy, The Nuclear Regulatory Commission, and the U.S. Environmental Protection Agency. Teledyne did not participate in the Sixth International Intercomparison of Environmental Dosimeters.

8th International Intercomparison

Lab Code	TLD Type	Measurement		TBEESML Results ± 2 Sigma	Known Value ± 2 Sigma	Average ± 2 Sigma (All Participants)
115-8A	LiF-100 Chips	Jan, 1986	Field, Site 1	29.5 ± 1.4	29.7 ± 1.5	28.9 ± 12.4
			Field, Site 2	11.3 ± 0.8	10.4 ± 0.5	10.1 ± 9.1
			Lab, Cs-137	13.7 ± 0.9	17.2 ± 0.9	16.2 ± 6.8
115-8B	CaF_2: Mn Bulb	Jan, 1986	Field, Site 1	32.3 ± 1.2	29.7 ± 1.5	28.9 ± 12.4
			Field, Site 2	9.0 ± 1.0	10.4 ± 0.5	10.1 ± 9.0
			Lab, Cs-137	15.8 ± 0.9	17.2 ± 0.9	16.2 ± 6.8
115-8C	$CaSO_4$:Dy Cards	Jan, 1986	Field, Site 1	32.2 ± 0.7	29.7 ± 1.5	28.9 ± 12.4
			Field, Site 2	10.6 ± 0.6	10.4 ± 0.5	10.1 ± 9.0
			Lab, Cs-137	18.1 ± 0.8	17.2 ± 0.9	16.2 ± 6.8

Eighth International Intercomparison of Environmental Dosimeters conducted in the fall and winter of 1985-1986 at New York, New York and sponsored by the U.S. Department of Energy.

10th International Intercomparison

Lab Code	TLD Type	Measurement		TBEESML Results ± 2 Sigma	Known Value ± 2 Sigma	Average ± 2 Sigma (All Participants)
115-10A	LiF-100 Chips	Aug, 1993	Field	25.7 ± 1.4	27.0 ± 1.6	26.4 ± 10.2
			Lab	22.7 ± 1.6	25.9 ± 1.3	25.0 ± 9.4
			Lab	62.7 ± 2.6	72.7 ± 1.9	69.8 ± 20.3

Tenth International Intercomparison of Environmental Dosimeters conducted in 1993 at Idaho State University and sponsored by the U.S. Department of Energy and the Idaho State University. The Nineth International Intercomparison of Environmental Dosimeters was not available to Teledyne's Midwest Laboratory.

Table A-2. Crosscheck program results; thermoluminescent dosimeters. (TLDs).

Lab Code	TLD Type	Measurement		mR: TBEESML Results ± 2 Sigma	mR: Known Value ± 2 Sigma	mR: Average ± 2 Sigma (All Participants)
115-10B	$CaSO_4$:Dy Cards	Aug, 1993	Field	26.0 ± 2.3	27.0 ± 1.6	26.4 ± 10.2
			Lab	24.1 ± 1.7	25.9 ± 1.3	25.0 ± 9.4
			Lab	69.2 ± 3.0	72.7 ± 1.9	69.8 ± 20.3
	Tenth International Intercomparison of Environmental Dosimeters conducted in 1993 at Idaho State University and sponsored by the U.S. Department of Energy and the Idaho State University. The Nineth International Intercomparison of Environmental Dosimeters was not available to Teledyne's Midwest Laboratory.					
Teledyne Testing						
89-1	LiF-100 Chips	Sep, 1989	Lab	21.0 ± 0.4	22.4	ND
	ND = No Data; Teledyne Testing was only performed by Teledyne Isotopes. Chips were irradiated by Teledyne Isotopes, Inc., Westwood NJ. in September, 1989					
89-2	Teledyne $CaSO_4$:Dy Cards	Nov, 1989	Lab	20.9 ± 1.0	20.3	ND
	ND = No Data; Teledyne Testing was only performed by Teledyne Isotopes. Cards were irradiated by Teledyne Isotopes, Inc., Westwood NJ. in November, 1989.					
90-1	Teledyne $CaSO_4$:Dy Cards	Jun, 1990	Lab	20.6 ± 1.4	19.6	ND
	ND = No Data; Teledyne Testing was only performed by Teledyne Isotopes. Cards were irradiated by Teledyne Isotopes, Inc., Westwood NJ. on June 19, 1990.					
90-2	Teledyne $CaSO_4$:Dy Cards	Sep, 1990	Lab	100.8 ± 4.3	100.0	ND
	ND = No Data; Teledyne Testing was only performed by Teledyne Isotopes. Cards were irradiated by Dosimetry Associates, Inc., Northville, MI on October 30, 1990.					
91-1	Teledyne $CaSO_4$:Dy Cards	Oct, 1990	Lab	33.4 ± 2.0	32.0	ND
				55.2 ± 4.7	58.8	ND
				87.8 ± 6.2	85.5	ND
	ND = No Data; Teledyne Testing was only performed by Teledyne Isotopes. Cards were irradiated by Teledyne Isotopes, Inc., Westwood NJ. on October 8, 1991.					
92-1	LiF-100 Chips	Feb, 1992	Lab	11.1 ± 0.2	10.7	ND
				25.6 ± 0.5	25.4	ND
				46.4 ± 0.5	46.3	ND
	ND = No Data; Teledyne Testing was only performed by Teledyne Isotopes. Chips were irradiated by Teledyne Isotopes, Inc., Westwood NJ. on February 26, 1992.					

Table A-2. Crosscheck program results; thermoluminescent dosimeters. (TLDs).

Lab Code	TLD Type	Measurement		mR TBEESML Results ± 2 Sigma	Known Value ± 2 Sigma	Average ± 2 Sigma (All Participants)
92-2	Teledyne $CaSO_4$:Dy Cards	Apr, 1992	Lab, Reader1	20.1 ± 0.1	20.1	ND
				40.6 ± 0.1	40.0	ND
				60.0 ± 1.3	60.3	ND
			Lab, Reader2	20.3 ± 0.3	20.1	ND
				39.2 ± 0.3	40.0	ND
				60.7 ± 0.4	60.3	ND

ND = No Data; Teledyne Testing was only performed by Teledyne Isotopes.
Cards were irradiated by Teledyne Isotopes, Inc., Westwood NJ. on April 1, 1992.

Lab Code	TLD Type	Measurement		mR TBEESML Results ± 2 Sigma	Known Value ± 2 Sigma	Average ± 2 Sigma (All Participants)
93-1	Teledyne LiF-100 Chips	Mar, 1993	Lab	10.0 ± 1.0	10.2	ND
				25.5 ± 2.2	25.5	ND
				42.7 ± 5.7	45.9	ND

ND = No Data; Teledyne Testing was only performed by Teledyne Isotopes.
Cards and Chips were irradiated by Teledyne Isotopes, Inc., Westwood NJ. on March 10, 1993.
Due to a potential error of 10-12% when cards where irradiated, results of the testing on the cards will not be published. Data is available upon request.

Table A-3. In-house "spike" samples.

				Concentration in pCi/L[a]		
Lab Code	Sample Type	Date Collected	Analyses	TBEESML Results 2s, n=1[b]	Known Activity	Control[c] Limits
QCMI-26	MILK	Jan, 1990	Cs-134	19.3 ± 1.0	20.8	10.8 - 30.8
			Cs-137	25.2 ± 1.2	22.8	12.8 - 32.8
QCMI-27	MILK	Feb, 1990	Sr-90	18.0 ± 1.6	18.8	8.8 - 28.8
QCMI-28	MILK	Mar, 1990	I-131	63.8 ± 2.2	62.6	50.1 - 75.1
QCMI-29	MILK	Apr, 1990	I-131	90.7 ± 9.2	82.5	66.0 - 99.0
			Cs-134	18.3 ± 1.0	19.7	9.7 - 29.7
			Cs-137	20.3 ± 1.0	18.2	8.2 - 28.2
QCW-61	WATER	Apr, 1990	Sr-89	17.9 ± 5.5	23.1	13.1 - 33.1
			Sr-90	19.4 ± 2.5	23.5	13.5 - 33.5
QCW-62	WATER	Apr, 1990	Co-60	8.7 ± 0.4	9.4	0.0 - 19.4
			Cs-134	20.0 ± 0.2	19.7	9.7 - 29.7
			Cs-137	28.7 ± 1.4	22.7	12.7 - 32.7
QCW-63	WATER	Apr, 1990	I-131	63.5 ± 8.0	66.0	52.8 - 79.2
QCW-64	WATER	Apr, 1990	H-3	1941.0 ± 130.0	1826.0	1141.5 - 2510.5
QCW-65	WATER	Jun, 1990	Ra-226	6.4 ± 0.2	6.9	4.8 - 9.0
QCW-66	WATER	Jun, 1990	Uranium	6.2 ± 0.2	6.0	3.6 - 8.4
QCMI-30	MILK	Jul, 1990	Sr-89	12.8 ± 0.4	18.4	8.4 - 28.4
			Sr-90	18.2 ± 1.4	18.7	8.7 - 28.7
			Cs-134	46.0 ± 1.3	49.0	39.0 - 59.0
			Cs-137	27.6 ± 1.3	25.3	15.3 - 35.3
QCW-68	WATER	Jul, 1990	Gr. Alpha	9.8 ± 0.3	10.6	0.6 - 20.6
			Gr. Beta	11.4 ± 0.6	11.3	1.3 - 21.3
QCMI-31	MILK	Aug, 1990	I-131	68.8 ± 1.6	61.4	49.1 - 73.7
QCW-69	WATER	Sep, 1990	Sr-89	17.7 ± 1.6	19.2	9.2 - 29.2
			Sr-90	13.9 ± 1.6	17.4	7.4 - 27.4
QC MI-32	MILK	Oct, 1990	I-131	34.8 ± 0.2	32.4	20.4 - 44.4
			Cs-134	25.8 ± 1.2	27.3	17.3 - 37.3
			Cs-137	25.3 ± 2.0	22.4	12.4 - 32.4
QCW-70	WATER	Oct, 1990	H-3	2355.0 ± 59.0	2276.0	1577.3 - 2974.7
QCW-71	WATER	Oct, 1990	I-131	55.9 ± 0.9	51.8	39.8 - 63.8
QCW-73	WATER	Oct, 1990	Co-60	18.3 ± 2.7	16.8	6.8 - 26.8
			Cs-134	28.3 ± 2.3	27.0	17.0 - 37.0
			Cs-137	22.7 ± 1.3	22.4	12.4 - 32.4
QCW-74	WATER	Dec, 1990	Gr. Alpha	21.4 ± 1.0	26.1	13.1 - 39.2
			Gr. Beta	25.9 ± 1.0	22.3	12.3 - 32.3

Table A-3. In-house "spike" samples.

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[a] TBEESML Results 2s, n=1[b]	Known Activity	Control[c] Limits
QCMI-33	MILK	Jan, 1991	Sr-89	20.7 ± 3.3	21.6	11.6 - 31.6
			Sr-90	19.0 ± 1.4	23.0	13.0 - 33.0
			Cs-134	22.2 ± 1.7	19.6	9.6 - 29.6
			Cs-137	26.1 ± 1.6	22.3	12.3 - 32.3
	The cause of the low Sr-90 data is unknown. All data was reviewed, no errors where found in the calculations. The employee was observed performing this analysis and no deviations from the procedure where observed. The employee's results have been good in the past; no further action is planned.					
QCMI-34	MILK	Feb, 1991	I-131	40.7 ± 1.8	40.1	28.1 - 52.1
QCW-75	WATER	Mar, 1991	Sr-89	18.8 ± 1.5	23.3	13.3 - 33.3
			Sr-90	16.0 ± 0.8	17.2	7.2 - 27.2
QCMI-35	MILK	Apr, 1991	I-131	48.0 ± 0.8	49.2	37.2 - 61.2
			Cs-134	19.2 ± 2.0	22.6	12.6 - 32.6
			Cs-137	22.8 ± 2.2	22.1	12.1 - 32.1
QCW-76	WATER	Apr, 1991	I-131	56.5 ± 1.7	59.0	47.2 - 70.8
QCW-77	WATER	Apr, 1991	Co-60	16.4 ± 2.2	15.7	5.7 - 25.7
			Cs-134	23.8 ± 2.5	22.6	12.6 - 32.6
			Cs-137	25.0 ± 2.4	21.1	11.1 - 31.1
QCW-78	WATER	Apr, 1991	H-3	4027.0 ± 188.0	4080.0	3264.0 - 4896.0
QCW-79	WATER	Jun, 1991	Gr. Alpha	7.4 ± 0.7	7.8	0.0 - 17.8
			Gr. Beta	11.0 ± 0.7	11.0	1.0 - 21.0
SPM-36	MILK	Jul, 1991	Sr-89	28.1 ± 2.1	34.0	24.0 - 44.0
			Sr-90	11.6 ± 0.7	11.5	1.5 - 21.5
			I-131	14.4 ± 1.9	18.3	6.3 - 30.3
			Cs-137	34.3 ± 3.0	35.1	25.1 - 45.1
	The cause of the low Sr-89 data is unknown. All data was reviewed, no errors where found in the calculations. The employee was observed performing this analysis and no deviations from the procedure where observed. The employee's results have been good in the past; no further action is planned.					
QCMI-37	MILK	Oct, 1991	I-131	23.6 ± 3.2	25.8	13.8 - 37.8
			Cs-134	22.7 ± 2.8	22.1	12.1 - 32.1
			Cs-137	38.3 ± 3.0	35.1	25.1 - 45.1
QCW-80	WATER	Oct, 1991	Sr-89	27.4 ± 6.9	24.4	14.4 - 34.4
			Sr-90	11.7 ± 1.4	14.1	4.1 - 24.1
QCW-81	WATER	Oct, 1991	I-131	19.1 ± 0.7	20.6	8.6 - 32.6
QCW-82	WATER	Oct, 1991	Co-60	22.6 ± 2.7	22.1	12.1 - 32.1
			Cs-134	15.5 ± 1.8	17.6	7.6 - 27.6
			Cs-137	17.5 ± 2.1	17.6	7.6 - 27.6

Table A-3. In-house "spike" samples.

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[a] TBEESML Results 2s, n=1[b]	Known Activity	Control[c] Limits
QCW-83	WATER	Oct, 1991	H-3	4639.0 ± 137.0	4382.0	3505.6 - 5258.4
QCW-84	WATER	Dec, 1991	Gr. Alpha	6.2 ± 6.0	7.8	0.0 - 17.8
			Gr. Beta	11.0 ± 0.7	11.0	1.0 - 21.0
QCMI-39	MILK	Jan, 1992	Sr-89	21.6 ± 6.5	31.2	21.2 - 41.2
			Sr-90	38.7 ± 1.8	42.3	33.8 - 50.8
			I-131	76.8 ± 0.9	83.7	67.0 - 100.4
			Cs-134	42.1 ± 5.7	49.4	39.4 - 59.4
			Cs-137	55.2 ± 6.4	53.0	43.0 - 63.0

The cause for the low result for Sr-89 analysis is unknown. Calculations and data were verified. The results of the next Sr-89 analysis in milk where within control limits (see sample QCMI-42 in this table). No further action is planned.

Lab Code	Sample Type	Date Collected	Analyses	TBEESML Results	Known Activity	Control Limits
QCW-85	WATER	Mar, 1992	Sr-89	26.2 ± 3.1	32.0	22.0 - 42.0
			Sr-90	24.4 ± 1.4	28.0	18.0 - 38.0

The cause of the low Sr-89 and Sr-90 data is unknown. All data was reviewed, no errors where found in the calculations. The employee was observed performing these analyses and no deviations from the procedures where observed. The employee's results have been good in the past; no further action is planned.

Lab Code	Sample Type	Date Collected	Analyses	TBEESML Results	Known Activity	Control Limits
QCMI-40	MILK	Apr, 1992	Cs-134	58.0 ± 2.6	55.9	45.9 - 65.9
			Cs-137	43.7 ± 3.0	38.9	28.9 - 48.9
QC MI-41	MILK	Apr, 1992	I-131	50.3 ± 0.8	55.9	44.7 - 67.1
QCW-86	WATER	Apr, 1992	H-3	4080.0 ± 190.0	4027.0	3221.6 - 4832.4
QCW-87	WATER	Apr, 1992	I-131	33.5 ± 0.6	33.2	21.2 - 45.2
QCW-88	WATER	Apr, 1992	Co-60	17.5 ± 2.7	19.7	9.7 - 29.7
			Cs-134	28.9 ± 2.5	33.5	23.5 - 43.5
			Cs-137	41.0 ± 3.0	38.9	28.9 - 48.9
QCW-89	WATER	Jun, 1992	Gr. Alpha	15.3 ± 0.8	13.6	3.6 - 23.6
			Gr. Beta	17.2 ± 0.9	17.6	7.6 - 27.6
QCMI-42	MILK	Aug, 1992	Sr-89	41.4 ± 5.9	51.2	41.0 - 61.4
			Sr-90	48.9 ± 2.5	51.9	41.5 - 62.3
			Cs-134	20.1 ± 2.8	20.2	10.2 - 30.2
			Cs-137	26.2 ± 2.7	26.1	16.1 - 36.1

The cause of the low Sr-89 data is unknown. All data was reviewed, no errors where found in the calculations. The employee was observed performing this analysis and no deviations from the procedure where observed. The employee's results have been good in the past; no further action is planned.

Table A-3. In-house "spike" samples.

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[a] TBEESML Results 2s, n=1[b]	Known Activity	Control[c] Limits
QCW-90	WATER	Sep, 1992	Sr-89	6.7 ± 3.4	12.6	2.6 - 22.6
			Sr-90	16.1 ± 1.4	15.6	5.6 - 25.6
	The cause for the low result for Sr-89 analysis is unknown. Calculations and data were verified. The results of the next Sr-89 analysis in water where within control limits (see sample SPW-3556 in this table). No further action is planned.					
QCMI-43	MILK	Oct, 1992	I-131	19.9 ± 1.0	21.5	9.5 - 33.5
			Cs-134	14.2 ± 3.4	12.7	2.7 - 22.7
			Cs-137	14.1 ± 5.2	17.1	7.1 - 27.1
QCMI-44	MILK	Oct, 1992	I-131	36.1 ± 1.2	43.0	31.0 - 55.0
			Cs-134	28.2 ± 4.0	25.4	15.4 - 35.4
			Cs-137	38.8 ± 5.1	34.2	24.2 - 44.2
	The cause of the low I-131 data is unknown. All data was reviewed, no errors where found in the calculations. The employee was observed performing this analysis and no deviations from the procedure where observed. The employee's results have been good in the past; no further action is planned.					
QCW-91	WATER	Oct, 1992	I-131	34.9 ± 2.2	34.9	22.9 - 46.9
QCW-92	WATER	Oct, 1992	Co-60	11.4 ± 1.9	9.2	0.0 - 19.2
			Cs-134	18.7 ± 2.3	14.3	4.3 - 24.3
			Cs-137	14.1 ± 1.8	15.0	5.0 - 25.0
QCW-93	WATER	Oct, 1992	H-3	3704.0 ± 186.0	3904.0	3169.2 - 4638.8
QCW-94	WATER	Oct, 1992	H-3	14925.0 ± 339.0	15616.0	12492.8 - 18739.2
QCW-95	WATER	Oct, 1992	I-131	64.2 ± 2.7	67.2	53.8 - 80.6
QCW-36	WATER	Dec, 1992	Alpha	11.5 ± 2.3	15.2	9.1 - 21.3
			Beta	26.5 ± 2.0	25.7	15.4 - 36.0
QCW-96	WATER	Dec, 1992	Gr. Alpha	8.3 ± 0.6	10.4	0.4 - 20.4
			Gr. Beta	19.8 ± 1.5	20.6	10.6 - 30.6
SPM-3341	MILK	Jan, 1993	Sr-89	6.7 ± 3.1	8.7	0.0 - 18.7
			Sr-90	20.0 ± 1.2	19.2	9.2 - 29.2
			Cs-134	17.1 ± 2.0	21.3	11.3 - 31.3
			Cs-137	21.4 ± 2.0	23.8	13.8 - 33.8
SPM-3387	MILK	Feb, 1993	I-131	72.5 ± 8.4	71.5	57.2 - 85.8
SPVE-3401	VEGETATION (SAW DUST)	Feb, 1993	I-131	994.5 ± 53.2	953.7	763.0 - 1144.4
SPCH-3402	CHARCOAL	Feb, 1993	I-131	95.2 ± 12.8	95.4	76.3 - 114.5
SPW-3434	WATER	Apr, 1993	Gr. Alpha	10.4 ± 1.8	10.4	0.4 - 20.4
			Gr. Beta	22.0 ± 2.0	20.6	10.6 - 30.6

Table A-3. In-house "spike" samples.

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[a] TBEESML Results 2s, n=1[b]	Known Activity	Control[c] Limits
SPW-3556	WATER	Apr, 1993	Sr-89	18.2 ± 5.0	22.2	12.2 - 32.2
			Sr-90	20.1 ± 1.8	17.0	7.0 - 27.0
SPW-3597	WATER	Apr, 1993	H-3	5464.0 ± 219.0	5428.0	4342.4 - 6513.6
SPW-3599	WATER	Apr, 1993	I-131	149.8 ± 1.9	145.0	116.0 - 174.0
SPW-3606	WATER	Apr, 1993	Co-60	24.8 ± 2.3	21.5	11.5 - 31.5
			Cs-134	26.4 ± 1.9	26.4	16.4 - 36.4
			Cs-137	33.9 ± 2.6	31.7	21.7 - 41.7
SPM-3631	MILK	Apr, 1993	I-131	139.8 ± 1.6	145.0	116.0 - 174.0
			Cs-134	48.8 ± 2.9	52.8	42.8 - 62.8
			Cs-137	65.2 ± 2.9	63.4	53.4 - 73.4
SPF-3681	FISH (JELLO)	May, 1993	Cs-137	68.2 ± 7.7	67.6	57.6 - 77.6
	Concentrations are in pCi/Total Volume (550g).					
SPW-3842	WATER	Jun, 1993	Th-230	4.2 ± 0.5	4.5	2.7 - 6.3
SPW-4160	WATER	Jun, 1993	Alpha	8.9 ± 1.4	12.9	7.7 - 18.1
			Beta	22.0 ± 1.9	31.9	19.1 - 44.7
SPW-4232	WATER	Aug, 1993	Fe-55	1684.0 ± 415.0	1420.0	1136.0 - 1704.0
SPW-4246	WATER	Aug, 1993	Sr-90	32.2 ± 2.6	30.4	24.3 - 36.5
SPM-4247	MILK	Aug, 1993	Sr-89	29.1 ± 4.9	35.4	25.4 - 45.4
			Sr-90	18.3 ± 1.3	19.2	9.2 - 29.2
SPW-4248	WATER	Aug, 1993	H-3	9910.0 ± 300.0	10430.0	8344.0 - 12516.0
SPW-4250	WATER	Aug, 1993	Co-60	247.0 ± 23.1	247.7	222.9 - 272.5
			Cs-134	141.6 ± 15.9	141.1	127.0 - 155.2
			Cs-137	283.5 ± 27.8	247.2	222.5 - 271.9
	The cause of the high Cs-137 data is unknown. All data was reviewed, no errors where found in the calculations. The employee was observed performing this analysis and no deviations from the procedure where observed. The employee's results have been good in the past; no further action is planned.					
SPF-4251	FISH (JELLO)	Aug, 1993	Cs-134	68.8 ± 3.3	75.3	65.3 - 85.3
			Cs-137	203.6 ± 8.2	198.1	178.3 - 217.9
SPS-4262	SEDIMENT (BOTTOM)	Aug, 1993	Cs-134	74.1 ± 9.9	71.0	61.0 - 81.0
			Cs-137	..4 ± 14.8	197.8	178.0 - 217.6
SPW-4377	WATER	Sep, 1993	I-131	39.0 ± 10.0	42.1	30.1 - 54.1
SPM-4378	MILK	Sep, 1993	I-131	44.5 ± 5.5	42.1	30.1 - 54.1
SPCH-4379	CHARCOAL	Sep, 1993	I-131	90.3 ± 13.5	84.3	67.4 - 101.2
SPVE-4380	VEGETATION (SAW DUST)	Sep, 1993	I-131	193.2 ± 20.0	170.2	136.2 - 204.2

Table A-3. In-house "spike" samples.

Lab Code	Sample Type	Date Collected	Analyses	Concentration in pCi/L[a] TBEESML Results 2s, n=1[b]	Known Activity	Control[c] Limits
SPW-4381	WATER	Sep, 1993	Sr-89	21.9 ± 4.0	28.8	18.8 - 38.8
			Sr-90	19.5 ± 1.8	19.0	9.0 - 29.0
SPW-4382	WATER	Sep, 1993	I-129	18.1 ± 1.0	18.6	6.6 - 30.6
SPW-4421	WATER	Oct, 1993	H-3	16900.0 ± 368.0	17380.0	13904.0 - 20856.0
SPW-4428	WATER	Oct, 1993	Co-60	19.3 ± 3.1	18.3	8.3 - 28.3
			Cs-134	31.5 ± 3.3	33.5	23.5 - 43.5
			Cs-137	44.4 ± 3.6	43.2	33.2 - 53.2
SPM-4426	MILK	Oct, 1993	I-131	49.7 ± 8.6	44.5	32.5 - 56.5
			Cs-134	30.8 ± 4.5	33.0	23.0 - 43.0
			Cs-137	43.4 ± 6.0	43.2	33.2 - 53.2
SPW-4427	WATER	Oct, 1993	I-131	95.2 ± 10.6	88.9	71.1 - 106.7

[a] All results are in pCi/L, except elemental potassium (K) data in milk, which are in mg/L.; air filter samples, which are in pCi/Filter; charcoal which are in pCi/charcoal; and food products which are in mg/kg.

[b] All samples prior to January 1991 are the results or three determinations; after January 1991, all determinations are single.

[c] Control Limits are based on EPA publication; "Environmental Radioactive Laboratory Intercomparison Studies Program", Fiscal Year 1981-1982, EPA-600/4-81-004 (see Attachment A) or limits imposed by TBEESML.

Table A-4. In-house "blank" samples.

				Concentration pCi/L[a]		
				TBEESML Results (4.66 Sigma)		Acceptance Criteria
Lab Code	Sample Type	Sample Date	Analyses	LLD	Activity[b]	(4.66 Sigma)
SPW-8039	WATER	Jan 1990	Ra-226	< 0.2		< 1.0
SPM-8040	MILK	Jan 1990	Sr-89	< 0.8		< 5.0
			Sr-90	< 1.0		< 1.0
SPM-8208	MILK	Jan 1990	Sr-89	< 0.8		< 5.0
			Sr-90	N/A	1.6 ± 0.5	< 1.0
			Cs-134	< 3.6		< 10.0
			Cs-137	< 4.7		< 10.0
	Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.					
SPM-8312	MILK	Feb 1990	Sr-89	< 0.3		< 5.0
			Sr-90	N/A	1.2 ± 0.3	< 1.0
	Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.					
SPW-8312	WATER	Feb 1990	Sr-89	< 0.6		< 5.0
			Sr-90	< 0.7		< 1.0
SPM-8314	MILK	Mar 1990	I-131	< 0.3		< 1.0
SPM-8510	MILK	May 1990	I-131	< 0.2		< 1.0
			Cs-134	< 4.6		< 10.0
			Cs-137	< 4.8		< 10.0
SPW-8511	WATER	May 1990	H-3	< 200.0		< 300.0
SPM-8600	MILK	Jul 1990	Sr-89	< 0.8		< 5.0
			Sr-90	N/A	1.7 ± 0.6	< 1.0
			I-131	< 0.3		< 1.0
			Cs-134	< 5.0		< 10.0
			Cs-137	< 7.0		< 10.0
	Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.					
SPM-8877	MILK	Aug 1990	I-131	< 0.2		< 1.0
SPW-8925	WATER	Aug 1990	H-3	< 200.0		< 300.0
SPW-8926	WATER	Aug 1990	Gr. Alpha	< 0.3		< 1.0
			Gr. Beta	< 0.7		< 5.0
SPW-8927	WATER	Aug 1990	U-234	< 0.01		< 1.0
			U-235	< 0.02		< 1.0
			U-238	< 0.01		< 1.0
SPW-8928	WATER	Aug 1990	Mn-54	< 4.0		< 10.0
			Co-58	< 4.1		< 10.0
			Co-60	< 2.4		< 10.0
			Cs-134	< 3.3		< 10.0
			Cs-137	< 3.7		< 10.0
SPW-8929	WATER	Aug 1990	Sr-89	< 1.4		< 5.0
			Sr-90	< 0.6		< 1.0

Table A-4. In-house "blank" samples.

				Concentration pCi/L[a]		
				TBEESML Results (4.66 Sigma)		Acceptance Criteria
Lab Code	Sample Type	Sample Date	Analyses	LLD	Activity[b]	(4.66 Sigma)
SPW-69	WATER	Sep 1990	Sr-89	< 1.8		< 5.0
			Sr-90	< 0.8		< 1.0
SPW-106	WATER	Oct 1990	H-3	< 180.0		< 300.0
			I-131	< 0.3		< 1.0
SPM-107	MILK	Oct 1990	I-131	< 0.4		< 1.0
			Cs-134	< 3.3		< 10.0
			Cs-137	< 4.3		< 10.0
SPW-370	WATER	Oct 1990	Mn-54	< 1.7		< 10.0
			Co-58	< 2.6		< 10.0
			Co-60	< 1.6		< 10.0
			Cs-134	< 1.7		< 10.0
			Cs-137	< 1.8		< 10.0
SPW-372	WATER	Dec 1990	Gr. Alpha	< 0.3		< 1.0
			Gr. Beta	< 0.8		< 5.0
SPM-406	MILK	Jan 1991	Sr-89	< 0.4		< 5.0
			Sr-90	N/A	1.8 ± 0.4	< 1.0
			Cs-134	< 3.7		< 10.0
			Cs-137	< 5.2		< 10.0
	Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.					
SPM-421	MILK	Feb 1991	I-131	< 0.3		< 1.0
SPM-451	MILK	Feb 1991	Ra-226	< 0.1		< 1.0
			Ra-228	< 0.9		< 1.0
SPW-514	WATER	Mar 1991	Sr-89	< 1.1		< 5.0
			Sr-90	< 0.9		< 1.0
SPW-586	WATER	Apr 1991	I-131	< 0.2		< 1.0
			Co-60	< 2.5		< 10.0
			Cs-134	< 2.4		< 10.0
			Cs-137	< 2.2		< 10.0
SPM-587	MILK	Apr 1991	I-131	< 0.2		< 1.0
			Cs-134	< 1.7		< 10.0
			Cs-137	< 1.9		< 10.0
SPW-837	WATER	Jun 1991	Gr. Alpha	< 0.6		< 1.0
			Gr. Beta	< 1.1		< 5.0
SPM-953	MILK	Jul 1991	Sr-89	< 0.7		< 5.0
			Sr-90	N/A	0.4 ± 0.3	< 1.0
			I-131	< 0.2		< 1.0
			Cs-137	< 4.9		< 10.0
SPM-1236	MILK	Oct 1991	I-131	< 0.2		< 1.0
			Cs-134	< 3.7		< 10.0
			Cs-137	< 4.6		< 10.0

Table A-4. In-house "blank" samples.

Lab Code	Sample Type	Sample Date	Analyses	Concentration pCi/L[a] TBEESML Results (4.66 Sigma) LLD	Activity[b]	Acceptance Criteria (4.66 Sigma)
SPW-1254	WATER	Oct 1991	Sr-89	< 2.8		< 5.0
			Sr-90	< 0.7		< 1.0
SPW-1256	WATER	Oct 1991	I-131	< 0.4		< 1.0
			Co-60	< 3.6		< 10.0
			Cs-134	< 4.0		< 10.0
			Cs-137	< 3.0		< 10.0
SPW-1259	WATER	Oct 1991	H-3	< 160.0		< 300.0
SPW-1444	WATER	Dec 1991	Gr. Alpha	< 0.4		< 1.0
			Gr. Beta	< 0.8		< 5.0
SPM-1578	MILK	Jan 1992	Sr-89	< 0.5		< 5.0
			Sr-90	N/A	1.3 ± 0.4	< 1.0
			I-131	< 0.2		< 1.0
			Cs-134	< 7.2		< 10.0
			Cs-137	< 8.0		< 10.0
	Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.					
SPW-1860	WATER	Mar 1992	Sr-89	< 0.6		< 5.0
			Sr-90	< 0.4		< 1.0
SPW-2067	WATER	Apr 1992	H-3	< 168.0		< 300.0
SPW-2114	WATER	Apr 1992	C-14	< 1.0		< 200.0
SPM-2119	MILK	Apr 1992	Co-60	< 6.3		< 10.0
			Cs-134	< 4.5		< 10.0
			Cs-137	< 5.4		< 10.0
SPW-2126	WATER	Apr 1992	I-131	< 0.2		< 1.0
SPM-2133	MILK	Apr 1992	I-131	< 0.2		< 1.0
SPW-2220	WATER	May 1992	Co-60	< 2.1		< 10.0
			Cs-134	< 2.1		< 10.0
			Cs-137	< 2.3		< 10.0
SPW-2369	WATER	Jun 1992	Gr. Alpha	< 0.4		< 1.0
			Gr. Beta	< 0.8		< 5.0
SPM-2500	MILK	Aug 1992	I-131	< 0.4		< 1.0
			Sr-89	< 1.2		< 5.0
			Sr-90	< 0.9		< 1.0
SPW-2666	WATER	Sep 1992	Sr-89	< 0.8		< 5.0
			Sr-90	< 0.5		< 1.0
SPW-2828	WATER	Oct 1992	Co-60	< 4.8		< 10.0
			Cs-134	< 6.0		< 10.0
			Cs-137	< 6.1		< 10.0
			I-131	< 0.3		< 1.0
			H-3	< 177.0		< 300.0

Table A-4. In-house "blank" samples.

				Concentration pCi/L[a].		
				TBEESML Results (4.66 Sigma)		Acceptance Criteria
Lab Code	Sample Type	Sample Date	Analyses	LLD	Activity[b]	(4.66 Sigma)
SPM-2829	MILK	Oct 1992	Co-60	< 9.3		< 10.0
			Cs-134	< 6.4		< 10.0
			Cs-137	< 7.2		< 10.0
SPW-3212	WATER	Oct 1992	Ra-228	< 1.0		< 1.0
SPW-3057	WATER	Nov 1992	Ra-226	< 0.03		< 1.0
SPW-3294	WATER	Dec 1992	Gr. Alpha	< 0.4		< 1.0
			Gr. Beta	< 0.8		< 5.0
SPM-3342	MILK	Jan 1993	Sr-89	< 0.7	-0.9 ± 1.1	< 5.0
			Sr-90	N/A	1.6 ± 0.5	< 1.0
			Cs-134	< 4.1	-0.9 ± 2.6	< 10.0
			Cs-137	< 3.9	0.8 ± 2.2	< 10.0
	Low levels of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.					
SPM-3386	MILK	Feb 1993	I-131	< 0.2	0.1 ± 0.1	< 1.0
SPW-3557	WATER	Mar 1993	Sr-89	< 0.5	0.3 ± 0.5	< 5.0
			Sr-90	< 0.5	0.1 ± 0.2	< 1.0
SPW-3598	WATER	Apr 1993	H-3	< 180.0	84.7 ± 94.2	< 300.0
SPW-3600	WATER	Apr 1993	I-131	< 0.2	0.1 ± 0.2	< 1.0
SPW-3601	WATER	Apr 1993	Co-60	< 4.2		< 10.0
			Cs-134	< 4.4		< 10.0
			Cs-137	< 3.4		< 10.0
			I-131	< 0.4	0.3 ± 0.9	< 1.0
	Activity results for the gamma-emitters are not available for this sample.					
SPM-3651	MILK	May 1993	I-131	< 0.2	0.1 ± 0.1	< 1.0
			Cs-134	< 4.4		< 10.0
			Cs-137	< 6.3		< 10.0
	Activity results for the gamma-emitters are not available for this sample.					
SPFP-3680	FOOD	May 1993	Cs-137	< 6.5	0.0 ± 0.0	< 10.0
SPW-3844	WATER	Jun 1993	Th-228	< 0.1	0.0 ± 0.1	< 1.0
			Th-230	< 0.1	0.2 ± 0.1	< 1.0
			Th-232	< 0.1	0.0 ± 0.0	< 1.0
SPW-4234	WATER	Jun 1993	Gr. Alpha	< 0.3	0.0 ± 0.2	< 1.0
			Gr. Beta	< 0.8	0.2 ± 0.3	< 5.0
SPS-4059	SEDIMENT (BOTTOM)	Jul 1993	Cs-134	< 5.0	0.0 ± 0.0	< 10.0
			Cs-137	< 7.2	0.0 ± 0.0	< 10.0
SPVE-4060	VEGETATION (SAW DUST)	Jul 1993	I-131(g)	< 13.5	0.0 ± 0.0	< 20.0
			Cs-134	< 4.8	0.0 ± 0.0	< 10.0
			Cs-137	< 6.4	0.0 ± 0.0	< 10.0
SPM-4061	MILK	Jul 1993	Cs-134	< 8.6	0.0 ± 0.0	< 10.0
			Cs-137	< 5.8	0.0 ± 0.0	< 10.0

Table A-4. In-house "blank" samples.

Lab Code	Sample Type	Sample Date	Analyses	Concentration pCi/L[a]. TBEESML Results (4.66 Sigma) LLD	Activity[b]	Acceptance Criteria (4.66 Sigma)
SPM-4062	MILK	Jul 1993	Cs-134	< 3.8	1.5 ± 1.5	< 10.0
			Cs-137	< 4.4	-1.6 ± 3.3	< 10.0
SPW-4063	WATER	Jul 1993	Co-60	< 4.0	1.2 ± 2.3	< 10.0
			Cs-134	< 3.7	0.3 ± 1.2	< 10.0
			Cs-137	< 3.2	0.4 ± 3.2	< 10.0
SPAP-4064	AIR FILTER (COMPOSITE)	Jul 1993	Cs-134	< 2.1	0.0 ± 0.0	< 10.0
			Cs-137	< 2.8	0.0 ± 0.0	< 10.0
SPCH-406	CHARCOAL	Jul 1993	I-131	< 0.1	0.0 ± 0.0	< 1.0
	Based on a volume of 300 m^3					
SPW-4233	WATER	Aug 1993	Fe-55	< 506.0	0.0 ± 0.3	< 1000.0
SPM-4235	MILK	Aug 1993	I-131	< 0.1	0.0 ± 0.2	< 1.0
			Cs-134	< 8.1	1.6 ± 1.8	< 10.0
			Cs-137	< 4.2	-1.7 ± 3.4	< 10.0
			Sr-89	< 0.8	-1.0 ± 1.1	< 5.0
			Sr-90	N/A	1.8 ± 0.5	< 1.0
	Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.					
SPW-4241	WATER	Aug 1993	H-3	< 190.0	72.9 ± 99.1	< 300.0
SPW-4243	WATER	Aug 1993	Sr-89	< 1.1	-0.6 ± 0.9	< 5.0
			Sr-90	< 0.7	0.4 ± 0.4	< 1.0
			I-131	< 0.5	0.0 ± 0.1	< 1.0
			Co-60	< 7.0	0.4 ± 3.1	< 10.0
			Cs-134	< 7.6	0.8 ± 15.6	< 10.0
			Cs-137	< 5.4	-0.7 ± 4.2	< 10.0
SPW-4244	WATER	Aug 1993	U-233/234	< 0.1	0.1 ± 0.1	< 1.0
			U-235	< 0.1	0.0 ± 0.1	< 1.0
			U-238	< 0.1	0.1 ± 0.1	< 1.0
			Th-228	< 0.4	-0.1 ± 0.3	< 1.0
			Th-230	< 0.1	0.0 ± 0.1	< 1.0
			Th-232	< 0.1	0.0 ± 0.0	< 1.0
			Pu-238	< 1.0	0.4 ± 0.7	< 1.0
			Pu-239/240	< 0.3	0.1 ± 0.2	< 1.0
SPW-4245	WATER	Aug 1993	Ra-226	< 0.1	0.0 ± 0.0	< 1.0
			Ra-228	< 0.8	-0.2 ± 0.5	< 1.0
SPW-4422	WATER	Oct 1993	H-3	< 180.0	-27.5 ± 88.9	< 300.0

[a] All results are in pCi/L, except for air filter samples, which are in pCi/Filter.

[b] Prior to 1993, results where reported as only an LLD, the activity reported is the net activity result.