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Quad Cities Nuclear Power Station
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RLB-92-048

February 20, 1992

Mr. Bert Davis
Administrator
Nuclear Regulatory Commission Region III
799 Roosevelt Road
Glen Ellyn, IL 60137

Dear Mr. Davis:

Enclosed is Part 3 of the 1991 Quad Cities Station Operating Report, Docket Number 50-254 and 50-265. This report contains the results of the Radiological Environmental and Meteorological Monitoring Programs. Part 1, facility operating experience was submitted under separate cover in February, and Part 2, radioactive effluents in February and August.

Two copies of the report are provided for your use. Two copies will be forwarded to Document Control Desk and one copy to the Resident Inspector.

Sincerely,

Richard L. Bax
Station Manager
Commonwealth Edison
Quad Cities Nuclear Power Station

RLB/JGW/as

Enclosures

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QUAD CITIES STATION
ANNUAL RADIOLOGICAL
ENVIRONMENTAL OPERATING
REPORT

1991

MARCH 1992

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INTRODUCTION

Units 1 and 2 of the Quad Cities Station located near Cordova, Illinois next to the Mississippi River, are 2511 Mwth boiling water reactors, similar in design to Dresden Units 2 and 3. The plant has been designed to keep releases to the environment at levels below those specified in the regulations.

Liquid effluents from Quad Cities are released to the Mississippi River in controlled batches after radioassay of each batch. Gaseous effluents are released to the atmosphere after delay to permit decay of short half-life gases. Releases to the atmosphere are calculated on the basis of analyses of grab samples of noble gases and continuously collected composite samples of iodine and particulate matter. The results of effluent analyses are summarized on a monthly basis and reported to the Nuclear Regulatory Commission as required per Technical Specifications. Airborne concentrations of noble gases, I-131, and particulate radioactivity in offsite areas are calculated using isotopic composition of effluents and meteorological data.

Environmental monitoring is conducted by sampling at indicator and reference (control) locations in the vicinity of the Quad Cities plant to measure changes in radiation or radioactivity levels that may be attributable to plant operations. If significant changes attributable to Quad Cities are measured, these changes are correlated with effluent releases. External gamma radiation exposure from noble gases and I-131 in milk are the most critical pathways at this site; however, an environmental monitoring program is conducted which includes other pathways.

SUMMARY

Gaseous and liquid effluents for the period remained at a fraction of the Technical Specification limits. Calculations of environmental concentrations based on effluents and meteorological data for the period indicate that consumption by the public of radionuclides attributable to the plant are well below the regulatory limits. Radiation exposure from radionuclides released to the atmosphere represented the critical pathway for the period with a maximum individual dose estimated to be $1.58E-03$ mrem for the year, when a shielding and occupancy factor of 0.7 is assumed. The assessment of radiation doses are performed in accordance with the Offsite Dose Calculation Manual (ODCM). The results of analysis confirm that the station is operating in compliance with 10CFR50 Appendix I and 40 CFR 190.

1.0 EFFLUENTS

1.1 Gaseous Effluents to the Atmosphere

Measured concentrations and isotopic composition of noble gases, radiiodine, and particulate radioactivity released to the atmosphere during the year, are listed in Table 1.1-1. A total of $4.22E+01$ curies of fission and activation gases were released with a quarterly average release rate of $1.33 \mu\text{Ci}/\text{sec}$.

A total of $1.57E-03$ curies of I-131 was released during the year, with a quarterly average release rate of $4.97E-05 \mu\text{Ci}/\text{sec}$.

A total of $1.62E-02$ curies of beta-gamma emitters was released as airborne particulate matter, with a quarterly average release rate of $5.16E-04 \mu\text{Ci}/\text{sec}$. Release of alpha emitters remained below the lower limit of detection throughout the year.

A total of $1.50E+02$ curies of tritium was released, with an average release rate of $4.74 \mu\text{Ci}/\text{sec}$.

1.2 Liquids Released to the Mississippi

A total of $9.74E+05$ liters of radioactive liquid waste (prior to dilution) containing $7.34E-01$ curies (excluding tritium, gases, and alpha) were discharged after dilution with a total of $3.90E+07$ liters of water. These wastes were released at a quarterly average concentration of $3.18E-09 \mu\text{Ci}/\text{mL}$. Total alpha activity and the average alpha emitter concentrations were below the lower limit of detection (LLD) for each quarter. A total of 4.43 curies of tritium was released at a quarterly average concentration of $8.94E-07 \mu\text{Ci}/\text{mL}$. Quarterly release estimates and principal radionuclides in liquid effluents are given in Table 1.2-1.

2.0 SOLID RADIOACTIVE WASTE

Solid radioactive wastes were shipped to Richland, Washington; Channahon, Illinois; Oak Ridge, Tennessee; Barnwell, South Carolina; and Madison, Pennsylvania. The record of waste shipments is summarized in Table 2.0-1.

3.0 DOSE TO MAN

3.1 Gaseous Effluent Pathways

Gamma Dose Rates

Gamma air and total body dose offsite were calculated based on measured release rates, isotopic composition of the noble gases, and meteorological data for the period (Table 3.1-1). Isodose contours of gamma dose are shown in Figure 3.1-1. Based on measured effluents and meteorological data, the maximum total dose to an individual would be $1.58E-03$ mrem for the year, with an occupancy or shielding factor of 0.7 included. The maximum gamma air dose was $2.81E-03$ mrad.

Beta Air and Skin Rates

The range of beta particles in air is relatively small (on the order of a few meters or less); consequently, plumes of gaseous effluents may be considered "infinite" for purpose of calculating the dose from beta radiation incident on the skin. However, the actual dose to sensitive skin tissues is difficult to calculate because this depends on the beta particle energies, thickness of inert skin, and clothing covering sensitive tissues. For purposes of this report the skin is taken to have a thickness of 7 mg/cm^2 and an occupancy factor of 1.0 is used. The skin dose from beta and gamma radiation for the year was $2.60E-03$ mrem.

The air concentrations of radioactive noble gases at the offsite receptor locations are given in Figure 3.1-2. The maximum offsite beta air dose for the year was $5.49E-04$ mrad.

Radioactive Iodine

The human thyroid exhibits a significant capacity to concentrate ingested or inhaled iodine. The radioiodine, $I-131$, released during routine operation of the plant, may be made available to a person, resulting in a dose to the thyroid. The principal pathway of interest for this radionuclide is ingestion of radioiodine in milk by an infant.

Radioiodine Concentrations in Air

The calculated concentration contours for iodine in air are shown in Figure 3.1-3. These calculations include an iodine cloud depletion factor which accounts for the phenomenon of elemental iodine

deposition on the ground. The maximum offsite iodine concentration is estimated to be $1.04E-04$ pCi/m³ for the year.

Dose to Infant's Thyroid

The hypothetical thyroid dose to an infant living near the plant via ingestion of milk was calculated. The radionuclide considered was I-131 and the source of milk was taken to be the nearest dairy farm with the cows pastured from May to October. The maximum infant's thyroid dose was 0.10 mrem during the year (Table 3.1-1).

Concentrations of Particulates in Air

Concentration contours of radioactive airborne particulates are shown in Figure 3.1-4. The maximum offsite level is estimated to be $1.97E-03$ pCi/m³.

Summary of Doses

Table 3.1-1 summarizes the doses resulting from releases of airborne radioactivity via the different exposure pathways.

3.2 Liquid Effluent Pathways

The three principal pathways through the aquatic environment for potential doses to man from liquid waste are ingestion of potable water, eating aquatic foods, and exposure while walking on the shoreline. Not all of these pathways are applicable at a given time or station but a reasonable approximation of the dose can be made by adjusting the dose formula for season of the year or type and degree of use of the aquatic environment. NRC* developed equations were used to calculate the doses to the whole body, lower GI tract, thyroid, bone and skin; specific parameters for use in the equations are given in the Commonwealth Edison Offsite Dose Calculation Manual. The maximum whole body dose for the year was $3.84E-03$ mrem and no organ dose exceeded $1.06E-02$ mrem (Table 3.2-1).

3.3 Assessment of Dose to Member of Public

In Section 3/4.8 of the Quad Cities Technical Specifications, 40CFR190 calculations of total dose due to the Uranium fuel Cycle are required only when calculated doses from liquid or gaseous releases of radioactivity exceed certain levels. These levels are twice the following limits:

* Nuclear Regulatory Commission, Regulatory Guide 1.109 (Rev. 1).

- The RETS limits on dose commitment due to radioactive materials in liquid effluents from each reactor unit (3 mrem to the whole body or 10 mrem to any organ during any calendar quarter; 6 mrem to the whole body or 20 mrem to any organ during any calendar year).
- The RETS limits on air dose in noble gases released in gaseous effluents to a member of the public from each reactor unit (5 mrad for gamma radiation or 10 mrad for beta radiation during any calendar quarter; 10 mrad for gamma radiation or 20 mrad for beta radiation during any calendar year).
- The RETS limits on dose to a member of the public due to iodine-131, iodine-133, tritium, and radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released from each reactor unit (7.5 mrems to any organ during any calendar quarter; 15 mrems to any organ during any calendar year).

During the period January to December, 1991, Quad Cities Station did not exceed these criteria offsite and members of the public did not exceed these criteria within the restricted area, as indicated by TLD measurements in Table 5.1-1 (assuming 100% occupancy).

4.0 SITE METEOROLOGY

A summary of the site meteorological measurements taken during each quarter of the year is given in Appendix II. The data are presented as cumulative joint frequency distributions of 296' level wind direction and wind speed class by atmospheric stability class determined from the temperature difference between the 296' and 33' levels. Data recovery for all measurements on the tower was about 99.5%.

5.0 ENVIRONMENTAL MONITORING

Table 5.0-1 provides an outline of the Radiological Environmental Monitoring Program as required in current Technical Specifications. Table 5.0-2 identifies the sampling locations, sample collections and analyses for each location. Figure 5.0-3 identifies the milk, fish, water and sediment locations. This program went into effect in November 1977 and differs from previous programs in the number and types of analyses performed. Tables 5.0-3 to 5.0-6 summarize data for the year.

5.1 Gamma Radiation

External radiation dose was measured at six indicator and ten reference (control) locations using $\text{CaSO}_4:\text{M}$ thermoluminescent dosimeters (TLDs). A comparison of the TLD results for reference stations with onsite and offsite indicator stations is included in Table 5.1-1. A total of 61 additional TLDs were installed on June 1, 1980 which includes TLDs in the inner and outer rings. Locations of the TLDs are shown in Figures 5.0-1 and 5.0-2.

Quarterly average of external radiation dose at sixteen air sampling locations averaged $(15.8 \pm 1.4 \text{ mR})$ and was similar to levels measured in 1986 (13.5 mR), 1987 (14.1 mR), 1988 (13.4 mR), 1989 (14.5 mR), and 1990 (14.6 mR). The differences are not statistically significant.

5.2 Airborne I-131 and Particulate Radioactivity

Locations of the air samplers are shown in Figure 5.0-1. Airborne I-131 remained below the LLD of 0.10 pCi/m^3 throughout the year.

Gross beta concentration ranged from 0.006 to 0.052 pCi/m^3 and averaged 0.022 pCi/m^3 and was similar to levels in 1985 (0.024 pCi/m^3), 1986 (0.025 pCi/m^3 , except for the period from May 17 through June 7 when it was influenced by the nuclear reactor accident at Chernobyl), 1987 (0.023 pCi/m^3), 1988 (0.030 pCi/m^3), 1989 (0.028 pCi/m^3), and 1990 (0.020 pCi/m^3).

No radioactivity attributable to plant operation was detected in any sample.

5.3 Aquatic Radioactivity

Water samples were collected daily and composited for analysis weekly from the Station's Inlet and Discharge Canal. Samples were collected from the East Moline Water Works, and Davenport Water Works. The cooling water samples were analyzed weekly for gross beta concentrations. Annual mean gross beta concentration in the inlet and discharge canal water samples averaged 4.0 and 4.3 pCi/L , respectively. The results were similar to those obtained in 1986 through 1990.

Samples from the two water works were composited monthly for each location and analyzed for gamma emitters. All samples analyzed were below the limits of detection for the program indicating that there was no measurable amount of radioactivity due to station operation present.

Levels of gamma radioactivity in fish were measured and found in all cases to be below the lower limits of detection for the program.

An upstream and two downstream sediment samples were analyzed by gamma spectrometry. All gamma-emitters, except Cs-137, were below the limits of detection. Cs-137 measured 0.13 pCi/g dry weight in the upstream sample. The downstream samples measured 0.053 and 0.038 pCi/g dry weight which were taken 3.3 and 15 miles, respectively, downstream of the discharge point in 1992. The results were similar to those obtained in 1985 through 1990.

5.4 Milk

Milk samples were collected monthly from November through April and weekly from May through October and analyzed for iodine-131. Sampled locations were the Dornbush Dairy Farm, located about 6.0 miles northeast of the Station, Musal Dairy Farm, located 5.5 miles southwest of the Station, and Waite Farm, located 13.0 miles east southeast of the station.

I-131 remained below the detection limits of 5.0 pCi/L during the non-grazing period (November to April) and 0.5 pCi/L during the grazing period (May to October).

5.5 Sample Collections

All samples were collected as scheduled except those listed in Listing of Missed Samples, Appendix III.

5.6 Program Modifications

The Quad Cities Station REMP sediment sample location was evaluated and found not to be a representative downstream sample. As a result of this determination, additional sediment samples were taken at approximately three and fifteen miles downstream from the plant. The program will now include one sediment sample location upstream and one downstream of the discharge point. Technical Specifications require one downstream sediment sample.

In April of 1991, Donald Waite Dairy Farm was added to the program. The addition of this farm was not required by the ODCM but was added to ensure that the program has at least two milking stations.

6.0 ANALYTICAL PROCEDURES

Analytical procedures used for analyzing radioactivity in environmental samples are presented in Appendix VI.

7.0 MILCH ANIMALS AND NEAREST CATTLE CENSUSES

Censuses of milch animals and nearest cattle were conducted around the Station. The survey conducted by "door-to-door" canvas and by information from Illinois and Iowa agricultural agents. The censuses were conducted by G. Kreuder on August 29, 1991.

Milch animal and nearest cattle census results are presented in Appendix IV.

8.0 NEAREST RESIDENCES CENSUS

A census of the nearest residences within a five (5) mile radius was conducted on August 29, 1991 by G. Kreuder. The location of residences remained unchanged from the previous census.

The nearest residence census results are presented in Appendix IV.

9.0 INTERLABORATORY COMPARISON PROGRAM RESULTS

Teledyne's Interlaboratory Comparison Program results are presented in Appendix IV.

Commonwealth Edison's Thermoluminescent Dosimeter (TLD) Program is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) which requires biennial review and evaluation. In addition to the biennial ANSI testing requirement, Commonwealth Edison also tests to the ANSI standard during the non-NVLAP visitation year. Commonwealth Edison additionally has an internal irradiation program that tests each of the six nuclear station TLD processors once per quarter. The results of all TLD performance tests are retained by Commonwealth Edison's Corporate Radiation Protection Department.

APPENDIX 1

DATA TABLES AND FIGURES

TABLE 1.1-1

EFFLUENT AND WASTE DISPOSAL
SEMI-ANNUAL REPORT January-June 1991
GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES

PROCEDURE: OCP 100-7

	Unit	Quarter First	Quarter Second	Est. Total Error, %
A. FISSION & ACTIVATION GASES				
1. Total Release	Ci	6.36E00	1.09E01	8.8
2. Average release rate for period	µCi/sec	8.17E-01	1.39E00	
3. Percent of Tech Spec limit * Chimney & stack	%	1.85E-02 1.75E-03	1.10E-02 1.02E-03	
B. IODINE				
1. Total Iodine-131	Ci	3.07E-04	3.44E-04	31.8
2. Average release rate for period	µCi/sec	3.95E-05	4.38E-05	
C. PARTICULATES				
1. Particulate: with half-lives > 8 days	Ci	6.25E-03	1.69E-03	17.7
2. Average release rate for period	µCi/sec	8.05E-04	2.15E-04	
3. Gross alpha radioactivity	Ci	LLD	LLD**	
D. TRITIUM				
1. Total Release	Ci	3.95E01	4.07E01	6.9
2. Average release rate for period	µCi/sec	5.08E00	5.17E00	
E. Iodine 131 & 133, Tritium and Particulates				
Percent of Tech spec Limit Chimney & stack	%	8.29E-01	6.39E-01	

*NOBLE GAS GAMMA/NOBLE GAS BETA DOSE LIMITS

** Projected value based on previous 6 months available data.

TABLE 1.1-1 (continued)

EFFLUENT AND WASTE DISPOSAL
 SFMI-ANNUAL REPORT July - December 1971
 GASEOUS EFFLUENTS - SUMMARY OF ALL RELEASES

PROCEDURE: OCP 100-7

	Unit	Quarter Third	Quarter Fourth	Est. Total Error, %
A. FISSION & ACTIVATION GASES				
1. Total Release	CI	3.17E+01	1.32E+01	8.7
2. Average release rate for period	μCi/sec	0.47E00	0.66E00	
3. Percent of Tech Spec limit * Chimney & stack	%	1.13E-02 1.10E-03	1.35E-02 1.47E-03	
B. IODINE				
1. Total Iodine-131	CI	5.05E-04	4.13E-04	31.8
2. Average release rate for period	μCi/sec	6.35E-05	5.20E-05	
C. PARTICULATES				
1. Particulates with half-lives > 8 days	CI	3.68E-03	4.62E-03	17.7
2. Average release rate for period	μCi/sec	4.64E-04	5.81E-04	
3. Gross alpha radioactivity	CI	<LLD	<LLD**	
D. TRITIUM				
1. Total Release	CI	2.97E01	3.96E01	6.2
2. Average release rate for period	μCi/sec	3.74E00	4.98E00	
E. Iodine 131 & 133, Tritium and Particulates				
Percent of Tech spec Limit Chimney & stack	%	9.56E-01	5.13E-01	

*NOBLE GAS GAMMA/NOBLE GAS BETA DOSE LIMITS

**Projected value based on previous six months available data.

TABLE 1.2-1

LIQUID EFFLUENTS - SUMMARY OF ALL RELEASES

	Unit	Quarter FIRST	Quarter SECOND	Est. Total Error, %
A. FISSION & ACTIVATION PRODUCTS				
1. Total release (not including tritium, gases, alpha)	CI **	7.20E-01	1.35E-03	7
2. Average diluted concentration during batch discharges period	µCi/ml	3.63E-09	1.79E-09	
3. Percent of applicable limit *	% **	2.02E-01	3.19E-03	
4. Maximum diluted concentration during batch discharges	µCi/ml	1.97E-01	1.44E-03	
B. TRITIUM **NOTE: A1, A3 and B1 First Quarter include activity from RRR leak. All other First Quarter are for normal batch release.				
1. Total release	CI **	3.35E-00	4.60E-01	6.7
2. Average diluted concentration during batch discharges	µCi/ml	2.00E-06	6.08E-07	
3. Percent of applicable limit	%	6.70E-03	2.03E-03	
C. DISSOLVED AND ENTRAINED GASES				
1. Total release	CI	1.11E-05	<LLD	7.2
2. Average diluted concentration during batch discharges	µCi/ml	6.85E-12	<LLD	
3. Percent of applicable limit	%	3.43E-06	0.00E+00	
D. GROSS ALPHA RADIOACTIVITY				
1. Total Release	CI	<LLD	<LLD	14.9
2. Average concentration released during batch discharges	µCi/ml	<LLD	<LLD	
E. VOLUME OF WASTE RELEASED (prior to dilution)				
	Liters	6.15E05	9.84E04	
F. VOLUME OF DILUTION WATER USED DURING BATCH DISCHARGES				
	Liters	1.62E09	7.56E08	
G. TOTAL VOLUME OF DILUTION WATER DURING PERIOD (QUARTER)				
	Liters	2.13E11	3.44E11	
*WHOLE BODY/ORGAN				

TABLE 1.2-1 (continued)

LIQUID EFFLUENTS - SUMMATION OF ALL RELEASES

	Unit	Quarter Third	Quarter Fourth	Est. Total Error, %
A. FISSION & ACTIVATION PRODUCTS				
1. Total release (not including tritium, gases, alpha)	CI **	2.56E-03	9.61E-03	7.2
2. Average diluted concentration during batch discharges period	µCi/ml	1.94E-09	5.35E-09	
		9.17E-03	3.74E-02	
3. Percent of applicable limit *	%	3.70E-03	1.69E-02	
4. Maximum diluted concentration during batch discharges	µCi/ml	1.94E-09	5.35E-09	
B. TRITIUM **Note: A1, A3 and B1 for both quarters include activity from U-1 RHF Hx leak. All other values are for normal batch release.				
1. Total release	CI **	2.20E-01	4.04E-01	6.1
2. Average diluted concentration during batch discharges	µCi/ml	2.16E-07	7.50E-07	
3. Percent of applicable limit	%	7.19E-03	2.50E-02	
C. DISSOLVED AND ENTRAINED GASES				
1. Total release	CI	<LLD	<LLD	N/A
2. Average diluted concentration during batch discharges	µCi/ml	<LLD	<LLD	
3. Percent of applicable limit	%	#	#	
D. GROSS ALPHA RADIOACTIVITY				
1. Total Release	CI	<LLD	<LLD	N/A
2. Average concentration released during batch discharges	µCi/ml	<LLD	<LLD	
E. VOLUME OF WASTE RELEASED (prior to dilution)				
	Liters	1.28E05	1.33E05	
F. VOLUME OF DILUTION WATER USED DURING BATCH DISCHARGES				
	Liters	1.02E09	5.05E08	
G. TOTAL VOLUME OF DILUTION WATER DURING PERIOD (QUARTER)				
	Liters	4.90E11	6.70E11	
*WHOLE BODY/ORGAN				

TABLE 2.0-1

SOLID RADIOACTIVE WASTE SUMMARY

UNITS 1/2

QUAD CITIES STATION

JANUARY 1991

DATE	TRANSPORT CO.	BURIAL SITE	VOLUME	MILLICURIES
1/4/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	33790.00
1/14/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	45270.00
1/17/91	RAY-TECH	U.S. ECOLOGY, WA	474.60	758.99
1/21/91	RAY-TECH	CHANNAHAN	660.00	394.30
1/29/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	27530.00
			-----	-----
		MONTHLY TOTALS	1752.00	107943.29

FEBRUARY 1991

DATE	TRANSPORT CO.	BURIAL SITE	VOLUME	MILLICURIES
2/6/91	RAY-TECH	CHANNAHAN	675.00	728.40
2/13/91	KINDRICK TRUCKING	QUADREX	2080.00	2.33
2/14/91	KINDRICK TRUCKING	QUADREX	1290.10	109.80
2/19/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	170.80	24260.00
2/22/91	RAY-TECH	U.S. ECOLOGY, WA	493.70	902.27
			-----	-----
		MONTHLY TOTALS	4709.60	26002.80

MARCH 1991

DATE	TRANSPORT CO.	BURIAL SITE	VOLUME	MILLICURIES
3/6/91	RAY-TECH	CHANNAHAN	630.00	564.50
3/11/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	170.80	21850.00
3/19/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	170.80	35850.00
3/20/91	CHEM NUCLEAR SYSTEMS	U.S. ECOLOGY, WA	105.00	3328.92
3/21/91	KINDRICK TRUCKING	QUADREX	1350.10	175.50
			-----	-----
		MONTHLY TOTALS	2426.70	61768.92

TABLE 2.0-1 (continued)

SOLID RADIOACTIVE WASTE SUMMARY

UNITS 1/3

QUAD CITIES STATION

APRIL 1991

DATE	TRANSPORT CO.	BURIAL SITE	VOLUME	MILLCURIES
4/9/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	170.80	23550.00
4/12/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	405.50
4/12/91	RAY-TECH	CHANNAHAN	502.50	497.61
4/16/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	539.50
4/17/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	308.34	726.30
4/24/91	HITTMAN	SCIENTIFIC ECOLOGY	1290.10	60.97
			-----	-----
		MONTHLY TOTALS	2683.34	25779.88

MAY 1991

DATE	TRANSPORT CO.	BURIAL SITE	VOLUME	MILLCURIES
5/2/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	741.70
5/8/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	120.30	68660.00
5/9/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	120.30	66590.00
5/9/91	RAY-TECH	U.S. ECOLOGY, WA	382.50	958.55
5/15/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	120.30	63900.00
5/20/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	120.30	130900.00
5/22/91	KINDRICK TRUCKING	QUADREX	1290.10	81.32
5/28/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	120.30	163400.00
			-----	-----
		MONTHLY TOTALS	2479.90	495231.57

JUNE 1991

DATE	TRANSPORT CO.	BURIAL SITE	VOLUME	MILLCURIES
6/3/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	120.30	103800.00
6/6/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	120.30	223600.00
6/13/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	120.30	184400.00
6/13/91	RAY-TECH	CHANNAHAN	525.00	240.30
6/24/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	17990.00
6/27/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	16200.00
			-----	-----
		MONTHLY TOTALS	1297.50	46230.30

TABLE 2.0-1 (continued)

SOLID RADIOACTIVE WASTE SUMMARY

UNITS 1/2

QUAD CITIES STATION

JULY 1991

Shipping Date	Carrier	Site	Volume	MilliCuries
07/09/91	KINDRICK TRUCKING	QUADREX	1290.10	181.80
07/15/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	18510.00
07/22/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	15390.00
07/29/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	9195.00
07/31/91	HITTMAN	WESTINGHOUSE, PA	1040.00	3.69
			-----	-----
			2947.50	43280.49

AUGUST 1991

Shipping Date	Carrier	Site	Volume	MilliCuries
08/05/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	11030.00
08/07/91	HITTMAN	SCIENTIFIC ECOLOGY	1290.10	87.66
08/13/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	37670.00
08/19/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	29620.00
08/21/91	KINDRICK TRUCKING	QUADREX	1290.10	27.69
			-----	-----
			3197.60	78435.35

SEPTEMBER 1991

Shipping Date	Carrier	Site	Volume	MilliCuries
09/05/91	RAY-TECH	CHANNAHAN	21.50	7.18
09/05/91	RAY-TECH	CHANNAHAN	570.00	281.72
09/10/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	16700.00
09/23/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	8992.00
			-----	-----
			1004.10	25980.90

TABLE 2.0-1 (continued)

SOLID RADIOACTIVE WASTE SUMMARY

UNITS 1/2

QUAD CITIES STATION

OCTOBER 1991

Shipping Date	Carrier	Site	Volume	MilliCuries
10/07/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	10310.00
10/21/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	18750.00
10/24/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	563.90
			617.40	29623.90

NOVEMBER 1991

Shipping Date	Carrier	Site	Volume	MilliCuries
11/04/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	18230.00
11/12/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	11770.00
11/17/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	170.80	483.30
11/18/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	9252.00
11/21/91	KINDRICK TRUCKING	QUADREX	981.50	57.76
11/25/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	14810.00
11/27/91	RAY-TECH	CHANNAHAN	622.50	344.10
			2598.00	54947.16

DECEMBER 1991

Shipping Date	Carrier	Site	Volume	MilliCuries
12/03/91	CHEM NUCLEAR SYSTEMS	U.S. ECOLOGY, WA	105.00	1053.50
12/09/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	16880.00
12/11/91	CHEM NUCLEAR SYSTEMS	U.S. ECOLOGY, WA	345.00	8.15
12/13/91	CHEM NUCLEAR SYSTEMS	U.S. ECOLOGY, WA	105.00	812.17
12/16/91	CHEM NUCLEAR SYSTEMS	BARNWELL, SC	205.80	21310.00
			966.60	40063.82

TOTALS: 11331.20 272331.62

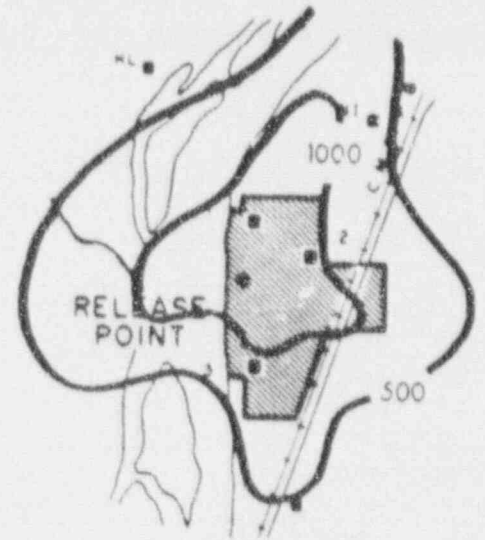
FIGURE 3.1-1

Estimated Cumulative Gamma Dose (in mrem)
from the Quad Cities Station for the period
January-December 1991

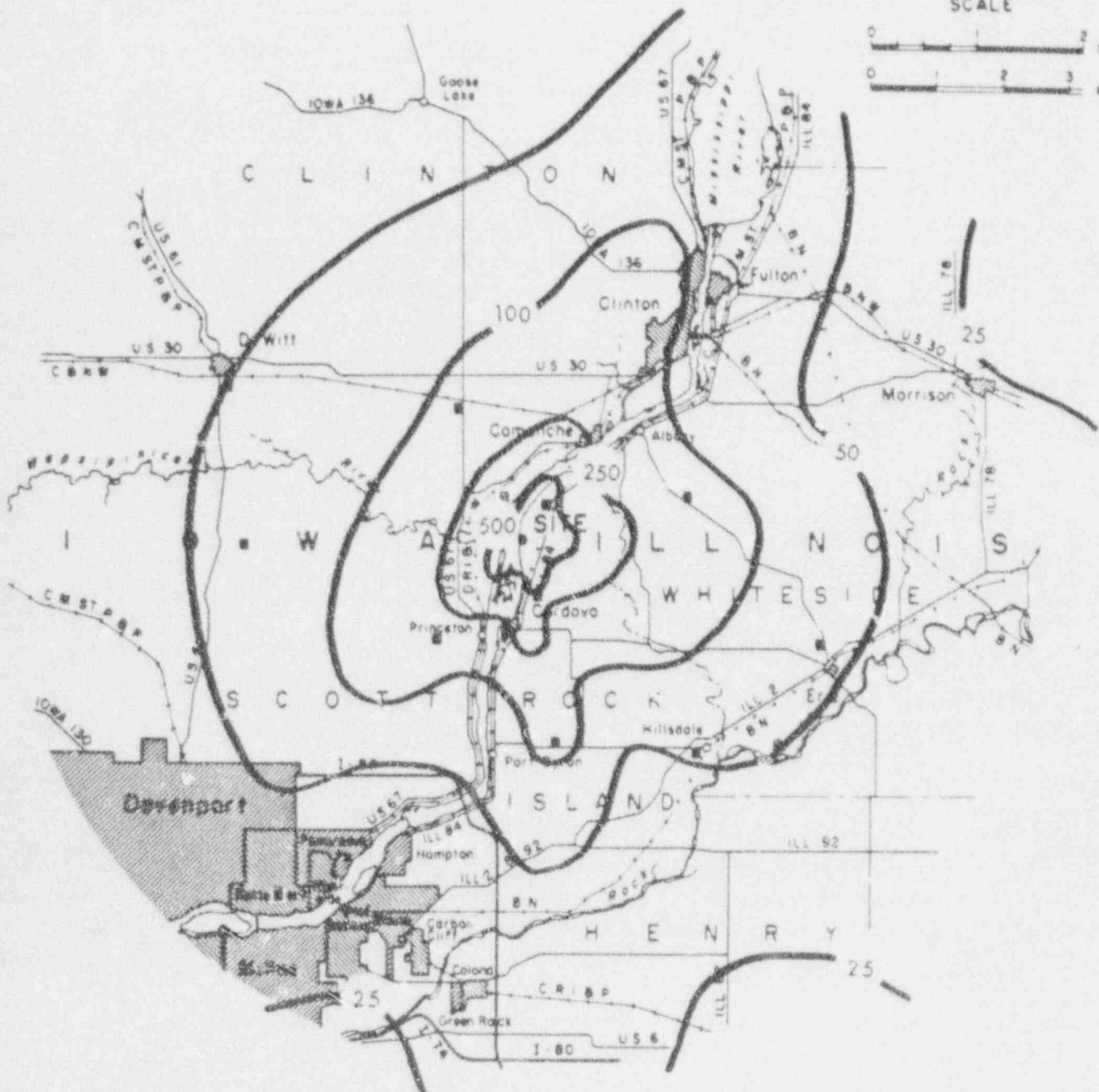
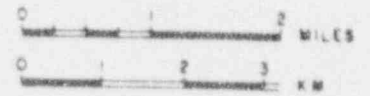
Isopleth Labels

Small figure - multiply by 10^{-6}

Large figure - multiply by 10^{-5}



SCALE



SCALE



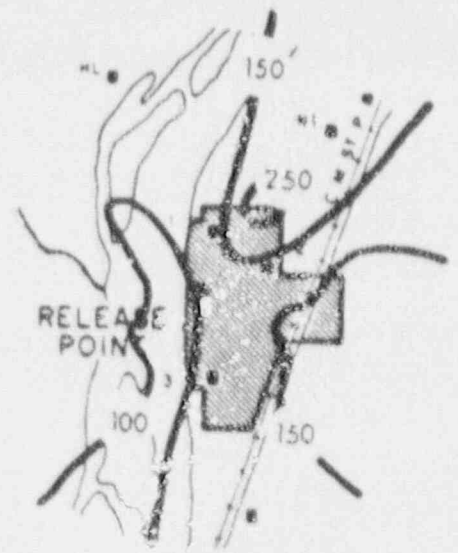
FIGURE 3.1-2

Estimated Total Concentrations (in pCi/m^3)
of Noble Gases from the Quad Cities Station
for the period January-December 1991

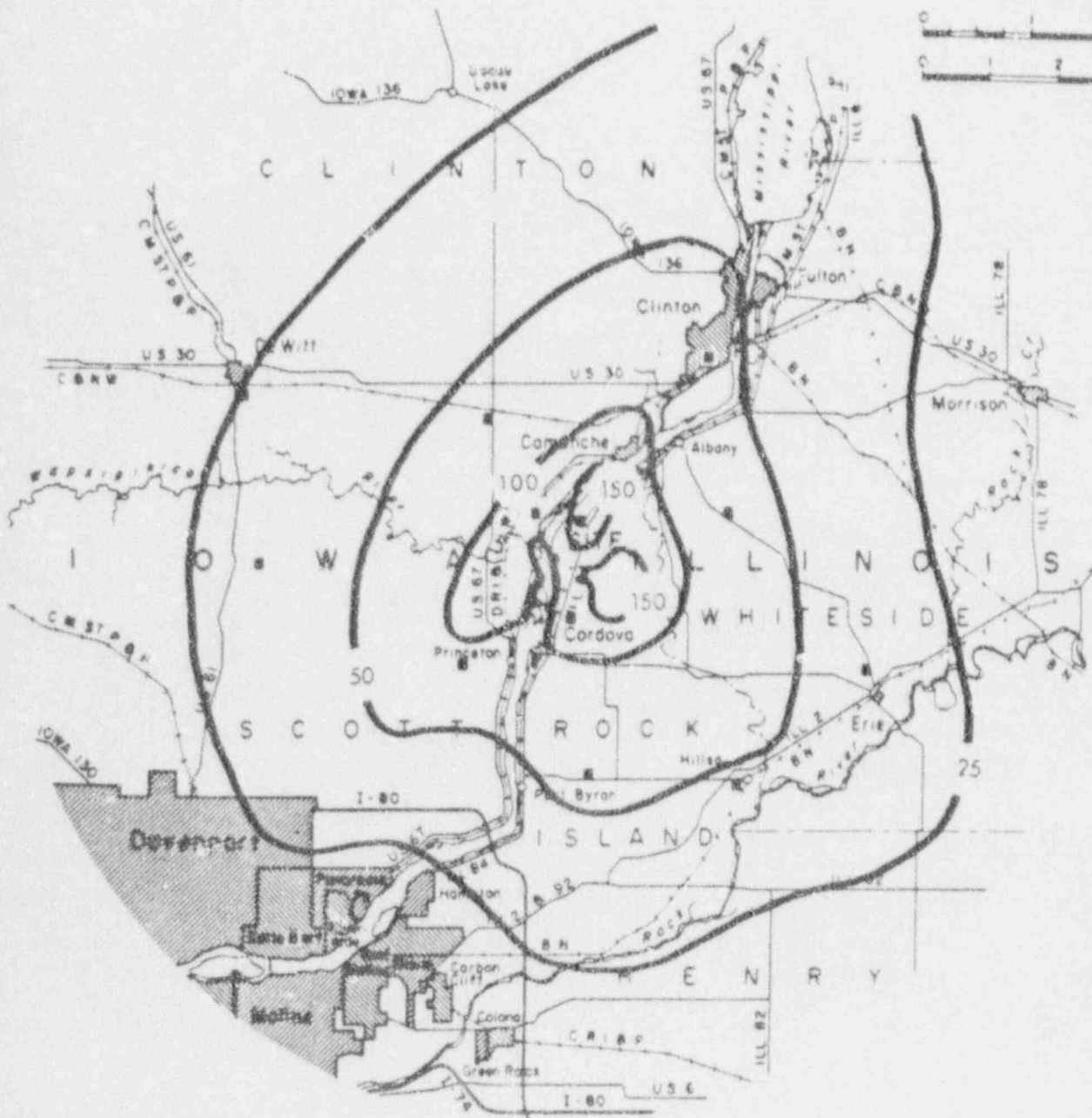
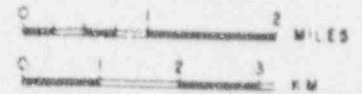
Isopleth Labels

Small figure - multiply by 10^{-3}

Large figure - multiply by 10^{-2}



SCALE



SCALE

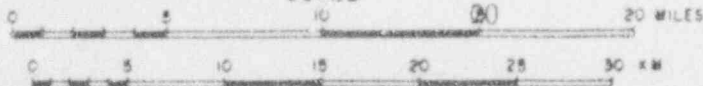


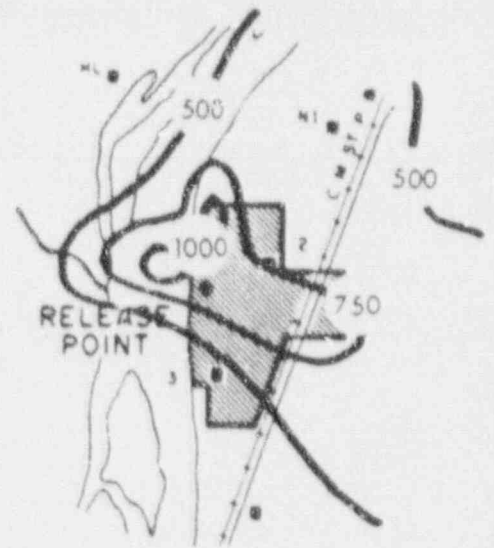
FIGURE 3.1-3

Estimated Total Concentrations (in pCi/m^3)
of Iodine from the Quad Cities Station for
the period January-December 1991

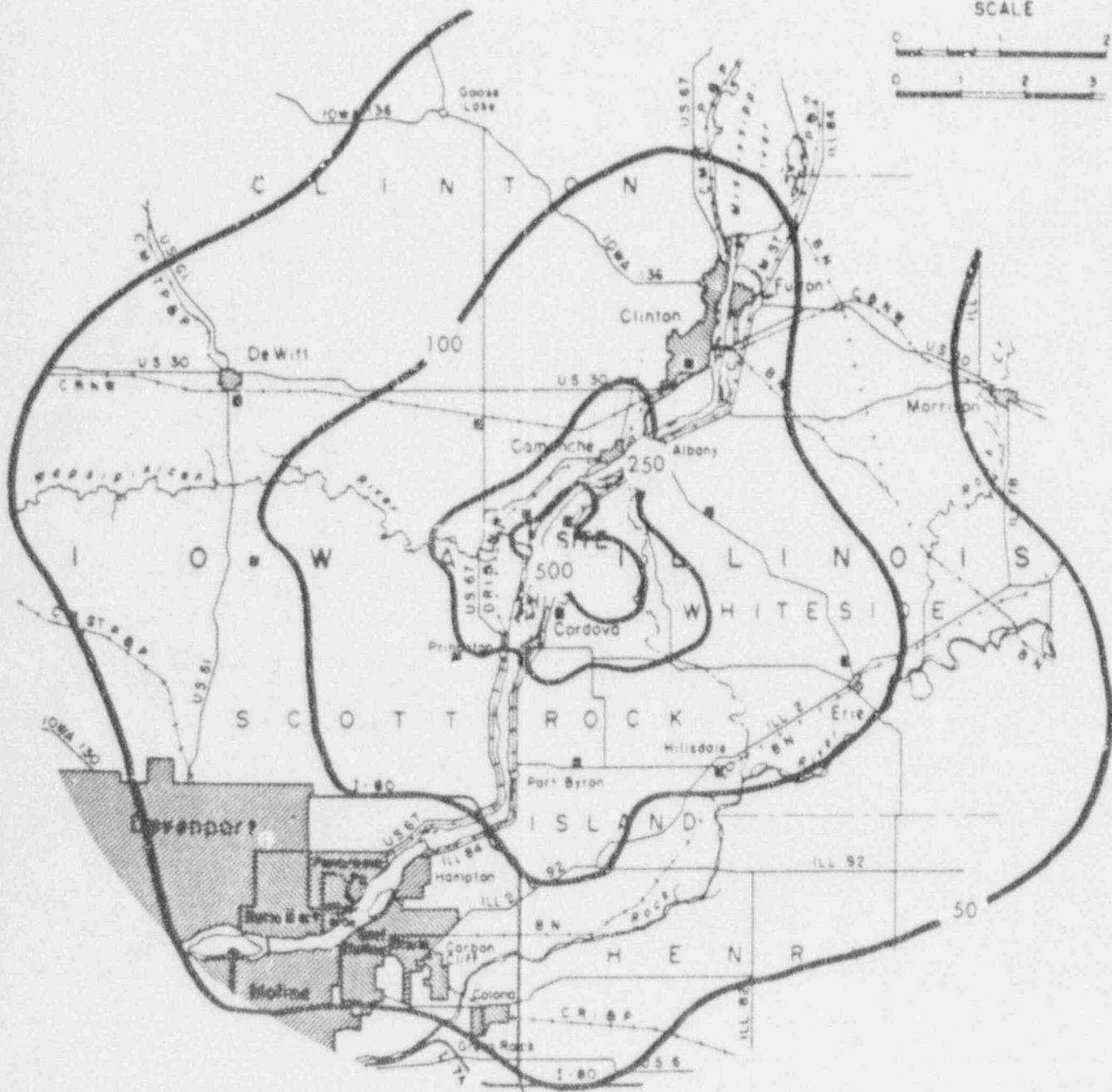
Isopleth Labels

Small figure - multiply by 10^{-7}

Large figure - multiply by 10^{-7}



SCALE



SCALE 21

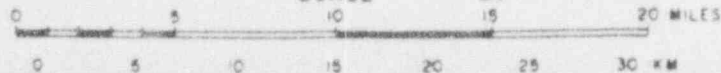


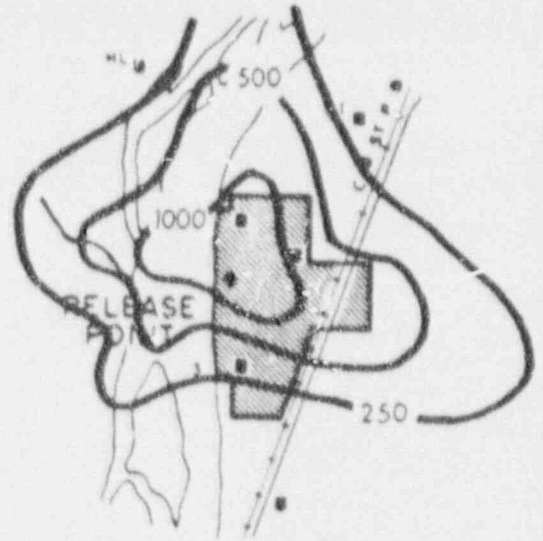
FIGURE 3.1-4

Estimated Total Concentrations (in pCi/m^3) of
Particulate Matter from the Quad Cities Station
for the period January-December 1991

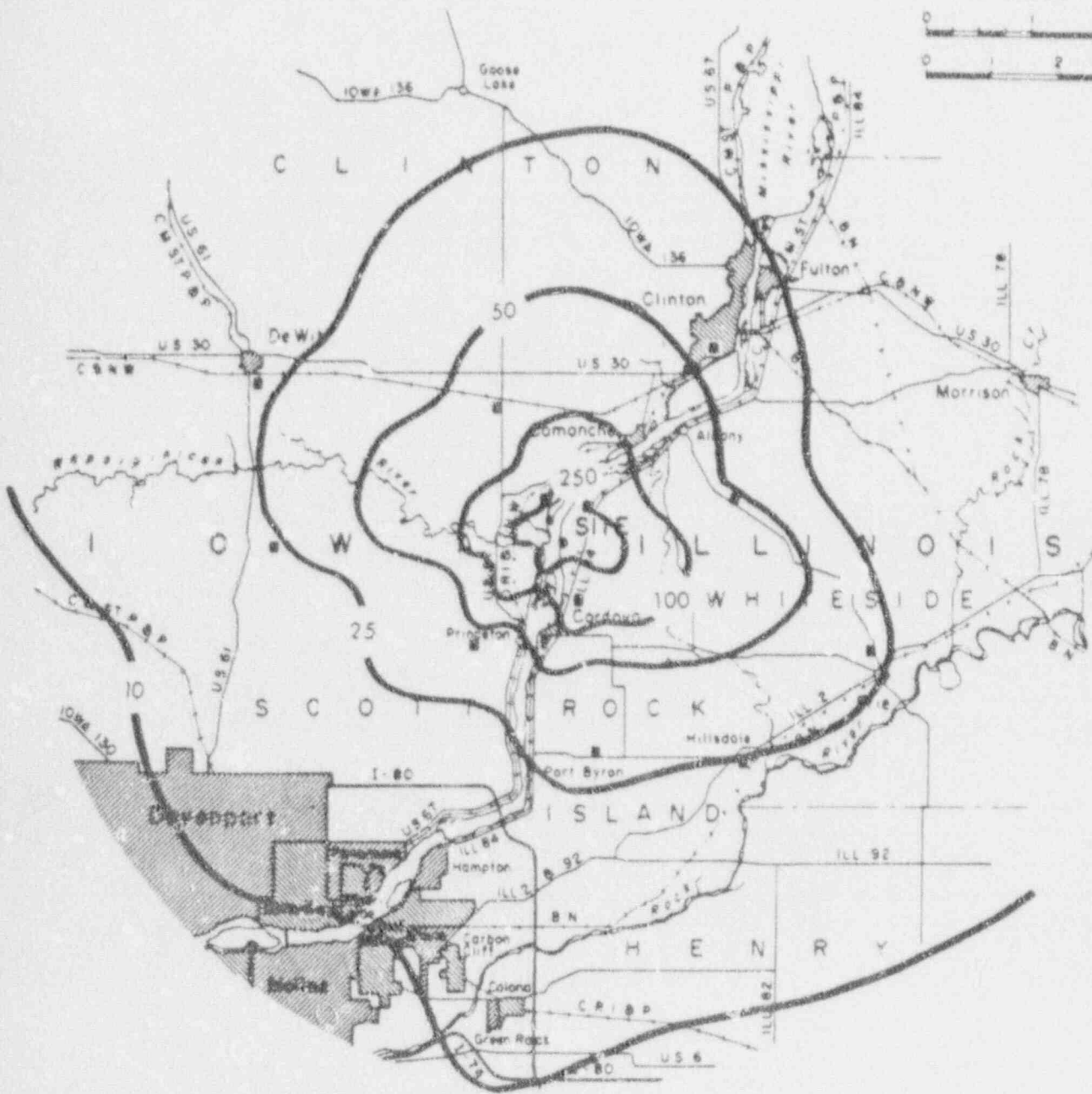
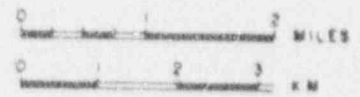
Isopleth Labels

Small figure - multiply by 10^{-6}

Large figure - multiply by 10^{-8}



SCALE



SCALE 22

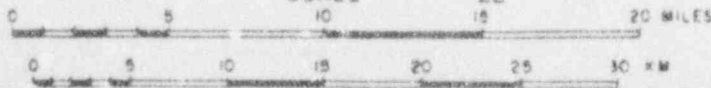


TABLE 3.1-1

QUAD CITIES UNIT ONE

1991 ANNUAL REPORT
 MAXIMUM DOSES RESULTING FROM AIRBORNE RELEASES
 PERIOD OF RELEASE - 01/01/91 TO 12/31/91 CALCULATED 02/26/92
 INFANT RECEPTOR

TYPE	1ST	2ND	3RD	4TH	ANNUAL
	QUARTER JAN-MAR	QUARTER APR-JUN	QUARTER JUL-SEP	QUARTER OCT-DEC	
GAMMA AIR (MRAD)	1.32E-05 (W)	1.65E-04 (W)	2.82E-04 (W)	3.38E-04 (W)	8.18E-04 (W)
BETA AIR (MRAD)	1.17E-06 (NW)	3.40E-05 (NW)	5.49E-05 (NW)	7.34E-05 (NW)	1.63E-04 (NW)
TOT. BODY (MREM)	6.68E-06 (W)	1.04E-04 (W)	1.58E-04 (W)	1.89E-04 (W)	4.57E-04 (W)
SKIN (MREM)	1.11E-05 (W)	1.70E-04 (W)	2.61E-04 (W)	3.19E-04 (W)	7.61E-04 (W)
ORGAN (MREM)	3.44E-02 (WNW)	7.68E-03 (WNW)	8.02E-03 (WNW)	1.12E-02 (WNW)	6.10E-02 (WNW)
	LUNG	LUNG	LUNG	THYROID	LUNG

THIS IS A REPORT FOR THE CALENDAR YEAR 1991

COMPLIANCE STATUS - 10 CFR 50 APP. I
 INFANT RECEPTOR

	QTRLY OBJ	% OF APP I.				YRLY OBJ	% OF APP. I
		1ST QTR JAN-MAR	2ND QTR APR-JUN	3RD QTR JUL-SEP	4TH QTR OCT-NOV		
GAMMA AIR (MRAD)	5.0	0.00	0.00	0.01	0.01	10.0	0.01
BETA AIR (MRAD)	10.0	0.00	0.00	0.00	0.00	20.0	0.00
TOT. BODY (MREM)	2.5	0.00	0.00	0.01	0.01	5.0	0.01
SKIN (MREM)	7.5	0.00	0.00	0.00	0.00	15.0	0.01
ORGAN (MREM)	7.5	0.46	0.10	0.11	0.15	15.0	0.41
		LUNG	LUNG	LUNG	THYROID		LUNG

TABLE 3.1-1 (continued)

QUAD CITIES UNIT ONE
 1991 ANNUAL REPORT
 MAXIMUM DOSES RESULTING FROM AIRBORNE RELEASES
 PERIOD OF RELEASE - 01/01/91 TO 12/31/91 CALCULATED 02/26/92
 ADULT RECEPTOR

TYPE	1ST QUARTER JAN-MAR	2ND QUARTER APR-JUN	3RD QUARTER JUL-SEP	4TH QUARTER OCT-DEC	ANNUAL
GAMMA AIR (MRAD)	1.32E-05 (W)	1.85E-04 (W)	2.82E-04 (W)	3.38E-04 (W)	8.18E-04 (W)
BETA AIR (MRAD)	1.17E-06 (NW)	3.40E-05 (NW)	5.49E-05 (NW)	7.34E-05 (NW)	1.63E-04 (NW)
TOT. BODY (MREM)	6.68E-06 (W)	1.04E-04 (W)	1.58E-04 (W)	1.89E-04 (W)	4.57E-04 (W)
SKIN (MREM)	1.11E-05 (W)	1.70E-04 (W)	2.61E-04 (W)	3.19E-04 (W)	7.61E-04 (W)
ORGAN (MREM)	3.51E-02 (WNW)	2.24E-02 (WNW)	2.89E-02 (WNW)	2.79E-02 (WNW)	1.12E-01 (WNW)
	LUNG	THYROID	GI-LLI	THYROID	THYROID

THIS IS A REPORT FOR THE CALENDAR YEAR 1991

COMPLIANCE STATUS - 10 CFR 50 APP. 1
 ADULT RECEPTOR

	QTRLY OBJ	% OF APP I.				YRLY OBJ	% OF APP.I
		1ST QTR JAN-MAR	2ND QTR APR-JUN	3RD QTR JUL-SEP	4TH QTR OCT-NOV		
GAMMA AIR (MRAD)	5.0	0.00	0.00	0.01	0.01	10.0	0.01
BETA AIR (MRAD)	10.0	0.00	0.00	0.00	0.00	20.0	0.00
TOT. BODY (MREM)	2.5	0.00	0.00	0.01	0.01	5.0	0.01
SKIN (MREM)	7.5	0.00	0.00	0.00	0.00	15.0	0.01
ORGAN (MREM)	7.5	0.47	0.30	0.38	0.37	15.0	0.74
		LUNG	THYROID	GI-LLI	THYROID		THYROID

TABLE 3.1-1 (continued)

QUAD CITIES UNIT TWO
 1991 ANNUAL REPORT
 MAXIMUM DOSES RESULTING FROM AIRBORNE RELEASES
 PERIOD OF RELEASE - 01/01/91 TO 12/31/91 CALCULATED 02/26/92
 INFANT RECEPTOR

TYPE	1ST	2ND	3RD	4TH	ANNUAL
	QUARTER JAN-MAR	QUARTER APR-JUN	QUARTER JUL-SEP	QUARTER OCT-DEC	
GAMMA AIR (MRAD)	1.00E-03 (W)	3.64E-04 (W)	2.82E-04 (W)	3.39E-04 (W)	1.99E-03 (W)
BETA AIR (MRAD)	1.90E-04 (NW)	6.76E-05 (NW)	5.49E-05 (NW)	7.37E-05 (NW)	3.8E-04 (NW)
TOT. BODY (MREM)	5.67E-04 (W)	2.04E-04 (W)	1.58E-04 (W)	1.90E-04 (W)	1.12E-03 (W)
SKIN (MREM)	9.25E-04 (W)	3.34E-04 (W)	2.61E-04 (W)	3.20E-04 (W)	1.84E-03 (W)
ORGAN (MREM)	2.71E-02 (WNW)	4.42E-03 (WNW)	7.88E-03 (WNW)	3.99E-03 (WNW)	4.29E-02 (WNW)
	LUNG	LUNG	THYROID	THYROID	LUNG

THIS IS A REPORT FOR THE CALENDAR YEAR 1991

COMPLIANCE STATUS - 10 CFR 50 APP. I
 INFANT RECEPTOR

QTRLY OBJ	% OF APP I.				YRLY OBJ	% OF APP. I
	1ST QTR JAN-MAR	2ND QTR APR-JUN	3RD QTR JUL-SEP	4TH QTR OCT-NOV		
GAMMA AIR (MRAD)	5.0	0.02	0.01	0.01	10.0	0.02
BETA AIR (MRAD)	10.0	0.00	0.00	0.00	20.0	0.00
TOT. BODY (MREM)	2.5	0.02	0.01	0.01	5.0	0.02
SKIN (MREM)	7.5	0.01	0.00	0.00	15.0	0.01
ORGAN (MREM)	7.5	0.36	0.06	0.11	15.0	0.29
	LUNG	LUNG	THYROID	THYROID	LUNG	

TABLE 3.1-1 (continued)

QUAD CITIES UNIT TWO
1991 ANNUAL REPORT
MAXIMUM DOSES RESULTING FROM AIRBORNE RELEASES
PERIOD OF RELEASE - 01/01/91 TO 12/31/91 CALCULATED 02/26/92
ADULT RECEPTOR

TYPE	1ST QUARTER JAN-MAR	2ND QUARTER APR-JUN	3RD QUARTER JUL-SEP	4TH QUARTER OCT-DEC	ANNUAL
GAMMA AIR (MRAD)	1.00E-03 (W)	3.64E-04 (W)	2.82E-04 (W)	3.39E-04 (W)	1.99E-03 (W)
BETA AIR (MRAD)	1.90E-04 (NW)	6.76E-05 (NW)	5.49E-05 (NW)	7.37E-05 (NW)	3.86E-04 (NW)
TOT. BODY (MREM)	5.67E-04 (W)	2.04E-04 (W)	1.58E-04 (W)	1.90E-04 (W)	1.12E-03 (W)
SKIN (MREM)	9.25E-04 (W)	3.34E-04 (W)	2.61E-04 (W)	3.20E-04 (W)	1.84E-03 (W)
ORGAN (MREM)	2.67E-02 (WNW)	2.57E-02 (WNW)	4.28E-02 (WNW)	1.06E-02 (WNW)	1.05E-01 (WNW)
	LUNG	GI-LLI	LIVER	THYROID	LUNG

THIS IS A REPORT FOR THE CALENDAR YEAR 1991

COMPLIANCE STATUS - 10 CFR 50 APP. I
ADULT RECEPTOR

	QTRLY OBJ	% OF APP I.				YRLY OBJ	% OF APP. I
		1ST QTR JAN-MAR	2ND QTR APR-JUN	3RD QTR JUL-SEP	4TH QTR OCT-NOV		
GAMMA AIR (MRAD)	5.0	0.02	0.01	0.01	0.01	10.0	0.02
BETA AIR (MRAD)	10.0	0.00	0.00	0.00	0.00	20.0	0.00
TOT. BODY (MREM)	2.5	0.02	0.01	0.01	0.01	5.0	0.02
SKIN (MREM)	7.5	0.01	0.00	0.00	0.00	15.0	0.01
ORGAN (MREM)	7.5	0.36	0.34	0.57	0.14	15.0	0.70
		LUNG	GI-LLI	LIVER	THYROID		LUNG

TABLE 3.2-1

QUAD CITIES UNIT ONE
ADULT RECEPTOR

1991 ANNUAL REPORT
MAXIMUM DOSES (MREM) RESULTING FROM LIQUID EFFLUENTS
PERIOD OF RELEASE - 01/01/91 TO 12/31/91 CALCULATED 02/26/92

DOSE TYPE	1ST QUARTER JAN-MAR	2ND QUARTER APR-JUN	3RD QUARTER JUL-SEP	4TH QUARTER OCT-DEC	ANNUAL
TOTAL BODY	2.48E-03	4.61E-05	6.13E-05	2.72E-04	2.86E-03
INTERNAL ORGAN	9.02E-03	6.93E-05	9.28E-05	4.08E-04	9.14E-03
	GI-LLI	LIVER	LIVER	LIVER	GI-LLI

THIS IS A REPORT FOR THE CALENDAR YEAR 1991

COMPLIANCE STATUS - 10 CFR 50 APP. I

	QTRLY OBJ	% OF APP I.				YRLY OBJ	% OF APP. I
		1ST QTR JAN-MAR	2ND QTR APR-JUN	3RD QTR JUL-SEP	4TH QTR OCT-NOV		
TOTAL BODY (MREM)	1.5	0.17	0.00	0.00	0.02	3.0	0.10
CRIT. ORGAN(MREM)	5.0	0.18	0.00	0.00	0.01	10.0	0.09
		GI-LLI	LIVER	LIVER	LIVER		GI-LLI

TABLE 3.2-1 (continued)

QUAD CITIES UNIT TWO
ADULT RECEPTOR

1991 ANNUAL REPORT
MAXIMUM DOSES (MREM) RESULTING FROM LIQUID EFFLUENTS
PERIOD OF RELEASE - 01/01/91 TO 12/31/91 CALCULATED 02/26/92

DOSE TYPE	1ST QUARTER JAN-MAR	2ND QUARTER APR-JUN	3RD QUARTER JUL-SEP	4TH QUARTER OCT-DEC	ANNUAL
TOTAL BODY	5.55E-04	6.11E-05	7.62E-05	2.91E-04	9.84E-04
INTERNAL ORGAN	8.39E-04	9.20E-05	1.15E-04	4.40E-04	1.49E-03
	LIVER	LIVER	LIVER	LIVER	LIVER

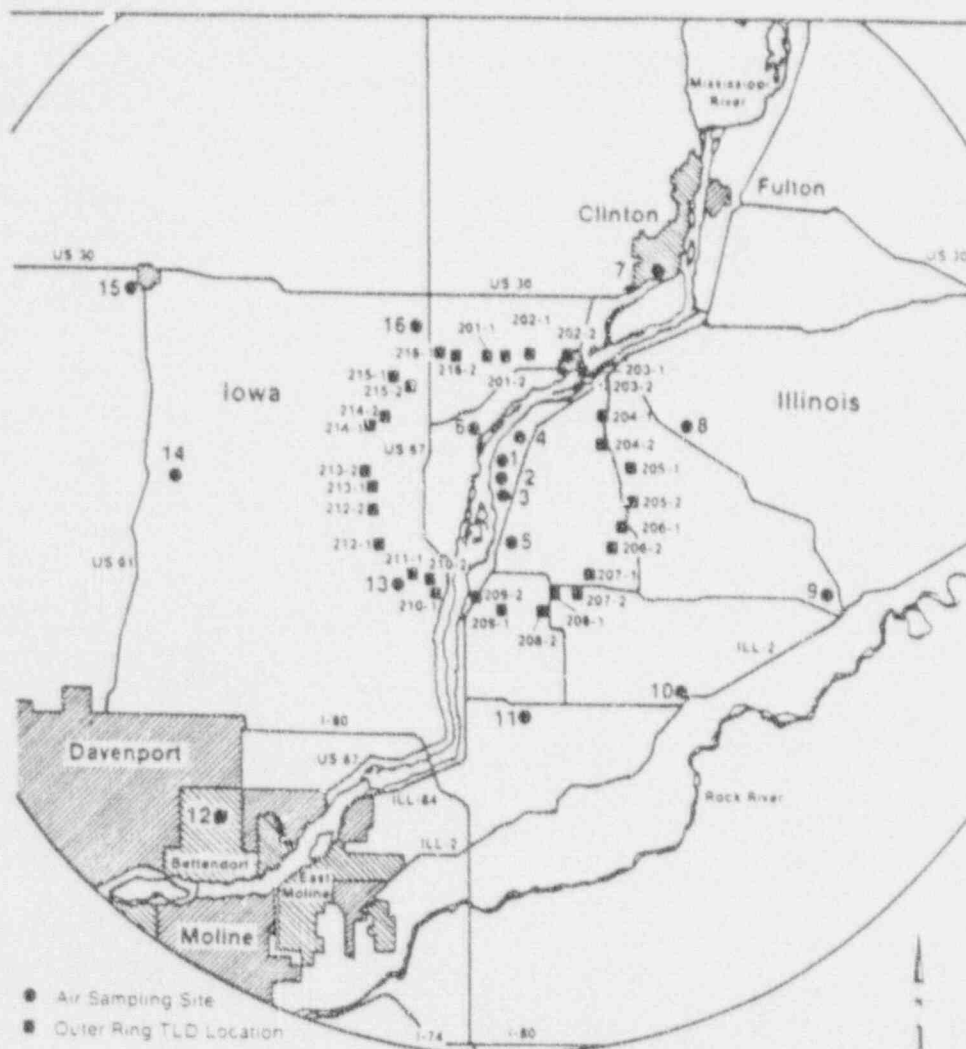
THIS IS A REPORT FOR THE CALENDAR YEAR 1991

COMPLIANCE STATUS - 10 CFR 50 APP. I

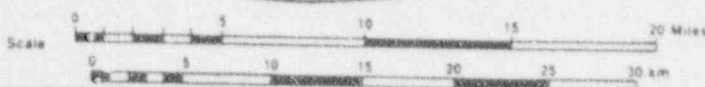
QTRLY OBJ	% OF APP I.				YRLY OBJ	% OF APP. I	
	1ST QTR JAN-MAR	2ND QTR APR-JUN	3RD QTR JUL-SEP	4TH QTR OCT-NOV			
TOTAL BODY (MREM)	1.5	0.04	0.00	0.01	0.02	3.0	0.03
CRIT. ORGAN(MREM)	5.0	0.02	0.00	0.00	0.01	10.0	0.01
	LIVER	LIVER	LIVER	LIVER	LIVER	LIVER	LIVER

FIGURE 5.0-1

FIXED AIR SAMPLING SITES AND
OUTER RING TLD LOCATIONS



- Air Sampling Site
- Outer Ring TLD Location



- 01 Onsite No. #1
- 02 Onsite No. #2
- 03 Onsite No. #3
- 04 Nitran
- 05 Saddle Club Dairy
- 06 Hansen's Boat Landing (Dock)
- 07 Clinton
- 08 Sikkens Farm
- 09 Erie
- 10 Hillsdale
- 11 Port Byron
- 12 Bettendorf
- 13 Princeton
- 14 Utica Ridge Road
- 15 DeMitt
- 16 Low Moor

FIGURE 5.0-2
INNER RING TLD LOCATIONS

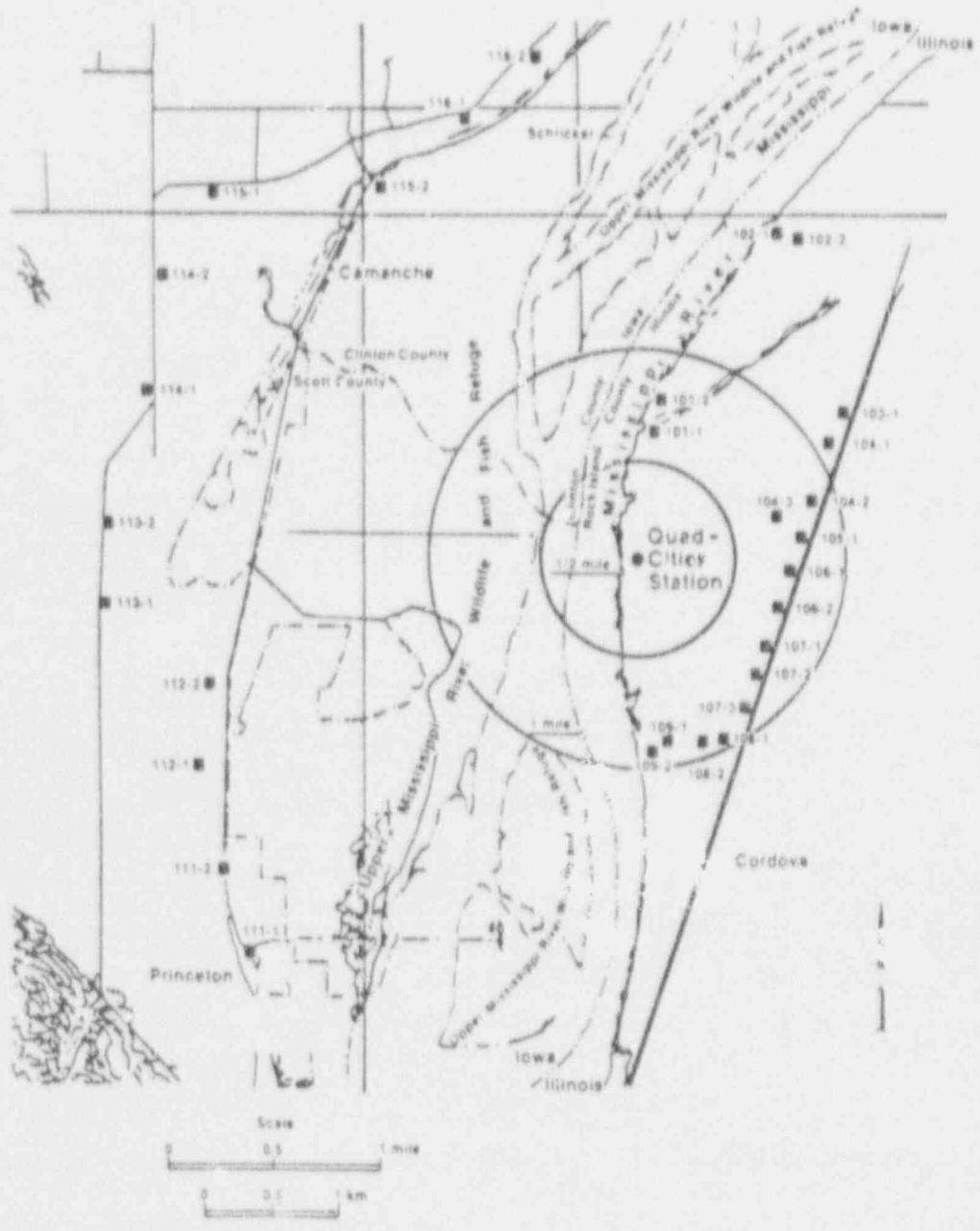
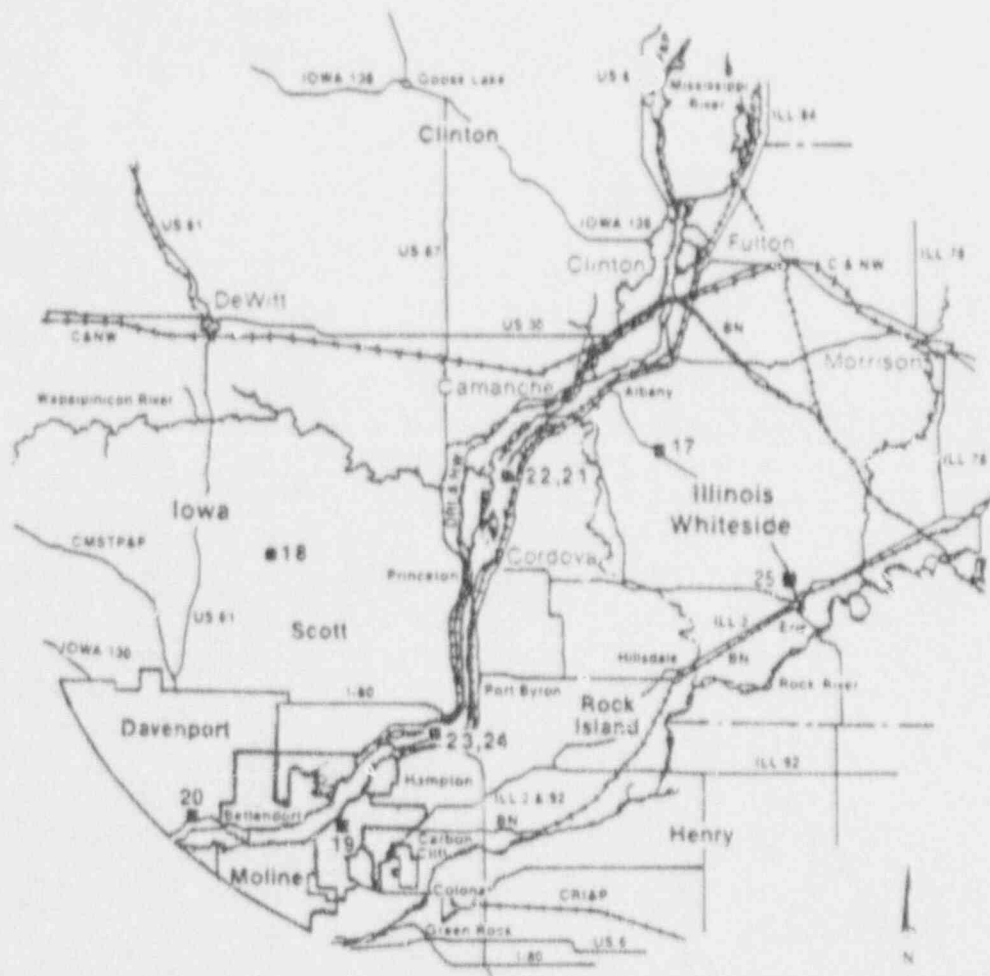
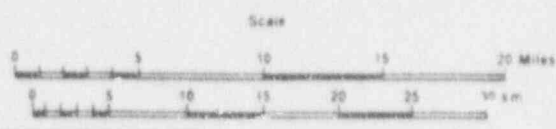


FIGURE 5.0-3

MILK, FISH, WATER, AND SEDIMENT
SAMPLE LOCATIONS



■ Sampling Station



- QC-17 Dornbush Dairy
- QC-18 Musal Dairy
- QC-19 East Moline Water Works
- QC-20 Davenport Water Works
- QC-21 Intake Canal
- QC-22 Discharge Canal
- QC-23 Lock & Dam #14
(Mississippi River)
- QC-24 Davenport Fish Market
(Pool #14 Miss. River)
- QC-25 Waite Dairy

TABLE 5.0-1

Quad Cities Station
Radiological Environmental Monitoring
Locations

	Air Sampling TLD	Cooling Water	Fish	Lake Water	Milk	Public Water	Rabbits	Sediments	Surface Water	Vegetables	Ground/Well Water
QC-01 Onsite No. #1	OO	.	.	.	.	.	.	.	.	.	.
QC-02 Onsite No. #2	OO	.	.	.	.	.	.	.	.	.	.
QC-03 Onsite No. #3	OO	.	.	.	.	.	.	.	.	.	.
QC-04 Nitrin	OO	.	.	.	.	.	.	.	.	.	.
QC-05 Saddle Club Dairy	OO	.	.	.	.	.	.	.	.	.	.
QC-06 Hansen's Boat Landing (Dock)	OO	.	.	.	.	.	.	.	.	.	.
QC-07 Clinton	OO	.	.	.	.	.	.	.	.	.	.
QC-08 Sit kema Farm	OO	.	.	.	.	.	.	.	.	.	.
QC-09 Erie	OO	.	.	.	.	.	.	.	.	.	.
QC-10 Hillsdale	OO	.	.	.	.	.	.	.	.	.	.
QC-11 Port Byron	OO	.	.	.	.	.	.	.	.	.	.
QC-12 Bettendorf	OO	.	.	.	.	.	.	.	.	.	.
QC-13 Princeton	OO	.	.	.	.	.	.	.	.	.	.
QC-14 Utica Ridge Road	OO	.	.	.	.	.	.	.	.	.	.
QC-15 DeWitt	OO	.	.	.	.	.	.	.	.	.	.
QC-16 Low Moor	OO	.	.	.	.	.	.	.	.	.	.
QC-17 Dornbush Dairy	.	.	.	.	O	.	.	.	.	.	.
QC-18 Musal Dairy	.	.	.	.	O	.	.	.	.	.	.
QC-19 East Moline Water Works	.	.	.	.	.	O	.	.	.	.	.
QC-20 Davenport Water Works	.	.	.	.	.	O	.	.	.	.	.
QC-21 Intake Canal	.	O	.	.	.	.	.	.	.	.	.
QC-22 Discharge Canal	.	O	.	.	.	.	.	.	.	.	.
QC-23 Miss. River Pool #14	.	.	.	.	.	.	.	O	.	.	.
QC-24 Miss. River Pool #14	.	.	O	.	.	.	.	.	.	.	.
QC-25 Waite Dairy	.	.	.	.	O	.	.	.	.	.	.
CENSUS											
Dairy											
Cattle											
Residence											

TABLE 5.0-2

QUAD CITIES STATION

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLING LOCATIONS

1. AIR SAMPLERS

<u>Site Code</u> ^a	<u>Location</u>	<u>Distance</u> <u>(miles)</u>	<u>Direction</u> <u>(°)</u>
Q-01	On-site Station No. 1	0.5	0
Q-02	On-site Station No. 2	0.5	70
Q-03	On-site Station No. 3	0.6	170
Q-04	Nitrin	1.5	40
Q-05	Saddle Club Dairy Farm	1.8	160
Q-06	Hanson's Boat Landing	1.8	340
Q-07	Clinton	9.0	40
Q-08	Sikkema Farm	7.0	70
Q-09 (C)	Erie	13.0	110
Q-10 (C)	Hillsdale	10.0	130
Q-11	Port Byron	8.0	170
Q-12	Bettendorf	13.0	218
Q-13	Princeton	4.8	220
Q-14 (C)	Utica Ridge Road	11.0	270
Q-15 (C)	Dewitt	13.0	300
Q-16 (C)	Low Moor	6.0	330

2. TLDs

a. Same as No. 1.

b. Special TLD Samplers

<u>Site Code</u>	<u>Distance</u> <u>(miles)</u>	<u>Direction</u> <u>(°)</u>
Inner Ring		
Q-101-1,2	0.7	4
Q-102-1,2	1.7	21
Q-103-1,2	1.2	58
Q-104-1	1.1	60
Q-104-2	1.0	77
Q-104-3	0.6	77
Q-105-1,2	0.8	91
Q-106-1	0.7	109
Q-106-2	0.7	118
Q-107-1	0.7	128

^a Control (reference) locations are denoted by a "C" after site code. All other locations are indicators.

TABLE 5.0-2 (continued)

QUAD CITIES STATION

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLING LOCATIONS

2. TLDs

b. Special TLD Samplers

<u>Site Code</u>	<u>Distance (miles)</u>	<u>Direction (°)</u>
Q-107-2	0.7	137
Q-107-3	0.8	146
Q-108-1,2	0.9	155
Q-109-1,2	0.9	176
Q-111-1,2	2.6	230
Q-112-1,2	2.4	246
Q-113-1,2	2.5	264
Q-114-1,2	2.6	286
Q-115-1,2	2.3	310
Q-116-1,2	2.2	339
Outer Ring		
Q-201-1,2	4.0	356
Q-202-1,2	4.4	17
Q-203-1,2	5.5	34
Q-204-1,2	4.5	61
Q-205-1,2	4.5	83
Q-206-1,2	4.8	113
Q-207-1,2	4.8	133
Q-208-1,2	4.4	158
Q-209-1,2	4.8	179
Q-210-1,2	4.4	210
Q-211-1,2	5.0	223
Q-212-1,2	4.8	242
Q-213-1,2	4.7	265
Q-214-1,2	4.8	310
Q-215-1,2	4.8	316
Q-216-1,2	4.5	333

3. MILK

<u>Site Code^a</u>	<u>Location</u>	<u>Distance (miles)</u>	<u>Direction (°)</u>
Q-17 (C)	Dornbush Dairy Farm	6.0	70
Q-18	Musal Farm	5.5	225
Q-25 (C)	Waite Dairy Farm	13.0	100

^a Control (reference) locations are denoted by a "C" after site code. All other locations are indicators.

TABLE 5.0-2 (continued)

QUAD CITIES STATION

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLING LOCATIONS

4. PUBLIC WATER SUPPLY

<u>Site Code^a</u>	<u>Location</u>	<u>Distance (miles)</u>	<u>Direction (°)</u>
Q-19	East Moline Water Works	16.0	206
Q-20 (C)	Davenport Water Works	18.0	219

5. COOLING WATER

<u>Site Code^a</u>	<u>Location</u>	<u>Distance (miles)</u>	<u>Direction (°)</u>
Q-21 (C)	Inlet	At Station	
Q-22	Discharge		

6. FISH

<u>Site Code^a</u>	<u>Location</u>	<u>Distance (miles)</u>	<u>Direction (°)</u>
Q-24	Mississippi River Pool #14	15.0	200

7. SHORELINE SEDIMENTS

<u>Site Code^a</u>	<u>Location</u>	<u>Distance (miles)</u>	<u>Direction (°)</u>
Q-23	Mississippi River Pool #14	15.0	210

^a Control (reference) locations are denoted by a "C" after site code. All other locations are indicators.

TABLE 5.0-2 (continued)

QUAD CITIES STATION
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLE COLLECTION AND ANALYSES

Sample Media	Location		Collection Frequency	Type of Analysis	Frequency of Analysis	Remarks
	Code ^a	Site				
1. Airborne Particulate	a. Onsite and Near Field		Continuous operation for one week.	Gross Beta	Weekly	On all samples.
	Q-1	Onsite No. 1		Gamma Isot.	Weekly	If gross beta in a sample exceeds by 5 times the average concentration of the preceding calendar quarter for the sample location.
	Q-2	Onsite No. 2				
	Q-3	Onsite No. 3				
	Q-4	Nitro				
	Q-5	Saddle Club Dairy Farm		Gamma Isot.	Quarterly		On quarterly composite from each location.
	Q-6	Hanson's Boat Landing	Filter Exchange	Weekly		
			Sampling Train	Weekly	Test and maintenance.	
	b. Far Field		Continuous operation for one week.	Gross Beta		See footnote "c."
	Q-7	Clinton		Gamma Isot.		See footnote "c."
	Q-8	Sikkema Farm				
	Q-9 (C)	Erie		Filter Exchange	Weekly	
	Q-10 (C)	Hillsdale				
	Q-11	Port Byron				
	Q-12	Bettendorf		Sampling Train	Weekly	Test and maintenance.
	Q-13	Princeton				
Q-14 (C)	Utica Ridge Road					
Q-15 (C)	DeWitt					
Q-16	Low Moor					
2. Airborne Iodine	Same as 1.		Continuous operation for two weeks	I-131	Biweekly	On all samples from onsite and near field; for far-field samples, see footnote "c."
3. Air Sampling Train	Same as 1.		--	Test and Maintenance	Weekly	On all samplers.

^a Control (reference) locations are denoted by a "C" in this column. All other locations are indicators.

^c Far-field samples are analyzed when near-field results are inconsistent with previous measurements and radioactivity is confirmed as having its origin in airborne effluents released from the station or at the discretion of the Emergency Planning Supervisor.

TABLE 5.0-2 (continued)

ROAD CITIES STATION

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLE COLLECTION AND ANALYSES

Sample Media	Code ^a	Location	Site	Collection Frequency	Type of Analysis	Frequency of Analysis	Remarks
4. TLD	4. Same as 1.			Quarterly	Gamma	Quarterly	Two TLDs at all AP locations.
	b.	Inner Ring		Quarterly	Gamma	Quarterly	One TLD at all Inner and Outer Ring locations. All TLDs are read quarterly.
	0-101-1,2						
	102-1,2						
	103-1,2						
	104-1,2,3						
	105-1,2						
	106-1,2						
	107-1,2,3						
	108-1,2						
	109-1,2						
	111-1,2						
	112-1,2						
	113-1,2						
	114-1,2						
	115-1,2						
	116-1,2						
	0-201-1,2	Outer Ring					
	202-1,2						
	203-1,2						
	204-1,2						
	205-1,2						
	206-1,2						
	207-1,2						
	208-1,2						
	209-1,2						
	210-1,2						
	211-1,2						
	212-1,2						
	213-1,2						
	214-1,2						
	215-1,2						
	216-1,2						

^a Control (reference) locations are denoted by a "C" in this column. All other locations are indicators.

TABLE 5.0-2 (continued)

QUAD CITIES STATION

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLE COLLECTION AND ANALYSES

Sample Media	Location		Collection Frequency	Type of Analysis	Frequency of Analysis	Remarks
	Code ^a	Site				
5. Milk	Q-17 (C) Q-18 Q-25	Dornbush Dairy Musal Farm Waite Dairy Farm	Weekly: May through October	I-131	Weekly: May through October	On all samples. LLD: 0.5 pCi/l while on pasture.
			Monthly: November through April	I-131	Monthly: November through April	On all samples. LLD: 5.0 pCi/l while not on pasture.
6. Public Water	Q-19	East Moline Water Works	Weekly	Gamma Isot.	Monthly	On monthly composite from each location.
	Q-20 (C)	Davenport Water Works				
7. Cooling Water	Q-21 (C) Q-22	Inlet Canal Discharge Canal	Weekly	Gross beta	Weekly	On notification samples will be provided by station personnel.
8. Fish	Q-24	Mississippi River Pool #14	Semi-annually	Gamma Isot	Semi-annually	On edible portions only; at least two species.
9. Shoreline Sediments	Q-23	Mississippi River Pool #14	Annually	Gamma Isot	Annually	
10. Dairy Census	a. Site boundary to 2 miles		--	a. Enumeration by a door-to-door or equivalent counting technique.	Annually	During grazing season.

^a Control (reference) locations are denoted by a "C" in this column. All other locations are indicators.

TABLE 5.0-2 (continued)

JHAD CITIES STATION

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLE COLLECTION AND ANALYSES

Sample Media	Location		Collection Frequency	Type of Analysis	Frequency of Analysis	Remarks
	Code ^a	Site				
10. Dairy Census (continued)	b.	2 miles to 5 miles	--	b. Enumeration by using referenced information from county agricultural agents or other reliable sources.	Annually	During grazing season.
	c.	At dairies listed in Item 5.	--	c. Inquire as to feeding practices: 1. Pasture only. 2. Feed and chop only. 3. Pasture and feed; if both, ask farmer to estimate fraction of food from pasture. <25%, 25-50%, 50-75%, or >75%.	Annually	During grazing season.
11. Nearest Residence Census		In all 16 sectors up to 5 miles			Annually	

TABLE 5.0-3

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM QUARTERLY SUMMARY

Name of Facility Quad Cities Nuclear Power Station Docket No. 50-254, 50-265
 Location of Facility Rock Island, Illinois Reporting Period 1st Quarter 1991
 (County, State)

Sample Type (Units)	Type and Number of Analyses	LLD	Indicator Locations Mean ^a Range	Location with Highest Quarterly Mean		Control Locations Mean ^a Range	Number of Non-routine Results
				Location	Mean Range		
Air Particulates (pCi/m ³)	Gross Beta	0.01	0.028 (78/78) (0.010-0.052)	Q-06, Harrison Boat Landings 1.8 mi @ 340°	0.031 (13/13) (0.015-0.052)	None	0
	Gamma Spec.	0.01	<LLD	-	-	None	0
Airborne Iodine (pCi/m ³)	I-131	0.10	<LLD	-	-	None	0
Gamma Background (TLDs) (mR/Qt.)	Gamma Dose	3.0	15.2 (6/6) (13.6-16.7)	Q-11, Port Byron 8.0 mi @ 170°	18.6 (1/1)	16.0 (10/10) (13.8-18.6)	0
	I-131	5.0	<LLD	-	-	None	0
Cooling Water (pCi/L)	Gross Beta	2.0	3.4 (12/12) (2.2-5.4)	Q-22A, Discharge at Station	3.4 (12/12) (2.2-5.4)	3.3 (12/12) (2.6-4.6)	0
	Gamma Spec.						
Public Water (pCi/L)	Cs-137	10.0	<LLD	-	-	None	0
	Cs-137	10.0	<LLD	-	-	None	0
	Other Gammas	20.0	<LLD	-	-	None	0

^a Mean and range based on detectable measurements only. Fractions indicated in parentheses

TABLE 5.0-4

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM QUARTERLY SUMMARY

Name of Facility Quad Cities Nuclear Power Station Docket No. 50-254, 50-265
 Location of Facility Rock Island, Illinois Reporting Period 2nd Quarter 1991
 (County, State)

Sample Type (Units)	Type and Number of Analyses	LLD	Indicator Locations Mean ^a Range	Location with Highest Quarterly Mean		Control Locations Mean ^a Range	Number of Non-routine Results
				Location	Mean Range		
Air Particulates (pCi/m ³)	Gross Beta 78	0.01	0.015 (77/78) (0.006-0.022)	Q-06 ^b , Hansons Boat Landings 1.8 mi @ 340°	0.016 (13/13) (0.010-0.021)	None	0
	Gamma Spec. 6	0.01	<LLD	-	-	None	0
Airborne Iodine (pCi/m ³)	I-131 36	0.10	<LLD	-	-	None	0
Gamma Background (TLDs) (mR/Qtr.)	Gamma Dose 16	3.0	15.1 (6/6) (13.9-16.5)	Q-12, Bettendorf 13.0 mi @ 218°	18.3 (1/1)	15.9 (10/10) (13.5±18.3)	0
Milk (pCi/L)	I-131 30	5.0/0.5 ^c	<LLD	-	-	<LLD	0
Cooling Water (pCi/L)	Gross Beta 26	1.0	3.9 (13/13) (3.4-4.7)	Q-21, Inlet at Station	4.6 (13/13) (3.8-5.1)	4.6 (13/13) (3.8-5.1)	0
Public Water (pCi/L)	Gamma Spec. 6						
	Cs-137	10.0	<LLD	-	-	None	0
	Cs-137	10.0	<LLD	-	-	None	0
	Other Gammas	20.0	<LLD	-	-	None	0
Fish (pCi/g wet)	Gamma Spec. 12						
	Cs-137	0.1	<LLD	-	-	None	0
	Cs-137	0.1	<LLD	-	-	None	0
	Other Gammas	0.2	<LLD	-	-	None	0

^a Mean and range based on detectable measurements only. Fractions indicated in parentheses.

^b Locations Q-01, Q-04 and Q-06 all had identical mean values of 0.016 pCi/m³.

^c November - April LLD = 5.0; May - October LLD = 0.5.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM QUARTERLY SUMMARY

Name of Facility Quad Cities Nuclear Power Station Docket No. 50-254, 50-265
 Location of Facility Rock Island, Illinois Reporting Period 3rd Quarter 1991
 (County, State)

Sample Type (Units)	Type and Number of Analyses	LLD	Indicator Locations Mean ^a Range	Location with Highest Quarterly Mean		Control Locations Mean ^a Range	Number of Non-compliance Results
				Location	Mean Range		
Air Particulates (pCi/m ³)	Gross Beta 78	0.01	0.020 (78/78) (0.010-0.035)	Q-06, ransons Boat Landings 1.8 mi @ 340°	0.022 (13/13) (0.016-0.035)	None	0
	Gamma Spec. 6	0.01	<LLD	-	-	None	0
Airborne Iodine (pCi/m ³)	I-131 42	0.10	<LLD	-	-	None	0
Gamma Background (TLDs) (mR/Qtr.)	Gamma Dose 16	3.0	16.0 (6/6) (14-17.1)	Q-11, Port Byron 8.0 mi @ 170°	19.4 (1/1)	16.5 (10/10) (13.1-19.4)	0
Milk (pCi/L)	I-131 39	5.0	<LLD	-	-	<LLD	0
Cooling Water (pCi/L)	Gross Beta 28	1.0	4.7 (14/14) (3.1-6.9)	Q-21, Inlet at Station	4.8 (14/14) (3.6-7.0)	4.8 (14/14) (3.6-7.0)	0
Public Water (pCi/L)	Gamma Spec. 6						
	Cs-137	10.0	<LLD	-	-	None	0
	Cs-137	10.0	<LLD	-	-	None	0
	Other Gammas	20.0	<LLD	-	-	None	0
Bottom Sediments (pCi/g dry)	Gamma Spec. 1						
	Cs-137	0.1	<LLD	-	-	None	0
	Cs-137	0.1	0.13 (1/1)	Q-23, Mississippi River (Pool 14) 1.8 mi @ 340°	0.13 (1/1)	None	0
	Other Gammas	0.15	<LLD	-	-	None	0

^a Mean and range based on detectable measurements only. Fractions indicated in parentheses.

TABLE 5.0-6

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM QUARTERLY SUMMARY

Name of Facility Quad Cities Nuclear Power Station Docket No. 50-254, 50-265
 Location of Facility Rock Island, Illinois Reporting Period 4th Quarter 1991
 (County, State)

Sample Type (Units)	Type and Number of Analyses	LLD	Indicator Locations Mean ^a Range	Location with Highest Quarterly Mean		Control Locations Mean ^a Range	Number of Non-routine Results
				Location	Mean Range		
Air Particulates (pCi/m ³)	Gross Beta 78	0.01	0.023 (78/78) (0.012-0.033)	Q-04, Nitrin, 1.5 mi @ 40°	0.024 (13/13) (0.014-0.031)	None	0
	Gamma Spec. 6	0.01	<LLD	Q-06, Hansons Boat Landings 1.8 mi @ 340°	0.024 (13/13) (0.018-0.030)	None	0
Airborne Iodine (pCi/m ³)	I-131 36	0.10	<LLD	-	-	None	0
Gamma Background (TLDs) (mR/Qtr.)	Gamma Dose 16	3.0	15.3 (6/6) (14.1-16.5)	Q-12, Bettendorf 13.0 mi @ 218°	18.7 (1/1)	16.0 (10/10) (13.4-18.7)	0
Milk (pCi/L)	I-131 18	5.0/0.5 ^b	<LLD	-	-	<LLD	0
Cooling Water (pCi/L)	Gross Beta 26	1.0	4.1 (13/13) (2.8-5.7)	Q-21, Inlet at Station	4.4 (13/13) (3.1-5.7)	4.4 (13/13) (3.1-5.7)	0
Public Water (pCi/L)	Gamma Spec. 6						
	Cs-137	10.0	<LLD	-	-	None	0
	Cs-137	10.0	<LLD	-	-	None	0
Fish (pCi/g wet)	Other Gammas	20.0	<LLD	-	-	None	0
	Gamma Spec. 12						
	Cs-137	0.1	<LLD	-	-	None	0
	Cs-137	0.1	<LLD	-	-	None	0
Fish (pCi/g wet)	Other Gammas	0.2	<LLD	-	-	None	0
	Gamma Spec. 12						

^a Mean and range based on detectable measurements only. Fractions indicated in parentheses.

^b November - April LLD = 5.0; May - October LLD = 0.5.

TABLE 5.1-1
 QUAD CITIES STATION

GAMMA RADIATION MEASURED IN mR BY TLDs

Commonwealth Edison Company - Version 3.1 System
 Computer Systems Department - Technical Center
 1319 S. First Ave.
 Maywood, Ill. 60153

Date: 27-JAN-92

Environmental Report for QUAD

Gamma Radiation Measured in mR by TLDs

	Quarter 1 1991	Quarter 2 1991	Quarter 3 1991	Quarter 4 1991
On-Site and Near Field Indicator Locations				
Q-01 AIR SAMPLE STATION -- ON-SITE #1	15.0	14.9	15.6	15.2
Q-02 AIR SAMPLE STATION -- ON-SITE #2	15.2	14.9	15.8	15.2
Q-03 AIR SAMPLE STATION -- ON-SITE #3	15.7	15.0	15.6	14.8
Q-04 AIR SAMPLE STATION -- NITRIN	13.6	13.9	14.1	14.1
Q-05 AIR SAMPLE STATION -- SADDLE CLUB DAIRY FARM	15.1	15.5	16.8	15.8
Q-06 AIR SAMPLE STATION -- HANSEN S BOAT LANDING	16.7	16.5	17.1	16.5
Mean ± S.D.	15.2 ± 1.0	15.1 ± 0.9	16.0 ± 1.0	15.3 ± 0.8
Far Field Locations				
Q-07 AIR SAMPLE STATION -- CLINTON	14.9	14.6	14.6	14.8
Q-08 AIR SAMPLE STATION -- SINKEMA'S FARM	16.0	16.4	17.7	16.4
Q-09 AIR SAMPLE STATION -- ERIE	15.5	15.7	16.6	15.8
Q-10 AIR SAMPLE STATION -- HILLSDALE	16.4	16.8	18.3	16.6
Q-11 AIR SAMPLE STATION -- PORT BYRON	18.6	18.2	19.4	18.0
Q-12 AIR SAMPLE STATION -- BETTENDORF	18.2	18.3	18.7	18.7
Q-13 AIR SAMPLE STATION -- PRINCETON	15.5	15.5	15.8	15.9
Q-14 AIR SAMPLE STATION -- UTICA RIDGE RD	15.3	15.3	15.6	15.3
Q-15 AIR SAMPLE STATION -- DEWITT	18.8	18.5	18.1	18.4
Q-16 AIR SAMPLE STATION -- LOW MOOR	18.9	18.8	18.6	18.2
Mean ± S.D.	16.0 ± 1.5	15.9 ± 1.5	16.5 ± 2.0	16.0 ± 1.5
Inner Ring, Near-site Boundary, Indicator Locations				
101-1 NORTH	13.9	14.2	14.9	15.1
101-2 NORTH	13.9	15.0	15.9	14.7
102-1 NORTH NORTHEAST	16.3	17.0	17.7	20.7
102-2 NORTH NORTHEAST	14.3	15.5	16.1	15.8
103-1 EAST NORTHEAST	14.5	14.4	14.8	15.2
103-2 EAST NORTHEAST	14.4	14.5	15.1	14.6
104-1 EAST NORTHEAST	14.1	14.5	15.1	15.1
104-2 EAST NORTHEAST	14.6	14.6	15.4	15.7
104-3 EAST NORTHEAST	15.2	15.7	15.6	15.4
105-1 EAST	14.1	14.5	15.0	14.6
105-2 EAST	14.3	14.8	14.9	14.7
106-1 EAST SOUTHEAST	14.2	14.3	15.5	15.0
106-2 EAST SOUTHEAST	14.4	15.1	15.2	14.9
107-1 SOUTHEAST	15.0	15.0	15.1	15.0
107-2 SOUTHEAST	14.7	15.1	14.9	14.9
107-3 SOUTHEAST	15.7	14.2	14.7	14.9
108-1 SOUTH SOUTHEAST	14.4	14.7	15.3	15.1
108-2 SOUTH SOUTHEAST	14.7	14.6	14.8	15.3
109-1 SOUTH	14.2	15.7	15.7	15.1
109-2 SOUTH	14.6	15.1	15.0	15.1
111-1 SOUTHWEST	16.2	17.3	17.4	17.1
111-2 SOUTHWEST	15.4	15.4	16.7	15.1
112-1 WEST SOUTHWEST	14.6	14.6	15.5	15.6
112-2 WEST SOUTHWEST	15.0	15.5	16.7	16.7
113-1 WEST	14.8	15.7	14.6	15.0
113-2 WEST	14.1	14.1	14.8	15.1
114-1 WEST NORTHWEST	14.3	14.6	15.5	15.0
114-2 WEST NORTHWEST	15.8	15.4	16.3	16.3
115-1 NORTHWEST	15.1	15.6	16.5	15.1
115-2 NORTHWEST	17.0	17.2	17.9	17.6
11-1 NORTH NORTHWEST	16.0	16.0	19.7	16.1
116-2 NORTH NORTHWEST	16.2	16.1	18.1	16.1
Mean ± S.D.	15.2 ± 0.8	15.4 ± 1.0	16.0 ± 1.4	15.6 ± 0.7

TABLE 5.1-1 (continued)
 QUAD CITIES STATION
 GAMMA RADIATION MEASURED IN mR BY TLDs

Commonwealth Edison Company - Version 3.1 System
 Computer Systems Department - Technical Center
 1219 S. First Ave.
 Maywood, Ill. 60153

Date: 27-JAN-92

Environmental Report for QUAD

Gamma Radiation Measured in mR by TLDs

	Quarter 1 1991	Quarter 2 1991	Quarter 3 1991	Quarter 4 1991
Outer Ring, Near 5 Mile Radius, Indicator Locations				
R01-1 NORTH	17.0	17.5	18.0	16.7
R01-2 NORTH	17.0	17.5	17.3	17.4
R02-1 NORTH NORTHEAST	15.7	14.8	14.8	15.1
R02-2 NORTH NORTHEAST	15.6	14.8*	14.9	14.9
R03-1 NORTHEAST	16.2	15.8	15.0	15.9
R03-2 NORTHEAST	17.4	18.0	19.5	18.0
R04-1 EAST NORTHEAST	18.0	18.2	18.8	18.8
R04-2 EAST NORTHEAST	17.8	18.0	19.2	18.8
R05-1 EAST	16.2	17.5	19.0	16.5
R05-2 EAST	15.1	15.8	16.4	15.1
R06-1 EAST SOUTHEAST	17.8	15.9	16.4	15.5
R06-2 EAST SOUTHEAST	15.4	16.0	16.4	15.9
R07-1 SOUTHEAST	16.3	17.6	17.9	16.7
R07-2 SOUTHEAST	15.6	15.4	16.1	15.3
R08-1 SOUTH SOUTHEAST	17.2	16.5	17.4	16.7
R08-2 SOUTH SOUTHEAST	18.4	17.9	18.8	17.1
R09-1 SOUTH	18.5	14.4	17.2	18.1
R09-2 SOUTH	15.5	15.5	15.5	15.9
R10-1 SOUTH SOUTHWEST	18.9	18.5	16.6	15.4
R10-2 SOUTH SOUTHWEST	17.8	18.8	16.6	15.7
R11-1 SOUTHWEST	18.6	19.5	20.3	19.7
R11-2 SOUTHWEST	18.8	19.0	19.3	18.8
R12-1 WEST SOUTHWEST	15.1	18.2	18.4	18.2
R12-2 WEST SOUTHWEST	15.4	15.5	16.2	15.7
R13-1 WEST	15.0	16.5	16.4	16.0
R13-2 WEST	14.6	14.6	14.9	14.2
R14-1 NORTHWEST	16.4	18.0	17.8	18.1
R14-2 NORTHWEST	16.9	18.7	18.3	17.8
R15-1 NORTHWEST	17.0	19.0	19.4*	18.0
R15-2 NORTHWEST	18.1	18.9	19.4	18.8
R16-1 NORTH NORTHWEST	16.5	17.2	17.4	17.3
R16-2 NORTH NORTHWEST	18.3	18.7	18.4	18.4
Mean ± S.D.	16.7 ± 1.2	17.2 ± 1.4	17.5 ± 1.5	16.9 ± 1.4

RESTRICTED AREA MONITORING PROGRAM

R001-1 PUBLIC OBSERVATION TOWER	25.2	25.0	27.8	26.8
R002-1 VISITORS CENTER	22.5	18.9	22.7	22.4
R003-2 FIRE TRAINING TOWER	15.4	15.0	15.1	14.6
R004-2 SIMULATOR BUILDING	17.6	-	19.1	25.3
R005-1 TRAINING BUILDING	15.1	13.5	14.6	15.6
R006-1,2,3 WAREHOUSES ON UPPER ACCESS ROAD	23.4	19.7	24.4	25.9
Mean ± S.D.	20.4 ± 5.2	18.0 ± 3.8	20.8 ± 5.4	21.9 ± 5.5

COMMENTS: "*" DENOTES LOST TLD, BECAUSE TWO TLD'S WERE PLACED AT THE SAME (R,THETA) VALUE, ASSUMES LOST TLD DOSE VALUE = KNOWN TLD DOSE VALUE AT THAT SPECIFIC LOCATION.
 "-" DENOTES LOST TLD WITHOUT A BACK-UP.

APPENDIX II

METEOROLOGICAL DATA

QUAC CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - JANUARY-MARCH 1991
 STABILITY CLASS - EXTREMELY UNSTABLE (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	.8-3	4-7	8-12	13-18	19-24	GT 24	
N	0	0	0	0	1	0	1
NNE	0	0	1	0	0	0	1
NE	0	0	1	0	0	0	1
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	1	1
SE	0	0	0	1	0	1	2
SSE	0	0	0	2	0	0	2
S	0	0	0	1	0	0	1
SSW	0	0	0	3	0	0	3
SW	0	0	5	2	1	0	8
WSW	0	0	4	0	1	0	5
W	0	0	3	1	1	0	5
WNW	0	0	4	5	6	0	15
NW	0	0	5	2	1	0	8
NNW	0	0	2	7	1	0	10
VARIABLE	0	0	0	0	0	0	0
TOTAL	0	0	25	24	12	2	63

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 0

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - JANUARY-MARCH 1991
 STABILITY CLASS - MODERATELY UNSTABLE (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	.8-3	4- 7	8-12	13-18	19-24	GT 24	
N	0	1	2	0	1	0	4
NNE	0	0	3	0	0	0	3
NE	0	0	1	5	0	0	6
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	1	0	3	4
SE	0	0	1	2	1	1	5
SSE	0	0	1	1	2	0	4
S	0	0	1	2	0	0	3
SSW	0	0	0	0	0	0	0
SW	0	1	1	3	0	0	5
WSW	0	2	4	4	0	0	10
W	0	1	5	1	0	0	7
WNW	0	3	3	3	0	0	9
NW	0	0	2	3	2	2	9
NNW	0	0	1	3	0	0	4
VARIABLE	0	0	0	0	0	0	0
TOTAL	0	8	25	28	6	6	73

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 0

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - JANUARY-MARCH 1991
 STABILITY CLASS - SLIGHTLY UNSTABLE (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	0-3	4-7	8-12	13-18	19-24	GT 24	
N	0	2	3	2	0	0	7
NNE	0	0	2	0	0	0	2
NE	0	0	1	0	0	0	1
ENE	0	0	1	1	0	0	2
E	0	0	2	0	0	0	2
ESE	0	1	0	0	0	1	2
SE	0	1	1	2	2	0	6
SSE	0	1	0	2	2	0	5
S	0	1	1	1	4	0	7
SSW	0	1	0	1	2	0	4
SW	0	4	6	7	0	0	17
WSW	0	4	4	2	1	1	12
W	0	4	6	8	0	1	19
WNW	0	1	5	1	9	4	20
NW	0	1	9	2	5	3	20
NNW	0	1	7	3	1	0	12
VARIABLE	0	0	0	0	0	0	0
TOTAL	0	22	48	32	26	10	138

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 0

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - JANUARY-MARCH 1991
 STABILITY CLASS - NEUTRAL (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	.8-3	4-7	8-12	13-18	19-24	GT 24	
N	0	9	23	31	9	2	74
NNE	0	12	14	20	2	0	48
NE	1	8	13	9	5	0	36
ENE	0	9	13	2	2	0	26
E	1	3	10	12	19	6	51
ESE	2	7	15	12	4	17	57
SE	2	2	16	11	2	1	34
SSE	2	0	9	9	7	5	32
S	3	6	2	13	4	2	30
SSW	0	5	3	26	10	4	48
SW	1	15	23	30	1	1	71
WSW	2	7	21	22	4	11	67
W	1	14	32	30	16	19	112
WNW	1	12	30	33	52	20	168
NW	3	6	26	60	30	21	146
NNW	1	8	29	20	5	1	64
VARIABLE	0	0	0	0	0	0	0
TOTAL	20	123	279	360	172	110	1064

Hours of calm in this stability class: 1
 Hours of missing wind measurements in this stability class: 48
 Hours of missing stability measurements in all stability classes: 0

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - JANUARY-MARCH 1991
 STABILITY CLASS - SLIGHTLY STABLE (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	.8-3	4-7	8-12	13-18	19-24	GT 24	
N	1	7	22	7	0	0	37
NNE	1	9	14	8	0	0	32
NE	1	4	7	2	6	0	20
ENE	0	2	16	8	0	0	26
E	0	1	4	6	2	1	14
ESE	2	4	6	15	10	4	41
SE	0	2	11	10	3	1	27
SSE	0	1	2	12	7	5	27
S	0	1	2	19	9	7	38
SSW	0	3	11	30	28	6	78
SW	0	3	19	26	4	1	53
WSW	0	3	4	16	11	0	34
W	0	2	11	16	7	0	36
WNW	0	3	12	18	7	0	40
NW	0	2	9	18	0	3	29
NNW	1	2	11	10	1	0	25
VARIABLE	0	0	0	0	0	0	0
TOTAL	6	49	161	221	95	25	557

Hours of calm in this stability class: 1
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 0

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - JANUARY-MARCH 1991
 STABILITY CLASS - MODERATELY STABLE (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	0-3	4-7	8-12	13-18	19-24	GT 24	
N	1	0	5	5	0	0	11
NNE	0	4	7	8	0	0	19
NE	0	2	6	2	0	0	10
ENE	1	0	7	9	0	0	17
E	1	0	1	4	0	0	6
ESE	0	1	0	8	2	0	11
SE	1	1	1	3	3	0	9
SSE	1	0	1	4	0	0	6
S	0	0	2	12	0	0	14
SSW	0	1	5	14	10	0	30
SW	0	2	2	5	0	0	9
WSW	0	1	2	2	0	0	5
W	0	0	3	4	0	0	7
WNW	0	2	3	5	1	0	11
NW	0	0	5	1	0	0	6
NNW	0	0	3	7	1	0	11
VARIABLE	0	0	0	0	0	0	0
TOTAL	5	14	53	93	17	0	182

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 0

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - JANUARY-MARCH 1991
 STABILITY CLASS - EXTREMELY STABLE (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	0-3	4-7	8-12	13-18	19-24	GT 24	
N	0	0	0	0	0	0	0
NNE	0	0	0	0	0	0	0
NE	0	0	0	0	0	0	0
ENE	0	0	1	1	0	0	2
E	0	0	4	0	0	0	4
ESE	0	0	0	0	0	0	0
SE	0	0	2	2	0	0	4
SSE	0	0	1	4	0	0	5
S	0	2	2	2	1	0	7
SSW	0	0	3	0	1	0	4
SW	0	4	0	1	0	0	5
WSW	0	0	1	0	0	0	1
W	0	0	1	0	0	0	1
WNW	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0
VARIABLE	0	0	0	0	0	0	0
TOTAL	0	6	15	10	2	0	33

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 0

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - APRIL-JUNE 1991
 STABILITY CLASS - EXTREMELY UNSTABLE (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	0-3	4-7	8-12	13-18	19-24	GT 24	
N	0	1	4	0	0	0	5
NNE	0	0	1	0	0	0	1
NE	0	1	2	0	0	0	3
ENE	0	1	2	3	0	1	7
E	0	0	10	6	5	0	21
ESE	0	0	0	3	6	0	9
SE	0	1	0	8	1	0	10
SSE	0	0	6	2	0	0	8
S	0	0	3	3	0	0	6
SSW	0	1	15	10	3	0	29
SW	0	1	3	6	0	0	10
WSW	0	1	1	2	1	0	5
W	0	1	7	1	1	0	10
WNW	1	0	4	3	0	0	8
NW	0	2	6	4	0	0	12
NNW	0	0	2	1	0	0	3
VARIABLE	0	0	0	0	0	0	0
TOTAL	1	10	66	52	17	1	147

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 0

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - APRIL-JUNE 1991
 STABILITY CLASS - MODERATELY UNSTABLE (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	0-3	4-7	8-12	13-18	19-24	GT 24	
N	0	1	5	0	0	0	6
NNE	0	0	1	0	0	0	1
NE	0	0	4	0	0	0	4
ENE	0	2	6	3	1	0	12
E	0	1	7	3	3	1	15
ESE	0	0	5	3	1	0	9
SE	0	2	3	2	1	0	8
SSE	0	6	4	2	0	0	12
S	0	1	2	9	1	0	13
SSW	0	2	19	7	5	1	34
SW	0	9	2	9	0	0	20
WSW	0	2	1	0	0	1	4
W	0	2	1	1	2	2	8
WNW	0	4	1	1	0	0	6
NW	0	9	1	0	0	0	10
NNW	0	5	0	1	0	0	6
VARIABLE	0	0	0	0	0	0	0
TOTAL	0	46	62	41	14	5	168

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 0

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - APRIL-JUNE 1991
 STABILITY CLASS - SLIGHTLY UNSTABLE (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	.8-3	4-7	8-12	13-18	19-24	GT 24	
N	0	5	3	0	0	0	8
NNE	1	0	1	0	0	0	2
NE	0	2	2	2	0	0	6
ENE	0	3	3	3	0	0	9
E	0	2	5	1	4	0	12
ESE	0	2	2	2	0	0	6
SE	0	4	3	2	0	0	9
SSE	0	2	2	3	0	0	7
S	0	7	5	4	1	0	17
SSW	1	9	9	9	3	0	31
SW	1	7	8	6	2	0	24
WSW	1	4	0	1	1	1	8
W	0	3	1	2	1	2	9
WNW	0	2	3	0	1	1	7
NW	2	3	1	1	0	0	7
NNW	3	4	1	0	0	0	8
VARIABLE	0	0	0	0	0	0	0
TOTAL	9	59	49	36	13	4	170

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 0

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - APRIL-JUNE 1991
 STABILITY CLASS - NEUTRAL (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	0-3	4-7	8-12	13-18	19-24	GT 24	
N	0	6	8	1	0	0	15
NNE	1	1	4	12	5	0	23
NE	2	5	21	35	14	2	79
ENE	1	4	24	33	28	6	96
E	0	5	23	23	20	15	86
ESE	0	3	19	15	6	4	47
SE	0	3	25	4	7	0	39
SSE	1	7	13	11	0	1	33
S	1	7	12	11	5	2	38
SSW	0	16	23	20	3	3	65
SW	0	11	23	9	4	5	52
WSW	1	1	6	5	3	9	25
W	2	7	3	6	13	24	55
WNW	2	8	9	11	16	8	54
NW	3	7	12	8	5	0	35
NNW	2	6	1	3	0	0	12
VARIABLE	0	0	0	0	0	0	0
TOTAL	16	97	226	207	129	79	754

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 0

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - APRIL-JUNE 1991
 STABILITY CLASS - SLIGHTLY STABLE (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	.8-3	4-7	8-12	13-18	19-24	GT 24	
N	0	2	5	4	0	1	12
NNE	1	5	10	5	2	0	23
NE	0	1	2	5	2	0	16
ENE	0	3	12	27	3	0	45
E	0	2	16	35	9	3	66
ESE	0	3	14	35	11	0	63
SE	2	2	13	3	5	2	27
SSE	2	5	3	10	8	2	30
S	1	7	23	37	6	0	74
SSW	2	2	26	44	18	2	96
SW	0	14	22	10	1	0	47
WSW	1	3	11	12	1	2	30
W	0	3	3	10	3	0	19
WNW	0	1	10	14	0	0	25
NW	1	1	5	5	1	0	13
NNW	0	2	6	0	0	0	8
VARIABLE	0	0	0	0	0	0	0
TOTAL	10	59	187	256	70	12	594

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 0

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - APRIL-JUNE 1991
 STABILITY CLASS - MODERATELY STABLE (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	.8-3	4-7	8-12	13-18	19-24	GT 24	
N	0	3	1	0	0	0	4
NNE	0	1	4	1	1	0	7
NE	0	2	1	0	0	0	3
ENE	0	3	1	6	0	0	10
E	0	2	4	8	1	0	15
ESE	1	1	15	13	1	0	31
SE	0	2	15	11	0	0	28
SSE	0	2	18	6	1	0	27
S	0	4	11	12	0	0	27
SSW	0	2	21	20	3	0	46
SW	1	8	13	6	0	0	28
WSW	0	1	6	3	0	0	10
W	0	1	4	2	0	0	7
WNW	0	0	10	2	0	0	12
NW	0	1	5	1	0	0	7
NNW	0	0	1	0	0	0	1
VARIABLE	0	0	0	0	0	0	0
TOTAL	2	33	130	91	7	0	263

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 0

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - APRIL-JUNE 1991
 STABILITY CLASS - EXTREMELY STABLE (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	.8-3	4-7	8-12	13-18	19-24	GT 24	
N	0	1	1	1	0	0	3
NNE	0	1	0	0	0	0	1
NE	0	3	1	0	0	0	7
ENE	3	2	0	2	0	0	7
E	0	1	1	0	0	0	2
ESE	0	2	5	0	0	0	7
SE	0	2	7	1	1	0	11
SSE	0	4	9	7	0	0	20
S	0	2	6	6	0	0	14
SSW	0	1	0	0	0	0	1
SW	0	1	1	1	0	0	3
WSW	1	3	3	0	0	0	7
W	0	1	0	0	0	0	1
WNW	0	0	2	0	0	0	2
NW	0	0	1	0	0	0	1
NNW	0	0	1	0	0	0	1
VARIABLE	0	0	0	0	0	0	0
TOTAL	7	24	38	18	1	0	88

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 0

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - JULY-SEPTEMBER 1991
 STABILITY CLASS - EXTREMELY UNSTABLE (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	0-3	4-7	8-12	13-18	19-24	GT 24	
N	0	0	16	6	0	0	22
NNE	0	1	6	4	0	0	11
NE	0	0	12	6	0	0	18
ENE	0	4	1	5	0	0	10
E	0	2	5	1	0	0	8
ESE	0	0	3	3	0	0	6
SE	0	0	3	4	0	0	7
SSE	0	1	4	2	0	0	7
S	0	0	4	14	1	0	19
SSW	0	4	23	12	0	0	39
SW	0	6	23	4	0	0	33
WSW	0	3	8	4	3	0	18
W	0	3	2	5	2	0	12
WNW	0	4	9	6	11	0	30
NW	0	2	4	13	3	0	22
NNW	0	0	11	3	0	0	14
VARIABLE	0	0	0	0	0	0	0
TOTAL	0	30	134	92	20	0	276

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 0

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - JULY-SEPTEMBER 1991
 STABILITY CLASS - MODERATELY UNSTABLE (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	.8-3	4-7	8-12	13-18	19-24	GT 24	
N	0	5	6	1	0	0	12
NNE	0	4	6	2	0	0	12
NE	0	5	10	2	0	0	17
ENE	0	6	0	1	0	0	7
E	0	1	3	2	0	0	6
ESE	0	2	3	1	0	0	6
SE	0	1	3	1	0	0	5
SSE	0	0	8	0	0	0	8
S	0	1	13	2	1	0	17
SSW	0	7	9	4	0	0	20
SW	1	5	4	3	0	0	13
WSW	0	4	3	2	2	1	12
W	0	4	2	1	4	0	11
WNW	0	7	4	3	1	0	15
NW	0	3	0	5	0	0	8
NNW	0	2	2	3	0	0	7
VARIABLE	0	0	0	0	0	0	0
TOTAL	1	57	76	33	8	1	176

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 0

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - JULY-SEPTEMBER 1991
 STABILITY CLASS - SLIGHTLY UNSTABLE (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 206 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	.8-3	4-7	8-12	13-18	19-24	GT 24	
N	0	1	3	2	0	0	6
NNE	0	3	5	1	0	0	9
NE	0	2	1	0	0	0	3
ENE	0	2	2	0	0	0	4
E	0	3	3	2	0	0	8
ESE	1	4	8	2	0	0	15
SE	0	2	5	5	0	0	12
SSE	0	3	2	1	0	0	6
S	0	2	7	4	1	0	14
SSW	0	9	5	4	0	0	18
SW	0	3	3	0	0	0	6
WSW	1	6	1	1	2	0	11
W	1	2	1	5	1	0	10
WNW	1	5	1	4	4	0	15
NW	0	2	2	4	0	0	8
NNW	1	0	1	2	0	0	4
VARIABLE	0	0	0	0	0	0	0
TOTAL	5	49	50	37	8	0	149

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 0

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - JULY-SEPTEMBER 1991
 STABILITY CLASS - NEUTRAL (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	.8-3	4-7	8-12	13-18	19-24	GT 24	
N	2	7	12	3	0	0	24
NNE	0	8	6	17	0	0	31
NE	3	1	6	8	1	0	19
ENE	2	3	5	0	2	0	12
E	3	9	9	4	0	0	25
ESE	1	5	17	18	0	0	41
SE	1	4	14	19	1	0	39
SSE	0	9	17	10	4	1	41
S	1	6	8	8	2	0	25
SSW	1	6	19	14	5	0	45
SW	3	11	26	11	1	0	52
WSW	2	5	3	7	0	0	17
W	1	4	12	8	1	0	26
WNW	3	5	6	10	2	0	26
NW	1	3	8	19	10	2	43
NNW	0	4	14	15	0	0	33
VARIABLE	0	0	0	0	0	0	0
TOTAL	24	90	182	171	29	3	499

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 0

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - JULY-SEPTEMBER 1991
 STABILITY CLASS - SLIGHTLY STABLE (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	.8-3	4- 7	8-12	13-18	19-24	GT 24	
N	1	1	12	15	1	0	30
NNE	0	5	9	7	0	0	21
NE	2	9	15	13	1	0	40
ENE	2	3	16	11	0	0	32
E	0	2	12	14	1	0	29
ESE	1	5	7	19	0	0	32
SE	0	4	14	20	0	0	38
SSE	2	3	17	15	1	0	38
S	0	3	10	18	3	0	34
SSW	0	4	27	53	7	0	91
SW	0	7	23	11	0	0	41
WSW	2	1	5	8	1	0	17
W	0	3	15	12	0	0	30
WNW	0	2	6	32	2	0	42
NW	1	2	5	26	6	0	40
NNW	2	4	5	7	0	0	18
VARIABLE	0	0	0	0	0	0	0
TOTAL	13	58	198	281	23	0	573

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 0

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - JULY-SEPTEMBER 1991
 STABILITY CLASS - MODERATELY STABLE (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	.8-3	4-7	8-12	13-18	19-24	GT 24	
N	1	2	20	4	0	0	27
NNE	0	5	9	3	0	0	17
NE	1	1	8	5	0	0	15
ENE	0	0	7	5	0	0	12
E	0	3	4	9	0	0	16
ESE	1	5	13	17	0	0	36
SE	0	3	7	14	1	0	25
SSE	1	4	12	9	0	0	26
S	1	4	17	18	1	0	41
SSW	0	2	12	48	6	0	68
SW	2	2	3	0	0	0	7
WSW	1	1	4	0	0	0	6
W	0	5	5	5	2	0	17
WNW	0	6	8	10	2	0	26
NW	1	1	3	6	0	0	11
NNW	1	4	6	3	0	0	14
VARIABLE	0	0	0	0	0	0	0
TOTAL	10	48	138	156	12	0	364

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 0

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - JULY-SEPTEMBER 1991
 STABILITY CLASS - EXTREMELY STABLE (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	0-3	4-7	8-12	13-18	19-24	GT 24	
N	3	6	2	1	0	0	12
NNE	0	4	3	0	0	0	7
NE	0	6	1	1	0	0	8
ENE	0	1	0	3	0	0	4
E	1	2	3	1	0	0	7
ESE	0	3	3	6	0	0	12
SE	1	2	8	4	0	0	15
SSE	0	3	3	10	2	0	24
S	0	3	8	14	0	0	25
SSW	2	5	13	20	2	0	42
SW	1	0	1	0	0	0	2
WSW	0	1	1	0	0	0	2
W	2	1	0	0	0	0	3
WNW	0	0	2	0	0	0	2
NW	1	1	0	0	0	0	2
NNW	0	1	0	3	0	0	4
VARIABLE	0	0	0	0	0	0	0
TOTAL	11	39	54	63	4	0	171

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 0

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - OCTOBER-DECEMBER 1991
 STABILITY CLASS - EXTREMELY UNSTABLE (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	.8-3	4-7	8-12	13-18	19-24	GT 24	
N	0	0	0	3	0	0	3
NNE	0	0	0	1	2	0	3
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	0	0	0	1	0	1
S	0	0	0	4	0	0	4
SSW	0	0	6	8	10	0	24
SW	0	0	3	2	0	0	5
WSW	0	0	3	0	0	0	3
W	0	0	1	3	0	0	4
WNW	0	0	0	7	2	0	9
NW	0	0	0	0	1	0	1
NNW	0	0	0	0	2	0	2
VARIABLE	0	0	0	0	0	0	0
TOTAL	0	0	13	26	18	0	59

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 1

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - OCTOBER-DECEMBER 1991
 STABILITY CLASS - MODERATELY UNSTABLE (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	.8-3	4-7	8-12	13-18	19-24	GT 24	
N	0	0	2	1	0	0	3
NNE	0	0	1	1	0	0	2
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	0	0	3	3	0	6
S	0	0	1	1	0	1	3
SSW	0	0	2	6	3	0	11
SW	0	1	7	0	0	0	8
WSW	0	1	1	1	0	0	3
W	0	0	1	3	5	2	11
WNW	0	0	2	1	2	0	5
NW	0	0	0	2	0	0	2
NNW	0	0	1	2	0	1	4
VARIABLE	0	0	0	0	0	0	0
TOTAL	0	2	18	21	13	4	58

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 1
 Hours of missing stability measurements in all stability classes: 1

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - OCTOBER-DECEMBER 1991
 STABILITY CLASS - SLIGHTLY UNSTABLE (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	.8-3	4-7	8-12	13-18	19-24	GT 24	
N	0	5	4	1	0	0	10
NNE	0	1	0	0	2	0	3
NE	0	1	0	0	0	0	1
ENE	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
ESE	0	2	0	0	0	0	2
SE	0	1	0	1	0	0	2
SSE	0	0	1	1	3	0	5
S	0	0	0	1	2	1	4
SSW	0	1	3	6	3	0	13
SW	0	1	6	0	0	0	7
WSW	0	1	4	3	2	2	12
W	0	1	6	2	2	4	15
WNW	0	2	3	0	9	0	14
NW	0	1	1	1	1	0	4
NNW	0	3	3	0	1	0	7
VARIABLE	0	0	0	0	0	0	0
TOTAL	0	20	31	16	25	7	99

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 3
 Hours of missing stability measurements in all stability classes: 1

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - OCTOBER-DECEMBER 1991
 STABILITY CLASS - NEUTRAL (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	.8-3	4-7	8-12	13-18	19-24	GT 24	
N	1	6	23	39	7	2	84
NNE	3	4	14	6	7	0	34
NE	2	9	40	26	0	0	77
ENE	1	7	32	15	2	0	58
E	1	6	15	28	3	0	54
ESE	0	5	10	3	12	8	38
SE	0	11	18	3	11	16	59
SSL	2	15	4	19	11	5	56
S	1	2	2	19	16	8	48
SSW	1	6	17	20	16	6	66
SW	1	10	21	10	6	4	52
WSW	2	18	13	13	23	23	92
W	3	4	19	35	28	38	127
WNW	3	8	17	39	61	22	150
NW	2	7	31	33	10	6	89
NNW	3	4	21	22	4	0	54
VARIABLE	0	0	0	0	0	0	0
TOTAL	26	122	304	331	217	138	1138

Hours of calm in this stability class. 0
 Hours of missing wind measurements in this stability class: 51
 Hours of missing stability measurements in all stability classes: 1

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - OCTOBER-DECEMBER 1961
 STABILITY CLASS - SLIGHTLY STABLE (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	.8-3	4-7	8-12	13-18	19-24	GT 24	
N	1	7	2	6	3	0	19
NNE	2	2	5	4	0	0	13
NE	1	4	2	0	2	0	9
ENE	3	2	4	2	0	0	11
E	1	3	1	6	1	0	12
ESE	0	0	1	5	4	1	11
SE	1	1	2	4	6	3	17
SSE	1	0	6	14	14	6	41
S	0	4	6	31	24	7	72
SSW	0	5	7	41	39	7	99
SW	1	5	23	25	3	0	57
WSW	1	3	5	7	0	0	16
W	1	2	8	34	1	0	46
WNW	3	4	8	23	4	0	42
NW	1	3	11	13	5	0	33
NNW	1	2	9	8	0	0	20
VARIABLE	0	0	0	0	0	0	0
TOTAL	18	47	100	223	106	24	518

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 12
 Hours of missing stability measurements in all stability classes: 1

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - OCTOBER-DECEMBER 1991
 STABILITY CLASS - MODERATELY STABLE (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	.8-3	4-7	8-12	13-18	19-24	GT 24	
N	0	2	4	4	0	0	10
NNE	1	1	2	1	0	0	5
NE	1	1	1	0	0	0	3
ENE	1	2	3	0	0	0	6
E	1	1	3	2	0	0	7
ESE	0	4	8	3	1	0	16
SE	0	3	0	9	0	0	12
SSE	1	0	6	9	0	0	16
S	0	1	4	40	3	0	48
SSW	0	2	12	13	5	1	33
SW	1	1	3	3	0	0	8
WSW	0	0	2	0	0	0	2
W	0	0	2	3	1	0	6
WNW	0	0	5	3	0	0	8
NW	1	4	4	2	0	0	11
NNW	0	0	3	2	0	0	5
VARIABLE	0	0	0	0	0	0	0
TOTAL	7	22	62	94	10	1	196

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 1

QUAD CITIES NUCLEAR POWER STATION
 PERIOD OF RECORD - OCTOBER-DECEMBER 1991
 STABILITY CLASS - EXTREMELY STABLE (DIFF TEMP 296-33 FT)
 WINDS MEASURED AT 296 FEET

WIND DIRECTION	WIND SPEED (IN MPH)						TOTAL
	.8-3	4- 7	8-12	13-18	19-24	GT 24	
N	1	1	0	0	0	0	2
NNE	0	0	1	0	0	0	1
NE	0	1	0	0	0	0	1
ENE	0	1	0	0	0	0	1
E	0	1	0	0	0	0	1
ESE	0	1	1	1	0	0	3
SE	3	1	0	1	0	0	5
SSE	0	2	3	6	0	0	11
S	0	0	0	2	0	0	2
SSW	1	1	10	9	0	0	21
SW	1	1	6	0	0	0	8
WSW	2	0	0	2	0	0	4
W	1	0	1	1	1	0	4
WNW	1	1	1	1	0	0	4
NW	0	0	1	1	0	0	2
NNW	0	2	0	0	0	0	2
VARIABLE	0	0	0	0	0	0	0
TOTAL	10	13	24	24	1	0	72

Hours of calm in this stability class: 0
 Hours of missing wind measurements in this stability class: 0
 Hours of missing stability measurements in all stability classes: 1

APPENDIX III

LISTING OF MISSED SAMPLES

QUAD CITIES

2.0 LISTING OF MISSED SAMPLES

Sample Type	Location	Expected Collection Date	Reason
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THERE WERE NO MISSED SAMPLES IN 1991.

Air Sampling Variances ¹

AP + I	Q-4	01-10-91	Low Sample Volume.
AP	Q-5	04-05-91	Filter light.
AP + I	Q-8	04-27-91	Meter (timer) Malfunction.
AP + I	Q-13	05-10-91	Low Sample Volume.
AP + I	Q-14	05-10-91	Low Sample Volume.
AP	Q-15	07-12-91	Low Sample Volume.
AP + I	Q-2	10-12-91	Low Sample Volume.
AP	Q-16	10-18-91	Low Sample Volume.

¹ = Air Sampling Variances are samples which have not been missed but indicate unusual sample results or factors which contribute to sample anomalies.

AP = Air Particulate (Filter)

I = Iodine (Cartridge)

APPENDIX IV

MILCH ANIMALS, NEAREST CATTLE, AND NEAREST RESIDENCES CENSUSES

QUAD CITIES

MILCH ANIMALS CENSUS, 1991

There are no dairy farms within a five (5) mile radius of Quad Cities.

Sampling Locations

Q-17 Dornbush Dairy Farm
Albany, IL

6.0 mi @ 70° (ESE)

Milks 8 to 14 cows.

Diet consists of ground corn, oats, baled hay, bean meal and protein.

Q-18 Musal Dairy Farm
Princeton, IA

5.5 mi @ 225° (SW)

Milks 60 to 100 cows.

Diet consists of chopped alfalfa and ground corn.

Q-25 Donald Waitz Farm
Erie, IL

10.0 miles (SE)

Milks 18 to 35 cows.

Diet consists of corn, oats, bean meal, sorghum, chopped alfalfa, and baled hay.

Census conducted by G. Kreuder on August 29, 1991.

QUAD CITIES

NEAREST RESIDENCE CENSUS, 1991

Nearest resident of the Quad Cities Station within a five (5) mile radius.

<u>Direction</u>	<u>Distance</u>
N	0.6 miles
NNE	1.0 miles
NE	1.3 miles
ENE	2.8 miles
E	2.3 miles
ESE	2.0 miles
SE	1.0 miles
SSE	1.1 miles
S	0.8 miles
SSW	3.0 miles
SW	2.8 miles
WSW	2.0 miles
W	2.5 miles
WNW	2.5 miles
NW	2.0 miles
NNW	2.0 miles

Census conducted by G. Kreuder on August 29, 1991. There was no change from 1990.

QUAD CITIES

NEAREST CATTLE CENSUS, 1991

Nearest cattle of the Quad Cities Station within a five (5) mile radius.

<u>Direction</u>	<u>Distance</u>
N	No cattle
NNE	No cattle
NE	No cattle
ENE	2.8 miles
E	2.8 miles
ESE	3.0 miles
SF	No cattle
SSE	3.7 miles
S	1.5 miles
SSW	No cattle
SW	3.7 miles
WSW	4.1 miles
W	5.0 miles
WNW	3.6 miles
NW	2.1 miles
NNW	2.5 miles

Census conducted by G. Kreuder on August 29, 1991.

APPENDIX V

INTERLABORATORY COMPARISON PROGRAM RESULTS

Appendix V

Interlaboratory Comparison Program Results

Teledyne Isotopes Midwest Laboratory (formerly Hazleton Environmental Sciences) has participated in interlaboratory comparison (crosscheck) programs since the formulation of its 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 known 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 January 1988 through November 1991. This program has been 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 dosimeters (TLDs) during the period 1976, 1977, 1979, 1980, 1984, and 1985-86 through participation in the Second, Third, Fourth, Fifth, Seventh, and Eighth International Intercomparison 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 B lists acceptance criteria for "spiked" samples.

Addendum to Appendix A provides explanation for out-of-limit results.

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne Isotopes Midwest Laboratory results for milk, water, air filters, and food samples, 1988 through 1991.^a

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L ^b		
				TIML Result $\pm 2\sigma^c$	EPA Result ^d N=1	Control Limits
STW-521	Water	Jan 1988	Sr-89	27.3 \pm 5.0	30.0 \pm 5.0	21.3-38.7
			Sr-90	15.3 \pm 1.2	15.0 \pm 1.5	12.4-17.6
STW-523	Water	Jan 1988	Gr. alpha	2.3 \pm 1.2	4.0 \pm 5.0	0.0-12.7
			Gr. beta	7.7 \pm 1.2	8.0 \pm 5.0	0.0-16.7
STF-524	Food	Jan 1988	Sr-89	44.0 \pm 4.0	46.0 \pm 5.0	37.3-54.7
			Sr-90	53.0 \pm 2.0	55.0 \pm 2.8	50.2-59.8
			I-131	102.3 \pm 4.2	102.0 \pm 10.2	84.3-119.7
			Cs-137	95.7 \pm 6.4	91.0 \pm 5.0	82.3-99.7
			K	1011 \pm 158	1230 \pm 62	1124-1336
STW-525	Water	Feb 1988	Co-60	69.3 \pm 2.3	69.0 \pm 5.0	60.3-77.7
			Zn-65	99.0 \pm 3.4	94.0 \pm 9.4	77.7-110.3
			Ru-106	92.7 \pm 14.4	105.0 \pm 10.5	86.8-123.2
			Cs-134	61.7 \pm 8.0	64.0 \pm 5.0	55.3-72.7
			Cs-137	99.7 \pm 3.0	94.0 \pm 5.0	85.3-102.7
STW-526	Water	Feb 1988	H-3	3453 \pm 103	3327 \pm 362	2700-3954
STW-527	Water	Feb 1988	Uranium	3.0 \pm 0.0	3.0 \pm 6.0	0.0-13.4
STM-528	Milk	Feb 1988	I-131	4.7 \pm 1.2	4.0 \pm 0.4	3.3-4.7
STW-529	Water	Mar 1988	Ra-226	7.1 \pm 0.6	7.6 \pm 1.1	5.6-9.6
			Ra-228	NA ^e	7.7 \pm 1.2	5.7-9.7
STW-530	Water	Mar 1988	Gr. alpha	4.3 \pm 1.2	6.0 \pm 5.0	0.0-14.7
			Gr. beta	13.3 \pm 1.3	13.0 \pm 5.0	4.3-21.7
STAF-531	Air Filter	Mar 1988	Gr. alpha	21.0 \pm 1.0	20.0 \pm 5.0	11.3-28.7
			Gr. beta	48.0 \pm 0.0	50.0 \pm 5.0	41.3-58.7
			Sr-90	16.7 \pm 1.2	17.0 \pm 1.5	14.4-19.6
			Cs-137	18.7 \pm 1.3	16.0 \pm 5.0	7.3-24.7
STW-532	Water	Apr 1988	I-131	9.0 \pm 2.0	7.5 \pm 0.8	6.2-8.8

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L ^b		
				TIML Result $\pm 2\sigma^c$	EPA Result ^d 1s, N=1	Control Limits
STW-533 534	Water (Blind)	Apr 1988				
	Sample A		Cr. alpha	ND ^f	46.0±11.0	27.0-65.0
			Ra-226	ND	6.4±1.0	4.7-8.1
			Ra-228	ND	5.6±0.8	4.2-7.0
			Uranium	6.0±6.0	6.0±6.0	0.0-16.4
	Sample B		Gr. beta	ND	57.0±5.0	48.3-65.7
			Sr-89	3.3±1.2	5.0±5.0	0.0-13.7
			Sr-90	5.3±1.2	5.0±1.5	2.4-7.6
			Co-60	63.3±1.3	50.0±5.0	41.3-58.7
			Cs-134	7.7±1.2	7.0±5.0	0.0-15.7
			Cs-137	8.3±1.2	7.0±5.0	0.0-15.7
STU-535	Urine	Apr 1988	H-3	6483±155	6202±620	5128-7276
STW-536	Water	Apr 1988	Sr-89	14.7±1.3	20.0±5.0	11.3-28.7
			Sr-90	20.0±2.0	20.0±1.5	17.4-22.6
STW-538	Water	Jun 1988	Cr-51	331.7±13.0	302.0±30.0	250.0-354.0
			Co-60	16.0±2.0	15.0±5.0	6.3-23.7
			Zn-65	107.7±11.4	101.0±10.0	83.7-118.3
			Ru-106	191.3±11.0	195.0±20.0	160.4-229.6
			Cs-134	18.3±4.6	20.0±5.0	11.3-28.7
			Cs-137	26.3±1.2	25.0±5.0	16.3-33.7
STW-539	Water	Jun 1988	H-3	5586±92	5565±557	4600-6530
STM-541	Milk	Jun 1988	Sr-89	33.7±11.4	40.0±5.0	31.3-48.7
			Sr-90	55.3±5.8	60.0±3.0	54.8-65.2
			I-131	103.7±3.1	94.0±9.0	78.4-109.6
			Cs-137	52.7±3.1	51.0±5.0	42.3-59.7
			K	1587±23	1600±80	1461-1739
STW-542	Water	Jul 1988	Gr. alpha	8.7±4.2	15.0±5.0	6.3-23.7
			Gr. beta	5.3±1.2	4.0±5.0	0.0-12.7
STF-543	Food	Jul 1988	Sr-89	ND ^f	33.0±5.0	24.3-41.7
			Sr-90	ND	34.0±2.0	30.5-37.5
			I-131	115.0±5.3	107.0±11.0	88.0-126.0
			Cs-137	52.7±6.4	49.0±5.0	40.3-57.7
			K	1190±66	1240±62	1133-1347

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L ^b		
				TIML Result $\pm 2\sigma^c$	EPA Result ^d 1s, N=1	Control Limits
STW-544	Water	Aug 1988	I-131	80.0 \pm 0.0	76.0 \pm 8.0	62.1-89.9
STW-545	Water	Aug 1988	Pu-239	11.0 \pm 0.2	10.2 \pm 1.0	8.5-11.9
STW-546	Water	Aug 1988	Uranium	6.0 \pm 0.0	6.0 \pm 6.0	0.0-16.4
STAF-547	Air Filter	Aug 1988	Gr. alpha	8.0 \pm 0.0	8.0 \pm 5.0	0.0-16.7
			Gr. beta	26.3 \pm 1.2	29.0 \pm 5.0	20.3-37.7
			Sr-90	8.0 \pm 2.0	8.0 \pm 1.5	5.4-10.6
			Cs-137	13.0 \pm 2.0	12.0 \pm 5.0	3.3-20.7
STW-548	Water	Sep 1988	Ra-226	9.3 \pm 0.5	8.4 \pm 2.6	6.2-10.6
			Ra-228	5.8 \pm 0.4	5.4 \pm 1.6	4.0-6.8
STW-549	Water	Sep 1988	Gr. alpha	7.0 \pm 2.0	8.0 \pm 5.0	0.0-16.7
			Gr. beta	11.3 \pm 1.2	10.0 \pm 5.0	1.3-18.7
STW-550	Water	Oct 1988	Cr-51	252.0 \pm 14.0	251.0 \pm 25.0	207.7-294.3
			Co-60	26.0 \pm 2.0	25.0 \pm 5.0	16.3-33.7
			Zn-65	158.3 \pm 10.2	151.0 \pm 15.0	125.0-177.0
			Ru-106	153.0 \pm 9.2	152.0 \pm 15.0	126.0-178.0
			Cs-134	28.7 \pm 5.0	25.0 \pm 5.0	16.3-33.7
			Cs-137	16.3 \pm 1.2	15.0 \pm 5.0	6.3-23.7
STW-551	Water	Oct 1988	H-3	2333 \pm 127	2316 \pm 350	1710-2927
STW-552 553	Water (Blind)	Oct 1988				
	Sample A		Gr. alpha	38.3 \pm 8.0	41.0 \pm 10.0	23.7-58.3
			Ra-226	4.5 \pm 0.5	5.0 \pm 0.8	3.6-6.4
			Ra-228	4.4 \pm 0.6	5.2 \pm 0.8	3.6-6.4
			Uranium	4.7 ?	5.0 \pm 6.0	0.0-15.4
	Sample B		Gr. beta	51.3 \pm 3.0	54.0 \pm 5.0	45.3-62.7
			Sr-89	3.7 \pm 1.2	11.0 \pm 5.0	2.3-19.7
			Sr-90	10.7 \pm 1.2	10.0 \pm 1.5	7.4-12.6
			Cs-134	15.3 \pm 2.3	15.0 \pm 5.0	6.3-23.7
			Cs-137	16.7 \pm 1.2	15.0 \pm 5.0	6.3-23.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L ^b		
				TIML Result $\pm 2\sigma^c$	EPA Result ^d	
					1s, N=1	Control Limits
STM-554	Milk	Oct 1988	Cr-89	40.3±7.0	40.0±5.0	31.3-48.7
			Sr-90	51.0±2.0	60.0±3.0	54.8-65.2
			I-131	94.0±3.4	91.0±9.0	75.4-106.6
			Cs-137	45.0±4.0	50.0±5.0	41.3-58.7
			K	1500±45	1600±80	1461-1739
STU-555	Urine	Nov 1988	H-3	3030±209	3025±359	2403-3647
STW-556	Water	Nov 1988	Gr. alpha	9.0±3.5	9.0±5.0	0.3-17.7
			Gr. beta	9.7±1.2	9.0±5.0	0.3-17.7
STW-557	Water	Dec 1988	I-131	108.7±3.0	115.0±12.0	94.2-135.8
STW-559	Water	Jan 1989	Sr-89	40.0±8.7	40.0±5.0	31.3-48.7
			Sr-90	24.3±3.1	25.0±1.5	22.4-27.6
STW-560	Water	Jan 1989	Pu-239	5.8±1.1	4.2±0.4	3.5-4.9
STW-561	Water	Jan 1989	Gr. alpha	7.3±1.2	8.0±5.0	0.0-16.7
			Gr. beta	5.3±1.2	4.0±5.0	0.0-12.7
STW-562	Water	Feb 1989	Cr-51	245±46	235±24	193.4-276.6
			Co-60	10.0±2.0	10.0±5.0	1.3-18.7
			Zn-65	170±10	159±16	139.2-186.7
			Ru-106	181±7.6	178±18	146.8-209.2
			Cs-134	9.7±3.0	10.0±5.0	1.3-18.7
			Cs-137	11.7±1.2	10.0±5.0	1.3-18.7
STW-563	Water	Feb 1989	I-131	109.0±4.0	106.0±11.0	86.9-125.1
STW-564	Water	Feb 1989	H-3	2820±20	2754±356	2137-3371
STW-565	Water	Mar 1989	Ra-226	4.2±0.3	4.9±0.7	3.7-6.1
			Ra-228	1.9±1.0	1.7±0.3	1.2-2.2
STW-566	Water	Mar 1989	U	5.0±0.0	5.0±6.0	0.0-15.4
STAF-567	Air Filter	Mar 1989	Gr. alpha	21.7±1.2	21.0±5.0	12.3-29.7
			Gr. beta	68.3±4.2	62.0±5.0	53.3-70.7
			Sr-90	20.0±2.0	20.0±1.5	17.4-22.6
			Cs-137	21.3±1.2	20.0±5.0	11.3-28.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L ^b		Control Limits
				TIML Result $\pm 2\sigma^c$	EPA Result ^d 1s, N=1	
STW-568 56f	Water (Blind)	Apr 1989				
	Sample A		Gr. alpha	22.7 \pm 2.3	29.0 \pm 7.0	16.9-41.2
			Ra-226	3.6 \pm 0.6	3.5 \pm 0.5	2.6-4.4
			Ra-228	2.6 \pm 1.0	3.6 \pm 0.5	2.7-4.5
			U	3.0 \pm 0.0	3.0 \pm 6.0	0.0-13.4
	Sample B		Gr. beta	52.3 \pm 6.1	57.0 \pm 5.0	43.3-65.7
			Sr-89	9.3 \pm 5.4	8.0 \pm 5.0	0.0-16.7
			Sr-90	7.0 \pm 0.0	8.0 \pm 1.5	5.4-10.6
			Cs-134	21.0 \pm 5.2	20.0 \pm 5.0	11.3-28.7
			Cs-137	23.0 \pm 2.0	20.0 \pm 5.0	11.3-28.7
STM-570	Milk	Apr 1989	Sr-89	26.0 \pm 10.0	39.0 \pm 5.0	30.3-47.7
			Sr-90	45.7 \pm 4.2	55.0 \pm 3.0	49.8-60.2
			Cs-137	54.0 \pm 6.9	50.0 \pm 5.0	41.3-58.7
			K-40	1521 \pm 208	1600 \pm 80	1461-1739
STW-5718	Water	May 1989	Sr-89	<0.7	6.0 \pm 5.0	0.0-14.7
			Sr-90	5.0 \pm 1.0	6.0 \pm 1.5	3.4-8.6
STW-572	Water	May 1989	Gr. alpha	24.0 \pm 2.0	30.0 \pm 8.0	16.1-43.9
			Gr. beta	49.3 \pm 15.6	50.0 \pm 5.0	41.3-58.7
STW-573	Water	Jun 1989	Ba-133	50.7 \pm 1.2	49.0 \pm 5.0	40.3-57.7
			Co-60	31.3 \pm 2.3	31.0 \pm 5.0	22.3-39.7
			Zn-65	167 \pm 10	165 \pm 17	135.6-194.4
			Ru-106	123 \pm 9.2	128 \pm 13	105.5-150.5
			Cs-134	40.3 \pm 1.2	39 \pm 5	30.3-47.7
			Cs-137	22.3 \pm 1.2	20 \pm 5	11.3-28.7
STW-574	Water	Jun 1989	H-3	4513 \pm 136	4503 \pm 450	3724-5282
STW-575	Water	Jul 1989	Ra-226	16.8 \pm 1	17.7 \pm 2.7	13.0-22.4
			Ra-228	13.8 \pm 3.7	18.3 \pm 2.7	13.6-23.0
STW-576	Water	Jul 1989	U	40.3 \pm 1.2	41.0 \pm 6.0	30.6 \pm 51.4
STW-577	Water	Aug 1989	I-131	84.7 \pm 5.8	83.0 \pm 8.0	69.1-96.9
STAF-579	Air Filter	Aug 1989	Gr. alpha	6.0 \pm 0.0	6.0 \pm 5.0	0.0-14.7
			Cs-137	10.3 \pm 2.3	10.0 \pm 5.0	1.3-18.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L ^b				
				TIML Result $\pm 2\sigma^c$	EPA Result ^d 1s, N=1	Control Limits		
STW-580	Water	Sep 1989	Sr-89	14.7 \pm 1.2	14.0 \pm 5.0	5.3-22.7		
			Sr-90	9.7 \pm 1.2	10.0 \pm 1.5	7.4-12.6		
STW-581	Water	Sep 1989	Gr. alpha	5.0 \pm 0.0	4.0 \pm 5.0	0.0-12.7		
			Gr. beta	8.7 \pm 2.3	6.0 \pm 5.0	0.0-14.7		
STW-583	Water	Oct 1989	Ba-133	60.3 \pm 10.0	59.0 \pm 6.0	48.6-69.4		
			Co-60	29.0 \pm 4.0	30.0 \pm 5.0	21.1-38.7		
			Zn-65	132.3 \pm 6.0	129.0 \pm 13.0	106.5-151.5		
			Ru-106	155.3 \pm 6.1	161.0 \pm 16.0	133.3-188.7		
			Cs-134	30.7 \pm 6.1	29.0 \pm 5.0	20.3-37.7		
			Cs-137	66.3 \pm 4.6	59.0 \pm 5.0	50.3 \pm 67.7		
STW-584	Water	Oct 1989	H-3	3407 \pm 150	3496 \pm 364	2866 \pm 4126		
STW-585 586	Water (Blind)	Oct 1989	Sample A	Gr. alpha	41.7 \pm 9.4	49.0 \pm 12.0	28.2-69.8	
			Ra-226	7.9 \pm 0.4	8.4 \pm 1.3	6.2-10.6		
	Ra-228		4.4 \pm 0.8	4.1 \pm 0.6	3.1-5.1			
	U		12.0 \pm 0.0	12.0 \pm 6.0	1.6-22.4			
	Sample B		Gr. beta	31.7 \pm 2.3	32.0 \pm 5.0	23.3-40.7		
	Sr-89		13.3 \pm 4.2	15.0 \pm 5.0	6.3-23.7			
	Sr-90		7.0 \pm 2.0	7.0 \pm 3.0	4.4-9.6			
	Cs-134		5.0 \pm 0.0	5.0 \pm 5.0	0.0-13.7			
	Cs-137		7.0 \pm 0.0	5.0 \pm 5.0	0.0-13.7			
	STW-587		Water	Nov 1989	Ra-226	7.9 \pm 0.4	8.7 \pm 1.3	6.4-11.0
					Ra-228	8.9 \pm 1.2	9.3 \pm 1.2	6.9-11.7
	STW-588		Water	Nov 1989	U	15.0 \pm 0.08	15.0 \pm 6.0	4.6-25.4
	STW-589		Water	Jan 1990	Sr-89	22.7 \pm 5.0	25.0 \pm 5.0	16.3-33.7
					Sr-90	17.3 \pm 1.2	20.0 \pm 1.5	17.4-22.6
STW-591	Water	Jan 1990	Gr. alpha	10.3 \pm 3.0	12.0 \pm 5.0	3.3-20.7		
			Gr. beta	12.3 \pm 1.2	12.0 \pm 5.0	3.3-20.7		

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L ^b				
				TIML Result $\pm 2\sigma^c$	EPA Result ^d 1s, N=1	Control Limits		
STW-592	Water	Jan 1990	Co-60	14.7±2.3	15±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	15.0±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±83	4976±498	4113-5839		
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	U	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-597 598	Water (Blind)	Apr 1990						
			Sample A	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		
	Sample B		Gr. 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		
	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		
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		

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L ^b		
				TIML Result $\pm 2\sigma^c$	EPA Result ^d 1s, N=1	Control Limits
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±306	2933±358	2312-3554
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
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	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.
STW-613	Water	Oct 1990	H-3	7167±330	7203±720	5954-8452

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L ^b		Control Limits
				TIML Result $\pm 2\sigma^c$	EPA Result ^d 1s, N=1	
STW-614 615	Water	Oct 1990				
	Sample A		Gr. alpha	68.7 \pm 7.2	62.0 \pm 16.0	34.2-89.8
			Ra-226	12.9 \pm 0.3	13.6 \pm 2.0	10.1-17.1
			Ra-228	4.2 \pm 0.6	5.0 \pm 1.3	2.7-7.3
			U	10.4 \pm 0.6	10.2 \pm 3.0	5.0-15.4
	Sample B		Gr. beta	55.0 \pm 8.7	53.0 \pm 5.0	44.3-61.7
			Sr-89	15.7 \pm 2.9	20.0 \pm 5.0	11.3-28.7
			Sr-90	12.0 \pm 2.0	15.0 \pm 5.0	6.3-23.7
			Cs-134	9.0 \pm 1.7	7.0 \pm 5.0	0.0-15.7
			Cs-137	7.7 \pm 1.2	5.0 \pm 5.0	0.0-13.7
STW-616	Water	Oct 1990	Ra-226	6.8 \pm 1.0	7.4 \pm 1.1	5.5-9.3
			Ra-228	5.3 \pm 1.7	7.7 \pm 1.9	4.4-11.0
STW-617B	Water	Nov 1990	U	35.0 \pm 0.4	35.5 \pm 3.6	29.3 \pm 41.7
STW-618	Water	Jan 1991	Sr-89	4.3 \pm 1.2	5.0 \pm 5.0	0.0-13.7
			Sr-90	4.7 \pm 1.2	5.0 \pm 5.0	0.0-13.7
STW-619	Water	Jan 1991	Pu-239	3.6 \pm 0.2	3.3 \pm 0.3	2.8-3.8
STW-620	Water	Jan 1991	Gr. alpha	6.7 \pm 3.0	5.0 \pm 5.0	0.0-13.7
			Gr. beta	6.3 \pm 1.2	5.0 \pm 5.0	0.0-13.7
STW-621	Water	Feb 1991	Co-60	41.3 \pm 8.4	40.0 \pm 5.0	31.3-48.7
			Zn-65	166.7 \pm 19.7	149.0 \pm 15.0	123.0-175.0
			Ru-106	209.7 \pm 18.6	186.0 \pm 19.0	153.0-219.0
			Cs-134	9.0 \pm 2.0	8.0 \pm 5.0	0.0-16.7
			Cs-137	9.7 \pm 1.2	8.0 \pm 5.0	0.0-16.7
			Ba-133	85.7 \pm 9.2	75.0 \pm 8.0	61.1-88.9
STW-622	Water	Feb 1991	I-131	81.3 \pm 6.1	75.0 \pm 8.0	61.1-88.9
STW-623	Water	Feb 1991	H-3	4310.0 \pm 144.2	4418.0 \pm 442.0	3651.2-5184.8
STW-624	Water	Mar 1991	Ra-226	31.4 \pm 3.2	31.8 \pm 4.8	23.5-40.1
			Ra-228	ND ^h	21.1 \pm 5.3	11.9-30.3
STW-625	Water	Mar 1991	U	6.7 \pm 0.4	7.6 \pm 3.0	2.4-12.8

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L ^b		
				TIML Result $\pm 2\sigma^c$	EPA Result ^d 1s, N=1	Control Limits
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
STW-627 628	Water Sample A	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
	Water Sample B	Gr. 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	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
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
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

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L ^b		Control Limits	
				TIML Result $\pm 2\sigma^c$	EPA Result ^d 1s, N=1		
STW-635	Water	Jul 1991	U	12.8 \pm 0.1	14.2 \pm 3.0	9.0-19.4	
STW-636	Water	Aug 1991	I-131	19.3 \pm 1.2	20.0 \pm 6.0	9.6-30.4	
STW-637	Water	Aug 1991	Pu-239	21.4 \pm 0.5	19.4 \pm 1.9	16.1-22.7	
STAF-638	Air Filter	Aug 1991	Gr. alpha	33.0 \pm 2.0	25.0 \pm 6.0	14.6-35.4	
			Gr. beta	88.7 \pm 1.2	92.0 \pm 10.0	80.4-103.6	
			Sr-90	27.0 \pm 4.0	30.0 \pm 5.0	21.3-38.7	
			Cs-137	26.3 \pm 1.2	30.0 \pm 5.0	21.3-38.7	
STW-639	Water	Sep 1991	Sr-89	47.0 \pm 10.4	49.0 \pm 5.0	40.3-57.7	
			Sr-90	24.0 \pm 2.0	25.0 \pm 5.0	16.3-33.7	
STW-640	Water	Sep 1991	Gr. alpha	12.0 \pm 4.0	10.0 \pm 5.0	1.3-18.7	
			Gr. beta	20.3 \pm 1.2	20.0 \pm 5.0	11.3-28.7	
STM-641	Milk	Sep 1991	Sr-89	20.3 \pm 5.0	25.0 \pm 5.0	16.3-33.7	
			Sr-90	19.7 \pm 3.1	25.0 \pm 5.0	16.3-33.7	
			I-131	130.7 \pm 16.8	108.0 \pm 11.0	88.9-127.1	
			Cs-137	33.7 \pm 3.2	30.0 \pm 5.0	21.3-38.7	
			K	1743.3 \pm 340.8	1740.0 \pm 87.0	1589.1-1890.9	
STW-642	Water	Oct 1991	Co-60	29.7 \pm 1.2	29.0 \pm 5.0	20.3-37.7	
			Zn-65	75.7 \pm 8.3	73.0 \pm 7.0	60.9-85.1	
			Ru-106	196.3 \pm 15.1	199.0 \pm 20.0	164.3-233.7	
			Cs-134	9.7 \pm 1.2	10.0 \pm 5.0	1.3-18.7	
			Cs-137	11.0 \pm 2.0	10.0 \pm 5.0	1.3-18.7	
			Ba-133	94.7 \pm 3.1	98.0 \pm 10.0	80.7-115.3	
STW-643	Water	Oct 1991	H-3	2640.0 \pm 156.2	2454.0 \pm 352.0	1843.3-3064.7	
STW-644 645	Water Sample A	Oct 1991	Gr. alpha	73.0 \pm 13.1	82.0 \pm 21.0	45.6-118.4	
			Ra-226	20.9 \pm 2.0	22.0 \pm 3.3	16.3-27.7	
			Ra-228	19.6 \pm 2.3	22.2 \pm 5.6	12.5-31.9	
			U	13.5 \pm 0.6	13.5 \pm 3.0	8.3-18.7	
	Sample B			Gr. beta	55.3 \pm 3.1	65.0 \pm 10.0	47.7-82.3
				Sr-89	9.7 \pm 3.1	10.0 \pm 5.0	1.3-18.7
				Sr-90	8.7 \pm 1.2	10.0 \pm 5.0	1.3-18.7
				Co-60	20.3 \pm 1.2	20.0 \pm 5.0	11.3-28.7
				Cs-134	9.0 \pm 5.3	10.0 \pm 5.0	1.3-18.7
				Cs-137	14.7 \pm 5.0	11.0 \pm 5.0	2.3-19.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L ^b		
				TIML Result $\pm 2\sigma^c$	EPA Result ^d 1s, N=1	Control Limits
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

^a Results obtained by Teledyne Isotopes 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, Nevada.

^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, which is in mg/kg.

^c Unless otherwise indicated, the TIML 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 EPA.

^e NA = Not analyzed.

^f ND = No data; not analyzed due to relocation of lab.

^g Sample was analyzed but the results not submitted to EPA because deadline was missed (all data on file).

^h ND = No data; sample lost during analyses.

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

Lab Code	TLD Type	Measurement $\pm 2\sigma^a$	Teledyne Result Value ^c	mR	
				Known Participants)	Average $\pm 2\sigma^d$ (All
<u>2nd International Intercomparison^b</u>					
115-2	CaF ₂ :Mn Bulb	Field	17.0 \pm 1.9	17.1	16.4 \pm 7.7
		Lab	20.8 \pm 4.1	21.3	18.8 \pm 7.6
<u>3rd International Intercomparison^e</u>					
115-3	CaF ₂ :Mn Bulb	Field	30.7 \pm 3.2	34.9 \pm 4.8	31.5 \pm 3.0
		Lab	89.6 \pm 6.4	91.7 \pm 14.6	86.2 \pm 24.0
<u>4th International Intercomparison^f</u>					
115-4	CaF ₂ :Mn Bulb	Field	14.1 \pm 1.1	14.1 \pm 1.4	16.0 \pm 9.0
		Lab (Low)	9.3 \pm 1.3	12.2 \pm 2.4	12.0 \pm 7.4
		Lab (High)	40.4 \pm 1.4	45.8 \pm 9.2	43.9 \pm 13.2
<u>5th International Intercomparison^g</u>					
115-5A	CaF ₂ :Mn Bulb	Field	31.4 \pm 1.8	30.0 \pm 6.0	30.2 \pm 14.6
		Lab at beginning	77.4 \pm 5.8	75.2 \pm 7.6	75.8 \pm 40.4
		Lab at the end	96.6 \pm 5.8	88.4 \pm 8.8	90.7 \pm 31.2
115-5B	LiF-100 Chips	Field	30.3 \pm 4.8	30.0 \pm 6.0	30.2 \pm 14.6
		Field at beginning	81.1 \pm 7.4	75.2 \pm 7.6	75.8 \pm 40.4
		Lab at the end	85.4 \pm 11.7	88.4 \pm 8.8	90.7 \pm 31.2
<u>7th International Comparison^h</u>					
115-7A	LiF-100 Chips	Field	75.4 \pm 2.6	75.8 \pm 6.0	75.1 \pm 29.8
		Lab (Co-60)	80.0 \pm 3.5	79.9 \pm 4.0	77.3 \pm 27.6
		Lab (Cs-137)	66.6 \pm 2.5	75.0 \pm 3.8	73.0 \pm 22.2

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

Lab Code	TLD Type	Measurement $\pm 2\sigma^a$	mR		
			Teledyne Result Value ^c	Known Participants)	Average $\pm 2\sigma^d$ (All
115-7B	CaF ₂ :Mn Bulbs	Field	71.5 \pm 2.6	75.8 \pm 6.0	75.1 \pm 29.8
		Lab (Co-60)	84.8 \pm 6.4	79.9 \pm 4.0	77.9 \pm 27.6
		Lab (Cs-137)	78.8 \pm 1.6	75.0 \pm 3.8	73.0 \pm 22.2
115-7C	CaSO ₄ :Dy Cards	Field	76.8 \pm 2.7	75.8 \pm 6.0	75.1 \pm 29.8
		Lab (Co-60)	82.5 \pm 3.7	79.9 \pm 4.0	77.9 \pm 27.6
		Lab (Cs-137)	79.0 \pm 3.2	75.0 \pm 3.8	73.0 \pm 22.2
<u>8th International Intercomparisonⁱ</u>					
115-8A	LiF-100 Chips	Field Site 1	29.5 \pm 1.4	29.7 \pm 1.5	28.9 \pm 12.4
		Field Site 2	11.3 \pm 0.8	10.4 \pm 0.5	10.1 \pm 9.06
		Lab (Cs-137)	13.7 \pm 0.9	17.2 \pm 0.9	16.2 \pm 6.8
115-8B	CaF ₂ :Mn Bulbs	Field Site 1	32.3 \pm 1.2	29.7 \pm 1.5	28.9 \pm 12.4
		Field Site 2	9.0 \pm 1.0	10.4 \pm 0.5	10.1 \pm 9.0
		Lab (Cs-137)	15.8 \pm 0.9	17.2 \pm 0.9	16.2 \pm 6.8
115-8C	CaSO ₄ :Dy Cards	Field Site 1	32.2 \pm 0.7	29.7 \pm 1.5	28.9 \pm 12.4
		Field Site 2	10.6 \pm 0.6	10.4 \pm 0.5	10.1 \pm 9.0
		Lab (Cs-137)	18.1 \pm 0.8	17.2 \pm 0.9	16.2 \pm 6.8
<u>Teledyne Testing^j</u>					
89-1	LiF-100 Chips	Lab	21.0 \pm 0.4	22.4	--
89-2	Teledyne CaSO ₄ :Dy Cards	Lab	20.9 \pm 1.0	20.3	--

Table A-2. (continued)

Lab Code	TLD Type	Measurement $\pm 2\sigma^a$	mR		
			Teledyne Result Value ^c	Known Participants)	Average $\pm 2\sigma^d$ (All
<u>Teledyne Testing^j</u>					
90-1 ^k	Teledyne CaSO ₄ :Dy Cards	Lab	20.6 \pm 1.4	19.6	--
90-1 ^l	Teledyne CaSO ₄ :Dy Cards	Lab	100.8 \pm 4.3	100.0	--
91-1 ^m	Teledyne CaSO ₄ :Dy Cards	Lab	33.4 \pm 2.0	32.0	--
			55.2 \pm 4.7	58.8	--
			87.8 \pm 6.2	85.5	--

^a Lab result given is the mean ± 2 standard deviations of three determinations.

^b 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.

^c Value determined by sponsor of the intercomparison using continuously operated pressurized ion chamber.

^d Mean ± 2 standard deviations of results obtained by all laboratories participating in the program.

^e Third International Intercomparison of Environmental Dosimeters conducted in summer of 1977 by Oak Ridge National Laboratory and the School of Public Health of the University of Texas, Houston, Texas.

^f Fourth international Intercomparison of Environmental Dosimeters conducted in summer of 1979 by the School of Public Health of the University of Texas Houston, Texas.

^g Fifth International Intercomparison of Environmental Dosimeters conducted in 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.

^h Seventh International Intercomparison of Environmental Dosimeters conducted in the spring and summer of 1984 at Las Vegas, Nevada, and sponsored by the U.S. Department of Energy, The U.S. Nuclear Regulatory Commission, and the U.S. Environmental Protection Agency.

ⁱ 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.

^j Chips were submitted in September 1989 and cards were submitted in November 1989 to Teledyne Isotopes, Inc., Westwood, NJ for irradiation.

^k Cards were irradiated by Teledyne Isotopes, Inc., Westwood, NJ on June 19, 1990.

^l Cards were irradiated by Dosimetry Associates, Inc., Northville, MI on October 30, 1990.

^m Irradiated cards were provided by Teledyne Isotopes, INC., Westwood, NJ. Irradiated on October 8, 1991.

Table A-3. In-house spiked samples.

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L		Expected Precision 1s, n=1 ^a
				TIML Result n=1	Known Activity	
QC-MI-16	Milk	Feb 1988	Sr-89	31.8±4.7	31.7±6.0	8.7
			Sr-90	25.5±2.7	27.8±3.5	5.2
			I-131	26.4±0.5	23.2±5.0	10.4
			Cs-134	23.8±2.3	24.2±6.0	8.7
			Cs-137	26.5±0.8	25.1±6.0	8.7
QC-MI-17	Milk	Feb 1988	I-131	10.6±1.2	14.3±1.6	10.4
QC-W-35	Water	Feb 1988	I-131	9.7±1.1	11.6±1.1	10.4
QC-W-36	Water	Mar 1988	I-131	10.5±1.3	11.6±1.0	10.4
QC-W-37	Water	Mar 1988	Sr-89	17.1±2.0	19.8±8.0	8.7
			Sr-90	18.7±0.9	17.3±5.0	5.2
QC-MI-18	Milk	Mar 1988	I-131	33.2±2.3	26.7±5.0	10.4
			Cs-134	31.3±2.1	30.2±5.0	8.7
			Cs-137	29.9±1.4	26.2±5.0	8.7
QC-W-38	Water	Apr 1988	I-131	17.1±1.1	14.2±5.0	10.4
QC-W-39	Water	Apr 1988	H-3	4439±31	1176±500	724
QC-W-40	Water	Apr 1988	Co-60	23.7±0.5	26.1±4.0	8.7
			Cs-134	25.4±2.6	29.2±4.5	8.7
			Cs-137	26.6±2.3	26.2±4.0	8.7
QC-W-41	Water	Jun 1988	Gr. alpha	12.3±0.4	13.1±5.0	8.7
			Gr. beta	22.6±1.0	20.1±5.0	8.7
QC-MI-19	Milk	Jul 1988	Sr-89	15.1±1.6	16.4±5.0	8.7
			Sr-90	18.0±0.6	18.3±5.0	5.2
			I-131	88.4±4.9	86.6±8.0	10.4
			Cs-137	22.7±0.8	20.8±6.0	8.7
QC-W-42	Water	Sep 1988	Sr-89	48.5±3.3	50.8±8.0	8.7
			Sr-90	10.9±1.0	11.4±3.5	5.2
QC-W-43	Water	Oct 1988	Co-60	20.9±3.2	21.4±3.5	8.7
			Cs-134	38.7±1.6	38.0±6.0	8.7
			Cs-137	19.0±2.4	21.0±3.5	8.7
QC-W-44	Water	Oct 1988	I-131	22.2±0.6	23.3±3.5	10.4

Table A-3. In-house spiked samples(continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L		Expected Precision 1s, n=1 ^a
				TIML Result n=1	Known Activity	
QC-W-45	Water	Oct 1988	H-3	4109±43	4153±500	724
QC-MI-20	Milk	Oct 1988	I-131	59.8±0.9	60.6±9.0	10.4
			Cs-134	49.6±1.8	48.6±7.5	8.7
			Cs-137	25.8±4.6	24.7±4.0	8.7
QC-W-46	Water	Dec 1988	Gr. alpha	11.5±2.3	15.2±5.0	8.7
			Gr. beta	26.5±2.0	25.7±5.0	8.7
QC-MI-21	Milk	Jan 1989	Sr-89	25.5±10.3	34.0±10.0	8.7
			Sr-90	28.3±3.2	27.1±3.0	5.2
			I-131	540±13	550±20	10.4
			Cs-134	24.5±2.6	22.6±5.5	8.7
			Cs-137	24.0±0.6	20.5±5.0	8.7
QC-W-47	Water	Mar 1989	Sr-89	15.2±3.8	16.1±5.0	8.7
			Sr-90	16.4±1.7	16.9±3.0	5.2
QC-MI-22	Milk	Apr 1989	I-131	36.3±1.1	37.2±5.0	10.4
			Cs-134	20.8±2.8	20.7±8.0	8.7
			Cs-137	22.2±2.4	20.4±8.0	8.7
QC-W-48	Water	Apr 1989	Co-60	23.5±2.0	25.1±8.0	8.7
			Cs-134	24.2±1.1	25.9±8.0	8.7
			Cs-137	23.6±1.2	23.0±8.0	8.7
QC-W-49	Water	Apr 1989	I-131	37.2±3.7	37.2±5.0	10.4
QC-W-50	Water	Apr 1989	H-3	3011±59	3089±500	724
QC-W-51	Water	Jun 1989	Gr. alpha	13.0±1.8	15.0±5.0	8.7
			Gr. beta	26.0±1.2	25.5±8.0	8.7
QC-MI-23	Milk	Jul 1989	Sr-89	19.4±6.5	22.0±10.0	8.7
			Sr-90	27.6±3.5	28.6±3.0	5.2
			I-131	46.8±3.2	43.4±5.0	10.4
			Cs-134	27.4±1.8	28.3±6.0	8.7
			Cs-137	24.1±1.8	20.8±6.0	8.7
QC-MI-24	Milk	Aug 1989	Sr-89	25.4±2.7	27.2±10.0	8.7
			Sr-90	46.0±1.1	47.8±9.6	8.3
QC-W-52	Water	Sep 1989	I-131	9.6±0.3	9.7±1.9	10.4

Table A-3. In-house spiked samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L		
				TIML Result n=1	Known Activity	Expected Precision 1s, n=1 ^a
QC-W-53	Water	Sep 1989	I-131	19.0±0.2	20.9±4.2	10.4
QC-W-54	Water	Sep 1989	Sr-89	25.8±4.6	24.7±4.0	8.7
			Sr-90	26.5±5.3	29.7±5.0	5.2
QC-MI-25	Milk	Oct 1989	I-131	70.0±3.3	73.5±20.0	10.4
			Cs-134	22.1±2.6	22.6±8.0	8.7
			Cs-137	29.4±1.5	27.5±8.0	8.7
QC-W-55	Water	Oct 1989	I-131	33.3±1.3	35.3±10.0	10.4
QC-W-56	Water	Oct 1989	Co-60	15.2±0.9	17.4±5.0	8.7
			Cs-134	22.1±4.4	18.9±8.0	8.7
			Cs-137	27.2±1.2	22.9±8.0	8.7
QC-W-57	Water	Oct 1989	H-3	3334±22	3379±500	724
QC-W-58	Water	Nov 1989	Sr-89	10.9±1.4 ^d	11.1±1.0 ^d	8.7
			Sr-90	10.4±1.0 ^d	10.3±1.0 ^d	5.2
QC-W-59	Water	Nov 1989	Sr-89	101.0±6.0 ^d	104.1±10.5 ^d	17.5
			Sr-90	98.0±3.0 ^d	95.0±10.0 ^d	17.0
QC-W-60	Water	Dec 1989	Gr. alpha	10.8±1.1	10.6±4.0	8.7
			Gr. beta	11.6±0.5	11.4±4.0	8.7
QC-MI-26	Milk	Jan 1990	Cs-134	19.3±1.0	20.8±8.0	8.7
			Cs-137	25.2±1.2	22.8±8.0	8.7
QC-MI-27	Milk	Feb 1990	Sr-90	18.0±1.6	18.8±5.0	5.2
QC-MI-28	Milk	Mar 1990	I-131	63.8±2.2	62.6±6.0	6.3
QC-MI-61	Water	Apr 1990	Sr-89	17.9±5.5	23.1±8.7	7.7
			Sr-90	19.4±2.5	23.5±5.2	5.2
QC-MI-29	Milk	Apr 1990	I-131	90.7±9.2	82.5±8.5	10.4
			Cs-134	18.3±1.0	19.7±5.0	8.7
			Cs-137	20.3±1.0	18.2±5.0	8.7
QC-W-62	Water	Apr 1990	Co-60	8.7±0.4	9.4±5.0	8.7
			Cs-134	20.0±0.2	19.7±5.0	8.7
			Cs-137	28.7±1.4	22.7±5.0	8.7

Table A-3. In-house spiked samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L		Expected Precision 1s, n=1 ^a
				TIML Result n=1	Known Activity	
QC-W-63	Water	Apr 1990	I-131	63.5±8.0	66.0±6.7	6.6
QC-W-64	Water	Apr 1990	H-3	1941±130	1826.0±350.0	724
QC-W-65	Water	Jun 1990	Ra-226	6.4±0.2	6.9±1.0	1.0
QC-W-66	Water	Jun 1990	U	6.2±0.2	6.0±6.0	6.0
QC-MI-30	Milk	Jul 1990	Sr-89	12.8±0.4	18.4±10.0	8.7
			Sr-90	18.2±1.4	18.7±6.0	5.2
			Cs-134	46.0±1.3	49.0±5.0	8.7
			Cs-137	27.6±1.3	25.3±5.0	8.7
QC-W-58	Water	Jun 1990	Gr. alpha	9.8±0.3	10.6±6.0	8.7
			Gr. beta	11.4±0.6	11.3±7.0	8.7
QC-MI-31	Milk	Aug 1990	I-131	68.8±1.6	61.4±12.3	10.4
QC-W-69	Water	Sep 1990	Sr-89	17.7±1.6	19.2±10.0	8.7
			Sr-90	13.9±1.6	17.4±10.0	5.2
QC-MI-32	Milk	Oct 1990	I-131	34.8±0.2	32.4±6.5	8.7
			Cs-134	25.8±1.2	27.3±10.0	8.7
			Cs-137	25.3±2.0	22.4±10.0	8.7
QC-W-70	Water	Oct 1990	H-3	2355±59	2276±455	605
QC-W-71	Water	Oct 1990	I-131	55.9±0.9	51.8±10.4	10.4
QC-W-73	Water	Oct 1990	Co-60	18.3±2.7	16.8±5.0	8.7
			Cs-134	28.3±2.3	27.0±5.0	8.7
			Cs-137	22.7±1.3	22.4±5.0	8.7
QC-W-74	Water	Dec 1990	Gr. alpha	21.4±1.0	26.1±6.5	11.3
			Gr. beta	25.9±1.0	22.3±5.6	9.7
QC-MI-33	Milk	Jan 1991	Sr-89	20.7±3.3	21.6±5.0	5.0
			Sr-90	19.0±1.4	23.0±3.0	3.0
			Cs-134	22.2±1.7	19.6±5.0	5.0
			Cs-137	26.1±1.6	22.3±5.0	5.0
QC-MI-34	Milk	Feb 1991	I-131	40.7±1.8	40.1±6.0	6.0
QC-W-75	Water	Mar 1991	Sr-89	18.8±1.5	23.3±5.0	5.0
			Sr-90	16.0±0.8	17.2±3.0	3.0

Table A-3. In-house spiked samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L		Expected Precision 1s, n=1 ^a
				TIML Result n=1	Known Activity	
QC-W-76	Water	Apr 1991	I-131	56.5±1.7	59.0±5.9	5.9
QC-W-77	Water	Apr 1991	Co-60	16.4±2.2	15.7±5.0	5.0
			Cs-134	23.8±2.5	22.6±5.0	5.0
			Cs-137	25.0±2.4	21.1±5.0	5.0
QC-W-78	Water	Apr 1991	H-3	4027±188	4080±408	408
QC-MI-35	Milk	Apr 1991	I-131	48.0±0.8	49.2±6.0	6.0
			Cs-134	19.2±2.0	22.6±5.0	5.0
			Cs-137	22.8±2.2	22.1±5.0	5.0
QC-W-79	Water	Jun 1991	Gr. alpha	7.4±0.7	7.8±5.0	5.0
			Gr. beta	11.0±0.7	11.0±5.0	5.0
QC-MI-36	Milk	Jul 1991	Sr-89	28.1±2.1	34.0±10.0	10.0
			Sr-90	11.6±0.7	11.5±3.0	3.0
			I-131	14.4±1.9	18.3±5.0	5.0
			Cs-137	34.3±3.0	35.1±5.0	5.0
QC-W-80	Water	Oct 1991	Sr-89	27.4±6.9	24.4±5.0	5.0
			Sr-90	11.7±1.4	14.1±5.0	5.0
QC-W-81	Water	Oct 1991	I-131	19.1±0.7	20.6±4.2	4.2
QC-W-82	Water	Oct 1991	Co-60	22.6±2.7	22.1±5.0	5.0
			Cs-134	15.5±1.8	17.6±5.0	5.0
			Cs-137	17.5±2.1	17.6±5.0	5.0
QC-W-83	Water	Oct 1991	H-3	4639±137	4382±438	438
QC-MI-37	Milk	Oct 1991	I-131	23.6±3.2	25.8±5.0	5.0
			Cs-134	22.7±2.8	22.1±5.0	5.0
			Cs-137	38.3±3.0	35.1±5.0	5.0
QC-W-84	Water	Dec 1991	Gr. alpha	6.2±0.6	7.8±5.0	5.0
			Gr. beta	11.0±0.7	11.0±5.0	5.0

^a n=3 unless noted otherwise.

^b n=2 unless noted otherwise.

^c n=1 unless noted otherwise.

^d Concentration in pCi/ml.

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L)	
				Results (4.66 σ)	Acceptance Criteria (4.66 σ)
SPS-5386	Milk	Jan 1988	I-131	<0.1	<1
SPW-5448	"Dead" Water	Jan 1988	H-3	<177	<300
SPS-5615	Milk	Mar 1988	Cs-134	<2.4	<10
			Cs-137	<2.5	<10
			I-131	<0.3	<1
			Sr-89	<0.4	<5
			Sr-90	2.4±0.5 ^a	<1
SPS-5650	D.I. Water	Mar 1988	Th-228	<0.3	<1
			Th-230	<0.04	<1
			Th-232	<0.05	<1
			U-234	<0.03	<1
			U-235	<0.03	<1
			U-238	<0.03	<1
			Am-241	<0.06	<1
			Cm-241	<0.01	<1
			Pu-238	<0.08	<1
			Pu-240	<0.02	<1
SPS-6090	Milk	Jul 1988	Sr-89	<0.5	<1
			Sr-90	1.8±0.5	<1
			I-131	<0.4	<1
			Cs-137	<0.4	<10
SPW-6209	Water	Jul 1988	Fe-55	<0.8	<1
SPW-6292	Water	Sep 1988	Sr-89	<0.7	<1
			Sr-90	<0.7	<1
SPS-6477	Milk	Oct 1988	I-131	<0.2	<1
			Cs-134	<6.1	<10
			Cs-137	<5.9	<10
SPW-6478	Water	Oct 1988	I-131	<0.2	<1
SPW-6479	Water	Oct 1988	Co-60	<5.7	<10
			Cs-134	<3.7	<10
			Cs-137	<4.3	<10
SPW-6480	Water	Oct 1988	H-3	<170	<300

Table A-4. In-house "blank" samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L)	
				Results (4.66 σ)	Acceptance Criteria (4.66 σ)
SPW-6625	Water	Dec 1988	Gr. alpha Gr. beta	<0.7 <1.9	<1 <4
SPS-6723	Milk	Jan 1989	Sr-89	<0.6	<5
			Sr-90	1.9±0.5 ^a	<1
			I-131	<0.2	<1
			Cs-134	<4.3	<10
			Cs-137	<4.4	<10
SPW-6877	Water	Mar 1989	Sr-89	<0.4	<5
			Sr-90	<0.6	<1
SPS-6963	Milk	Apr 1989	I-131	<0.3	<1
			Cs-134	<5.9	<10
			Cs-137	<6.2	<10
SPW-7561	Water	Apr 1989	H-3	<150	<300
SPW-7207	Water	Jun 1989	Ra-226	<0.2	<1
			Ra-228	<0.6	<1
SPS-7208	Milk	Jun 1989	Sr-89	<0.6	<5
			Sr-90	2.1±0.5 ^a	<1
			I-131	<0.3	<1
			Cs-134	<6.4	<10
			Cs-137	<7.2	<10
SPW-7588	Water	Jun 1989	Gr. alpha	<0.2	<1
			Gr. beta	<1.0	<4
SPS-7322	Milk	Aug 1989	Sr-89	<1.4	<5
			Sr-90	4.8±1.0 ^a	<1
			I-131	<0.2	<1
			Cs-134	<6.9	<10
			Cs-137	<8.2	<10
SPW-7559	Water	Sep 1989	Sr-89	<2.0	<5
			Sr-90	<0.7	<1
SPW-7560	Water	Oct 19	I-131	<0.1	<1
SPW-7562	Water	Oct 1989	H-3	<140	<300

Table A-4. In-house "blank" samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L)	
				Results (4.66 σ)	Acceptance Criteria (4.66 σ)
SPS-7605	Milk	Nov 1989	I-131	<0.2	<1
			Cs-134	<8.6	<10
			Cs-137	<10	<10
SPW-7971	Water	Dec 1989	Gr. alpha	<0.4	<1
			Gr. beta	<0.8	<4
SPW-8039	Water	Jan 1990	Ra-226	<0.2	<1
SPS-8040	Milk	Jan 1990	Sr-89	<0.8	<5
			Sr-90	<1.0	<1
SPS-8208	Milk	Jan 1990	Sr-89	<0.8	<5
			Sr-90	1.6±0.5 ^a	<1
			Cs-134	<3.6	<10
			Cs-137	<4.7	<10
SPS-8312	Milk	Feb 1990	Sr-89	<0.3	<5
			Sr-90	1.2±0.3 ^a	<1
SPW-8312A	Water	Feb 1990	Sr-89	<0.6	<5
			Sr-90	<0.7	<5
SPS-8314	Milk	Mar 1990	I-131	<0.3	<1
SPS-8510	Milk	May 1990	I-131	<0.2	<1
			Cs-134	<4.6	<10
			Cs-137	<4.8	<10
SPW-8511A	Water	May 1990	H-3	<200	<300
SPS-8600	Milk	Jul 1990	Sr-89	<0.8	<5
			Sr-90	1.7±0.6 ^a	<1
			I-131	<0.3	<1
			Cs-134	<5.0	<10
			Cs-137	<7.0	<10
SPM-8877	Milk	Aug 1990	I-131	<0.2	<1
SPW-8925	Water	Aug 1990	H-3	<200	<300

Table A-4. In-house "blank" samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L)	
				Results (4.66 σ)	Acceptance Criteria (4.66 σ)
SPW-8926	Water	Aug 1990	Gr. alpha	<0.3	<1
			Gr. beta	<0.7	<4
SPW-8927	Water	Aug 1990	U-234	<0.01	<1
			U-235	<0.02	<1
			U-238	<0.01	<1
SPW-8928	Water	Aug 1990	Mn-54	<4.0	<5
			Co-58	<4.1	<5
			Co-60	<2.4	<5
			Cs-134	<3.3	<5
			Cs-137	<3.7	<5
SPW-8929	Water	Aug 1990	Sr-89	<1.4	<5
			Sr-90	<0.6	<1
SPW-69	Water	Sep 1990	Sr-89	<1.8	<5
			Sr-90	<0.8	<1
SPW-106	Water	Oct 1990	H-3	<180	<300
			I-131	<0.3	<1
SPM-107	Milk	Oct 1990	I-131	<0.4	<1
			Cs-134	<3.3	<5
			Cs-137	<4.3	<5
SPW-370	Water	Oct 1990	Mn-54	<1.7	<5
			Co-58	<2.6	<5
			Co-60	<1.6	<5
			Cs-134	<1.7	<5
			Cs-137	<1.8	<5
SPW-372	Water	Dec 1990	Gr. alpha	<0.3	<1
			Gr. beta	<0.8	<4
STS-406	Milk	Jan 1991	Sr-89	<0.4	<5
			Sr-90	1.8±0.4 ^a	<1
			Cs-134	<3.7	<5
			Cs-137	<5.2	<5
SPS-421	Milk	Feb 1991	I-131	<0.3	<1
SPW-451	Water	Feb 1991	Ra-226	<0.1	<1
			Ra-228	<0.9	<1

Table A-4. In-house "blank" samples (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration (pCi/L)	
				Results (4.66 σ)	Acceptance Criteria (4.66 σ)
SPW-514	Water	Mar 1991	Sr-89	<1.1	<5
			Sr-90	<0.9	<1
SPW-586	Water	Apr 1991	I-131	<0.2	<1
			Co-60	<2.5	<5
			Cs-134	<2.4	<5
			Cs-137	<2.2	<5
SPS-587	Milk	Apr 1991	I-131	<0.2	<1
			Cs-134	<1.7	<5
			Cs-137	<1.9	<5
SPW-837	Water	Jun 1991	Gr. alpha	<0.6	<1
			Gr. beta	<1.1	<4
SPM-953	Milk	Jul 1991	Sr-89	<0.7	<5
			Sr-90	0.4±0.3 ^a	<1
			I-131	<0.2	<1
			Cs-137	<4.9	<5
SPM-1236	Milk	Oct 1991	I-131	<0.2	<1
			Cs-134	<3.7	<5
			Cs-137	<4.6	<5
SPW-1254	Water	Oct 1991	Sr-89	<2.8	<5
			Sr-90	<0.7	<1
SPW-1256	Water	Oct 1991	I-131	<0.4	<1
			Co-60	<3.6	<5
			Cs-134	<4.0	<5
			Cs-137	<3.6	<5
SPW-1259	Water	Oct 1991	H-3	<160	<300
SPW-1444	Water	Dec 1991	Gr. alpha	<0.4	<1
			Gr. beta	<0.8	<4

^a Low level of Sr-90 concentration in milk (1 - 5 pCi/L) is not unusual.

ATTACHMENT B

ACCEPTANCE CRITERIA FOR "SPIKED" SAMPLES

LABORATORY PRECISION: ONE STANDARD DEVIATION VALUES FOR VARIOUS ANALYSES^a

Analysis	Level	One Standard Deviation for Single Determination
Gamma Emitters	5 to 100 pCi/liter or kg >100 pCi/liter or kg	5 pCi/liter 5% of known value
Strontium-89 ^b	5 to 50 pCi/liter or kg >50 pCi/liter or kg	5 pCi/liter 10% of known value
Strontium-90 ^b	2 to 30 pCi/liter or kg >30 pCi/liter or kg	3.0 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 pCi/liter 25% of known value
Gross beta	<100 pCi/liter >100 pCi/liter	5 pCi/liter 5% of known value
Tritium	<4,000 pCi/liter >4,000 pCi/liter	1s = (pCi/liter) = 169.85 x (known) 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 pCi/liter 10% of known value
Uranium-238, Nickel-64 ^b , Technetium-99 ^b	<35 pCi/liter >35 pCi/liter	6 pCi/liter 15% of known value
Iron-55 ^b	50 to 100 pCi/liter >100 pCi/liter	10 pCi/liter 10% of known value

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

^b TIML limit.

ADDENDUM TO APPENDIX A

The following is an explanation of the reasons why certain samples were outside the control limit specified by the Environmental Protection Agency for the Interlaboratory Comparisons Program starting January 1988.

Lab Code	Analysis	TIML Result (pCi/L) ^a	EPA Control Limit (pCi/L) ^a	Explanation
STF-524	K	1010.7±158.5 ^b	1123.5-1336.5 ^b	Error in transference of data. Correct data was 1105±33 mg/kg. Results in the past have been within the limits and TIML will monitor the situation in the future.
STW-532	I-131	9.0±2.0	6.2-8.8	Sample recounted after 12 days. The average result was 8.8±1.7 pCi/L (within EPA control limits). The sample was recounted in order to check the decay. Results in the past have been within the limits and TIML will continue to monitor the situation in the future.
STW-534	Co-60	63.3±1.3	41.3-58.7	High level of Co-60 was due to contamination of beaker. Beaker was discarded upon discovery of contamination and sample was recounted. Recount results were 53.2±3.6 and 50.9±2.4 pCi/L.
STM-554	Sr-90	51.0±2.0	54.8-65.2	The cause of low result was due to very high fat content of milk. It should be noted that 63% of all participants failed this test. Also, the average for all participants was 54.0 pCi/L before the Grubb and 55.8 pCi/L after the Grubb.
STW-560	Pu-239	5.8±1.1	3.5-4.9	The cause of high results is not known though it is suspected that the standard was not properly calibrated by supplier and is under investigation. New Pu-236 standard was obtained and will be used for the next test.
STW-568	Ra-228	2.6±1.0	2.7-4.5	The cause of low results is not known. Next EPA cross check results were within the control limits. No further action is planned.

ADDENDUM TO APPENDIX A (continued)

Lab Code	Analysis	TIML Result (pCi/L) ^a	EPA Control Limit (pCi/L) ^a	Explanation
STM-570	Sr-89 Sr-90	26.0±10.0 45.7±4.2	30.3-47.7 49.8-60.2	The cause of low results was falsely high recovery due to suspected incomplete calcium removal. Since EPA sample was used up, internal spike was prepared and analyzed. The results were within control limits (See table A-3, sample QC-MI-24). No further action is planned.
STW-589	Sr-90	17.3±1.2	17.4-22.6	Sample was reanalyzed in triplicate; results of reanalyses were 18.8±1.5 pCi/L. No further action is planned.
STM-599	K	1300.0±69.2 ^c	1414.7-1685.3 ^c	Sample was reanalyzed in triplicate. Results of reanalyses were 1421.7±95.3 mg/L. The cause of low results is unknown.
STW-601	Gr. alpha	11.0±2.0	11.6-32.4	Sample was reanalyzed in triplicate. Results of reanalyses were 13.4±1.0 pCi/L.
STAF-626	Gr. alpha	38.7±1.2	14.6-35.4	The cause of high results is the difference in geometry between standard used in the TIML lab and EPA filter.
STW-632	Ba-133	74.0±6.9	51.6-72.4	Sample was reanalyzed. Results of the reanalyses were 63.8±6.9 pCi/L within EPA limit.
STM-641	I-131	130.7±16.8	88.9-127.1	The cause of high result is unknown. In-house spike sample was prepared with activity of I-131 68.3±6.8 pCi/L. Result of the analysis was 69.1±9.7 pCi/L.

^a Reported in pCi/L unless otherwise noted.

^b Concentrations are reported in mg/kg.

^c Concentrations are reported in mg/L.

APPENDIX VI

ANALYTICAL PROCEDURES

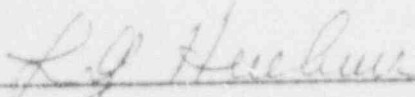
ANALYTICAL PROCEDURES MANUAL
TELEDYNE ISOTOPES MIDWEST LABORATORY
PREPARED FOR
COMMONWEALTH EDISON COMPANY

Note: Only procedures applicable to the CECO Radiological Environmental Monitoring Program are included in this manual.


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CECo

List of Procedures

<u>Procedure Number</u>		<u>Revision Number</u>	<u>Revision Date</u>
SP-01	Sample Preparation	0	07-02-86
AP-02	Determination of Gross Alpha and/ or Gross Beta in Air Particulate Filters	1	07-15-91
AP-03	Procedure for Compositing Air Particulate Filters for Gamma Spectroscopic Analysis	0	12-15-89
W(DS)-01	Determination of Gross Alpha and/ or Gross Beta in Water (Dissolved Solids or Total Residue)	2	05-03-91
W(SS)-02	Determination of Gross Alpha and/ or Gross Beta in Water (Suspended Solids)	0	11-22-85
AB-01	Determination of Gross Alpha and/ or Gross Beta in Solid Samples	0	08-04-86
GS-01	Determination of Gamma Emitters by Gamma Spectroscopy	0	07-21-86
T-02	Determination of Tritium in Water	1	09-27-91
I-131-01	Determination of I-131 in Milk by Anion Exchange (Batch Method)	3	04-10-91
I-131-02	Determination of Airborne I-131 in Charcoal Cartridges by Gamma Spectroscopy	0	07-04-86
COMP-01	Procedure for Compositing Water and Milk Samples	0	11-07-88

SAMPLE PREPARATION

PROCEDURE NO. TIML-SP-01

Prepared by
Teledyne Isotopes Midwest Laboratory

Copy No. _____

<u>Revisio</u>	<u>No.</u>	<u>Date</u>	<u>Pages</u>	<u>Prepared by</u>	<u>Approved by</u>
0		07-02-86	11	<i>pa Grob</i>	<i>L.H. Huebner</i>
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

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E. Eggs	TIML-SP-01-08
F. Slime and Aquatic Vegetation	TIML-SP-01-09
G. Bottom Sediments and Soil	TIML-SP-01-10
H. Drinking (Clear) Water (EPA Method 900.0)	TIML-SP-01-11

SAMPLE PREPARATION

Principle of Method

Different classes of samples require different preparations. In general, food products are prepared as for home use, while others are dried and ashed as received.

Reagents

Formaldehyde

Apparatus

Balance
Blender
Ceramic Dishes
Counting Containers
Cutting Board
Drying Oven
Drying Pans
Grinder
High Temperature Marking Pen
Knives
Muffle Furnace
Plastic Bags
Pulverizer
Scissors
Spatulas

Procedure for Packing Counting Containers

- A. 3.5 l - Place 3.5 l of water into the container. Mark the level and then empty the container. Fill with the sample to the mark.
- B. 500 ml - Fill to the rim of the inside wall, which is 1/4" from the top.
- C. 100 ml - Fill to the 100 ml mark.

Pack the sample tightly. When filling with soil and bottom sediments, make sure it is level.

A. Vegetables and Fruits

1. Wash and prepare vegetables and fruits as for eating.
2. Homogenize in a blender.
3. Transfer blended sample to a standard calibrated container (3.5 l, 500 ml, or 4 oz); use the largest size possible for the amount of sample available. Record the wet weight.
4. Add a few cc of formaldehyde to prevent spoilage.
5. Seal with cover. Attach paper tape on top of the cover and write sample number, net weight, and date and time collected.
6. Submit to the counting room for gamma spectroscopic analysis without delay or store in a cooler until counting (for short period).

NOTE: If I-131 analysis is required, it is imperative that the sample be prepared and submitted to the counting room immediately. Mark "I-131" on the tape.

7. After gamma scanning is completed, transfer the sample to a drying pan and dry at 110° C.

NOTES: If only gamma scan is required, skip drying and ashing (Steps 7 through 11). Transfer the sample to a plastic bag, seal, label, and store in the cooler until disposal.

If there is sufficient quantity, use surplus sample for drying and ashing instead of waiting for gamma scanning to be completed.

8. Cool, weigh, and record dry weight. Grind.
9. Weigh out accurately in a tarred ceramic dish 100-120 g of the ground sample. Record the weight. (If sample weight is less than 100 g, use two dishes; mark one as "A" and the second one as "B.") Ash in a muffle furnace by gradually increasing the temperature to 600° C. Ash overnight.

NOTE: If ashing is incomplete (black carbon remains), cool the dish, crush the ash with spatula, and continue ashing overnight at 600° C. At this stage, it is not necessary to increase the temperature gradually. Set the temperature at 600° C and turn on the furnace.

10. Cool and weigh the ashed sample and record the ash weight. Grind to pass a 30 mesh screen. Transfer to 4 oz container, seal, and write sample number, weight, analysis required, and date and time of collection. The sample is now ready for analysis.
11. Store remaining ground sample in a plastic bag for possible future rechecking.

B. Grass and Cattle Feed

1. Take approximately 1 kg of fresh grass or 2 kg of cattle feed or silage.
2. Cut up grass into approximately 1" - 2" long stems and pack into a standard calibrated container (3.5 l or 500 ml). Pack cattle feed and silage as is; use 3.5 l size if enough sample is available. Record the wet weight.
3. Add a few cc of formaldehyde.
4. Seal with cover. Attach paper tape on top of the cover and label with sample number, net weight, and date and time collected.
5. Submit to the counting room for gamma spectroscopic analysis or store in a cooler until counting (for a short period) without delay.

NOTE: If I-131 analysis is required, it is imperative that the sample be prepared and submitted to the counting room immediately. Mark "I-131" on the tape.

6. After gamma scanning is completed, transfer the sample to a drying pan and dry at 110° C.

NOTES: If only gamma scan is required, skip drying and ashing (Steps 6 through 10). Transfer the sample to a plastic bag, seal, label, and store in the cooler until disposal.

If there is sufficient quantity, use surplus sample for drying and ashing instead of waiting for gamma scanning to be completed.

7. Cool, weigh, and record dry weight. Grind.
8. Weigh out accurately in a tarred ceramic dish 100-120 g. of the ground sample. Record the weight. (If sample weight is less than 100 g, use two dishes; mark one as "A" and the second one as "B.") Ash in a muffle furnace by gradually increasing the temperature to 600° C. Ash overnight.

NOTE: If ashing is incomplete (black carbon remains), cool the dish, crush the ash with spatula, and continue ashing overnight at 600° C. At this stage, it is not necessary to increase the temperature gradually. Set the temperature at 600° C and turn on the furnace.

9. Cool and weigh the ashed sample and record the ash weight. Grind to pass a 30 mesh screen. Transfer to 4 oz container, seal, and write sample number, weight, analyses required, and date and time of collection. The sample is now ready for analyses.
10. Store the remaining ground sample in a plastic bag for possible future rechecking.

C. Fish

1. Wash the fish.
2. Fillet and place the flesh immediately (to prevent moisture loss) in a 500 ml or 4 oz standard calibrated container. Use 500 ml size if enough sample is available. Record the wet weight.
3. Add a few cc of formaldehyde.
4. Seal with cover. Attach paper tape on top of the cover and label with sample number, weight, and date and time of collection.

NOTE: If bones are to be analyzed, boil remaining fish in water for about 1 hour. Clean the bones. Air dry, weigh, and record as wet weight. Dry at 110° C. Record dry weight. Ash at 800° C, cool, weigh, and record the ash weight. Grind to a homogeneous sample. The sample is ready for analysis.

4. Submit to the counting room for gamma spectroscopic analysis without delay or store in a refrigerator until counting.

NOTE: If I-131 analysis is required, it is imperative that the sample be prepared and submitted to the counting room immediately. Mark "I-131" on the tape.

5. After gamma spectroscopic analysis is completed, transfer the sample to a drying pan and dry at 110° C.

NOTES: If only gamma scan is required, skip drying and ashing (Steps 5 through 9). Transfer the sample to a plastic bag, seal, label, and store in the freezer until disposal.

If there is sufficient quantity, use surplus flesh for drying and ashing instead of waiting for gamma scanning to be completed.

6. Cool, weigh, and record dry weight.
7. Transfer to a tarred ceramic dish. Record dry weight for ashing.
8. Ash in a muffle furnace by gradually increasing the temperature to 450° C. If considerable amount of carbon remains after overnight ashing, the sample should be brushed and placed back in the muffle furnace until ashing is completed.
9. Cool and weigh the ashed sample and record the ash weight. Grind to pass a 30 mesh screen. Transfer to a 4 oz container, seal, and write sample number, weight, analyses required, and date and time of collection. The sample is now ready for analysis.

D. Waterfowl, Meat, and Wildlife

1. Skin and clean the animal. Remove a sufficient amount of flesh to fill an appropriate standard calibrated container (500 or 4 oz). Weigh without delay (to prevent moisture loss), and record the wet weight.
2. Add a few cc of formaldehyde.

NOTE: If bones are to be analyzed, boil remaining flesh in water for about 1 hour. Clean the bones. Air dry, weigh, and record as wet weight. Dry at 110° C. Record dry weight. Ash at 800° C, cool, weigh, and record the ash weight. Grind to a homogeneous sample. The sample is ready for analysis.

3. Seal with the cover. Attach paper tape on top of the cover and label with sample number, wet weight, and date and time of collection.
4. Submit to the counting room for gamma spectroscopic analysis without delay or store in a refrigerator until counting (for short period).

NOTE: If I-131 analysis is required, it is imperative that the sample be prepared and submitted to the counting room immediately. Mark "I-131" on the tape.

5. After the gamma scanning is completed, transfer the sample to a drying pan and dry at 110° C.
6. Cool, weigh, and record dry weight.
7. Transfer to a tarred ceramic dish. Record dry weight for ashing.
8. Ash in a muffle furnace by gradually increasing the temperature to 450° C. If considerable amounts of carbon remain after overnight ashing, the sample should be brushed and placed back in the muffle furnace until ashing is completed.
9. Cool and weigh the ashed sample and record the ash weight. Grind to pass a 30 mesh screen. Transfer to a 4 oz container. Seal and write sample number, weight, analyses required, and date and time of collection. The sample is now ready for analyses.

E. Eggs

1. Remove the egg shells and mix the eggs with a spatula. Use about one (1) dozen eggs.
2. Transfer the mixed eggs to a standard calibrated 500 ml container. Record the wet weight.
3. Add a few cc of formaldehyde.
4. Seal with cover. Attach paper tape on top of the cover and label with sample number, wet weight, and date and time of collection.
5. Submit to the counting room for gamma spectroscopic analysis without delay or store in a refrigerator until counting (for short period).
6. After gamma spectrascopic analysis is completed, tranfer the sample to a plastic bag, seal, label, and store in a freezer until disposal.

NOTE: If only a gamma scan is required, skip Steps 7 through 11.
7. Weigh the rest of the sample, record wet weight, and dry in an oven at 110° C.
8. Cool, weigh, and record dry weight.
9. Weigh out accurately 100-120 g of the sample in a tarred ceramic dish. Record the weight. Ash in a muffle furnace by gradually increasing the temperature to 550° C. If a considerable amount of carbon remains after overnight ashing, the sample should be crushed and placed back in the muffle furnace until ashing is completed.
10. Cool and weigh the ashed sample and record the weight. Grind to pass a 20 mesh screen. Transfer to a 4 oz container, seal, and write sample number, weight, analyses required, and date and time of collection. The sample is now ready for analysis.
11. Store the remaining ground sample in a plastic bag for possible future rechecking.

F. Slime and Aquatic Vegetation

1. Remove foreign materials.
2. Place the sample in a sieve pan and wash until all sand and dirt is removed (turn the sample over several times.)
3. Squeeze out the water by hand.
4. Place the sample in a standard calibrated 500 ml or 4 oz container; weigh and record wet weight. Use 500 ml container if enough sample is available.
5. Add a few cc of formaldehyde.
6. Seal with cover. Attach paper tape on top of the cover and label with sample number, weight, and date and time of collection.
7. Submit to the counting room without delay. Slime decomposes quickly even with formaldehyde. If gamma scanning must be delayed, freeze.

NOTE: If I-131 analysis is required, it is imperative that the sample be prepared and analyzed immediately. Mark "I-131" on the tape.

8. After gamma scanning is completed, transfer the sample to a drying pan and dry at 110° C.

NOTE: If only gamma scan is required, skip drying and ashing (Steps 8 through 11). Transfer the sample to a plastic bag, seal, label, and store in the freezer until disposal.

9. Cool, weigh, and record dry weight.
10. Transfer to a tarred ceramic dish, and record dry weight for ashing. Ash in a muffle furnace by gradually increasing the temperature to 600° C.

NOTE: If ashing is incomplete (black carbon remains), cool the dish, crush the ash with spatula, and continue ashing overnight at 600° C. At this stage, it is not necessary to increase the temperature gradually. Set the temperature at 600° C. and turn on the furnace.

11. Cool and weigh the ashed sample and record ash weight. Grind to pass a 30 mesh screen. Transfer to a 4 oz container, seal, and label with sample number, weight, analyses required, and date and time of collection. The sample is now ready for analyses.

G. Bottom Sediments and Soil

1. Remove rocks, roots, and any other foreign materials.
2. Place approximately 1 kg of sample on the drying pan and dry at 110° C.
3. Seal, label, and save remaining sample.
4. Grind or pulverize the dried sample and sieve through a No. 20 mesh screen.
5. For gamma spectroscopic analysis, transfer sieved sample to a standard calibrated 500 ml container or to 4 oz container.
6. Seal with cover. Weigh and record dry weight. Attach paper tape on top of the cover and write sample number, weight, and date and time of collection.
7. Submit to the counting room for gamma spectroscopic analysis without delay.
8. For other analyses, e.g. gross beta, radiostrontium, etc., fill 4 oz container to the top, seal, and write sample number, types of analyses required, and date and time of collection.
9. Store the remaining sieved sample in a plastic bag for possible future rechecking.
10. After the gamma scanning is completed, transfer the sample to a plastic bag, seal, label, and store until disposal.

H. Drinking (Clear) Water (EPA Method 900.0)

A representative sample must be collected from a free-flowing source of drinking water and should be large enough so that adequate aliquots can be taken to obtain the required sensitivity.

It is recommended that samples be preserved at the time of collection by adding enough 1N HNO₃ to the sample to bring it to pH 2 (15 ml 1N HNO₃ per liter of sample is usually sufficient). If samples are to be collected without preservation, they should be brought to the laboratory within 5 days, then preserved and held in the original container for a minimum of 16 hours before analysis or transfer of the sample.

The container choice should be plastic over glass to prevent loss due to breakage during transportation and handling.

If the sample was not acidified at the time of collection, use the following procedure:

Procedure

1. Remove 100 ml of sample for tritium analysis and 1 l for I-131 analysis, if required.
2. Add 15 ml of 1:1 HNO₃ per gallon of sample in the original container.
3. Hold the sample in the original container for a minimum of 16 hours before analysis or transfer of the sample.
4. When taking an aliquot for analysis, take acid addition into account. For example:

<u>Sample Volume to Be analyzed</u>	<u>Volume of Aliquot Required</u>
200 ml	203 ml
400 ml	406 ml
600 ml	609 ml
800 ml	812 ml
1000 ml	1015 ml
2000 ml	2030 ml
3000 ml	3045 ml
3500 ml	3552 ml

For other volumes, adjust aliquots accordingly, at the rate of 1.5 ml per 100 ml of sample.

DETERMINATION OF GROSS ALPHA AND/OR GROSS BETA
IN AIR PARTICULATE FILTERS

PROCEDURE NO. TIML-AP-02

Prepared by
Teledyne Isotopes Midwest Laboratory

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Revised Pages	Revision No.	Date	Pages	Prepared by	Approved by
_____	0	07-11-86	3	<u>B. Galt</u>	<u>L. G. Huebner</u>
2	1	07-15-91	3	<u>B. Galt</u>	<u>L. G. Huebner</u>
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DETERMINATION OF GROSS ALPHA AND/OR GROSS BETA
IN AIR PARTICULATE FILTERS

Principle of Method

Air particulate filters are stored for at least 72 hours to allow for the decay of short-lived radon and thoron daughters and then counted in the proportional counter.

Apparatus

Forceps
Loading Sheet
Proportional Counter
Stainless Steel Planchets (standard 2" x 1/8")

Procedure

1. Store the filters for at least 72 hours from the day of collection.
2. Place filters on a stainless steel planchet.
3. Fill out a sample loading sheet. Fill in the date, counter number, counting time, sample identification number, sample collection date, and initials.

NOTES: When loading samples in the holder, load blanks (unexposed filter paper) in positions 1, 12, 23, 34, 45, etc.

If filters from more than one project are loaded, make sure that the appropriate blanks are loaded with each batch. Load the counter blank planchet as a last sample.

4. Count in a proportional counter long enough to obtain the required LLDs.
5. After counting is completed, return the filters to the original envelopes.
6. Submit the counter printout, field collection sheet, and the loading sheet to the data clerk for calculations.

Calculations

Gross alpha (beta) concentration:

$$(\text{pCi/liter}) = \frac{A}{B \times C \times 2.22} \pm \frac{2 \sqrt{E_{sb}^2 + E_b^2}}{B \times C \times 2.22}$$

Where:

- A = Net alpha (beta) count (cpm)
- B = Efficiency for counting alpha (beta) activity (cpm/dpm)
- C = Volume of sample
- E_{sb} = Counting error of sample plus background
- E_b = Counting error of background

PROCEDURE FOR COMPOSITING AIR PARTICULATE FILTERS
FOR GAMMA SPECTROSCOPIC ANALYSIS

PROCEDURE NO. TIML-AP-03

Prepared by
Teledyne Isotopes Midwest Laboratory

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0	12-15-89	3	<i>J. Job</i>	<i>L. J. Huebner</i>
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PROCEDURE FOR COMPOSITING AIR PARTICULATE FILTERS
FOR GAMMA SPECTROSCOPIC ANALYSIS

Principle of Method

AP filters are placed in a Petrie Dish in chronological order, labeled and submitted to counting room for analysis.

Materials

Forceps (long)
Blank filter paper
Small Petrie Dish
Scotch Tape

Procedure

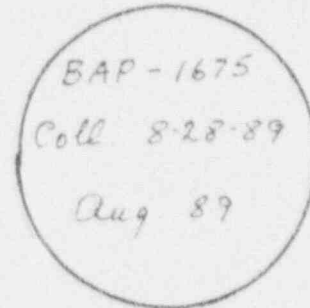
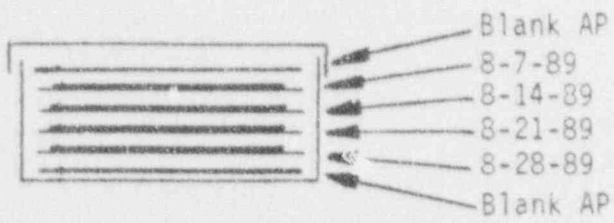
1. Stack APs from each location in chronological order, with the latest collection date on top.
2. Place blank filter paper in the Petrie Dish.
3. Starting from the top of the stack, remove each AP from the envelope and place it in the Petrie Dish with the deposit facing up.
4. Continue transferring AP's from envelopes to the Petrie Dish until all are transferred.
5. Place blank filter paper on top.
6. Cap the Petrie Dish. Use scotch tape to hold cap in place, if needed.
7. Record sample ID (project), sample No., location, last date of collection, collection period and date composited in the Recording Book.
8. Write sample ID, sample No., last date of collection and collection period on the Petrie Dish using black marker.
9. Submit the samples to the counting room.
10. After counting, return AP's to the original envelopes in reverse order.

Example

Project: BAP
Location: 2
Sample No.: 1675
Last Collection Date: 08-28-89
Collection period: August, 1989
Samples collected: 8-7, 8-14, 8-21, 8-28

Side View

Top View



DETERMINATION OF GROSS ALPHA AND/OR GROSS BETA IN WATER
(DISSOLVED SOLIDS OR TOTAL RESIDUE)

PROCEDURE NO. TIML-W(DS)-01

Prepared by
Teledyne Isotopes Midwest Laboratory

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	0	11-25-85	4	<i>B. Gorb</i>	<i>L.P. Huebner</i>
2,3	1	02-28-91	4	<i>B. Gorb</i>	<i>L.P. Huebner</i>
3	2	05-03-91	4	<i>B. Gorb</i>	<i>L.P. Huebner</i>

DETERMINATION OF GROSS ALPHA AND/OR GROSS BETA
IN WATER
(Dissolved Solids or Total Residue^{a,b})

Principle of Method

Water samples containing suspended matter are filtered through a membrane filter and the filtrate is analyzed. The filtered water sample is evaporated and the residue is transferred to a tared planchet for counting gross alpha and gross beta activity.

Reagents

All chemicals should be of "reagent-grade" or equivalent whenever they are commercially available.

Lucite: 0.5 mg/ml in acetone

Nitric acid, HNO₃: 16 N (concentrated), 3 N (127 ml of 16 N HNO₃ diluted to 1 liter), 1 N (62 ml of 16 N HNO₃ diluted to 1 liter)

Apparatus

Filter, Millipore, membrane Type AA, 0.08
Filtration equipment
Planchets (Standard 2" x 1/8" ringed planchet)
Proportional counter
Electric hot plate
Drying oven
Muffle furnace

Procedure

1. Filter a volume of sample containing not more than 100 mg of dissolved solids for alpha assay, or not more than 200 mg of dissolved solids for beta assay.^{a,b} | 1

NOTE: For gross alpha and gross beta assay in the same sample, limit the amount of solids to 100 mg.

^a For analysis of total residue (for clear water), proceed as described above but do not filter the water. Measure out the appropriate amount and proceed to Step 3.

^b For Duquesne Light Company samples ONLY - Procedure, Step 1: Do NOT filter. Shake well and immediately withdraw required aliquot. Do not allow solids to settle. | 1

2. Transfer assembly holding filter paper to another filtering flask and wash the non-filterable solids on the filter paper with D.I. water. Discard wash water. (Save the filters with suspended matter for separate analysis. See Procedure No. TIML-W-02.)
3. Evaporate the filtrate to NEAR dryness on a hot plate.
4. Add 25 ml of concentrated HNO_3 and evaporate to NEAR dryness again.

NOTE: If water samples are known or suspected to contain chloride salts, these chloride salts should be converted to nitrate salts before the sample residue is transferred to a stainless steel planchet. (Chlorides will attack stainless steel and increase the sample solids. No correction can be made for these added solids.) Chloride salts can be converted to nitrate salts by adding concentrated HNO_3 and evaporating to near dryness.

5. With D.I. water and a few drops of 3 N HNO_3 , transfer the residue to a 50 ml beaker using a rubber policeman to wash the walls. Evaporate to NEAR dryness.
6. Transfer quantitatively the residue to a TARED PLANCHET, using an unused plastic disposable pipette for each sample, (not more than 1 mL at a time) evaporating each portion to dryness under the lamp. Spread residue uniformly on the planchet.

NOTE: Non-uniformity of the sample residue in the counting planchet interferes with the accuracy and precision of the method.

7. Wash the beaker with a minimum amount of 1 N HNO_3 several times and combine the washings and the residue in the planchet, using the rubber policeman to wash the walls. Evaporate to dryness.^c

NOTE: Rinse the rubber policeman with D.I. water between samples.

8. Bake in muffle furnace at 450°C for 45 minutes, cool and weigh.
9. Add a few drops (6 - 7) of the lucite solution and dry under the infrared lamp for 10 - 20 minutes.
10. Store the sample in a dessicator until ready to count because vapors from the moist residue can damage the detector and the window and can cause erratic measurements.

^c For Duquesne Light Company and CH₂M Hill samples ONLY - Procedure, Step 7: Do NOT bake. Proceed directly to Step 9. | 2

11. Count the gross alpha and/or the gross beta activity in a low background proportional counter.

NOTE: If the gas-flow internal proportional counter does not discriminate for the higher energy alpha pulses at the beta plateau, the activity must be subtracted from the beta plus alpha activity. This is particularly important for samples with high alpha activity.

Samples may be counted for beta activity immediately after baking; alpha counting should be delayed at least 72 hours (until equilibrium has occurred).

Calculations

Gross alpha (beta) activity:

$$(\text{pCi/liter}) = \frac{A}{B \times C \times D \times 2.22} \pm \frac{2 \sqrt{E_{sb}^2 + E_b^2}}{B \times C \times D \times 2.22}$$

Where:

- A = Net alpha (beta) count (cpm)
- B = Efficiency for counting alpha (beta) activity (cpm/dpm)
- C = Volume of sample (liters)
- D = Correction factor for self-absorption in the sample
- E_{sb} = Counting error of sample plus background
- E_b = Counting error of background

References: Radioassay Procedures for Environmental Samples, U.S. Department of Health, Education and Welfare. Environmental Health Series, January 1967.

EPA Prescribed Procedures for Measurement of Radioactivity in Drinking Water. August 1980.

DETERMINATION OF GROSS ALPHA AND/OR GROSS BETA IN WATER
(SUSPENDED SOLIDS)

PROCEDURE NO. TIML-W(SS)-02

Prepared by
Teledyne Isotopes Midwest Laboratory

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<u>0</u>	<u>11-22-85</u>	<u>3</u>	<u>L. G. Huebner</u>	<u><i>L. G. Huebner</i></u>
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DETERMINATION OF GROSS ALPHA AND/OR GROSS BETA IN WATER
(SUSPENDED SOLIDS)

Principle of Method

The sample is filtered through a tared membrane filter. The filter containing the solids is transferred to a stainless steel planchet, dried, and fixed to the planchet. The gross alpha and gross beta activities are measured in a low background internal proportional counter. If the sample contains sand, it is placed in the separatory funnel the sand allowed to settle to the bottom and drained off.

Reagents

Acetone

Apparatus

Filter, Millipore, membrane Type AA 0.08
Filtration equipment
Planchets (Standard 2" x 1/8" planchet)
Proportional counter

Procedure

1. Filter one liter of sample through a TARED membrane filter. Wash the non-filterable solids on the filter with D.I. water.

Note: If the sample contains sand, place it in the separatory funnel, allow the sand to settle for 30 minutes, then drain off the sand at the bottom. Shake the funnel and repeat as above two (2) more times.

2. Place the filter in a planchet, placing the ring over it to prevent curling, and air dry for 24 hours.
3. Dry under the infrared lamp for 20-30 minutes. Dessicate to constant weight and weigh.
4. Fix the filter to the planchet at four peripheral points using glue. Air dry.
5. Count for gross alpha and gross beta activity using a proportional counter.
6. Calculate the activity in pCi/l using the computer program designed for this analysis.

Calculations

Gross alpha (beta) activity:

$$(\text{pCi/liter}) = \frac{A}{B \times C \times D \times 2.22} \pm \frac{2 \sqrt{E_{sb}^2 + E_b^2}}{B \times C \times D \times 2.22}$$

Where:

- A = Net alpha (beta) count (cpm)
- B = Efficiency for counting alpha (beta) activity (cpm/dpm)
- C = Volume of sample (liters)
- D = Correction factor for self-absorption in the sample
- E_{sb} = Counting error of sample plus background
- E_b = Counting error of background

References: Radioassay Procedures for Environmental Samples, U.S. Department of Health, Education and Welfare. Environmental Health Series, January 1967.

DETERMINATION OF GROSS ALPHA AND/OR GROSS BETA
IN SOLID SAMPLES

PROCEDURE NO. TIML-AB-01

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<u>0</u>	<u>08-04-86</u>	<u>5</u>	<u><i>p. Job</i></u>	<u><i>L. J. Hubner</i></u>
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DETERMINATION OF GROSS ALPHA AND/OR GROSS BETA
IN SOLID SAMPLES

Principle of Method

100 mg to 200 mg of sample is distributed evenly on a 2" ringed planchet, counted in a proportional counter, and concentrations of gross alpha and/or gross beta are calculated.

Reagents

Lucite: 0.5 mg/ml in acetone

Appartus

Balance
Infrared lamp
Planchets (standard 2" x 1/8" ringed planchet)
Proportional counter

A. Gross Alpha and/or Gross Beta in VegetationProcedure

1. Weigh out accurately in a planchet no more than 100 mg of ashed or dried and ground sample for gross alpha assay and no more than 200 mg for gross beta assay.

NOTE: If both gross alpha and gross beta analyses are required, do not use more than 100 mg.

2. Add a few drops of water and spread uniformly over the area of the planchet. Dry under the infrared lamp.
3. Add 2 - 3 drops of lucite solution in acetone and dry again under the infrared lamp.
4. Store the planchets in a desiccator until counting.
5. Count the gross alpha and gross beta activity in a low background proportional counter.

Calculations

Gross alpha (beta) concentration:

$$(\text{pCi/g wet}) = \frac{A}{B \times C \times D \times F \times 2.22} \pm \frac{2 \sqrt{\frac{E_{sb}^2}{B \times C \times D \times F \times 2.22} + \frac{E_b^2}{B \times C \times D \times F \times 2.22}}}{B \times C \times D \times F \times 2.22}$$

Where:

- A = Net alpha (beta) count (cpm)
- B = Efficiency for counting alpha (beta) activity (cpm/dpm)
- C = Weight of sample (grams), ash or dry
- D = Correction factor for self-absorption in the sample
- E_{sb} = Counting error of sample plus background
- E_b = Counting error of background
- F = Ratio of wet weight to ashed or dry weight

REFERENCE: Radioassay Procedures for Environmental Samples, U. S. Department of Health, Education and Welfare. Environmental Health Series, January 1967.

B. Gross Alpha and/or Gross Beta in Meat, Fish, and WildlifeProcedure

1. Weigh out accurately in a planchet no more than 100 mg of ashed sample for gross alpha assay and no more than 200 mg for gross beta assay.

NOTE: If both gross alpha and gross beta analyses are required, do not use more than 100 mg.

2. Add a few drops of water and spread uniformly over the area of the planchet. Dry under the infrared lamp.
3. Add 2 - 3 drops of lucite solution in acetone and dry again under the infrared lamp.
4. Store the planchets in a desiccator until counting.
5. Count the gross alpha and gross beta activity in a low background proportional counter.

Calculations

Gross alpha (beta) concentration:

$$(\text{pCi/g wet}) = \frac{A}{B \times C \times D \times F \times 2.22} \pm \frac{2 \sqrt{E_{sb}^2 + E_b^2}}{B \times C \times D \times F \times 2.22}$$

Where:

- A = Net alpha (beta) count (cpm)
- B = Efficiency for counting alpha (beta) activity (cpm/dpm)
- C = Weight of sample (grams), ash
- D = Correction factor for self-absorption in the sample
- E_{sb} = Counting error of sample plus background
- E_b = Counting error of background
- F = Ratio of wet weight to ashed weight

REFERENCE: Radioassay Procedures for Environmental Samples, U. S. Department of Health, Education and Welfare. Environmental Health Series, January 1967.

C. Gross Alpha and/or Gross Beta in Soil and Bottom SedimentsProcedure

1. Weigh out accurately in a planchet no more than 100 mg of a pulverized sample for gross alpha assay and no more than 200 mg for a gross beta assay.

NOTE: If both gross alpha and gross beta analyses are required, do not use more than 100 mg.

2. Add a few drops of water and spread uniformly over the area of the planchet. Dry under the infrared lamp.
3. Add 2 - 3 drops of lucite solution in acetone and dry again under the infrared lamp.
4. Store the planchets in a desiccator until counting.
5. Count the gross alpha and gross beta activity in a low background proportional counter.

Calculations

Gross alpha (beta) concentration:

$$(\text{pCi/g dry}) = \frac{A}{B \times C \times D \times 2.22} \pm \frac{2\sqrt{E_{sb}^2 + E_b^2}}{B \times C \times D \times 2.22}$$

Where:

- A = Net alpha (beta) count (cpm)
- B = Efficiency for counting alpha (beta) activity (cpm/dpm)
- C = Weight of sample (grams)
- D = Correction factor for self-absorption in the sample
- E_{sb} = Counting error of sample plus background
- E_b = Counting error of background

REFERENCE: Radioassay Procedures for Environmental Samples, U. S. Department of Health, Education and Welfare. Environmental Health Series, January 1967.

DETERMINATION OF GAMMA EMITTERS
BY GAMMA SPECTROSCOPY
(GERMANIUM DETECTORS)

PROCEDURE NO. TIML-GS-01

Prepared by
Teledyne Isotopes Midwest Laboratory

Copy No. _____

<u>Revision no.</u>	<u>Date</u>	<u>Pages</u>	<u>Prepared by</u>	<u>Approved by</u>
<u>0</u>	<u>07-21-86</u>	<u>5</u>	<u>B. Gorb</u>	<u>L. J. H. [Signature]</u>
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DETERMINATION OF GAMMA EMITTERS
BY GAMMA SPECTROSCOPY
(GERMANIUM DETECTORS)

Principle of Method

The sample is placed in a calibrated container and counted for a length of time required to reach the required LLD. The results are decay corrected to the sampling time, where appropriate, using a dedicated computer and software.

Apparatus

Counting containers
Counting Equipment
Cylinders
Marking Pens
Recording Books

A. Milk and Water

1. Measure accurately 3.5 l or 500 ml of sample and put it in the calibrated counting container. Always use larger volume if sample is in sufficient quantity.

NOTE: Occasionally the sample size is too large for 500 ml geometry but not sufficient for 3.5 l geometry. In such a case, follow the following procedure.

- a. If the sample size is less than 2 l, use 500 ml geometry.
 - b. If the sample size is more than 2 l, measure the sample accurately and dilute to 3.5 l with deionized water. Use 3.5 l geometry but use actual sample volume when doing the calculations. Return the diluted sample to the original container and mark the volume of the original sample and deionized water used.
2. Cover and attach a gummed label to the cover; write the sample number, volume, and date and time of collection on the label. Mark "I-131" if analysis for I-131 is required by gamma spectroscopy.
 3. Count without delay for estimated time required to meet LLDs. Record file number, sample identification number, date and time counting started, detector number, geometry, sample size, and date and time of collection.
 4. Stop counting; transfer spectra to the disc and print out the results.
 5. Check LLDs before taking the sample off. If LLDs are not met, continue counting until they do.
 6. After counting is completed, record the date and time counting ended and counting time.
 7. Return the sample to the original container and mark with a red marker.

B. Airborne Particulates

1. Place air filters in a filter cup container.
2. Place on the detector and count long enough to meet the LLD requirements. Record the file number, sample identification number, date and time counting started, detector number, geometry, sample size, and date and time collected.
3. Stop counting and transfer spectra to the disc. Print out the results and check the LLDs before taking the sample off. If LLD levels are not met, continue counting until they do.
4. After counting is completed, record the date and time counting ended and counting time.
5. Replace air filters in the original envelopes for storage or further analyses.

C. Other Samples

NOTE: Samples, e.g., soil, vegetation, fish, etc., are prepared in the prep lab and delivered to the counting room.

1. Place the sample on the detector and count long enough to meet LLD requirements. Record the file number, sample identification number, date and time counting started, detector number, geometry, sample size, and date and time of collection.
2. Stop counting and transfer spectra to the disc. Print out the results and check the LLDs before taking the sample off. If LLD levels are not met, continue counting until they are.
3. After counting is completed, record date and time counting ended and counting time. Mark the container with red marker and return to the prep lab for transfer to the plastic bag for storage or further analyses.

DETERMINATION OF TRITIUM IN WATER
(DIRECT METHOD)

PROCEDURE NO. TIML-T-02

Prepared by
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	0	11-22-85	5	L. G. Huebner	<i>L. G. Huebner</i>
2,3	1	09-27-91	4	<i>K. Grob</i>	<i>L. G. Huebner</i>

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DETERMINATION OF TRITIUM IN WATER
(DIRECT METHOD)

Principle of Method

The water sample is purified by distillation, a portion of the distillate is transferred to a counting vial and the scintillation fluid added. The contents of the vial are thoroughly mixed and counted in a liquid scintillation counter.

Reagents

Scintillation medium, Insta-Gel scintillator
Tritium standard solution
Dead water
Ethyl alcohol

Apparatus

Condenser
Distillation flask, 250-ml capacity
Liquid scintillation counter
Liquid scintillation counting vials
Kimwipes

Procedure

NOTE: All glassware must be dry. Dry it in the drying oven at 100-125°C. |1

1. Place 60-70 ml of the sample in a 250-ml distillation flask. Add a boiling chip to the flask. Add one NaOH pellet and ca. 0.02g $KMnO_4$. Connect a side arm adapter and a condenser to the outlet of the flask. Place a receptacle at the outlet of the condenser. Set variac at 70 mark. Heat to boiling to distill. Discard the first 5-10 ml of distillate. Collect next 20-25 ml of distillate for analysis. Do not distill to dryness. |1

2. Mark the vial caps with the sample number and date.

Note: Use the same type of vial for the whole batch (samples, background, and standard.

3. Mark three (3) vial caps "Bkg 1", "Bkg 2", "Bkg 3", and date.
4. Mark three (3) vial caps "St-1", "St-2", "St-3"; standard number, and date.

5. Dispense 13 ml of sample into marked vials and "dead" water into vials marked Bkg-1,2, and 3.

Note 1: Pipetter is set (and calibrated) to deliver 6.5 ml, so pipette twice into each vial. Use new tip for each sample and new tip (one) for three background samples.

Note 2: Make sure the pipetter has not been reset. If it has been reset, or if you are not sure, do not use it; check with your supervisor.

Note 3: Make sure the plastic tip is pushed all the way on to the pipetter and is tight. If it is not, the air will be drawn in and the volume withdrawn will not be correct (it will be smaller).

6. Dispense 13 ml (see Notes 1,2, and 3, above) of "dead" water into each vial marked "St-1", "St-2", and "St-3."
7. Take a 0.1 ml (100) pipetter and withdraw 0.1 ml of water from each of the three standard vials. Discard this 0.1 ml of water.
8. Take a new 0.1 ml tip. Dispense 0.1 ml of standard into each of the three vials marked "St-1", "St-2", and "St-3."
9. Take all vials containing samples, background, and standard to the counting room.

Note: To avoid spurious counts, scintillator should not be added under fluorescent light.

10. Dispense 10 ml of Insta-Gel into each vial (one at a time), cap tightly, and shake VIGOROUSLY for at least 0.5 minutes. Recheck the cap for tightness.
11. Wet a Kimwipe with alcohol and wipe off each vial in the following order:

Background
Samples
Standard

12. Load the vials in the following order:

Bkg 1
St-1
Samples
Bkg-2*
St-2*
Samples
Bkg-3
St-3

* Bkg 2 and St-2 should be approximately in the middle of the batch. |1

13. Let the vials dark- and temperature-adapt for about one hour.

Note 1: To check if vials reached counter temperature, inspect one vial (Bkg). The liquid should be transparent. If the temperature is too high (or too low), the liquid will be white and very viscous.

Note 2: The temperature inside the counter should be between 10° and 14° C (check thermometer). In this temperature range, the liquid is transparent.

14. Set the counter for 100 min counting time and infinite cycles. (Follow manufacturer's procedure for setting the counter.)

15. Fill out the loading sheet, being sure to indicate the date and time counting started, and your initials.

Note: Do not count prepared background and standard sets with another batch of samples if plastic vials are used. Prepare new backgrounds and standards for each batch.

If glass vials are used, the prepared background and standard sets can be counted with other batches up to one (1) month after preparation provided they are not taken out of the counter (not warmed up) and the same vial type from the same manufacturing batch (the same carton) is used. After one month prepare new sets of backgrounds and standards.

Calculations

$$pCi/l = \frac{\frac{A}{t_1} - \frac{B}{t_2}}{2.22 \times E \times V \times e^{-\lambda t_3}} \pm \frac{2 \sqrt{\frac{A}{t_1^2} + \frac{B}{t_2^2}}}{2.22 \times E \times V \times e^{-\lambda t_3}}$$

Where:

A = Total counts, sample

B = Total counts, background

E = Efficiency (cpm/dpm)

V = Volume (liter)

e = Base of the natural logarithm = 2.71828

$\lambda = \frac{0.693}{12.26} = 0.05652$

t₁ = Counting time, sample

t₂ = Counting time, background

t₃ = Elapsed time from the time of collection to the time of counting (in years)

DETERMINATION OF I-131 IN MILK BY ANION EXCHANGE
(BATCH METHOD)

PROCEDURE NO. TIML-I-131-01

Prepared by
Teledyne Isotopes Midwest Laboratory

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_____	0	06-12-85	6	<i>P. Job</i>	<i>L. G. Huebner</i>
5	1	11-25-85	6	<i>P. Job</i>	<i>L. G. Huebner</i>
2,3,4,5	2	03-24-89	6	<i>P. Job</i>	<i>L. G. Huebner</i>
2,3,5	3	04-10-91	6	<i>P. Job</i>	<i>L. G. Huebner</i>

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Determination of I-131 in Milk by Ion Exchange

(Batch Method)

Principle of Method

After samples have been treated to convert all iodine in the sample to a common oxidation state, the iodine is isolated by solvent extraction or a combination of ion exchange and solvent extraction steps.

Iodine, as the iodide, is concentrated by adsorption on an anion resin. Following a NaCl wash, the iodine is eluted with sodium hypochlorite. Iodine in the iodate form is reduced to I₂ and the elemental iodine extracted into CHCl₃, back-extracted into water then finally precipitated as palladium iodide.

Chemical recovery of the added carrier is determined gravimetrically from the PdI₂ precipitate. I-131 is determined by beta counting the PdI₂.

Reagents

Anion Exchange Resin, Dowex 1-X8 (20-50 mesh) chloride form

| 3

Chloroform, CHCl₃ - reagent grade

Hydrochloric Acid, HCl, 1N

Hydrochloric Acid, HCl, 3N

Wash Solution: H₂O - HNO₃ - NH₂OH HCl, 50 mL H₂O; 10 mL 1M - NH₂OH-HCl;
10 mL conc. HNO₃

Hydroxylamine Hydrochloride, NH₂OH HCl - 1 M

Nitric Acid, HNO₃ - concentrated

Palladium Chloride, PdCl₂, 7.2 mg Pd⁺⁺/mL (1.2 g PdCl₂/100 mL of 6N HCl) | 3

Sodium Bisulfite, NaHSO₃ - 1 M

Sodium Chloride, NaCl - 2M

Sodium Hypochlorite, NaOCl - 5% (Clorox)

Special Apparatus

Chromatographic Column, 20 mm x 150 mm (Reliance Glass Cat. #R2725T)

Vacuum Filter Holder, 2.5 cm² filter area

Filter Paper, Whatman #42, 21 mm

Mylar

Polyester Gummed Tape, 1 1/2", Scotch #853

Heat Lamp

Part AIon Exchange Procedure

1. Transfer 2 liters (if available) of sample to the beaker. Add 1.00 mL of standardized iodide carrier to each sample. 3
2. Add a clean magnetic stirring bar to each sample beaker. Stir each sample for 5 minutes or longer on a magnetic stirrer. Allow sample to equilibrate at least 1/2 hour. If a milk sample is curdled or lumpy, vacuum filter the sample through a Buchner funnel using a cheesecloth filter. Wash the curd thoroughly with deionized water, collecting the washings with the filtrate. Pour the filtrate back into the original washed and labeled 4 liter beaker and discard the curd.
3. Add approximately 45 grams of Dowex 1X8 (20-50 mesh) anion resin to each sample beaker and stir on a magnetic stirrer for at least 1 hour. Turn off the stirrer and allow the resin to settle for 10 minutes.
4. Gently decant and discard the milk or water sample taking care to retain as much resin as possible in the beaker. Add approximately 1 liter of deionized water to rinse the resin, allow to settle 2 minutes, and pour off the rinse. Repeat rinsing in the case of milk samples until all traces of milk are removed from the resin.
5. Using a deionized water wash bottle, transfer the resin to the column marked with the sample number. Allow resin to settle 2 minutes and drain the standing water. Wash the resin with 100 mL of 2M NaCl.
6. Measure 50 mL 5% sodium hypochlorite in a graduated cylinder. Add sodium hypochlorite to column in 10-20 mL increments, stirring resin as needed to eliminate gas bubbles and maintain flow rate of 2 mL/min. Collect eluate in 250 mL beaker and discard the resin.

Part BIodine Extraction Procedure

1. Acidify the eluate from Step 6 using concentrated HNO_3 to make the sample 2-3 N in HNO_3 and transfer to 250 mL separatory funnel. (Add the acid slowly with stirring until the vigorous reaction subsides.) Volume of concentrated HNO_3 required will depend on eluate volume as follows:

<u>Eluate Volume</u> (mL)	<u>Concentrated HNO_3</u> (mL)
50-60	10
60-70	12
70-80	14
80-90	16

2. Add 50 mL of CHCl_3 and 10 mL of 1 M hydroxylamine hydrochloride (freshly prepared). Extract iodine into organic phase (about 2 minutes equilibration). Draw off the organic phase (lower phase) into another separatory funnel.
3. Add 25 mL of CHCl_3 and 5 mL of 1 M hydroxylamine hydrochloride to the first separatory funnel and again equilibrate for 2 minutes. Combine the organic phases. Discard the aqueous phase (Upper phase) if no other analyses are required. If Pu, U or Sr is required on the same sample aliquot, submit the aqueous phase and data sheet to the appropriate laboratory section.
4. Add 20 mL $\text{H}_2\text{O}-\text{HNO}_3-\text{NH}_2\text{OH HCl}$ wash solution to the separatory funnel containing the CHCl_3 . Equilibrate 2 minutes. Allow phases to separate and transfer CHCl_3 (lower phase) to a clean separatory funnel. Discard the wash solution.
5. Add 25 mL H_2O and 10 drops of 1 M sodium bisulfite (freshly prepared) to the separatory funnel containing the CHCl_3 . Equilibrate for 2 minutes. Discard the organic phase (lower phase). Drain aqueous phase (upper phase) into a 100 mL beaker. Proceed to the Precipitation of PdI_2 .

Part CPrecipitation of Palladium IodideCAUTION: AMMONIUM HYDROXIDE INTERFERES WITH THIS PROCEDURE

1. Add 10 mL of 3 N HCl to the aqueous phase from the iodine extraction procedure in Step 5.
2. Place the beaker on a stirrer-hot plate. Using the magnetic stirrer, boil and stir the sample until it evaporates to 30 mL or begins to turn yellow.
3. Turn the heat off. Remove the magnetic stirrer, rinse with deionized water.
4. Add, dropwise, to the solution, 2.0 mL of palladium chloride.
5. Cool the sample to room temperature. Place the beaker with sample on the stainless steel tray and put in the refrigerator overnight.
6. Weigh a clean 21 mm Whatman #42 filter which has been dried under a heat lamp.
7. Place the weighed filter in the filter holder. Filter the sample and wash the residue with water and then with absolute alcohol.
8. Remove filter from filter holder and place it in the labeled petri dish.
9. Dry under the lamp for 5-10 minutes. | 3
10. Weigh the filter with the precipitate.
11. Cut a 1-1/2" strip of polyester tape and lay it on a clean surface, gummed side up. Place the filter, precipitate side up, in the center of the tape.
12. Cut a 1-1/2" wide piece of mylar. Using a spatula to press it in place, put it directly over the precipitate and seal the edges to the polyester tape. Trim to about 5 mm from the edge of the filter with scissors.
13. Mount the sample on the plastic disc and write the sample number on the back side of the disc.
14. Count the sample on a proportional beta counter.

Calculations

Calculate the sample activity using computer program I131.

Part CPrecipitation of Palladium Iodide (continued)

I-131 concentration:

$$(pCi/l) = \frac{A}{2.22 \times B \times C \times D} \pm \frac{2 \sqrt{E_{sb}^2 + E_b^2}}{2.22 \times B \times C \times D}$$

where:

A = Net cpm, sample

B = Efficiency for counting beta I-131 (cpm/dpm)

C = Volume of sample (liters)

D = Correction for decay to the time of collection = $e^{-\lambda t} =$

$$\text{Exp}\left(-\frac{0.693 \times t}{8.04}\right) = e^{-0.0862t}$$

where t = elapsed time from the time of collection to the counting time (in days)

 E_{sb} = Counting error of sample plus background E_b = Counting error of background

Reference: "Determination of I-131 by Beta-Gamma coincidence Counting of PdI_2 ", Radiological Science Laboratory, Division of Laboratories and Research, New York State Department of Health, March 1975, Revised February 1977.

DETERMINATION OF AIRBORNE I-131 IN CHARCOAL CARTRIDGES
BY GAMMA SPECTROSCOPY

PROCEDURE NO. TIML-I-131-02

Prepared by

Teledyne Isotopes Midwest Laboratory

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<u>0</u>	<u>07-04-86</u>	<u>3</u>	<u><i>p. Job</i></u>	<u><i>L.H. Huchner</i></u>
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DETERMINATION OF AIRBORNE I-131 IN CHARCOAL CARTRIDGES
BY GAMMA SPECTROSCOPY

Principle of Method

Each charcoal cartridge is placed on the detector and counted. A peak of 0.36 MeV is used to calculate the concentration at counting time. The equilibrium concentration at the end of collection is then calculated. Decay correction between the end of collection period and the counting time is then made.

Materials

Charcoal Cartridges

Apparatus

Counting Container
Germanium Detector
Plastic Bags
Plastic Bag Sealer
Paper Tape
Scissors

Procedure

NOTE: Because of the short half-life of I-131, count the samples as soon as possible after receipt and no later than 48 hours.

1. Load the charcoal cartridges in a specially designed holder or transfer charcoal from each cartridge to individual plastic bags. Seal the bags.
2. Label each bag with corresponding project ID, locations ID, and date of collection.
3. Place the bags in a standard geometry container, cap the container and secure the cap with a tape.
4. Place the holder or container on the detector and count for a period of time that will meet the required Lower Limit of Detection (LLD).

Calculation:

$$A_1 = \text{I-131 activity (pCi/sample)} = \frac{A}{2.22 \times B} \quad (\text{at counting time}) \quad (1)$$

Where:

A = Net count rate of I-131 in the 0.36 MeV peak (cpm)

B = Efficiency for the I-131 in 0.36 MeV peak (cpm/dpm)

Correction for Equilibrium (assuming constant concentration over the sampling period) and Decay:

$$C = \frac{\lambda A_1 e^{\lambda t_1}}{F (1 - e^{-\lambda t_2})} \quad (2)$$

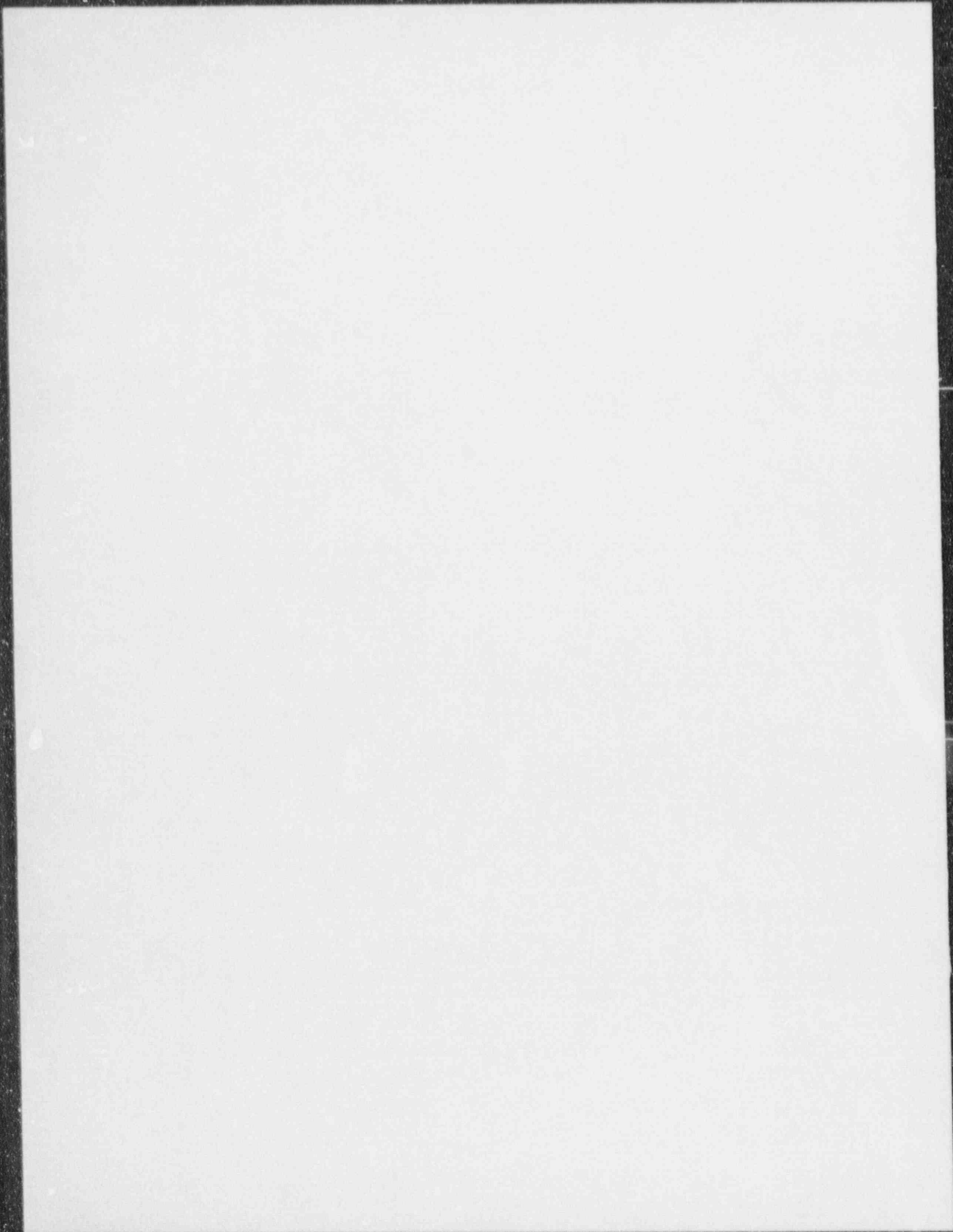
Where:

C = Equilibrium concentration of I-131 (pCi/m³)A₁ = Activity of I-131 at the time of counting (pCi/sample)

e = The base of the natural logarithm = 2.71828

 λ = 0.693/half life (days) = 0.693/8.04 = 0.0862/dayt₁ = Elapsed time between the end of sampling and mid-counting point (in days)t₂ = Duration of collection (in days)F = m³/day

 Reference: Radiation Safety Technician Training Course, Argonne National Laboratory, Section 14, pp. 361-364, May 1972.



PROCEDURE FOR COMPOSITING
WATER AND MILK SAMPLES

PROCEDURE NO. TIML-COMP-01

Prepared by
Teledyne Isotopes Midwest Laboratory

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_____	0	11-07-88	2	<i>J. Job</i>	<i>R. H. Hesse</i>
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TIML-CUMP-01

Procedure for Compositing Water and Milk Samples

1. At the beginning of each composite period, (month, quarter, semi-annual), prepare a one-gallon cubitainer for a specific location and time-period.
2. Remove an equal aliquot of original sample (for example, one liter) and transfer to prepared cubitainer. Do this for each week, month, etc. Mark date of original sample on prepared cubitainer.
3. When prepared container is complete, give the sample to the recording clerk for assigning a number.
4. Analyze according to the client requirement.

TIML-COMP-02