ENVIRONMENTAL MONITORING
TECHNICAL SPECIFICATION (5.9.4.b.)

January 1, 1988 to December 31, 1988

IE25
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5.9.4.b Radiological Environmental Operating Report

1(a) The number of sample locations, sample collection frequency and the number of samples collected this period for each class of sample is delineated in Table 1.

A complete summary of the program findings is presented in Table 2. For each type of analysis of each sampled medium this table considers separately all indicator locations, all control locations and the location with the highest annual mean result. For each of these classes, the table specifies the following:

(1) The total number of analyses.

(2) The fraction of these yielding detectable results (i.e., results above the highest lower limit of detection for the period).

(3) The average, lowest, and highest results.

In addition, the distance and direction relative to the Reactor Containment Building are specified for the location with the highest annual mean.

Table 3 is a listing of missed samples.

(b) Results obtained show background levels of radioactivity in the environmental samples collected in 1988. The residual effect of previous nuclear tests was detected in one silt sample (cesium-137). No station effect on the environment was indicate.

(c) See Appendix A for Interlaboratory Comparison, Appendix B is a description of the data reporting conventions for Appendix A.

(d) See Table 4 for land use survey.

(e) The limits of Technical Specification 2.1.3 were not exceeded by the primary coolant during the reporting period.

Table 1. Sample Collection Program.

Sample Class	Collection Frequency	Sample Locations	Number of Samples Collected This Period
Background Radiation (TLD)	Quarterly	Eleven (11)	42
Air Particulates	Weekly	Five (5)	261
Airborne Iodine	Weekly	Five (5)	261
Milk	Semimonthly	Two (2)	20
Surface Water	Monthly	Three (3)	36
Fish	Annually	Two (2)	5
Mud and Silt	Semiannually	One (1)	2
		TOTAL:	627

Table 2. Environmental Radiological Monitoring Program Summary.

Name of Facility Fort Calhoun Nuclear Power Station - Unit 1 Docket No. 50-285

Location of Facility Washington, Nebraska Reporting Period January - December, 1988
(County, State)

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F) Range[c]	Location with Highest Annual Mean		Control Locations Mean (F) Range	Number of Non-routine Results[e]
				Location[d]	Mean (F) Range		
Background Radiation (TLD) (mR/week)	Gamma 42	0.5	1.4 (38/38) (0.8-2.0)	OFA, Onsite Station No. 1	1.7 (4/4) (1.7-1.8)	1.6 (4/4) (1.1-1.8)	0
Airborne Particulates (pCi/m^3)	GB 261	0.01	0.024 (209/209) (0.004-0.064)	OAG, Onsite Station No. 2 0.6 mi SW of Reactor	0.025 (52/52) (0.009-0.058)	0.024 (52/52) (0.007-0.055)	0
	GS 61						
	Cs-134	0.007	<LLD	--	--	<LLD	0
	Cs-137	0.010	<LLD	--	--	<LLD	0
	Other gammas[f]	0.010	<LLD	--	--	<LLD	0
Airborne Iodine (pCi/m^3)	I-131 261	0.07[g]	<LLD	--	--	<LLD	0
Milk, Fresh (pCi/l)	I-131 20	0.5[h]	<LLD	--	--	<LLD	0
	GS 20						
	K-40	150	1300 (10/10) (1030-1410)	0-21, Japp Dairy 6.3 mi @ 219°	1380 (10/10) (1180-1530)	1380 (10/10) (1180-1530)	0
	Cs-134	15	<LLD	--	--	<LLD	0
	Cs-137	1	<LLD	--	--	<LLD	0
	Other gammas	15	<LLD	--	--	<LLD	0
Surface Water (pCi/l)	GS 36						
	Cs-134	15	<LLD	--	--	<LLD	0
	Cs-137	18	<LLD	--	--	<LLD	0
	Other Gammas	15	<LLD	--	--	<LLD	0
	H-3 36	300	<LLD	--	--	<LLD	0

Table 2. Environmental Radiological Monitoring Program Summary (continued)

Name of Facility Fort Calhoun Nuclear Power Station - Unit 1 Docket No. 50-285

Location of Facility Washington, Nebraska Reporting Period January - December, 1988
(County, State)

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F) Range[c]	Location with Highest Annual Mean		Control Locations Mean (F) Range	Number of Non-routine Results[e]
				Location[d]	Mean (F) Range		
Fish (pCi/g wet)	GS 5						
	Mn-54	0.039	<LLD	--	--	<LLD	0
	Co-58	0.054	<LLD	--	--	<LLD	0
	Co-60	0.032	<LLD	--	--	<LLD	0
	Zn-65	0.085	<LLD	--	--	<LLD	0
	Cs-134	0.031	<LLD	--	--	<LLD	0
	Cs-137	0.034	<LLD	--	--	<LLD	0
	Other Gammas	0.069	<LLD	--	--	<LLD	0
Mud and Silt (pCi/g dry)	GS 2						
	Cs-134	0.05	<LLD	--	--	None	0
	Cs-137	0.05	0.09 (1/2) -	0-13, Downstream 0.5 mi @ 106°	0.09 (1/2) -	None	0
	Other Gammas	0.05	<LLD	--	--	None	0

[a] GB = Gross beta; GS = Gamma scan.
[b] LLD = Lower limit of detection (based on 3 sigma error for background sample unless otherwise indicated).
[c] Mean and range are based on detectable measurements only (i.e., >LLD). Fraction of detectable measurements at specified locations is indicated in parentheses (F).
[d] Locations are specified: (1) by code, (2) by name, and (3) by distance and direction relative to Reactor Containment Building.
[e] Non-routine results are those which exceed ten times the control station value. If no control station value is available, the result is considered non-routine if it exceeds ten times the typical pre-operational value for the medium or location.
[f] Value given is for Ru-103.
[g] Six results (<0.223, <3.716, <0.435, <0.998, <0.124, and <2.252) are excluded from the determination of LLD. They resulted from low volume.
[h] Two results (<0.9 and <1.6) did not meet required LLD due to delay in analyses resulting from relocation of laboratory.

TABLE 3

LISTING OF MISSED SAMPLES

Sample Type	Location	Expected Collection Date	Reason
Well Water	OWW-A OWW-B OWW-C	1st Qtr. 1st Qtr. 1st Qtr.	No data available due to frozen pump.
Airborne Particulates	OAH	05-09-88	Pump switch left in "off" position.
TLD	OFD	2nd Qtr.	TLD missing due to vandalism.
TLD	OFK	4th Qtr.	TLD missing due to vandalism.
Well Water	OWW-A OWW-B OWW-C	4th Qtr. 4th Qtr. 4th Qtr.	No data available due to frozen pump.

Appendix A

Interlaboratory Comparison Program Results

NOTE: TIML participates in intercomparison studies administered by U.S. EPA Environmental Monitoring Systems Laboratory, Las Vegas, Nevada. The results are reported in Appendix A. Also reported are results of in-house spikes and blanks. Appendix A is updated twice a year and the complete Appendix is included in January and July monthly reports only. Please refer to January and July Reports for information.

January, 1989

Appendix A

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 concentrations 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 May 1984 through November, 1988. 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 (TLD's) during the period 1976, 1977, 1979, 1980, 1984, and 1985-1986 through participation in the Second, Third, Fourth, Fifth, Seventh, and Eighth International Intercomparison of Environmental Dosimeters under the sponsorships listed in Table A-2.

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, 1984 through 1988.[a]

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-358	Water	May 1984	Gr. alpha	3.0±0.6	3±5.0	0.0-11.7
			Gr. beta	6.7±1.2	6±5.0	0.0-14.7
STM-366	Milk	June 1984	Sr-89	21±3.1	25±5.0	16.3-33.7
			Sr-90	13±2.0	17±1.5	14.4-19.6
			I-131	46±5.3	43±6.0	32.6-53.4
			Cs-137	38±4.0	35±5.0	26.3-43.7
			K	1577±172	1496±75	1336-1626
STW-368	Water	July 1984	Gr. alpha	5.1±1.1	6±5.0	0.0-14.7
			Gr. beta	11.9±2.4	13±5.0	4.3-21.7
STW-369	Water	August 1984	I-131	34.3±5.0	34.0±6.0	23.6-44.4
STW-370	Water	August 1984	H-3	3003±253	2817±356	2200-3434
STF-371	Food	July 1984	Sr-89	22.0±5.3	25.0±5.0	14.3-33.7
			Sr-90	14.7±3.1	20.0±1.5	17.4-22.6
			I-131	<172	39.0±6.0	28.6-49.4
			Cs-137	24.0±5.3	25.0±5.0	14.3-33.7
			K	2503±132	2605±130	2379-2831
STAF-372	Air Filter	August 1984	Gr. alpha	15.3±1.2	17±5.0	8.3-25.7
			Gr. beta	56.0±0.0	51±5.0	42.3-59.7
			Sr-90	14.3±1.2	18±1.5	15.6-20.4
			Cs-137	21.0±2.0	15±5.0	6.3-23.7
STW-375	Water	Sept 1984	Ra-226	5.1±0.4	4.9±0.7	3.6-6.2
			Ra-228	2.2±0.1	2.3±0.4	1.7-2.9
STW-377	Water	Sept 1984	Gr. alpha	3.3±1.2	5.0±5.0	0.0-13.7
			Gr. beta	12.7±2.3	16.0±5.0	7.3-24.7
STW-379	Water	Oct 1984	H-3	2860±312	2810±205	2454-3166
STW-380	Water	Oct 1984	Cr-51	<36	40±5.0	31.3-48.7
			Co-60	20.3±1.2	20±5.0	11.3-28.7
			Zn-65	150±8.1	147±5.0	138.3-155.7
			Ru-106	<30	47±5.0	36.3-55.7
			Cs-134	31.3±7.0	31±5.0	22.3-39.7
			Cs-137	26.7±1.2	24±5.0	15.3-32.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STM-382	Milk	Oct 1984	Sr-89	15.7±4.2	22±5.0	13.3-30.7
			Sr-90	12.7±1.2	16±1.5	13.4-18.6
			I-131	41.7±3.1	42±6.0	31.6-42.4
			Cs-137	31.3±6.1	32±5.0	23.3-40.7
			K	1447±66	1517±76	1386-1648
STW-384	Water (Blind)	Oct 1984 Sample A	Gr. alpha	9.7±1.2	14±5.0	5.3-22.7
			Ra-226	3.3±0.2	3.0±0.5	2.2-3.8
			Ra-228	3.4±1.6	2.1±0.3	1.6-2.6
			Uranium	NA[e]	5.0±6.0	0.0-15.4
		Sample B	Gr. beta	48.3±5.0	64±5.0	55.3-72.7
			Sr-89	10.7±4.6	11±5.0	2.3-19.7
			Sr-90	7.3±1.2	12±1.5	9.4-14.6
			Co-60	16.3±1.2	14±5.0	5.3-22.7
			Cs-134	<2	2±5.0	0.0-10.7
			Cs-137	16.7±1.2	14±5.0	5.3-22.7
STAF-387	Air Filter	Nov 1984	Gr. alpha	18.7±1.2	15±5.0	6.3-23.7
			Gr. beta	59.0±5.3	52±5.0	43.3-60.7
			Sr-90	18.3±1.2	21±1.5	18.4-23.6
			Cs-137	10.3±1.2	10±5.0	1.3-18.7
STW-388	Water	Dec 1984	I-131	28.0±2.0	36±6.0	25.6-36.4
STW-389	Water	Dec 1984	H-3	3583±110	3182±360	2558-3806
STW-391	Water	Dec 1984	Ra-226	8.4±1.7	8.6±1.3	6.4-10.8
			Ra-228	3.1±0.2	4.1±0.6	3.0-5.2
STW-392	Water	Jan 1985	Sr-89	<3.0	3.0±5.0	0.0-11.7
			Sr-90	27.3±5.2	30.0±1.5	27.4-32.6
STW-393	Water	Jan 1985	Gr. alpha	3.3±1.2	5±5.0	0.0-13.7
			Gr. beta	17.3±3.0	15±5.0	6.3-23.7
STF-395	Food	Jan 1985	Gr. alpha	4.7±2.3	6.0±5.0	0.0-14.7
			Gr. beta	11.3±1.2	15.0±5.0	6.3-23.7
			Sr-89	25.3±6.4	34.0±5.0	25.3-42.8
			Sr-90	27.0±8.8	26.0±1.5	23.4-28.6
			I-131	38.0±2.0	35.0±6.0	24.6-45.4
			Cs-137	32.7±2.4	29.0±5.0	20.3-37.7
			K	1410±212	1382±120	1174-1590

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-397	Water	Feb 1985	Cr-51	<29	48±5.0	39.3-56.7
			Co-60	21.3±3.0	20±5.0	11.3-28.7
			Zn-65	53.7±5.0	55±5.0	46.3-63.7
			Ru-106	<23	25±5.0	16.3-33.7
			Cs-134	32.3±1.2	35±5.0	26.3-43.7
			Cs-137	25.3±3.0	25±5.0	16.3-33.7
STW-398	Water	Feb 1985	H-3	3869±319	3796±634	3162-4430
STM-400	Milk	March 1985	I-131	7.3±2.4	9.0±0.9	7.4-10.6
STW-402	Water	March 1985	Ra-226	4.6±0.6	5.0±0.8	3.7-6.3
			Ra-228	<0.8	9.0±1.4	6.7-11.3
		Reanalysis	Ra-228	9.0±0.4		
STW-404	Water	March 1985	Gr. alpha	4.7±2.3	6±5.0	0.0-14.7
			Gr. beta	11.3±1.2	15±5.0	6.3-23.7
STAF-405	Air Filter	March 1985	Gr. alpha	9.3±1.0	10.0±5.0	1.3-18.7
			Gr. beta	42.0±1.1	36.0±5.0	27.3-44.7
			Sr-90	13.3±1.0	15.0±1.5	12.4-17.6
			Cs-137	6.3±1.0	6.0±5.0	0.0-14.7
STW-407	Water	April 1985	I-131	8.0±0.0	7.5±0.8	6.2-8.8
STW-408	Water	April 1985	H-3	3399±150	3559±630	2929-4189
STW-409	Water	April 1985				
	(Blind) Sample A		Gr. alpha	29.7±1.8	32.0±5.0	23.3-40.7
			Ra-226	4.4±0.2	4.1±0.6	3.1-5.1
			Ra-228	NA[e]	6.2±0.9	4.6-7.8
			Uranium	NA[e]	7.0±6.0	0.0-17.4
	Sample B		Gr. beta	74.3±11.8	72.0±5.0	63.3-80.7
			Sr-89	12.3±7.6	10.0±5.0	1.3-18.7
			Sr-90	14.7±2.4	15.0±1.5	12.4-17.6
			Co-60	14.7±2.4	15.0±5.0	6.3-23.7
			Cs-134	12.0±2.0	15.0±5.0	6.3-23.7
			Cs-137	14.0±2.0	12.0±5.0	3.3-20.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	Control Limits
STW-413	Water	May 1985	Sr-89	36.0±12.4	39.0±5.0	30.3-47.7
			Sr-90	14.3±4.2	15.0±1.5	12.4-17.6
STW-414	Water	May 1985	Gr. alpha	8.3±4.1	12.0±5.0	3.3-20.7
			Gr. beta	8.7±1.2	11.0±5.0	2.3-19.7
STW-416	Water	June 1985	Cr-51	44.7±6.0	44.0±5.0	45.3-52.7
			Co-60	14.3±1.2	14.0±5.0	5.3-22.7
			Zn-65	50.3±7.0	47.0±5.0	38.3-55.7
			Ru-106	55.3±5.8	62.0±5.0	53.3-70.7
			Cs-134	32.7±1.2	35.0±5.0	26.3-43.7
			Cs-137	22.7±2.4	20.0±5.0	11.3-28.7
STW-418	Water	June 1985	H-3	2446±132	2416±351	1807-3025
STM-421	Milk	June 1985	Sr-89	10.3±4.6	11.0±5.0	2.3-19.7
			Sr-90	9.0±2.0	11.0±1.5	8.4-13.6
			I-131	11.7±1.2	11.0±6.0	0.6-21.4
			Cs-137	12.7±1.2	11.0±5.0	2.3-19.7
			K	1512±62	1525±132	1393-1657
STW-423	Water	July 1985	Gr. alpha	5.0±0.0	11.0±5.0	2.3-19.7
			Gr. beta	5.0±2.0	8.0±5.0	0.0-16.7
STW-425	Water	August 1985	I-131	25.7±3.0	33.0±6.0	22.6-43.4
STW-426	Water	August 1985	H-3	4363±83	4480±447	3704-5256
STAF-427	Air Filter	August 1985	Gr. alpha	11.3±0.6	13.0±5.0	4.3-21.7
			Gr. beta	46.0±1.0	44.0±5.0	35.3-52.7
			Sr-90	17.7±0.6	18.0±1.5	15.4-20.6
			Cs-137	10.3±0.6	8.0±5.0	0.0-16.7
STW-429	Water	Sept 1985	Sr-89	15.7±0.6	20.0±5.0	11.3-28.7
			Sr-90	7.0±0.0	7.0±1.5	4.4-9.6
STW-430	Water	Sept 1985	Ra-226	8.2±0.3	8.9±1.3	6.6-11.1
			Ra-228	4.1±0.3	4.6±0.7	3.4-5.8
STW-431	Water	Sept 1985	Gr. alpha	4.7±0.6	8.0±5.0	0.0-16.7
			Gr. beta	4.7±1.2	8.0±5.0	0.0-16.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-433	Water	Oct 1985	Cr-51	<13	21.0±5.0	12.3-29.7
			Co-60	19.3±0.6	20.0±5.0	11.3-28.7
			Zn-65	19.7±0.6	19.0±5.0	10.3-27.7
			Ru-106	<19	20.0±5.0	11.3-28.7
			Cs-134	17.0±1.0	20.0±5.0	11.3-28.7
			Cs-137	19.3±1.2	20.0±5.0	11.3-28.7
STW-435	Water	Oct 1985	H-3	1957±50	1974±345	1376-2572
STW-436 437	Water (Blind)	Oct 1985				
	Sample A		Gr. alpha	53.0±1.0	52.0±13	29.4-74.6
			Ra-226	5.9±0.1	6.3±1.0	4.1-7.9
			Ra-228	8.2±0.1	10.1±1.5	7.5-12.7
			Uranium	NA[e]	8.0±10.4	0.0-18.4
	Sample B		Gr. beta	85.7±2.5	75.0±5.0	76.3-83.7
			Sr-89	21.3±1.5	27.0±5.0	18.3-35.7
			Sr-90	10.3±0.6	9.0±1.5	6.4-11.6
			Co-60	18.3±1.2	18.0±5.0	9.3-26.7
			Cs-134	16.3±1.2	18.0±5.0	9.3-26.7
			Cs-137	19.0±1.0	18.0±5.0	9.3-26.7
STM-439	Milk	Oct 1985	Sr-89	50.3±0.6	48.0±5.0	39.3-56.7
			Sr-90	23.3±0.6	26.0±1.5	23.4-28.6
			I-131	45.7±3.2	42.0±6.0	31.6-52.4
			Cs-137	60.7±0.6	56.0±5.0	47.3-64.7
			K	1547±29	1540±77	1406-1674
STW-441	Water	Nov 1985	Gr. alpha	5.3±0.6	10.0±5.0	1.3-18.7
			Gr. beta	11.7±1.2	13.0±5.0	4.3-21.7
STW-443	Water	Dec 1985	I-131	46.7±2.1	45.0±6.0	34.6-55.4
STW-444	Water	Dec 1985	Ra-226	6.5±0.1	7.1±1.1	5.2-9.0
			Ra-228	6.1±0.1	7.3±1.1	5.4-9.2
STW-445	Water	Jan 1986	Sr-89	29.7±2.5	31.0±5.0	22.3-39.7
			Sr-90	13.7±0.6	15.0±1.5	12.4-17.6
STW-446	Water	Jan 1986	Gr. alpha	3.0±0.0	3.0±5.0	0.0-11.7
			Gr. beta	5.3±0.6	7.0±5.0	0.0-15.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	Control Limits
STF-447	Food	Jan 1986	Sr-89	24.3±2.5	25.0±5.0	16.3-33.7
			Sr-90	17.3±0.6	10.0±1.5	7.4-12.6
			I-131	22.7±2.3	20.0±6.0	9.6-30.4
			Cs-137	16.3±0.6	15.0±5.0	6.3-23.7
			K	927±46	950±144	701-1199
STW-448	Water	Feb 1986	Cr-51	45.0±3.6	38.0±5.0	29.3-46.7
			Co-60	19.7±1.5	18.0±5.0	9.3-26.7
			Zn-65	44.0±3.5	40.0±5.0	31.3-48.7
			Ru-106	<9.0	0.0±5.0	0.0-8.7
			Cs-134	28.3±2.3	30.0±5.0	21.3-38.7
			Cs-137	23.7±0.6	22.0±5.0	13.3-30.7
STW-449	Water	Feb 1986	H-3	5176±48	5227±525	4317-6137
STW-450	Water	Feb 1986	U total	8.0±0.0	9.0±6.0	0.0-19.4
STW-451	Milk	Feb 1986	I-131	7.0±0.0	9.0±6.0	0.0-19.4
STW-452	Water	March 1986	Ra-226	3.8±0.1	4.1±0.6	3.0-5.2
			Ra-228	11.0±0.5	12.4±1.8	9.2-15.5
STW-453	Water	March 1986	Gr. alpha	6.7±0.6	15.0±5.0	6.3-23.7
			Gr. beta	7.3±0.6	8.0±5.0	0.0-16.7
STW-454	Water	April 1986	I-131	7.0±0.0	9.0±6.0	0.0-19.4
STW-455 456	Water (Blind)	April 1986				
	Sample A		Gr. alpha	15.0±1.0	17.0±5.0	8.3-25.7
			Ra-226	3.1±0.1	2.9±0.4	2.1-3.7
			Ra-228	1.5±0.2	2.0±0.3	1.5-2.5
			Uranium	4.7±0.6	5.0±6.0	0.0-15.4
	Sample B		Gr. beta	28.7±1.2	35.0±5.0	26.3-43.7
			Sr-89	5.7±0.6	7.0±5.0	0.0-15.7
			Sr-90	7.0±0.0	7.0±1.5	4.4-9.6
			Co-60	10.7±1.5	10.0±5.0	1.3-18.7
			Cs-134	4.0±1.7	5.0±5.0	0.0-13.7
			Cs-137	5.3±0.6	5.0±5.0	0.0-13.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	Control Limits
STAF-457	Air Filter	April 1986	Gr. alpha	13.7±0.6	15.0±5.0	6.3-23.7
			Gr. beta	46.3±0.6	47.0±5.0	38.3-55.7
			Sr-90	14.7±0.6	18.0±1.5	15.4-20.6
			Cs-137	10.7±0.6	10.0±5.0	1.3-18.7
STU-458	Urine	April 1986	Tritium	4313±70	4423±189	4096-4750
STW-459	Water	May 1986	Sr-89	4.3±0.6	5.0±5.0	0.0-13.7
			Sr-90	5.0±0.0	5.0±1.5	2.4-7.6
STW-460	Water	May 1986	Gr. alpha	5.3±0.6	8.0±5.0	0.0-16.7
			Gr. beta	11.3±1.2	15.0±5.0	6.3-23.7
STW-461	Water	June 1986	Cr-51	<9.0	0.0±5.0	0.0-8.7
			Co-60	66.0±1.0	66.0±5.0	57.3-74.7
			Zn-65	87.3±1.5	86.0±5.0	77.3-94.7
			Ru-106	39.7±2.5	50.0±5.0	41.3-58.7
			Cs-134	49.3±2.5	49.0±5.0	40.3-57.7
			Cs-137	10.3±1.5	10.0±5.0	1.3-18.7
STW-462	Water	June 1986	Tritium	3427±25	3125±361	2499-3751
STM-464	Milk	June 1986	Sr-89	<1.0	0.0±5.0	0.0-8.7
			Sr-90	15.3±0.6	16.0±1.5	13.4-18.6
			I-131	48.3±2.3	41.0±6.0	30.6-51.4
			Cs-137	43.7±1.5	31.0±5.0	22.3-39.7
			K	1567±114	1600±80	1461-1739
STW-465	Water	July 1986	Gr. alpha	4.7±0.6	6.0±5.0	0.0-14.7
			Gr. beta	18.7±1.2	18.0±5.0	9.3-26.7
STW-467	Water	August 1986	I-131	30.3±0.6	45.0±6.0	34.4-55.4
STW-468	Water	August 1986	Pu-239	11.3±0.6	10.1±1.0	8.3-11.9
STW-469	Water	August 1986	Uranium	4.0±0.0	4.0±6.0	0.0-14.4
STAF-470 471 472	Air Filter	Sept 1986	Gr. alpha	19.3±1.5	22.0±5.0	13.3-30.7
			Gr. beta	64.0±2.6	66.0±5.0	57.3-74.7
			Sr-90	22.0±1.0	22.0±5.0	19.4-24.6
			Cs-137	25.7±1.5	22.0±5.0	13.3-30.7
STW-473	Water	Sept 1986	Ra-226	6.0±0.1	6.1±0.9	4.5-7.7
			Ra-228	8.7±1.1	9.1±1.4	6.7-11.5

Table A-1. (continued).

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	Control Limits
STW-474	Water	Sept 1986	Gr. alpha	16.3±3.2	15.0±5.0	6.3-23.7
			Gr. beta	9.0±1.0	8.0±5.0	0.0-16.7
STW-475	Water	Oct 1986	Cr-51	63.3±5.5	59.0±5.0	50.3-67.7
			Co-60	31.0±2.0	31.0±5.0	22.3-39.7
			Zn-65	87.3±5.9	85.0±5.0	76.3-93.7
			Ru-106	74.7±7.4	74.0±5.0	65.3-82.7
			Cs-134	25.7±0.6	28.0±5.0	19.3-36.7
			Cs-137	46.3±1.5	44.0±5.0	35.3-52.7
STW-476	Water	Oct 1986	H-3	5918±60	5973±597	4938-7008
SPW-477 478	Water (Blind)	Oct 1986				
	Sample A		Gr. alpha	34.0±6.0	40.0±5.0	31.3-48.7
			Ra-226	5.8±0.2	6.0±0.9	4.4-7.6
			Ra-228	2.7±1.0	5.0±0.8	3.7-6.3
			Uranium	11.0±0.0	10.0±6.0	0.0-20.4
	Sample B		Gr. beta	38.7±1.2	51.0±5.0	42.3-59.7
			Sr-89	5.0±0.0	10.0±5.0	1.3-18.7
			Sr-90	3.0±0.0	4.0±1.5	1.4-6.6
			Co-60	24.7±1.2	24.0±5.0	15.3-32.7
			Cs-134	11.0±2.0	12.0±5.0	3.3-20.7
			Cs-137	9.3±1.2	8.0±5.0	0.0-16.7
STM-479	Milk	Nov 1986	Sr-89	7.7±1.2	9.0±5.0	0.3-17.7
			Sr-90	1.0±0.0	0.0±1.5	0.0-2.6
			I-131	52.3±3.1	49.0±6.0	38.6-59.4
			Cs-137	45.7±3.1	39.0±5.0	30.3-47.7
			K	1489±104	1565±78	1430-1700
STU-480	Urine	Nov 1986	H-3	5540±26	5257±912	4345-6169
STW-481	Water	Nov 1986	Gr. alpha	12.0±4.0	20.0±5.0	11.3-28.7
			Gr. beta	20.0±3.5	20.0±5.0	11.3-28.7
STW-482	Water	Dec 1986	Ra-226	6.7±0.2	6.8±1.0	5.0-8.6
			Ra-228	5.2±0.2	11.1±1.7	8.2-14.0
STW-483	Water	Jan 1987	Sr-89	19.7±5.0	25.0±5.0	16.3-33.7
			Sr-90	21.0±2.0	25.0±1.5	22.4-27.6

Table A-1. (continued).

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	Control Limits
STW-484	Water	Jan 1987	Pu-239	17.0±2.3	16.7±1.7	13.8-19.6
STF-486	Food	Jan 1987	Sr-90	36.0±4.0	49.0±10.0	31.7-66.3
			I-131	78.0±3.4	78.0±8.0	64.1-91.9
			Cs-137	89.7±3.0	84.0±5.0	75.3-92.7
			K	942±56	980±49	895-1065
STF-487	Food (Blank)	Jan 1987	SR-90	2.0±0.0	---	
			I-131	<3	---	
			Cs-137	<2	---	
			K	993±102	---	
STW-488	Water	Feb 1987	Co-60	49.0±0.0	50.0±5.0	41.3-58.7
			Zn-65	96.0±7.2	91.0±5.0	82.3-99.7
			Ru-106	92.0±20.2	100.0±5.0	91.3-108.7
			Cs-134	53.0±3.4	59.0±5.0	50.3-67.7
			Cs-137	89.3±4.6	87.0±5.0	78.3-95.7
STW-489	Water	Feb 1987	H-3	4130±140	4209±420	3479-4939
STW-490	Water	Feb 1987	Uranium	8.3±1.2	8.0±6.0	0.0-18.4
STM-491	Milk	Feb 1987	I-131	10.0±0.0	9.0±0.9	7.4-10.6
STW-492	Water	Mar 1987	Gr. alpha	3.7±1.2	3.0±5.0	0.0-11.7
			Gr. beta	11.3±1.2	13.0±5.0	4.3-21.7
STW-493	Water	Mar 1987	Ra-226	7.0±0.1	7.3±1.1	5.4-9.2
			Ra-228	7.1±2.3	7.5±1.1	5.5-9.5
STW-494	Water	Apr 1987	I-131	8.0±0.0	7.0±0.7	5.8-8.2
STAF-495	Air Filter	Apr 1987	Gr. alpha	15.0±0.0	14.0±5.0	5.3-22.7
			Gr. beta	41.0±2.0	43.0±5.0	34.3-51.7
			Sr-90	16.3±1.2	17.0±1.5	14.4-19.6
			Cs-137	7.0±0.0	8.0±5.0	0.0-16.7
STW-496 497	Water (Blind)	Apr 1987				
	Sample A		Gr. alpha	30.7±1.2	30.0±8.0	16.1-43.9
			Ra-226	3.9±0.2	3.9±0.6	2.9-4.9
			Ra-228	4.9±0.9	4.0±0.6	3.0-5.0
			Uranium	5.0±0.0	5.0±6.0	0.0-15.4

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-496 497	Water (Blind)	Apr 1987				
	Sample B		Gr. Beta	69.3±9.4	66.0±5.0	57.3-74.7
			Sr-89	16.3±3.0	19.0±5.0	10.3-27.7
			Sr-90	10.0±0.0	10.0±1.5	7.4-12.6
			Co-60	8.3±3.0	8.0±5.0	0.0-16.7
			Cs-134	19.0±2.0	20.0±5.0	11.3-28.7
			Cs-137	14.7±1.2	15.0±5.0	6.3-23.7
STU-498	Urine	Apr 1987	H-3	6017±494	5620±795	4647-6593
STW-499	Water	May 1987	Sr-89	38.0±6.0	41.0±5.0	32.3-49.7
			Sr-90	21.0±2.0	20.0±1.5	17.4-22.6
STW-500	Water	May 1987	Gr. alpha	9.0±3.4	11.0±5.0	2.3-19.7
			Gr. beta	10.3±1.2	7.0±5.0	0.0-15.7
STW-501	Water	June 1987	Cr-51	40.0±8.0	41.0±5.0	32.3-49.7
			Co-60	60.3±3.0	64.0±5.0	55.3-72.7
			Zn-65	11.3±5.0	10.0±5.0	1.3-18.7
			Ru-106	78.3±6.4	75.0±5.0	66.3-83.7
			Cs-134	36.7±3.0	40.0±5.0	31.3-48.7
			Cs-137	80.3±4.2	80.0±5.0	71.3-88.7
STW-502	Water	June 1987	H-3	2906±86	2895±357	2277-3513
STW-503	Water	June 1987	Ra-226	6.9±0.1	7.3±1.1	5.4-9.2
			Ra-228	13.3±1.0	15.2±2.3	11.2-19.2
STM-504	Milk	June 1987	Sr-89	57.0±4.3	69.0±5.0	60.3-77.7
			Sr-90	32.0±1.0	35.0±1.5	32.4-37.6
			I-131	64.0±2.0	59.0±6.0	48.6-69.4
			Cs-137	77.7±0.6	74.0±5.0	65.3-82.7
			K	1383±17	1525±76	1393-1657
STW-505	Water	July 1987	Gr. alpha	2.3±0.7	5.0±5.0	0.0-13.7
			Gr. beta	4.0±1.0	5.0±5.0	0.0-13.7
STF-506	Food	July 1987	I-131	82.7±4.6	80.0±8.0	66.1-93.9
			Cs-137	53.7±3.0	50.0±5.0	41.3-58.7
			K	1548±57	1680±84	1534-1826
STW-507	Water	Aug 1987	I-131	45.7±4.2	48.0±6.0	37.6-58.4
STW-508	Water	Aug 1987	Pu-239	5.8±0.2	5.3±0.5	4.4-6.2

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-509	Water	Aug 1987	Uranium	13.3±0.3	13.0±6.0	2.6-23.4
STAF-510	Air Filter	Aug 1987	Gr. alpha	9.7±0.4	10.0±5.0	1.3-18.7
			Gr. beta	28.3±0.6	30.0±5.0	21.3-38.7
			Sr-90	10.0±0.9	10.0±1.5	7.4-12.6
			Cs-137	10.0±1.0	10.0±5.0	1.3-18.7
STW-511	Water	Sept 1987	Ra-226	9.9±0.1	9.7±1.5	7.2-12.2
			Ra-228	8.1±1.4	6.3±1.0	4.6-8.0
STW-512	Water	Sept 1987	Gr. alpha	2.0±0.6	4.0±5.0	0.0-12.7
			Gr. beta	11.3±1.3	12.0±5.0	3.3-20.7
STW-513	Water	Oct 1987	H-3	4473±100	4492±449	3714-5270
STW-514	Water (Blind)	Oct 1987				
	Sample A		Gr. alpha	29.3±2.6	28.0±7.0	15.9-40.1
			Ra-226	4.9±0.1	4.8±0.7	3.6-6.1
			Ra-228	4.2±1.0	3.6±0.5	2.7-4.5
			Uranium	3.0±0.1	3.0±6.0	0.0-13.4
	Sample B		Sr-89	14.3±1.3	16.0±5.0	7.3-24.7
			Sr-90	9.7±0.4	10.0±1.5	7.4-12.6
			Co-60	16.7±3.0	16.0±5.0	7.3-24.7
			Cs-134	16.7±2.3	16.0±5.0	7.3-24.7
			Cs-137	24.3±3.3	24.0±5.0	15.3-32.7
STW-516	Water	Oct 1987	Cr-51	80.3±17.5	70.0±5.0	61.3-78.7
			Co-60	16.0±2.3	15.0±5.0	6.3-23.7
			Zn-65	46.3±5.6	46.0±5.0	37.3-54.7
			Ru-106	57.3±15.4	61.0±5.0	52.3-69.7
			Cs-134	23.7±2.5	25.0±5.0	16.3-33.7
			Cs-137	51.7±3.2	51.0±5.0	42.3-59.7
STU-517	Urine	Nov 1987	H-3	7267±100	7432±743	6145-8719
STW-518	Water	Nov 1987	Gr. alpha	3.0±2.0	7.0±5.0	0.0-15.7
			Gr. beta	15.7±2.3	19.0±5.0	10.3-27.7
STW-519	Water	Dec 1987	I-131	26.0±3.0	26.0±6.0	15.6-36.4

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	Control Limits
STW-520	Water	Dec 1987	Ra-226	5.1±0.8	4.8±0.7	3.6-6.0
			Ra-228	3.4±0.1	5.3±0.8	3.9-6.7
STW-521	Water	Jan 1988	Sr-89	27.3±5.0	30.0±5.0	21.3-38.7
			Sr-90	15.3±1.2	15.0±1.5	12.4-17.6
STW-523	Water	Jan 1988	Gr. alpha	2.3±1.2	4.0±5.0	0.0-12.7
			Gr. beta	7.7±1.2	8.0±5.0	0.0-16.7
STF-524	Food	Jan 1988	Sr-89	44.0±4.0	46.0±5.0	37.3-54.7
			Sr-90	53.0±2.0	55.0±2.8	50.2-59.8
			I-131	102.3±4.2	102.0±10.2	84.3-119.7
			Cs-137	95.7±6.4	91.0±5.0	82.3-99.7
			K	1010.7±158.5	1230.0±61.5	1123.5-1336.5
STW-525	Water	Feb 1988	Co-60	69.3±2.3	69.0±5.0	60.3-77.7
			Zn-65	99.0±3.4	94.0±9.4	77.7-110.3
			Ru-106	92.7±14.4	105.0±10.5	86.8-123.2
			Cs-134	61.7±8.0	64.0±5.0	55.3-72.7
			Cs-137	99.7±3.0	94.0±5.0	85.3-102.7
STW-526	Water	Feb 1988	H-3	3453±103	3327±362	2700-3954
STW-527	Water	Feb 1988	Uranium	3.0±0.0	3.0±6.0	0.0-13.4
STM-538	Milk	Feb 1988	I-131	4.7±1.2	4.0±0.4	3.3-4.7
STW-529	Water	Mar 1988	Ra-226	7.1±0.6	7.6±1.1	5.6-9.6
			Ra-228	NA[e]	7.7±1.2	5.7-9.7
STW-530	Water	Mar 1988	Gr. alpha	4.3±1.2	6.0±5.0	0.0-14.7
			Gr. beta	13.3±1.3	13.0±5.0	4.3-21.7
STAF-531	Air Filter	Mar 1988	Gr. alpha	21.0±2.0	20.0±5.0	11.3-28.7
			Gr. beta	48.0±0.0	50.0±5.0	41.3-58.7
			Sr-90	16.7±1.2	17.0±1.5	14.4-19.6
			Cs-137	18.7±1.3	16.0±5.0	7.3-24.7
STW-532	Water	Apr 1988	I-131	9.0±2.0	7.5±0.8	6.2-8.8

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	Control Limits
STW-533 534	Water (Blind)	Apr 1988				
	Sample A		Gr. 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±0.0	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	June 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	June 1988	H-3	5586±92	5565±557	4600-6530
STM-541	Milk	June 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	1586.7±23.1	1600.0±80.0	1461.4-1738.6
STW-542	Water	July 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	July 1988	Sr-89	ND	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	1190.0±66.1	1240.0±62.0	1132.6-1347.4

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l[b] TIML Result ±2σ[c]	EPA Result[d] 1s, N=1	EPA Result[d] Control Limits
STW-544	Water	Aug 1988	I-131	80.0±0.0	76.0±8.0	62.1-89.9
STW-545	Water	Aug 1988	Pu-239	11.0±0.2	10.2±1.0	8.5-11.9
STW-546	Water	Aug 1988	Uranium	6.0±0.0	6.0±6.0	0.0-16.4
STAF-547	Air Filter	Aug 1988	Gr. alpha	8.0±0.0	8.0±5.0	0.0-16.7
			Gr. beta	26.3±1.2	29.0±5.0	20.3-37.7
			Sr-90	8.0±2.0	8.0±1.5	5.4-10.6
			Cs-137	13.0±2.0	12.0±5.0	3.3-20.7
STW-548	Water	Sep 1988	Ra-226	9.3±0.5	8.4±2.6	6.2-10.6
			Ra-228	5.8±0.4	5.4±1.6	4.0-6.8
STW-549	Water	Sep 1988	Gr. alpha	7.0±2.0	8.0±5.0	0.0-16.7
			Gr. beta	11.3±1.2	10.0±5.0	1.3-18.7
STW-550	Water	Oct 1988	Cr-51	252.0±14.0	251.0±25.0	207.7-294.3
			Co-60	26.0±2.0	25.0±5.0	16.3-33.7
			Zn-65	158.3±10.2	151.0±15.0	125.0-177.0
			Ru-106	153.0±9.2	152.0±15.0	126.0-178.0
			Cs-134	28.7±5.0	25.0±5.0	16.3-33.7
			Cs-137	16.3±1.2	15.0±5.0	6.3-23.7
STW-551	Water	Oct 1988	H-3	2333.3±127.0	2316.0±350.0	1709.8-2927.2
STU-555	Urine	Nov 1988	H-3	3030.0±208.8	3025.0±359.0	2403.2-3646.8
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

[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 the 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 the lab.

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

Lab Code	TLD Type	Measurement	mR: Teledyne Result ±2σ[a]	mR: Known Value[c]	mR: Average ±2 σ[d] (all participants)
2nd International Intercomparison[b]					
115-2	CaF_2:Mn Bulb	Field	17.0±1.9	17.1	16.4±7.7
		Lab	20.8±4.1	21.3	18.8±7.6
3rd International Intercomparison[e]					
115-3	CaF_2:Mn Bulb	Field	30.7±3.2	34.9±4.8	31.5±3.0
		Lab	89.6±6.4	91.7±14.6	86.2±24.0
4th International Intercomparison[f]					
115-4	CaF_2:Mn Bulb	Field	14.1±1.1	14.1±1.4	16.0±9.0
		Lab (Low)	9.3±1.3	12.2±2.4	12.0±7.6
		Lab (High)	40.4±1.4	45.8±9.2	43.9±13.2
5th International Intercomparison[g]					
115-5A	CaF_2:Mn Bulb	Field	31.4±1.8	30.0±6.0	30.2±14.6
		Lab at beginning	77.4±5.8	75.2±7.6	75.8±40.4
		Lab at end	96.6±5.8	88.4±8.8	90.7±31.2

Table A-2. (Continued)

Lab Code	TLD Type	Measurement	mR		
			Teledyne Result ±2σ[a]	Known Value[c]	Average ±2σ [d] (all participants)
115-5B	LiF-100 Chips	Field	30.3±4.8	30.0±6.0	30.2±14.6
		Lab at beginning	81.1±7.4	75.2±7.6	75.8±40.4
		Lab at the end	85.4±11.7	88.4±8.8	90.7±31.2
7th International Intercomparison[h]					
115-7A	LiF-100 Chips	Field	75.4±2.6	75.8±6.0	75.1±29.8
		Lab (Co-60)	80.0±3.5	79.9±4.0	77.9±27.6
		Lab (Cs-137)	66.6±2.5	75.0±3.8	73.0±22.2
115-7B	CaF_2:Mn Bulbs	Field	71.5±2.6	75.8±6.0	75.1±29.8
		Lab (Co-60)	84.8±6.4	79.9±4.0	77.9±27.6
		Lab (Cs-137)	78.8±1.6	75.0±3.8	73.0±22.2
115-7C	$CaSO_4$:Dy Cards	Field	76.8±2.7	75.8±6.0	75.1±29.8
		Lab (Co-60)	82.5±3.7	79.9±4.0	77.9±27.6
		Lab (Cs-137	79.0±3.2	75.0±3.8	73.0±22.2

Table A-2. (Continued)

Lab Code	TLD Type	Measurement	mR: Teledyne Result ±2σ[a]	mR: Known Value[c]	mR: Average ±2σ[d] (all participants)
8th International Intercomparison[i]					
115-8A	LiF-100 Chips	Field Site 1	29.5±1.4	29.7±1.5	28.9±12.4
		Field Site 2	11.3±0.8	10.4±0.5	10.1±9.06
		Lab (Cs-137)	13.7±0.9	17.2±0.9	16.2±6.8
115-8B	CaF_2:Mn Bulbs	Field Site 1	32.3±1.2	29.7±1.5	28.9±12.4
		Field Site 2	9.0±1.0	10.4±0.5	10.1±9.0
		Lab (Cs-137)	15.8±0.9	17.2±0.9	16.2±6.8
115-8C	$CaSO_4$:Dy Cards	Field Site 1	32.3±0.7	29.7±1.5	28.9±12.4
		Field Site 2	10.6±0.6	10.4±0.5	10.1±9.0
		Lab (Cs-137	18.1±0.8	17.2±0.9	16.2±6.8

[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 (GASL), 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 Dosimeter 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.

Table A-3. In-house spiked samples.

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l TIML Result n=3	Known Activity	Expected Precision 1s, n=3[a]
QC-MI-6	Milk	Feb. 1986	Sr-89	6.0±1.9	6.4±3.0	8.7
			Sr-90	14.2±1.7	12.9±2.0	5.2
			I-131	34.2±3.8	35.2±3.5	10.4
			Cs-134	32.0±1.8	27.3±5.0	8.7
			Cs-137	35.8±2.1	35.0±5.0	8.7
QC-W-14	Water	Mar. 1986	Sr-89	1.5±0.4	1.6±1.0	7.1
			Sr-90	2.4±0.2	2.4±2.0	4.2
QC-W-15	Water	Apr. 1986	I-131	44.9±2.4	41.5±7.0	10.6
			Co-60	10.6±1.7	12.1±5.0	7.1[b]
			Cs-134	30.2±2.4	25.8±8.0	7.1[b]
			Cs-137	21.9±1.9	19.9±5.0	7.1[b]
QC-MI-7	Milk	Apr. 1986	I-131	39.7±3.3	41.5±7.0	10.4
			Cs-134	28.7±2.8	25.8±8.0	8.7
			Cs-137	21.2±2.8	19.9±5.0	8.7
SPW-1	Water	May 1986	Gross alpha	15.8±1.8	18.0±5.0	5[c]
QC-W-16	Water	June 1986	Gross alpha	16.2±0.7	16.9±2.5	8.7
			Gross beta	38.4±3.5	30.2±5.0	8.7
QC-MI-9	Milk	June 1986	Sr-89	<1.0	0.0	7.1[b]
			Sr-90	12.6±1.8	13.3±3.0	4.2[b]
			I-131	38.9±7.0	34.8±7.0	10.4
			Cs-134	33.0±3.4	36.1±5.0	8.7
			Cs-137	38.5±2.8	39.0±5.0	8.7
SPW-2	Water	June 1986	Gross alpha	16.8±1.8	18.0±5.0	5[c]
SPW-3	Water	June 1986	Gross alpha	17.7±0.8	18.0±5.0	5[c]
QC-W-18	Water	Sep. 1986	Cs-134	34.7±5.6	31.3±5.0	8.7
			Cs-137	51.1±7.0	43.3±8.0	8.7
QC-W-19	Water	Sep. 1986	Sr-89	13.6±4.1	15.6±3.5	7.1[b]
			Sr-90	6.4±1.6	6.2±2.0	4.2[b]

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l TIML Result n=3	Known Activity	Expected Precision 1s, n=3[a]
QC-W-21	Water	Oct. 1986	Co-60	19.2±2.2	18.5±3.0	8.7
			Cs-134	31.7±5.2	25.6±8.0	8.7
			Cs-137	23.8±1.0	21.6±5.0	8.7
QC-MI-11	Milk	Oct 1986	Sr-89	12.3±1.8	14.3±3.0	8.7
QC-W-20	Water	Nov. 1986	H-3	3855±180	3960±350	520[b]
QC-W-22	Water	Dec. 1986	Gross alpha	9.8±1.4	11.2±4.0	8.7
			Gross beta	21.7±2.0	23.8±5.0	8.7
QC-W-23	Water	Jan. 1987	I-131	29.8±2.5	27.9±3.0	10.4
QC-MI-12	Milk	Jan. 1987	I-131	36.5±1.3	32.6±5.0	10.4
			Cs-137	32.6±4.2	27.4±8.0	8.7
SPM-13	Milk	Jan 1987	Sr-89	10.4±2.1	12.2±4.0	8.7
			Sr-90	14.6±1.6	12.6±3.0	5.2
			I-131	49.5±1.2	54.9±8.0	10.4
			Cs-134	<1.6	0.0	8.7
			Cs-137	33.3±0.6	27.4±8.0	8.7
SPW-24	Water	Mar 1987	Sr-89	24.7±3.6	25.9±5.0	8.7
			Sr-90	23.9±3.8	22.8±8.0	5.2
SPW-25	Water	Apr 1987	I-131	28.0±1.9	29.3±5.0	10.6
SPM-14	Milk	Apr 1987	I-131	25.0±2.2	23.9±5.0	10.4
			Cs-134	<2.1	0.0	8.7
			Cs-137	34.2±2.0	27.2±7.0	8.7
SPW-26	Water	Jun 1987	H-3	3422±100	3362±300	520
			Co-60	24.8±1.4	26.5±7.0	8.7
			Cs-134	<2.0	0.0	8.7
			Cs-137	21.2±0.5	21.6±7.0	8.7
SPW-27	Water	Jun 1987	Gr. alpha	8.5±1.3	10.1±4.0	8.7
			Gr. beta	22.6±1.9	21.2±5.0	8.7
SPW-28	Water	Jun 1987	Gr. alpha	8.7±1.3	10.1±4.0	8.7
			Gr. beta	12.2±5.2	9.4±3.0	8.7

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l TIML Result n=3	Known Activity	Expected Precision 1s, n=3[a]
SPW-29	Water	Jun 1987	Gr. alpha	16.4±1.3	18.9±5.0	8.7
			Gr. beta	15.9±4.0	11.8±4.0	8.7
SPM-15	Milk	Jul 1987	Sr-89	19.4±1.6	18.8±3.5	5.2
			I-131	43.5±0.7	45.3±7.0	10.4
			Cs-134	17.9±2.2	16.0±5.3	8.7
			Cs-137	25.4±1.8	22.7±5.0	8.7
SPW-30	Water	Sep 1987	Sr-89	17.5±3.0	14.3±5.0	8.7
			Sr-90	18.4±2.2	17.5±2.2	5.2
SPW-31	Water	Oct 1987	H-3	2053±939	2059±306	520
SPW-32	Water	Dec 1987	Gr. alpha	8.6±1.0	10.1±5.0	8.7
			Gr. beta	15.2±0.1	13.1±3.0	8.7
SPW-33	Water	Dec 1987	Gr. alpha	7.7±1.4	10.1±5.0	8.7
			Gr. beta	10.9±1.0	7.9±3.0	8.7
SPW-34	Water	Dec 1987	Gr. alpha	4.0±0.9	5.1±3.0	8.7
			Gr. beta	9.4±0.9	7.9±3.0	8.7
SPM-16	Milk	Jan 1988	Sr-89	31.7±6.0	31.8±4.7	8.7
			Sr-90	27.8±3.5	25.5±2.7	8.7
			I-131	23.2±5.0	26.4±0.5	10.4
			Cs-134	24.2±6.0	23.8±2.3	8.7
			Cs-137	25.1±6.0	26.5±0.8	8.7
SPM-17	Milk	Feb 1988	I-131	10.6±1.2	14.3±1.6	10.4
SPW-35	Water	Feb 1988	I-131	9.7±1.1	11.6±1.1	10.4
SPW-36	Water	Feb 1988	I-131	10.5±1.3	11.6±1.0	10.4
SPW-37	Water	Mar 1988	Sr-89	19.8±8.0	17.1±2.0	8.7
			Sr-90	17.3±5.0	18.7±0.9	5.2
SPM-18	Milk	Apr 1988	I-131	26.7±5.0	33.2±2.3	10.4
			Cs-134	30.2±5.0	31.3±2.1	8.7
			Cs-137	26.2±5.0	29.9±1.4	8.7

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l TIML Result n=3	Known Activity	Expected Precision 1s, n=3[a]
SPW-38	Water	Apr 1988	I-131	14.2±5.0	17.1±1.1	10.4
SPW-39	Water	Apr 1988	H-3	4176±500	4439±31	724
SPW-40	Water	Apr 1988	Co-60	26.1±4.0	23.7±0.5	8.7
			Cs-134	29.2±4.5	25.4±2.6	8.7
			Cs-137	26.2±4.0	26.6±2.3	8.7
SPW-41	Water	Jun 1988	Gr. alpha	13.1±5.0	12.3±0.4	8.7
			Gr. beta	20.1±5.0	22.6±1.0	8.7
SPS-42	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	8.7
			I-131	88.4±4.9	86.6±8.0	10.4
			Cs-137	22.7±0.8	20.8±6.0	8.7
SPW-43	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
SPW-44	Water	Oct 1988	Co-60	20.9±3.2	21.4±3.5	8.7
			Cs-134	38.7±1.6	33.0±6.0	8.7
			Cs-137	19.0±2.4	21.0±3.5	8.7
SPW-45	Water	Oct 1988	I-131	22.2±0.6	23.3±3.5	10.4
SPW-46	Water	Oct 1988	H-3	4109±43	4153±500	724
SPS-46	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
SPW-47	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

[a] n=3 unless noted otherwise.
[b] n=2.
[c] n=1.

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l Results (4.66σ)	Concentration in pCi/l Acceptance Criteria (4.66σ)
BL-1	D.I. Water	Nov. 1985	Gross alpha	<0.1	<1
			Gross beta	<0.4	<4
BL-2	D.I. Water	Nov. 1985	Cs-137 (gamma)	<1.9	<10
BL-3	D.I. Water	Nov. 1985	Sr-89	<0.5	<5
			Sr-90	<0.6	<1
BL-5	D.I. Water	Nov. 1985	Ra-226	<0.4	<1
			Ra-228	<0.4	<1
SPW-2265	D.I. Water	Apr. 1985	Gross alpha	<0.6	<1
			Gross beta	<2.2	<4
			Sr-89	<0.2	<5
			Sr-90	<0.4	<1
			I-131	<0.2	<1
			Cs-137 (gamma)	<7.4	<10
BL-6	D.I. Water	Apr. 1986	Gross alpha	<0.4	<1
BL-7	D.I. Water	Apr. 1986	Gross alpha	<0.4	<1
BL-8	D.I. Water	June 1986	Gross alpha	<0.4	<1
BL-9	D.I. Water	June 1986	Gross alpha	<0.3	<1
SPW-3185	D.I. Water	Jan 1987	Ra-226	<0.1	<1
			Ra-228	<0.9	<1
SPS-3292	Milk	Jan 1987	I-131	<0.1	<1
			Cs-134	<6.2	<10
			Cs-137	<6.4	<10
SPW-3554	D.I. Water	Feb 1987	H-3	<180	<300
			Gross beta	<2.6	<4
SPS-3555	Milk	Feb 1987	Sr-89	<0.6	<5
			Sr-90	1.9±0.4[a]	<1
SPS-3731	Milk	Mar 1987	Cs-134	<2.2	<10
			Cs-137	<2.5	<10

[a] Low level (1 - 4 pCi/l) of Sr-90 concentration in milk is not unusual.

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l Results (4.66σ)	Concentration in pCi/l Acceptance Criteria (4.66σ)
SPS-3732	D.I. Water	Mar 1987	Sr-89	<0.9	<5
			Sr-90	<0.8	<1
			I-131	<0.3	<1
			Co-60	<2.3	<10
			Cs-134 (gamma)	<2.2	<10
			Cs-137 (gamma)	<2.4	<10
			Ra-226	<0.1	<1
			Ra-228	<1.0	<1
			Np-237	<0.04	<1
			Th-230	<0.05	<0.1
			Th-232	<0.02	<0.1
			U-234	<0.05	<0.1
			U-235	<0.03	<0.1
			U-238	<0.03	<0.1
SPS-4023	Milk	May 1987	I-131	<0.1	<1
SPS-4203	D.I. Water	May 1987	Gross alpha	<0.7	<1
			Gross beta	<1.7	<4
SPS-4204	Milk	May 1987	Sr-89	<0.5	<5
			Sr-90	2.4±0.6[a]	<1
SPS-4390	Milk	Jun 1987	Cs-134	<4.7	<10
			Cs-137	<5.2	<10
SPS-4391	D.I. Water	Jun 1987	Sr-89	<0.4	<5
			Sr-90	<0.4	<1
			I-121	<0.1	<1
			Co-60	<3.8	<10
			Cs-137	<5.7	<10
			Ra-226	<0.1	<1
			Ra-228	<0.9	<1
SPW-4627	D.I. Water	Aug 1987	Gross alpha	<0.5	<1
			Gross beta	<1.4	<4
			Tritium	<150	
SPS-4628	Milk	Aug 1987	Sr-89	<0.6	<5
			Sr-90	2.4±0.6[a]	<1
SPS-4847	Milk	Sep 1987	Cs-134	<4.4	<10
			Cs-137	<5.3	<10

[a] Low level (1 - 4 pCi/l) of Sr-90 concentration in milk is not unusual.

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l Results (4.66σ)	Concentration in pCi/l Acceptance Criteria (4.66σ)
SPS-4848	D.I. Water	Sep 1987	I-131	<0.2	<1
SPW-4849	D.I. Water	Sep 1987	Co-60	<4.1	<10
			Cs-134	<4.8	<10
			Cs-137	<4.0	<10
			Sr-89	<0.7	<5
			Sr-90	<0.7	<1
SPW-4850	D.I. Water	Sep 1987	Th-228	<0.04	<1
			Th-232	<0.8	<1
			U-234	<0.03	<1
			U-235	<0.03	<1
			U-238	<0.02	<1
			Am-241	<0.06	<1
			Cm-242	<0.04	<1
			Ra-226	<0.1	<1
			Ra-228	<1.0	<2
SPW-4859	D.I. Water	Oct 1987	Fe-55	<0.5	<1
SPS-5348	Milk	Dec 1987	Cs-134	<2.3	<10
			Cs-137	<2.5	<10
SPW-5384	D.I. Water	Dec 1987	Co-60	2.8	<10
			Cs-134	<2.6	<10
			Cs-137	<2.8	<10
			I-131	<0.2	<1
			Ra-226	<0.1	<1
			Ra-228	<1.2	<2
			Sr-89	<0.5	<1
			Sr-90	<0.4	<1
SPW-5385	D.I. Water	Nov 1987	Gr. alpha	<0.4	<1
			Gr. beta	<2.2	<4
			Fe-55	<0.3	<1
SPS-5386	Milk	Jan 1988	I-131	<0.1	<1
SPW-5448	"Dead" Water	Jan 1988	H-3	<177	<300

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l Results (4.66)	Concentration in pCi/l Acceptance Criteria (4.66)
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-242	<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[a]	<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
SPW-6625	Water	Dec 1988	Gr. alpha	<0.7	<1
			Gr. beta	<1.9	<4

[a] Low level (1 - 4 pCi/l) of Sr-90 concentration in milk 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 of 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, Radium-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-63[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	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 Comparison Program starting January 1987.

Lab Code	Analysis	TIML Result	EPA Control Limit	Explanation
STM-504	Sr-89 Sr-90	57.0±4.3 32.0±1.0	60.3-77.7 32.4-37.6	Milk had high fat content which made analyses difficult. Addition of errors to TIML result would put values within EPA control limits. EPA also had the same problem in analyzing its own sample.
STW-511	Ra-228	8.1±1.4	4.6-8.0	TIML results are usually within EPA control limits. Analysis of the next sample was within EPA control limits. No further action is planned.
STW-516	Cr-51	80.3±17.5	61.3-78.7	Results in the past have been within EPA control limits and TIML will monitor the situation in the future.
STF-524	K	1010.7±158.5	1123.5-1336.5	Error in transferrance of data. Correct data was 1105±33. 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	6.2-8.3	Sample recounted after 12 days. The average result was 8.8±1.7 (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.

Appendix B

Data Reporting Conventions

Data Reporting Conventions

1.0. All activities, except gross alpha and gross beta, are decay corrected to collection time or the end of the collection period.

2.0. Single Measurements

Each single measurement is reported as follows:

$$x \pm s$$

where x = value of the measurement;

$s = 2\sigma$ counting uncertainty (corresponding to the 95% confidence level).

In cases where the activity is found to be below the lower limit of detection L it is reported as

$$<L$$

where L = is the lower limit of detection based on 4.66σ uncertainty for a background sample.

3.0. Duplicate Analyses

3.1. Individual results: $x_1 \pm s_1$
$x_2 \pm s_2$

Reported result: $x \pm s$

where $x = (1/2)\ (x_1 + x_2)$

$$s = (1/2)\sqrt{s_1^2 + s_2^2}$$

3.2. Individual results: $<L_1$

$<L_2$

Reported result: $<L$

where L = lower of L_1 and L_2

3.3. Individual results: $x \pm s$

$<L$

Reported result: $x \pm s$ if $x \geq L$;

$<L$ otherwise

4.0. Computation of Averages and Standard Deviations

4.1 Averages and standard deviations listed in the tables are computed from all of the individual measurements over the period averaged; for example, an annual standard deviation would not be the average of quarterly standard deviations. The average $\bar{x}$ and standard deviation(s) of a set of n numbers $x_1, x_2, \ldots x_n$ are defined as follows:

$$\bar{x} = \frac{1}{n} \Sigma x$$

$$s = \sqrt{\frac{\Sigma (x-\bar{x})^2}{n-1}}$$

4.2 Values below the highest lower limit of detection are not included in the average.

4.3 If all of the values in the averaging group are less than the highest LLD, the highest LLD is reported.

4.4 If all but one of the values are less than the highest LLD, the single value x and associated two sigma error is reported.

4.5. In rounding off, the following rules are followed:

4.5.1. If the figure following those to be retained is less than 5, the figure is dropped, and the retained figures are kept unchanged. As an example, 11.443 is rounded off to 11.44.

4.5.2 If the figure following those to be retained is greater than 5, the figure is dropped, and the last retained figure is raised by 1. As an example, 11.446 is rounded off to 11.45.

4.5.3. If the figure following those to be retained is 5, and if there are no figures other than zeros beyond the five, the figure 5 is dropped, and the last-place figure retained is increased by one if it is an odd number or it is kept unchanged if an even number. As an example, 11.435 is rounded off to 11.44, while 11.425 is rounded off to 11.42.

Table 4

Environmental Radiological Monitoring - Land Use Survey

Sector	Date/Time	Location (One nearest to Plant Site)	Distance/Azimuth	*Within One Mile Radius (✓)	**Within One to Five Mile Radius (✓)	Breed/Number of Milk Animals	Remarks
A	6-10-88/0830	Brewer	7376 meters/349°30'	NA	✓	NA	Has Veg Garden
B	6-10-88/0900	Rand	3085 meters/11°35'	NA	✓	NA	Has Veg Garden
C	6-10-88/1000	Robbins	2454 meters/41°00'	NA	✓	NA	NA
		Salter	5438 meters/45°00'	NA	✓	NA	Has Veg Garden
D	6-10-88/1030	Meade	7759 meters/64°00'	NA	✓	NA	Has Veg Garden
E	6-10-88/1115	Crispin	7549 meters/89°00'	NA	✓	NA	Has Veg Garden
F	6-10-88/1145	Seitz	6753 meters/121°10'	NA	Note***	NA	Garden Possible
		Taylo	8104 meters/106°30'	NA	✓	NA	Has Veg Garden
G	6-10-88/1300	Welchert	2723 meters/138°00'	NA	✓	NA	Has Veg Garden
		Barnes	7644 meters/134°00'	NA	✓	NA	Has Beef Cattle
H	6-10-88/1330	Pechnik	1437 meters/164°45'	✓	NA	NA	
		Valnion	1465 meters/163°00'	✓	NA	NA	Has Veg Garden
J	6-10-88/1345	Ellis	1189 meters/180°25'	✓	NA	NA	Has Veg Garden
K	6-10-88/1415	Booze	1045 meters/204°20'	✓	NA	NA	
		Miller	1125 meters/193°45'	✓	NA	NA	Has Veg Garden
L	6-10-88/1430	Whittle	1205 meters/232°45'	✓	NA	NA	
		Ryder	1360 meters/226°15'	✓	NA	NA	Has Veg Garden
M	6-10-88/1445	Rouse	1676 meters/256°00'	NA	✓	NA	Has Veg Garden
N	6-10-88/1500	Nielsen	1925 meters/262°15'	NA	✓	NA	Has Veg Garden
P	6-10-88/1530	Shroeder	3226 meters/294°00'	NA	✓	NA	Has Veg Garden
Q	6-10-88/1615	Hansen	3947 meters/318°00'	NA	✓	NA	Has Veg Garden
R	6-10-88/1645	Mencke	3294 meters/329°80'	NA	✓	NA	Has Veg Garden

NOTE: *Within one mile radius from plant: door to door or equivalent counting technique.

**Within one to five mile radius from plant: county agricultural references or equivalent accounting sources.

(Reference Technical Specification 3.11 for further survey details)

***Seitz, a resident in Sector F, said he might plant a garden at a later date, but currently did not have one.

Omaha Public Power District
1623 Harney Omaha, Nebraska 68102-2247
402/536-4000

April 28, 1989
LIC-89-387

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station P1-137
Washington, DC 20555

Reference: Docket No. 50-285

Gentlemen:

SUBJECT: Radiological Environmental Operating Report for 1988

Please find enclosed one (1) copy of the Radiological Environmental Operating Report, containing the data taken in the radiological environmental monitoring program, in accordance with the ODCM for the period January 1, 1988 to December 31, 1988. The report is submitted in accordance with the Fort Calhoun Station Technical Specifications 5.9.4.b Radiological Environmental Operating Reports.

Sincerely,

for K. J. Morris
Division Manager
Nuclear Operations

KJM/jak

Attachments

c: LeBoeuf, Lamb, Leiby & MacRae
R. D. Martin, NRC Regional Administrator
P. D. Milano, NRC Project Manager
P. H. Harrell, NRC Senior Resident Inspector
American Nuclear Insurers
Roger Cochran, University of Iowa Hygienic Lab

		Ltr	Encl
Add:	NRR/DREP/DIR OE	1	0
	NRR/PMAS/PMSB	1	1
	OC/LFMB	1	0
IE25	OGC	1	0
1/1			