



MIDWEST LABORATORY

1508 FRONTAGE RD.

NORTHBROOK, IL 60062-4197

(312) 564-0700

MONTHLY PROGRESS REPORT
TO
CONSUMERS POWER COMPANY
JACKSON, MICHIGAN

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
FOR
BIG ROCK POINT NUCLEAR GENERATING PLANT

PREPARED AND SUBMITTED
BY
TELEDYNE ISOTOPES MIDWEST LABORATORY

Project No: 8022

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Approved by:

L. G. Huebner
L. G. Huebner
General Manager

Date

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Distribution: T. P. Neal (1 copy)
R. L. Burdette (1 copy)

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BIG ROCK POINT

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^a Numbers are given only to tables presented in this report. Other tables will be added in later reports.

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1.0 INTRODUCTION

The following constitutes the current Monthly Progress Report for the Radiological Environmental Monitoring Program conducted at the Big Rock Point Nuclear Generating Plant, Big Rock, Michigan. Results of completed analyses are presented in the attached tables. Missing entries indicate analyses that are not completed and the results will appear in subsequent reports.

Data obtained in the program are well within the ranges previously encountered in the program and to be expected in the environmental media sampled.

None of the media sampled this month contained radioactivity attributable to the operation of Big Rock Nuclear Generating Plant.

For all gamma isotopic analyses, spectrum is computer scanned from 80 to 2048 KeV. Specifically included are Mn-54, Co-58, Fe-59, Co-60, Zn-65, Zr-95, Nb-95, I-131, Ba-La-140, Cs-134, and Cs-137. Naturally-occurring gamma-emitters, such as K-40 and Ra daughters, are frequently detected but not listed here. Data listed as "<" are at the 4.66 sigma level, others are 2 sigma.

All concentrations, except gross beta, are decay corrected to the time of collection.

Deviations from Scheduled Sampling

All samples were collected within the scheduled period unless noted otherwise in the Listing of Missed Samples.

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2.0 LISTING OF MISSED SAMPLES

Sample Type	Location	Expected Collection Date	Reason
TLD	BRP-08	03-05-87	Lost in the field.
TLD	BRP-09	05-07-87	Lost in the field.

NOTE: Page 3 is intentionally left out.

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Table 1. Airborne Particulates and Iodine-131
Collection: Weekly
Units: pCi/m³

Collection Date	ST-BIG ROCK POINT (1)			NM-NINE MILE POINT (2)			CH-CHARLEVOIX (3)			SL-S. OF SUSAN LK (4)		
	Volume (m ³)	Gross Beta	I-131	Volume (m ³)	Gross Beta	I-131	Volume (m ³)	Gross Beta	I-131	Volume (m ³)	Gross Beta	I-131
01-08-87	195	0.016±0.004	<0.059	186	0.021±0.005	<0.062	186	0.016±0.005	<0.062	186	0.019±0.005	<0.062
01-15-87	224	0.027±0.004	<0.067	221	0.026±0.004	<0.068	211	0.023±0.004	<0.071	223	0.024±0.004	<0.067
01-22-87	227	0.015±0.004	<0.067	216	0.020±0.004	<0.070	211	0.013±0.004	<0.072	219	<0.006	<0.069
01-29-87	228	0.019±0.004	<0.033	218	0.019±0.004	<0.034	212	0.014±0.004	<0.035	218	0.020±0.004	<0.034
02-05-87	234	0.022±0.004	<0.063	223	0.022±0.004	<0.067	217	0.018±0.004	<0.068	223	0.023±0.004	<0.067
02-12-87	229	0.022±0.004	<0.043	200	0.020±0.004	<0.049	211	0.013±0.004	<0.047	215	0.015±0.004	<0.067
02-19-87	224	0.019±0.004	<0.051	236	0.019±0.004	<0.048	213	0.018±0.004	<0.053	220	0.015±0.004	<0.052
02-26-87	231	0.015±0.004	<0.061	216	0.017±0.004	<0.066	308	0.015±0.003	<0.046	219	0.016±0.004	<0.065
03-05-87	235	0.012±0.003	<0.066	224	0.012±0.004	<0.069	316	0.012±0.003	<0.049	224	0.013±0.004	<0.069
03-12-87	223	0.030±0.005	<0.019	221	0.025±0.004	<0.020	306	0.020±0.003	<0.014	215	0.029±0.005	<0.020
03-19-87	221	0.023±0.004	<0.060	221	0.021±0.004	<0.060	317	0.019±0.003	<0.039	224	0.024±0.004	<0.055
03-26-87	227	0.012±0.004	<0.056	226	0.010±0.003	<0.056	305	0.007±0.002	<0.042	223	0.014±0.004	<0.057
04-02-87	224	0.015±0.004	<0.055	222	0.014±0.004	<0.056	314	0.009±0.003	<0.039	220	0.013±0.004	<0.056
1st Qtr mean±sd	0.019±0.006			0.019±0.005			0.015±0.004			0.019±0.005		

BIG ROCK POINT

Table 1. Airborne Particulates and Iodine-131 (continued)
Collection: Weekly
Units: pCi/m³

Collection Date	ST-BIG ROCK POINT (1)			NM-NINE MILE POINT (2)			CH-CHARLEVOIX (3)			SL-S. OF SUSAN LK (4)		
	Volume (m ³)	Gross Beta	I-131	Volume (m ³)	Gross Beta	I-131	Volume (m ³)	Gross Beta	I-131	Volume (m ³)	Gross Beta	I-131
04-09-87	224	0.018±0.003	<0.055	223	0.016±0.003	<0.057	310	0.016±0.002	<0.040	218	0.019±0.003	<0.057
04-16-87	225	<0.006	<0.065	231	0.014±0.004	<0.063	298	0.015±0.003	<0.049	225	0.014±0.004	<0.065
04-23-87	229	0.017±0.004	<0.039	221	0.008±0.003	<0.040	325	0.007±0.002	<0.028	222	0.013±0.004	<0.040
04-30-87	226	0.011±0.003	<0.066	225	0.009±0.003	<0.066	286	0.010±0.003	<0.052	222	0.008±0.003	<0.068
05-07-87	225	0.020±0.004	<0.058	225	0.016±0.004	<0.058	306	0.020±0.003	<0.043	219	0.018±0.004	<0.060
05-14-87	230	0.017±0.004	<0.053	230	0.014±0.004	<0.053	301	0.015±0.003	<0.041	222	0.016±0.004	<0.056
05-21-87	228	0.009±0.004	<0.054	229	0.010±0.004	<0.054	300	0.011±0.003	<0.041	227	0.019±0.004	<0.054
05-28-87	227	0.015±0.004	<0.058	224	0.012±0.004	<0.059	228	0.010±0.003	<0.053	221	0.010±0.003	<0.060
06-04-87	234	0.017±0.004	<0.027	234	0.024±0.005	<0.027	261	0.018±0.004	<0.024	231	0.021±0.005	<0.027
06-11-87	227	0.035±0.005	<0.052	220	0.012±0.005	<0.054	281	0.014±0.004	<0.042	217	0.012±0.005	<0.055
06-18-87	228	0.021±0.004	<0.055	224	0.021±0.004	<0.056	254	0.020±0.004	<0.049	228	0.020±0.004	<0.055
06-25-87	234	0.018±0.004	<0.059	229	0.020±0.004	<0.060	268	0.023±0.008	<0.051	229	0.016±0.004	<0.060
2nd Qtr mean ± s.d.		0.018±0.007			0.015±0.005			0.023±0.032			0.015±0.004	

BIG ROCK POINT

Table 1. Airborne Particulates and Iodine-131 (continued)

Collection: Weekly

Units: pCi/m³

Collection Date	ST-BIG ROCK POINT (1)			NM-NINE MILE POINT (2)			CH-CHARLEVOIX (3)			SL-S. OF SUSAN LK (4)		
	Volume (m ³)	Gross Beta	I-131	Volume (m ³)	Gross Beta	I-131	Volume (m ³)	Gross Beta	I-131	Volume (m ³)	Gross Beta	i-131
07-02-87	231	0.007±0.003	<0.050	230	0.014±0.004	<0.051	283	0.009±0.003	<0.041	227	0.012±0.004	<0.051
07-09-87	232	0.012±0.003	<0.060	229	0.014±0.004	<0.061	258	0.013±0.003	<0.054	222	0.019±0.004	<0.063
07-16-87	226	0.012±0.004	<0.058	221	0.009±0.003	<0.059	263	0.011±0.003	<0.049	254	0.007±0.003	<0.051
07-23-87	233	0.030±0.004	<0.055	217	0.024±0.004	<0.059	240	0.026±0.004	<0.053	228	0.030±0.004	<0.056
07-30-87	232	0.023±0.004	<0.051	219	0.025±0.004	<0.054	243	0.019±0.004	<0.049	228	0.025±0.004	<0.052
08-06-87	228	0.018±0.003	<0.074	231	0.015±0.004	<0.062	502	0.013±0.002	<0.029	231	0.014±0.004	<0.062
08-13-87	226	0.016±0.004	<0.059	225	0.013±0.004	<0.060	453	0.031±0.003	<0.030	222	0.015±0.004	<0.060
08-20-87	226	0.016±0.004	<0.037	231	0.018±0.004	<0.036	572	0.017±0.002	<0.015	230	0.011±0.003	<0.036
08-27-87	224	0.014±0.004	<0.065	223	0.011±0.004	<0.065	576	0.014±0.002	<0.064	223	0.014±0.004	<0.065
09-03-87	227	0.015±0.004	<0.061	229	0.016±0.004	<0.061	584	0.014±0.002	<0.024	228	0.013±0.004	<0.051
09-10-87	224	0.029±0.004	<0.064	229	0.018±0.004	<0.062	298	0.009±0.003	<0.048	226	0.012±0.004	<0.063
09-17-87	226	0.018±0.003	<0.051	226	0.019±0.003	<0.051	300	0.020±0.002	<0.038	225	0.016±0.003	<0.051
09-24-87	225	0.009±0.003	<0.054	230	0.008±0.003	<0.053	295	0.008±0.002	<0.041	228	0.008±0.003	<0.054
10-01-87	228	0.024±0.004	<0.056	230	0.021±0.004	<0.055	298	0.040±0.004	<0.043	229	0.019±0.004	<0.005
3rd Qtr mean ± s.d.		0.018±0.007			0.016±0.005			0.019±0.010			0.015±0.006	

BIG ROCK POINT

Table 1. Airborne Particulates and Iodine-131 (continued)

Collection: Weekly

Units: pCi/m³

Collection Date	ST-BIG ROCK POINT (1)			NM-BIG ROCK POINT (2)			CH-CHARLEVOIX (3)			SL-S. OF SUSAN LK (4)		
	Volume (m ³)	Gross Beta	I-131	Volume (m ³)	Gross Beta	I-131	Volume (m ³)	Gross Beta	I-131	Volume (m ³)	Gross Beta	I-131
10-08-87	221	0.018±0.004	<0.070	218	0.009±0.003	<0.070	35 ^a	0.017±0.019	<0.447	222	0.009±0.003	<0.069
10-15-87	219	0.029±0.004	<0.059	224	0.025±0.004	<0.057	199	0.028±0.005	<0.065	222	0.037±0.005	<0.058
10-22-87	223	0.024±0.003	<0.062	223	0.026±0.003	<0.062	213	0.016±0.003	<0.065	220	0.021±0.003	<0.063
10-29-87	221	0.005±0.003	<0.066	226	0.006±0.003	<0.064	208	0.005±0.003	<0.070	223	0.040±0.005	<0.065
11-05-87	221	0.048±0.005	<0.063	227	0.018±0.004	<0.061	209	0.022±0.004	<0.067	224	0.022±0.004	<0.062
11-12-87	219	0.015±0.004	<0.023	221	0.006±0.003	<0.023	209	0.013±0.004	<0.024	217	0.015±0.004	<0.023
11-19-87	218	0.024±0.004	<0.038	223	0.035±0.005	<0.037	204	0.030±0.005	<0.040	222	0.029±0.004	<0.037
11-27-87	251	0.015±0.004	<0.036	254	0.018±0.009	<0.035	238	0.017±0.004	<0.038	251	0.014±0.004	<0.036
12-03-87	186 ^b	0.014±0.004	<0.048	189 ^b	0.011±0.004	<0.047	176 ^b	0.011±0.004	<0.051	187 ^b	0.010±0.004	<0.048
12-10-87	217	0.012±0.004	<0.062	223	0.015±0.004	<0.060	101 ^c	0.013±0.007	<0.133 ^d	219	0.009±0.003	<0.061
12-17-87	218	0.013±0.004	<0.049	195	0.005±0.004	<0.055	203	0.007±0.004	<0.052	195	0.013±0.004	<0.055
12-23-87	188 ^b	0.026±0.005	<0.066	190	0.027±0.005	<0.065	180	0.022±0.005	<0.069	188	0.025±0.005	<0.066
12-30-87	216	0.038±0.005	<0.058	221	0.029±0.004	<0.056	204	0.037±0.005	<0.061	219	0.034±0.005	<0.057
4th Qtr mean±s.d.		0.022±0.012			0.018±0.010			0.018±0.009			0.021±0.011	

^a Low volume due to blown fuse.

^b Pump ran for 6 days.

^c Low volume due to motor not working.

^d Elevated volume due to low volume.

BIG ROCK POINT

Table 2. Airborne Particulates and Iodine-131

Collection: Weekly

Units: pCi/m³

Collection Date	PT-PETOSKY (5)			BC-BOYNE CITY (6)			TR-TRAVERSE CITY (7)			
	Volume (m ³)	Gross Beta	I-131	Volume (m ³)	Gross Beta	I-131	Collection Date	Volume (m ³)	Gross Beta	I-131
01-08-87	194	0.016±0.004	<0.059	183	0.015±0.005	<0.063	01-07-87	159	0.019±0.005	<0.072
01-15-87	228	0.023±0.004	<0.069	223	0.028±0.004	<0.067	01-14-87	221	0.024±0.004	<0.068
01-22-87	224	0.014±0.004	<0.068	216	0.019±0.004	<0.070	01-21-87	215	0.020±0.004	<0.071
01-29-87	222	0.022±0.004	<0.033	218	0.017±0.004	<0.034	01-28-87	219	0.022±0.004	<0.034
02-05-87	229	0.023±0.004	<0.065	223	0.019±0.004	<0.067	02-05-87	250	0.025±0.004	<0.059
02-12-87	225	0.019±0.004	<0.044	218	0.019±0.005	<0.045	02-11-87	188	0.022±0.004	<0.052
02-19-87	226	0.016±0.004	<0.050	216	0.016±0.004	<0.053	02-18-87	219	0.015±0.004	<0.052
02-26-87	225	0.015±0.004	<0.063	217	0.016±0.004	<0.065	02-26-87	257	0.011±0.004	<0.055
03-05-87	232	0.008±0.003	<0.067	223	0.010±0.003	<0.069	03-05-87	212	0.010±0.004	<0.073
03-12-87	228	0.025±0.004	<0.019	219	0.031±0.005	<0.020	03-11-87	189	0.031±0.005	<0.023
03-19-87	230	0.025±0.004	<0.053	216	0.023±0.004	<0.057	03-18-87	212	0.021±0.004	<0.058
03-26-87	232	0.012±0.004	<0.055	227	0.012±0.004	<0.056	03-25-87	222	0.012±0.004	<0.057
04-02-87	225	0.011±0.004	<0.055	215	0.017±0.004	<0.058	04-02-87	257	0.004±0.003	<0.048
1st Qtr mean±sd		0.018±0.006			0.019±0.006				0.018±0.007	

BIG ROCK POINT

Table 2. Airborne Particulates and Iodine-131 (continued)
 Collection: Weekly
 Units: pCi/m³

Collection Date	PT-PETOSKY (5)			Collection Date	BC-BOYNE CITY (6)			Collection Date	IR-TRAVERSE CITY (7)		
	Volume (m ³)	Gross Beta	I-131		Volume (m ³)	Gross Beta	I-131		Volume (m ³)	Gross Beta	I-131
04-09-87	229	<0.004	<0.054	04-08-87	219	0.010±0.003	<0.057	04-08-87	182	0.017±0.004	<0.068
04-16-87	233	0.019±0.004	<0.062	04-15-87	225	0.020±0.004	<0.065	04-15-87	221	0.013±0.004	<0.066
04-23-87	231	0.011±0.003	<0.039	04-22-87	213	0.010±0.004	<0.042	04-22-87	222	0.014±0.004	<0.040
04-30-87	239	0.009±0.003	<0.062	04-29-87	226	0.011±0.003	<0.066	04-29-87	219	0.014±0.004	<0.068
05-07-87	235	0.020±0.004	<0.056	05-07-87	220	0.019±0.004	<0.059	05-07-87	253	0.017±0.004	<0.052
05-14-87	242	0.015±0.004	<0.051	05-13-87	225	0.019±0.004	<0.055	05-13-87	196	0.019±0.004	<0.063
05-21-87	244	0.010±0.004	<0.050	05-20-87	231	0.014±0.004	<0.053	05-20-87	231	0.011±0.004	<0.053
05-28-87	233	0.008±0.003	<0.057	05-27-87	218	0.010±0.004	<0.061	05-27-87	229	0.008±0.003	<0.058
06-04-87	251	0.017±0.004	<0.026	06-04-87	235	0.017±0.004	<0.027	06-04-87	270	0.023±0.004	<0.024
06-11-87	235	0.014±0.004	<0.051	06-10-87	219	0.017±0.005	<0.054	06-10-87	195	0.018±0.005	<0.061
06-18-87	241	0.016±0.004	<0.052	06-18-87	225	0.022±0.004	<0.056	06-18-87	269	0.018±0.003	<0.047
06-25-87	245	0.020±0.004	<0.056	06-24-87	226	0.023±0.004	<0.061	06-24-87	200	0.026±0.005	<0.069
2nd Qtr mean±sd		0.014±0.004				0.013±0.006				0.014±0.008	

BIG ROCK POINT

Table 2. Airborne Particulates and Iodine-131 (continued)
 Collection: Weekly
 Units: pCi/m³

PT-PETOSKY (5)				BC-BOYNE CITY (6)			TR-TRAVERSE CITY (7)				
Collection Date	Volume (m ³)	Gross Beta	I-131	Volume (m ³)	Gross Beta	I-131	Collection Date	Volume (m ³)	Gross Beta	I-131	
07-02-87	249	0.010±0.003	<0.047	232	0.010±0.003	<0.050	07-02-87	268	0.007±0.003	<0.043	
07-09-87	243	0.014±0.003	<0.057	220	0.017±0.004	<0.063	07-08-87	199	0.008±0.007	<0.070	
07-16-87	241	0.009±0.003	<0.054	220	0.014±0.004	<0.057	07-16-87	233	0.011±0.003	<0.056	
07-23-87	244	0.024±0.004	<0.052	224	0.024±0.004	<0.057	07-22-87	236	0.025±0.004	<0.054	
07-30-87	248	0.019±0.004	<0.048	227	0.026±0.004	<0.052	07-30-87	268	0.022±0.004	<0.044	
08-06-87	255	0.011±0.003	<0.056	235	0.009±0.003	<0.061	08-06-87	237	0.195±0.010	<0.061	
08-13-87	241	0.017±0.004	<0.056	218	<0.006	<0.062	08-12-87	200	0.012±0.004	<0.067	
08-20-87	242	0.017±0.004	<0.034	227	0.016±0.004	<0.037	08-19-87	236	0.014±0.003	<0.035	
08-27-87	241	0.017±0.004	<0.060	228	0.030±0.004	<0.064	08-26-87	230	<0.006	<0.063	
09-03-87	240	0.013±0.003	<0.058	221	0.038±0.005	<0.063	09-03-87	264	0.023±0.004	<0.053	
09-10-87	226	0.118±0.008	<0.063	231	0.056±0.006	<0.062	09-09-87	202	0.024±0.005	<0.071	
09-17-87	237	0.020±0.003	<0.049	218	0.189±0.010	<0.053	09-17-87	269	0.013±0.002	<0.043	
09-24-87	246	0.697±0.017	<0.050	229	0.008±0.003	<0.053	09-23-87	191	0.007±0.004	<0.064	
10-01-87	245	0.016±0.004	<0.052	227	0.050±0.005	<0.056	10-01-87	265	0.017±0.003	<0.048	
3rd Qtr											
mean ± s.d		0.071±0.182		0.037±0.048				0.035±0.052			

BIG ROCK POINT

Table 2. Airborne Particulates and Iodine-131 (continued)
 Collection: Weekly
 Units: pCi/m³

Collection Date	PT-PETOSKY (5)			Collection Date	BC-BOYNE CITY (6)			Collection Date	TR-TRAVERSE CITY (7)		
	Volume (m ³)	Gross Beta	I-131		Volume (m ³)	Gross Beta	I-131		Volume (m ³)	Gross Beta	I-131
10-08-87	240	0.008±0.003	<0.064	10-08-87	227	0.009±0.003	<0.069	10-08-87	227	0.009±0.003	<0.068
10-15-87	238	0.032±0.004	<0.054	10-15-87	229	0.016±0.004	<0.058	10-15-87	229	0.037±0.005	<0.056
10-22-87	234	0.015±0.003	<0.059	10-22-87	233	0.023±0.004	<0.072	10-22-87	233	0.019±0.003	<0.060
10-29-87	239	0.009±0.003	<0.061	10-29-87	225	0.027±0.005	<0.074	10-29-87	225	0.009±0.003	<0.065
11-05-87	246	0.586±0.016	<0.057	11-05-87	229	0.021±0.004	<0.068	11-05-87	229	0.024±0.004	<0.061
11-12-87	233	0.012±0.003	<0.022	11-12-87	227	0.014±0.004	<0.027	11-12-87	227	0.006±0.003	<0.022
11-19-87	239	0.031±0.004	<0.034	11-19-87	227	0.040±0.005	<0.041	11-19-87	227	0.082±0.007	<0.036
11-27-87	268	0.012±0.003	<0.033	11-27-87	263	0.019±0.004	<0.041	11-27-87	263	0.017±0.004	<0.034
12-03-87	204 ^a	0.035±0.005	<0.044	12-03-87	184 ^a	0.043±0.006	<0.054	12-03-87	184 ^a	0.010±0.004	<0.049
12-10-87	242	0.029±0.004	<0.056	12-10-87	198	0.019±0.004	<0.068	12-10-87	195	0.010±0.003	<0.069
12-17-87	235	0.014±0.004	<0.045	12-17-87	187	0.050±0.006	<0.057	12-17-87	225	<0.006	<0.047
12-23-87	200 ^a	0.023±0.005	<0.062	12-23-87	166	0.018±0.005	<0.070	12-23-87	185	0.078±0.008	<0.067
12-30-87	238	0.030±0.004	<0.050	12-30-87	173	0.030±0.005	<0.069	12-30-87	229	0.030±0.004	<0.052
4th Qtr mean±s.d.		0.021±0.010 ^b				0.025±0.012				0.026±0.025	

^a Pump ran for 6 days.

^b Gross beta value for 11-05-87 is excluded from the mean.

BIG ROCK POINT

Table 3. Gamma Radiation, as Measured by TLDs
Exposure: Monthly

	January	February	March	April	May	June
Date Placed	01-02-87	02-05-87	03-05-87	04-02-87	05-07-87	06-04-87
Date Removed	02-05-87	03-05-87	04-02-87	05-07-87	06-04-87	07-02-87
In-Transit (mR)	3.1±0.3	2.2±0.2	4.2±0.3	3.3±0.4	3.8±0.3	6.3±0.5
Location	mR/30 days net					
BRP-01 (ST)	13.0±0.8	12.6±1.0	15.7±0.8	17.4±0.8	14.1±1.3	11.3±0.8
BRP-02 (NM)	3.6±0.4	4.0±0.4	4.1±0.3	3.0±0.4	3.5±1.0	3.0±0.7
BRP-03 (CH)	4.4±0.6	3.6±0.2	4.8±0.8	3.6±0.5	3.8±0.5	3.4±0.5
BRP-04 (SL)	4.5±0.5	4.5±0.3	4.4±0.4	4.5±0.4	3.6±0.4	4.3±0.8
BRP-05 (PT)	4.5±0.4	3.4±0.2	4.5±0.5	4.5±0.6	3.8±0.5	3.3±0.6
BRP-06 (BC)	4.8±0.5	4.9±0.4	4.8±0.6	4.9±0.5	3.5±0.4	5.3±1.0
BRP-07 (TR)	3.9±0.3	4.2±0.4	4.2±0.4	3.9±0.5	3.0±0.4	3.8±0.5
Mean ± s.d.	5.5±3.3	5.3±3.2	6.0±4.2	6.0±5.1	5.0±4.0	4.9±2.9
BRP-08 (Shield-Offsite)	3.1±0.5 ^a	NDC	2.8±0.5	2.8±0.4	2.5±0.7	2.6±0.6
BRP-09 (Onsite)	4.3±0.5	3.0±0.2	3.7±0.5	ND	2.9±0.6	2.0±0.6
BRP-10 (Onsite)	4.0±0.4	3.5±0.6	3.6±0.5	3.8±0.4	2.6±0.4	2.4±0.6
BRP-11 (Onsite)	6.0±0.6	4.3±0.5	4.9±0.4	3.8±0.5	3.6±0.4	3.2±1.0
BRP-12 (Onsite)	6.0±0.5	4.4±0.3	4.9±0.5	4.4±0.4	5.2±0.5	4.4±0.7
BRP-13 (Onsite)	4.9±0.4	3.6±0.2	4.8±0.4	3.8±0.4	5.1±0.9	3.4±0.5
BRP-14 (Onsite)	67.5±1.4	70.5±1.9	81.0±3.0	94.5±4.2	78.1±1.0	79.9±5.7
BRP-15 (Onsite)	82.2±1.7	86.4±2.2	131.9±1.1	162.1±3.5	126.2±2.4	119.1±2.0
BRP-16 (Onsite)	4.2±0.4	3.2±0.5	2.7±0.4	3.0±0.3	3.1±0.4	3.9±0.7
BRP-17 (Onsite)	11.0±0.5	10.0±0.3	10.8±0.8	10.0±1.0	9.2±0.6	8.5±1.0
BRP-18 (Onsite)	32.2±0.7	27.7±0.9	31.6±0.8	31.4±1.3	27.5±1.5	27.2±1.2
Control 1 (Shield-Onsite)	1.9±0.4 ^a	2.6±0.2 ^b	2.3±0.6	1.8±0.4	1.0±0.5	1.9±0.5
Control 2 (Shield-Onsite)	1.8±0.3 ^a	2.8±0.2 ^b	2.3±0.6	1.7±0.5	1.0±0.3	2.0±0.6

^a Placed 12-24-86; removed 02-05-87; in-transit exposure, (1.4±0.2)mR.^b Placed 01-29-87; removed 03-05-87, in-transit exposure: (1.2±1)mR^c ND = No Data. TLDs not received.

BIG ROCK POINT

Table 3. Gamma Radiation, as Measured by TlUs (continued)
Exposure: Monthly

	July	August	September	October	November	December
Date 1987-07-02	07-02-87	08-06-87	09-03-87	10-01-87	11-05-87	12-03-87
Date 1987-08-06	08-06-87	09-03-87	10-01-87	11-05-87	12-03-87	01-07-88
BRP-07 (1K)	2.4±0.3	3.4±0.3	8.3±0.3	3.0±0.3	2.4±0.2	4.5±0.3
Unit: mR/30 days net						
BRP-01 (1K)	15.2±2.2	14.6±1.8	13.5±1.0	14.0±1.1	13.1±0.4	12.3±0.8
BRP-02 (1K)	3.7±0.4	3.6±1.0	3.5±0.6	3.5±0.3	4.5±0.3	3.3±0.4
BRP-03 (1K)	5.2±0.5	3.9±0.7	4.0±0.8	4.2±0.4	4.5±0.3	3.8±0.3
BRP-04 (1K)	4.4±0.4	5.2±0.8	4.3±0.5	4.8±0.3	4.9±0.3	4.4±0.4
BRP-05 (1K)	4.7±0.3	4.5±0.6	4.6±0.4	5.2±0.8	5.0±0.3	3.8±0.2
BRP-06 (1K)	4.6±0.5	5.2±1.4	4.0±0.4	5.3±0.6	5.0±0.4	4.4±0.3
BRP-07 (1K)	3.9±0.3	3.9±0.4	3.9±0.5	4.4±0.3	4.5±0.4	3.9±0.3
Mean ± s.d.	6.0±4.1	5.8±3.9	5.4±3.6	5.9±3.6	5.9±3.2	5.1±3.2
BRP-08 (Shield-Offsite)	3.1±0.4	3.1±0.4	2.7±0.7	2.3±0.4	3.2±0.4	2.8±0.5
BRP-09 (Onsite)	3.5±0.3	2.9±0.4	3.1±0.4	3.0±0.3	3.8±0.2	2.9±0.2
BRP-10 (Onsite)	3.5±0.3	3.4±0.3	3.6±0.4	4.2±0.3	4.1±0.4	3.5±0.3
BRP-11 (Onsite)	4.4±0.3	4.3±0.7	4.9±0.5	5.0±0.6	5.0±0.3	4.3±0.4
BRP-12 (Onsite)	4.6±0.3	4.8±0.4	5.2±0.6	5.5±0.6	5.4±0.4	4.4±0.4
BRP-13 (Onsite)	4.2±0.4	4.4±0.4	4.4±0.4	5.5±0.7	4.7±0.3	4.0±0.3
BRP-14 (Onsite)	78.7±6.4	103.5±4.0	81.7±0.6	98.1±5.7	63.0±0.9	83.1±2.6
BRP-15 (Onsite)	125.3±4.9	180.5±3.4	153.3±1.8	172.1±1.7	138.3±3.2	141.0±1.9
BRP-16 (Onsite)	3.5±0.4	3.1±0.6	2.7±0.4	3.4±0.4	3.3±0.3	3.0±0.4
BRP-17 (Onsite)	8.2±0.7	10.4±0.8	10.8±0.8	10.6±0.6	10.4±0.5	9.1±0.5
BRP-18 (Onsite)	24.0±1.8	29.4±1.3	23.7±0.9	21.1±0.5	22.6±0.5	26.6±0.3
Control 1 (Shield-Onsite)	2.1±0.3	2.3±0.4	1.8±0.4	2.1±0.3	1.8±0.3	1.9±0.3
Control 2 (Shield-Onsite)	2.3±0.3	2.3±0.3	2.1±0.4	2.1±0.3	2.0±0.2	2.1±0.3

BIG ROCK POINT

Table 4. Gamma Radiation, as Measured by TLDs
Exposure: Quarterly

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Date Placed	01-02-87	04-02-87	07-02-87	10-01-87
Date Removed	04-02-87	07-02-87	10-01-87	01-07-88
In-Transit (mR)	3.6±0.7	5.5±0.7	5.1±0.8	4.4±0.7
Location	mR/91 days net ^a			
BRP-01 (ST)	32.6±1.6	41.4±1.6	32.6±1.2	38.4±2.0
BRP-02 (NM)	10.6±0.8	10.4±0.7	11.2±1.0	11.5±0.7
BRP-03 (CH)	11.0±0.8	12.0±0.8	11.0±0.9	12.9±0.7
BRP-04 (SL)	12.1±1.3	14.3±1.4	13.2±1.3	14.2±1.3
BRP-05 (PT)	11.5±0.9	13.4±0.9	11.8±0.8	13.9±0.7
BRP-06 (BC)	11.8±0.7	12.6±0.9	12.7±1.1	13.6±0.8
BRP-07 (TR)	11.6±0.9	11.5±0.7	11.0±1.2	12.8±0.8
Mean ± s.d.	14.4±0.7	16.5±11.0	14.8±7.9	16.8±9.6
BRP-08 (Shield-Offsite)	8.8±0.7	7.0±1.0	7.7±0.9	9.7±1.1
BRP-09 (Onsite)	9.8±0.9	9.9±0.7	9.3±1.0	10.4±0.8
BRP-10 (Onsite)	10.4±0.8	9.4±0.9	10.6±1.2	10.7±0.8
BRP-11 (Onsite)	12.3±0.9	13.0±1.1	12.0±1.1	13.6±0.9
BRP-12 (Onsite)	13.3±0.9	15.2±0.8	13.9±0.9	15.4±0.9
BRP-13 (Onsite)	11.2±0.7	12.5±1.0	12.5±1.3	13.0±1.1
BRP-14 (Onsite)	180.5±7.6	230.4±4.3	209.6±5.5	226.9±3.8
BRP-15 (Onsite)	255.7±8.8	385.7±5.1	354.6±16.5	425.7±3.5
BRP-16 (Onsite)	9.0±0.9	10.2±1.0	9.0±1.0	10.6±0.8
BRP-17 (Onsite)	26.2±1.5	28.0±1.5	21.1±1.2	28.1±1.4
BRP-18 (Onsite)	74.2±0.9	78.6±2.1	58.3±1.6	64.8±1.5
Control 1 (Shield-Onsite)	6.2±0.8	6.2±0.7	5.8±0.9	6.6±0.8
Control 2 (Shield-Onsite)	6.6±0.8	7.2±0.8	6.0±0.9	6.7±0.7

^a In-transit exposure has been subtracted from total exposure.

NOTE: Page 15 is intentionally left out.

BIG ROCK POINT

Table 5. Gamma Radiation, as Measured by TLDs
Exposure: Annually

	1987 Annual
Date Placed	01-02-1987
Date Removed	01-07-1988
In-Transit (mR)	13.9±2.7
Location	mR/365 days net ^a
BRP-01 (ST)	209.8±6.1
BRP-02 (NM)	52.7±3.4
BRP-03 (CH)	57.7±3.3
BRP-04 (SL)	60.0±3.5
BRP-05 (PT)	57.9±3.3
BRP-06 (BC)	61.4±3.5
BRP-07 (TR)	54.1±2.8
Mean ± s.d.	79.1±57.7
BRP-08 (Shield-Offsite)	MISSING
BRP-09 (Onsite)	38.0±3.0
BRP-10 (Onsite)	44.8±3.3
BRP-11 (Onsite)	62.8±4.1
BRP-12 (Onsite)	73.7±2.9
BRP-13 (Onsite)	60.3±3.3
BRP-14 (Onsite)	1187.3±35.7
BRP-15 (Onsite)	2008.3±74.5
BRP-16 (Onsite)	43.9±3.4
BRP-17 (Onsite)	139.6±8.0
BRP-18 (Onsite)	391.5±19.6
Control 1 (Shield-Onsite)	26.2±3.0
Control 2 (Shield-Onsite)	25.6±3.0

^a In-transit exposure has been subtracted from total exposure.

BIG ROCK POINT

Table 7. Charlevoix Drinking Water (Lake Water)
 Collection: Monthly Composites
 Units: pCi/l

Compositing Period	Lab Code	Gross Beta	Tritium
Required LLD		<u>4.0</u>	<u>500</u>
January 1987	BRDW-353	2.3±0.5	180±80
February 1987	636	1.8±0.5	<198
March 1987	1007	2.2±0.5	<151
April 1987 ^a	1393	2.8±0.6	<302
May 1987	1796	1.5±0.7	<297
June 1987	2279	1.8±0.6	<313
July 1987	2580	2.1±0.6	<301
August 1987	2903	2.8±0.6	<291
September 1987	3365	2.0±0.5	<328
October 1987	3691	<0.8	251±90
November 1987	4179	1.9±0.6	<130
December 1987	4531	1.8±0.6	<232

^a Changed from well water to lake water 04-04-87.

BIG ROCK POINT

Table 6. Lake Water, Inlet and Discharge
Collection: Monthly Composites
Units: pCi/l

Compositing Period	Lab Code	Gross Alpha	Gross Beta	Sr-89	Sr-90	Tritium	Cs-134	Cs-137	Other ^a Gammas
Required LLD		<u>1.0</u>	<u>4.0</u>	<u>5.0</u>	<u>1.0</u>	<u>500</u>	<u>15.0</u>	<u>18.0</u>	<u>15.0</u>
ST - Big Rock Point NGP - Inlet									
January 1987	BRLW-351	NA	2.4±0.4	NA ^a	NA	<140	NA	NA	NA
February 1987	633,4	NA	2.5±0.5	NA	NA	<198	NA	NA	NA
March 1987	1004	NA	1.6±0.5	NA	NA	<151	NA	NA	NA
April 1987	1389	NA	10.0±1.0 ^c	<1.6	0.9±0.4	<302	<2.7	10.6±3.3	<2.6
May 1987	1733	NA	15.0±0.8	<2.5	<0.7	<297	<2.6	19.7±3.2	<2.4
June 1987	2276	NA	2.0±0.4	NA	NA	<313	NA	NA	NA
July 1987	2577	NA	10.8±1.0 ^d	<1.3	<0.7	<301	<10.5	<13.8	<10.2
August 1987	2900	NA	5.8±0.5	NA	NA	<291	NA	NA	NA
September 1987	3362	NA	4.3±0.4	NA	NA	<328	NA	NA	NA
October 1987	3687,8	NA	2.3±0.6	NA	NA	213±63	NA	NA	NA
November 1987	4175	NA	2.5±0.5	NA	NA	173±83	NA	NA	NA
December 1987	4527,8	NA	2.9±0.4	NA	NA	230±90	NA	NA	NA
ST - Big Rock Point NGP - Discharge									
January 1987	BRLW-352	<0.6	2.6±0.4	<1.9	1.5±0.7	200±80	NA	NA	NA
February 1987	635	<0.5	2.8±0.4	<1.0	<0.8	272±76	NA	NA	NA
March 1987	1005	<0.5	2.2±0.4	<1.0	<0.8	<151	NA	NA	NA
April 1987	1390	<0.6	2.7±0.4	<0.9	0.8±0.5	<302	NA	NA	NA
May 1987	1794	<0.6	3.5±0.4	<0.3	0.6±0.2	<297	NA	NA	NA
June 1987	2277	<0.7	2.4±0.4	<0.9	<0.6	<313	NA	NA	NA
July 1987	2578	<0.7	2.6±0.4	<0.8	<0.8	<301	NA	NA	NA
August 1987	2901	<0.6	3.2±0.4	<0.6	<0.6	<291	NA	NA	NA
September 1987	3363	<0.5	1.9±0.4	<0.7	0.5±0.3	<328	NA	NA	NA
October 1987	3689	<0.5	2.9±0.4	<0.8	0.4±0.3	167±89	NA	NA	NA
November 1987	4176	<0.3	2.4±0.4	<0.7	0.5±0.3	1908±141	NA	NA	NA
December 1987	4529	<0.6	3.8±0.5	<1.2	1.7±0.9	258±88	NA	NA	NA

^a See introduction.

^b NA = Not analyzed; analysis not required.

^c Sample was reanalyzed; reported result is an average of the two analyses.

^d Result of reanalysis.

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Table 8. Site Well Water
 Collection: Monthly
 Units: pCi/l

Collection Date	Lab Code	Gross Beta	Tritium
Required LLD		<u>4.C</u>	<u>500</u>
01-31-87	BRLW-354	1.5±0.5	<140
02-28-87	637	1.5±0.5	<140
03-31-87	1006	1.9±0.5	<151
04-30-87	1391,2	1.8±0.6	<302
05-31-87	1795	2.9±1.0	<297
06-30-87	2278	1.6±0.6	<313
07-31-87	2579	1.9±0.8	<301
08-31-87	2902	2.0±0.6	<291
09-30-87	3354	2.2±0.6	<328
10-31-87	3690	2.2±0.6	<164
11-30-87	4177,8	1.9±0.5	<150
12-31-87	4530	2.4±0.7	<147

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Table 9. Milk
Collection: Monthly
Units: pCi/l

Collection Date	Lab Code	I-131	Sr-89	Sr-90	Cs-134	Cs-137	Ba-La-140
Required LLD		<u>1.0</u>	<u>5.0</u>	<u>1.0</u>	<u>15</u>	<u>18</u>	<u>15</u>
J. Golovich (1)							
01-08-87	BRMI-45	<0.4	<0.8	6.8±1.0	<7.7	<9.4	<9.5
02-12-87	141	<0.5	<0.6	6.9±0.9	<6.9	<6.4	<8.4
03-12-87	208	<0.3	<0.9	6.9±1.0	<1.8	<18	<2.2
04-09-87	280	<0.4	<0.8	7.8±0.9	<4.8	<5.1	<5.8
05-14-87	392	<0.4	<0.6	5.6±0.8	<5.7	<5.8	<6.8
06-11-87	540	<0.2	<0.6	7.5±0.8	<4.5	<7.9	<5.5
07-09-87	702	<0.4	<0.6	4.8±0.6	<7.5	<7.6	<10.6
08-13-87	929	<0.2	<0.2	5.4±0.3	<7.0	<6.6	<11.4
09-10-87	1078	<0.2	<0.6	5.4±0.8	<4.0	<4.5	<6.9
10-08-87	1239	<0.2	<0.5	8.2±0.9	<5.8	<6.5	<9.4
11-12-87	1403	<0.2	<0.6	4.9±0.6	<4.3	<4.6	<5.0
12-10-87	1476	<0.4	<0.7	5.5±0.7	<6.8	<7.4	<8.3
D. Kuebler (2)							
01-08-87	BRMI-44	<0.3	<0.8	5.2±0.8	<4.6	<7.5	<9.2
02-12-87	140	<0.5	<0.6	4.0±0.7	<5.7	<7.6	<11.0
03-12-87	207	<0.3	<0.7	3.1±0.6	<2.5	<3.3	<2.4
04-09-87	281	<0.3	<0.9	5.2±0.7	<7.3	<8.4	<11.3
05-14-87	393	<0.3	<0.6	4.8±0.8	<5.0	<6.8	<5.0
06-11-87	541	<0.3	<0.7	3.5±0.8	<7.6	<8.3	<9.4
07-09-87	703	<0.4	<0.6	3.3±0.6	<6.2	<8.0	<10.5
08-13-87	930	<0.3	<0.2	2.8±0.2	<7.4	<7.7	<11.5
09-10-87	1079	<0.2	<0.6	3.7±0.7	<6.3	<6.1	<6.2
10-08-87	ND ^a						
11-12-87	1404	<0.2	<0.8	4.2±0.7	<2.2	<3.1	<2.6
12-10-87	1477	<0.3	<0.7	4.6±0.7	<5.2	<5.2	<5.3

^a ND = No data; milk not available.

BIG ROCK POINT

Table 9. Milk (continued)

Collection Date	Lab Code	I-131	Sr-89	Sr-90	Cs-134	Cs-137	Ba-La-140
Required LLD		<u>1.0</u>	<u>5.0</u>	<u>1.0</u>	<u>15</u>	<u>18</u>	<u>15</u>
<u>R. McCraney (3)</u>							
01-08-87	BRMI-43	<0.3	<0.9	6.0±0.9	<4.9	<5.5	<7.6
02-12-87	139	<0.7	<0.7	4.9±0.8	<6.2	<7.1	<9.7
03-12-87	209	<0.3	<0.7	4.3±0.7	<5.8	<5.2	<6.9
04-09-87	282	<0.3	<0.8	5.4±0.7	<6.9	<6.6	<8.6
05-14-87	395	<0.3	<0.6	3.9±0.8	<6.9	<7.1	<7.5
06-11-87	542	<0.2	<0.7	3.2±0.6	<6.1	<5.5	<7.3
07-09-87	704	<0.5	<0.7	2.8±0.6	<6.9	<7.2	<7.4
08-13-87	931,2	<0.3	<0.2	2.2±0.1	<1.6	<1.7	<2.3
09-10-87	1080	<0.2	<0.5	4.5±0.7	<5.0	<5.3	<5.5
10-08-87	1240 ^a	<0.2	<0.5	5.3±0.8	<6.6	<7.1	<6.6
11-12-87	1405	<0.2	<0.8	5.0±0.7	<1.6	<2.2	<2.1
12-10-87	1478	<0.3	<0.7	5.0±0.6	<6.9	<8.1	<11.4
<u>B. Bochniak (4)</u>							
01-08-87	BRMI-42	<0.3	<0.9	5.4±0.9	<7.1	<6.6	<8.5
02-12-87	137,8	<0.4	<0.7	3.8±1.0	<6.1	<7.5	<11.0
03-13-87	210	<0.3	<0.8	2.9±0.6	<5.6	<6.8	<9.4
04-09-87	283	<0.3	<0.8	3.0±0.6	<7.1	<7.0	<10.4
05-14-87	394	<0.3	<0.7	4.1±0.8	<5.4	<7.9	<4.5
06-11-87	543,4	<0.2	<0.7	2.0±0.8	<7.5	<8.7	<8.6
07-09-87	705	<0.2	<0.7	2.5±0.5	<7.1	<7.8	<9.3
08-13-87	933	<0.3	<0.3	2.8±0.3	<3.9	<6.2	<3.1
09-10-87	1081	<0.2	<0.8	2.3±0.7	<6.9	<7.7	<7.3
10-08-87	1241,2 ^a	<0.2	<0.4	2.6±0.8	<5.9	<7.4	<7.5
11-12-87	1406	<0.2	<0.5	1.9±0.4	<2.3	<2.7	<2.6
12-10-87	1479	<0.4	<0.6	2.1±0.5	<1.4	<2.5	<1.8

^a Corrected result.

BIG ROCK POINT

Table 10. Vegetation
Collection: Monthly, during harvest season
Units: pCi/g wet

Sample Description and Concentration		Required LLD
Location	J. Golovich (1)	
Date Collected	09-10-87	
Sample Type	Cabbage	
Lab Code	BRVE-308	
Gross beta	ND ^b	1.0
Sr-89	<0.004	0.025
Sr-90	0.013±0.003	0.005
I-131	<0.030	0.06
Mn-54	<0.028	0.08
Co-58	<0.026	0.08
Co-60	<0.029	0.08
Fe-59	<0.062	0.1
Zn-65	<0.058	0.1
Zr-Nb-95	<0.024	0.1
Cs-134	<0.024	0.08
Cs-137	<0.028	0.08
Ba-La-140	<0.032	0.1
Location	D. Kuebler (2)	
Date Collected	09-10-87	
Sample Type	Cauliflower Leaves/Pepper Leaves	
Lab Code	BRVE-309	
Gross beta	ND ^b	1.0
Sr-89	<0.002	0.025
Sr-90	0.022±0.002	0.005
I-131	<0.058	0.06
Mn-54	<0.053	0.08
Co-58	<0.050	0.08
Co-60	<0.053	0.08
Fe-59	<0.13 ^a	0.1
Zn-65	<0.12 ^a	0.1
Zr-Nb-95	<0.048	0.1
Cs-134	<0.043	0.08
Cs-137	<0.048	0.08
Ba-La-140	<0.047	0.1

^a Required LLD could not be reached because of small sample size. The sample was counted for 16 hours.

^b ND=No data; analysis not required

BIG ROCK POINT

Table 11. Fish
Collection: Semiannually
Units: pCi/g wet

Sample Description and Concentration				Required LLD
Location	Ludington North Jetty (Control)			
Date Collected	04-10-87	04-10-87	04-10-87	
Sample Type	Sucker	Steelhead	Steelhead	
Lab Code	PAF-201	PAF-202	PAF-203	
Gross Beta	1.45±0.08	1.59±0.07	1.57±0.07	1.0
Sr-89	<0.002	<0.002	<0.003	0.025
Sr-90	0.005±0.001	0.003±0.001	0.006±0.002	0.005
Mn-54	<0.012	<0.007	<0.009	0.13
Co-58	<0.013	<0.007	<0.009	0.13
Co-60	<0.012	<0.007	<0.011	0.13
Fe-59	<0.030	<0.017	<0.025	0.26
Zn-65	<0.027	<0.017	<0.023	0.26
Zr-Nb-95	<0.012	<0.008	<0.010	0.1
Cs-134	<0.009	<0.006	<0.010	0.13
Cs-137	0.036±0.014	0.046±0.006	0.047±0.012	0.15
Ba-La-140	<0.017	<0.011	<0.017	0.1
Location	Ludington North Jetty (Control)			
Date Collected	10-15-87	10-15-87	10-15-87	
Sample Type	Salmon	Perch	Sucker	
Lab Code	PAF-331	PAF-332	PAF-333	
Gross Beta	2.74±0.1	2.49±0.2	3.70±0.2	1.0
Sr-89	<0.004	<0.01	<0.01	0.025
Sr-90	0.002±0.001	0.022±0.006	0.016±0.005	0.005
Mn-54	<0.022	<0.018	<0.013	0.13
Co-58	<0.016	<0.021	<0.014	0.13
Co-60	<0.020	<0.024	<0.016	0.13
Fe-59	<0.047	<0.043	<0.038	0.26
Zn-65	<0.048	<0.052	<0.036	0.26
Zr-Nb-95	<0.013	<0.020	<0.016	0.1
Cs-134	<0.019	<0.018	<0.013	0.13
Cs-137	0.071±0.022	<0.030	<0.015	0.15
Ba-La-140	<0.025	<0.017	<0.021	0.1

BIG ROCK POINT

Table 11. Fish (continued)

Sample Description and Concentration				Required LLD
Location	<u>Discharge</u>			
Date Collected	06-12-87	06-12-87	09-26-87	
Sample Type	Carp	Sucker	Salmon	
Lab Code	BRF-261	BRF-262	BRF-307	
Gross Beta	1.83±0.07	1.52±0.03	2.80±0.10	1.0
Sr-89	<0.006	<0.011	<0.006	0.025
Sr-90	<0.004	0.005±0.005	0.002±0.002	0.005
Mn-54	<0.022	<0.031	<0.028	0.13
Co-58	<0.024	<0.032	<0.032	0.13
Co-60	<0.025	<0.041	<0.026	0.13
Fe-59	<0.064	<0.085	<0.091	0.26
Zn-65	<0.056	<0.074	<0.050	0.26
Zr-Nb-95	<0.021	<0.037	<0.031	0.1
Cs-134	<0.019	<0.033	<0.021	0.13
Cs-137	0.039±0.018	<0.041	0.09±0.03	0.15
Ba-La-140	<0.024	<0.049	<0.050	0.1
Location				
Date Collected				
Sample Type				
Lab Code				
Gross Beta				1.0
Sr-89				0.025
Sr-90				0.005
Mn-54				0.13
Co-58				0.13
Co-60				0.13
Fe-59				0.26
Zn-65				0.26
Zr-Nb-95				0.1
Cs-134				0.13
Cs-137				0.15
Ba-La-140				0.1

BIG ROCK POINT

Table 11. Fish (continued)

Sample Description and Concentration				Required LLD
Location	<u>1/4 Mi. North</u>			
Date Collected	06-10-87	06-10-87	09-26-87	
Sample Type	Sucker	Carp	Salmon	
Lab Code	BRF-264	BRF-263	BRF-308	
Gross Beta	2.12±0.08	2.23±0.08	2.37±0.09	1.0
Sr-89	<0.004	<0.005	<0.005	0.025
Sr-90	<0.003	<0.004	<0.002	0.005
Mn-54	<0.032	<0.020	<0.031	0.13
Co-58	<0.034	<0.023	<0.033	0.13
Co-60	<0.028	<0.018	<0.031	0.13
Fe-59	<0.074	<0.058	<0.087	0.26
Zn-65	<0.066	<0.035	<0.076	0.26
Zr-Nb-95	<0.030	<0.023	<0.034	0.1
Cs-134	<0.024	<0.019	<0.023	0.13
Cs-137	0.070±0.037	0.063±0.018	0.13±0.05	0.15
Ba-La-140	<0.046	<0.017	<0.095	0.1
Location	<u>1/4 Mi. South</u>			
Date Collected	06-12-87	09-26-87		
Sample Type	Sucker	Salmon		
Lab Code	BRF-260	BRF-309		
Gross Beta	2.07±0.07	2.64±0.09		1.0
Sr-89	<0.004	<0.005		0.025
Sr-90	<0.004	0.002±0.001		0.005
Mn-54	<0.020	<0.033		0.13
Co-58	<0.016	<0.033		0.13
Co-60	<0.016	<0.028		0.13
Fe-59	<0.048	<0.095		0.26
Zn-65	<0.062	<0.074		0.26
Zr-Nb-95	<0.020	<0.040		0.1
Cs-134	<0.016	<0.026		0.13
Cs-137	0.082±0.023	0.12±0.05		0.15
Ba-La-140	<0.021	<0.099		0.1

BIG ROCK POINT

Table 11. Fish (continued)

Sample Description and Concentration				Required LLD
Location	<u>9 Mi. Point</u>			
Date Collected	06-12-87	06-12-87	09-26-87	
Sample Type	Alewife	Sucker	Salmon	
Lab Code	BRF-265	BRF-266	BRF-310	
Gross Beta	1.72±0.10	2.18±0.04	2.23±0.07	1.0
Sr-89	<0.005	<0.004	<0.005	0.025
Sr-90	0.014±0.003	<0.003	0.003±0.001	0.005
Mn-54	<0.030	<0.014	<0.022	0.13
Co-58	<0.035	<0.020	<0.025	0.13
Co-60	<0.022	<0.013	<0.026	0.13
Fe-59	<0.092	<0.050	<0.072	0.26
Zn-65	<0.073	<0.034	<0.055	0.26
Zr-Nb-95	<0.034	<0.017	<0.018	0.1
Cs-134	<0.028	<0.010	<0.023	0.13
Cs-137	<0.044	0.067±0.018	0.070±0.022	0.15
Ba-La-140	<0.071	<0.029	<0.073	0.1
 Location				
Date Collected				
Sample Type				
Lab Code				
Gross Beta				1.0
Sr-89				0.025
Sr-90				0.005
Mn-54				0.13
Co-58				0.13
Co-60				0.13
Fe-59				0.26
Zn-65				0.26
Zr-Nb-95				0.1
Cs-134				0.13
Cs-137				0.15
Ba-La-140				0.1

BIG ROCK POINT

Table 11. Fish (continued)

Sample Description and Concentration				Required LLD
Location	<u>Mt. Mc Sauba</u>			
Date Collected	06-10-87	06-10-87	09-26-87	
Sample Type	Sucker	Alewife	Salmon	
Lab Code	BRF-258	BRF-259	BRF-311,2	
Gross Beta	1.88±0.07	1.76±0.06	2.72±0.06	1.0
Sr-89	<0.003	<0.007	<0.005	0.025
Sr-90	<0.002	0.007±0.003	<0.002	0.005
Mn-54	<0.029	<0.019	<0.028	0.13
Co-58	<0.029	<0.022	<0.035	0.13
Co-60	<0.029	<0.027	<0.027	0.13
Fe-59	<0.070	<0.052	<0.084	0.26
Zn-65	<0.059	<0.046	<0.067	0.26
Zr-Nb-95	<0.025	<0.024	<0.031	0.1
Cs-134	<0.024	<0.019	<0.025	0.13
Cs-137	0.086±0.032	<0.019	0.12±0.04	0.15
Ba-La-140	<0.028	<0.045	<0.086	0.1
 Location				
Date Collected				
Sample Type				
Lab Code				
Gross Beta				
Sr-89				
Sr-90				
Mn-54				
Co-58				
Co-60				
Fe-59				
Zn-65				
Zr-Nb-95				
Cs-134				
Cs-137				
Ba-La-140				

BIG ROCK POINT

Table 12. Crayfish
Collection: Semiannually
Units: pCi/g wet

Sample Description and Concentration			Required LLD
Location	<u>Discharge</u>		
Date Collected	06-12-87 ^a	09-26-87	
Lab Code		BRB0-162	
Gross Beta		4.54±0.89	1.0
Sr-89		<0.073 ^c	0.025
Sr-90		0.56±0.03	0.005
Mn-54		0.22±0.04	0.08
Co-58		<0.039	0.08
Co-60		0.34±0.04	0.05
Fe-59		<0.092	0.1
Zn-65		<0.078	0.1
Zr-Nb-95		<0.041	0.1
Cs-134		<0.028	0.08
Cs-137		0.079±0.031	0.08
Ba-La-140		<0.089	0.1
Location	<u>1/4 Mi. North</u>		
Date Collected	06-10-87	09-26-87	
Lab Code	BRB0-152 ^b	BRB0-163	
Gross Beta	1.66±0.16	0.82±0.17	1.0
Sr-89	<0.016	0.062±0.040	0.025
Sr-90	0.41±0.04	0.14±0.01	0.005
Mn-54	<0.023	<0.041	0.08
Co-58	<0.020	<0.029	0.08
Co-60	<0.023	<0.052	0.05
Fe-59	<0.049	<0.088	0.1
Zn-65	<0.039	<0.063	0.1
Zr-Nb-95	<0.020	<0.042	0.1
Cs-134	<0.018	<0.028	0.08
Cs-137	0.034±0.025	<0.041	0.08
Ba-La-140	<0.023	<0.099	0.1

^a Sample unavailable.

^b Includes some crayfish from 1/4 mi. south.

^c Required LLD not reached due to small sample size.

BIG ROCK POINT

Table 12. Crayfish (continued)

Sample Description and Concentration		Required LLD
Location	<u>1/4 Mi. South</u>	
Date Collected	06-11-87 ^a	09-26-87
Lab Code		BRBO-164
Gross Beta	1.93±0.39	1.0
Sr-89	<0.044 ^b	0.025
Sr-90	0.34±0.02	0.005
Mn-54	<0.030	0.13
Co-58	<0.029	0.13
Co-60	<0.029	0.13
Fe-59	<0.078	0.26
Zn-65	<0.057	0.26
Zr-Nb-95	<0.028	0.1
Cs-134	<0.019	0.13
Cs-137	<0.024	0.15
Ba-La-140	<0.095	0.1
Location	<u>9 Mi. Point</u>	
Date Collected	06-12-87 ^a	09-26-87
Lab Code		SRBO-165
Gross Beta	1.77±0.35	1.0
Sr-89	<0.030 ^b	0.025
Sr-90	0.25±0.01	0.005
Mn-54	<0.026	0.13
Co-58	<0.028	0.13
Co-60	<0.034	0.13
Fe-59	<0.066	0.26
Zn-65	<0.047	0.26
Zr-Nb-95	<0.029	0.1
Cs-134	<0.020	0.13
Cs-137	0.042±0.019	0.15
Ba-La-140	<0.10	0.1

^a Sample unavailable.^b Required LLD not reached due to small sample size.

BIG ROCK POINT

Table 12. Crayfish (continued)

Sample Description and Concentration		Required LLD
Location	<u>Mt. McSaubu</u>	
Date Collected	06-10-87 ^a 09-26-87	
Lab Code	BRBO-166	
Gross Beta	1.28±0.33	1.0
Sr-89	0.19±0.09	0.025
Sr-90	0.26±0.02	0.005
Mn-54	<0.027	0.13
Co-58	<0.032	0.13
Co-60	<0.026	0.13
Fe-59	<0.084	0.26
Zn-65	<0.057	0.26
Zr-Nb-95	<0.031	0.1
Cs-134	<0.022	0.13
Cs-137	<0.026	0.15
Ba-La-140	<0.098	0.1
Location		
Date Collected		
Lab Code		
Gross Beta		1.0
Sr-89		0.025
Sr-90		0.005
Mn-54		0.13
Co-58		0.13
Co-60		0.13
Fe-59		0.26
Zn-65		0.26
Zr-Nb-95		0.1
Cs-134		0.13
Cs-137		0.15
Ba-La-140		0.1

^a Sample unavailable.

BIG ROCK POINT

Table 13. Periphyton
Collection: Semiannually
Units: pCi/g wet

Sample Description and Concentration		Required LLD
Location	<u>Discharge</u>	
Date Collected	06-12-87 ^a	09-25-87
Lab Code		BR80-167
Gross Beta	3.09±1.1	1.0
Sr-89	<0.15 ^b	0.025
Sr-90	0.35±0.04	0.005
Mn-54	3.31±0.08	0.08
Co-58	<0.037	0.08
Co-60	2.80±0.07	0.05
Fe-59	<0.066	0.1
Zn-65	0.088±0.046	0.1
Zr-Nb-95	<0.036	0.1
Cs-134	<0.027	0.08
Cs-137	0.25±0.04	0.08
Ba-La-140	<0.061	0.1
Location		
Date Collected		
Lab Code		
Gross Beta		1.0
Sr-89		0.025
Sr-90		0.005
Mn-54		0.08
Co-58		0.08
Co-60		0.05
Fe-59		0.1
Zn-65		0.1
Zr-Nb-95		0.1
Cs-134		0.08
Cs-137		0.08
Ba-La-140		0.1

^a Sample unavailable.

^b Required LLD not reached due to small sample size.

BIG ROCK POINT

Table 13. Periphyton (continued)

Sample Description and Concentration			Required LLD
Location	<u>1/4 Mi. North</u>		
Date Collected	06-10-87	09-25-87	
Lab Code	BRB0-151	BRB0-168	
Gross Beta	1.25±0.16	<0.83	1.0
Sr-89	<0.028 ^a	<0.08 ^a	0.025
Sr-90	0.16±0.02	0.23±0.02	0.005
Mn-54	<0.080	0.30±0.05	0.08
Co-58	<0.092	<0.036	0.08
Co-60	<0.075	0.40±0.05	0.05
Fe-59	<0.18	<0.070	0.1
Zn-65	<0.19	<0.069	0.1
Zr-Nb-95	<0.098	<0.034	0.1
Cs-134	<0.090	<0.029	0.15
Cs-137	<0.084	0.29±0.04	0.18
Ba-La-140	<0.083	<0.092	0.1
Location	<u>1/4 Mi. South</u>		
Date Collected	06-11-87	09-25-87	
Lab Code	BRB0-150	BRB0-169,70	
Gross Beta	3.09±0.52	<1.25	1.0
Sr-89	<0.024	<0.19 ^a	0.025
Sr-90	0.24±0.02	0.37±0.05	0.005
Mn-54	<0.026	<0.034	0.08
Co-58	<0.027	<0.030	0.08
Co-60	<0.033	0.086±0.034	0.05
Fe-59	<0.080	<0.024	0.1
Zn-65	<0.057	<0.060	0.1
Zr-Nb-95	<0.026	<0.033	0.1
Cs-134	<0.022	<0.024	0.15
Cs-137	0.23±0.04	<0.035	0.18
Ba-La-140	<0.054	<0.099	0.1

^a Elevated LLD due to small sample size.

BIG ROCK POINT

Table 13. Periphyton (continued)

Sample Description and Concentration		Required LLD
Location	<u>9 Mi. Point</u>	
Date Collected	06-12-87	09-25-87 ^b
Lab Code	BRB0-153	
Gross Beta	4.90±0.59	1.0
Sr-89	<0.038 ^a	0.025
Sr-90	0.14±0.02	0.005
Mn-54	<0.018	0.08
Co-58	<0.019	0.08
Co-60	<0.024	0.05
Fe-59	<0.053	0.1
Zn-65	<0.040	0.1
Zr-Nb-95	<0.018	0.1
Cs-134	<0.017	0.15
Cs-137	0.055±0.023	0.18
Ba-La-140	<0.033	0.1
Location	<u>Mt. Mc Sauba</u>	
Date Collected	06-10-87 ^b	09-25-87
Lab Code		BRB0-171
Gross Beta	4.30±1.15	1.0
Sr-89	<0.001	0.025
Sr-90	0.001±0.001	0.005
Mn-54	<0.015	0.08
Co-58	<0.017	0.08
Co-60	<0.017	0.05
Fe-59	<0.047	0.1
Zn-65	<0.043	0.1
Zr-Nb-95	<0.024	0.1
Cs-134	<0.020	0.15
Cs-137	0.043±0.012	0.18
Ba-La-140	<0.067	0.1

^a Elevated LLD due to small sample size.^b Sample unavailable.

BIG ROCK POINT

Table 14. Algae
Collection: Semiannually
Units: pCi/g wet

Sample Description and Concentration			Required LLD
Location	<u>Ludington North and South Jetty</u>		
Date Collected	04-10-87	10-15-87	
Lab Code	PASL-45	PASL-91	
Gross Beta	2.2±0.1	0.9±0.1	1.0
Sr-89	<0.010	<0.008	0.025
Sr-90	0.008±0.004	<0.003	0.005
Mn-54	<0.020	<0.017	0.13
Co-58	<0.021	<0.019	0.13
Co-60	<0.018	<0.019	0.13
Fe-59	<0.042	<0.052	0.26
Zn-65	<0.052	<0.042	0.26
Zr-Nb-95	<0.026	<0.020	0.1
Cs-134	<0.028	<0.018	0.13
Cs-137	<0.021	<0.026	0.15
Ba-La-140	<0.040	<0.028	0.1
Location	<u>Discharge</u>		
Date Collected	06-11-87		
Lab Code	BRSL-60		
Gross Beta	1.47±0.15		1.0
Sr-89	<0.011		0.025
Sr-90	0.012±0.005		0.005
Mn-54	0.50±0.06 ^a		0.13
Co-58	<0.051		0.13
Co-60	0.49±0.05 ^a		0.13
Fe-59	<0.099		0.26
Zn-65	<0.10		0.26
Zr-Nb-95	<0.045		0.1
Cs-134	<0.038		0.13
Cs-137	0.12±0.05		0.15
Ba-La-140	<0.061		0.1

^a Corrected result.

BIG ROCK POINT

Table 14. Algae (continued)

Sample Description and Concentration			Required LLD
Location	<u>1/4 Mi. North</u>		
Date Collected	06-10-87	09-25-87	
Lab Code	BRSL-61	BRSL-84	
Gross beta	1.39±0.08	<0.53	0.1
Sr-89	<0.006	<0.10 ^a	0.025
Sr-90	0.005±0.002	0.028±0.017	<0.005
Mn-54	<0.11	1.12±0.06	0.13
Co-58	<0.053	<0.034	0.13
Co-60	<0.061	0.94±0.06	0.13
Fe-59	<0.12	<0.077	0.26
Zn-65	<0.11	<0.066	0.26
Zr-Nb-95	<0.048	<0.035	0.1
Cs-134	<0.040	<0.023	0.13
Cs-137	<0.050	0.14±0.04	0.15
Ba-La-140	<0.071	<0.078	0.1
Location	<u>1/4 Mi. South</u>		
Date Collected	06-11-87	09-25-87	
Lab Code	BRSL-59	BRSL-85	
Gross beta	0.61±0.07	<0.28	0.1
Sr-89	<0.010	<0.060 ^a	0.025
Sr-90	0.012±0.005	0.024±0.011	<0.005
Mn-54	<0.033	0.086±0.035	0.13
Co-58	<0.034	<0.032	0.13
Co-60	<0.030	0.10±0.04	0.13
Fe-59	<0.091	<0.088	0.26
Zn-65	<0.067	<0.056	0.26
Zr-Nb-95	<0.033	<0.039	0.1
Cs-134	<0.030	<0.022	0.13
Cs-137	<0.033	<0.031	0.15
Ba-La-140	<0.076	<0.10	0.1

^a Required LLD not reached due to late sample arrival.

BIG ROCK POINT

Table 14. Algae (continued)

Sample Description and Concentration			Required LLD
Location	<u>9 Mi. Point</u>		
Date Collected	06-10-87	09-26-87	
Lab Code	BRSL-62	BRSL-86	
Gross Beta	0.54±0.04	<0.15	1.0
Sr-89	<0.007	<0.024	0.025
Sr-90	0.005±0.003	0.017±0.007	0.005
Mn-54	<0.024	<0.022	0.13
Co-58	<0.024	<0.016	0.13
Co-60	<0.023	<0.018	0.13
Fe-59	<0.054	<0.052	0.26
Zn-65	<0.049	<0.038	0.26
Zr-Nb-95	<0.028	<0.017	0.1
Cs-134	<0.021	<0.015	0.13
Cs-137	<0.022	<0.021	0.15
Ba-La-140	<0.045	<0.064	0.1
Location	<u>Mt. Mc Sauba</u>		
Date Collected	06-10-87	09-25-87	
Lab Code	BRSL-58	BRSL-87	
Gross Beta	2.69±0.24	<0.36	1.0
Sr-89	<0.013	<0.017	0.025
Sr-90	0.009±0.006	0.025±0.006	0.005
Mn-54	<0.048	<0.020	0.13
Co-58	<0.049	<0.027	0.13
Co-60	<0.049	<0.019	0.13
Fe-59	<0.11	<0.056	0.26
Zn-65	<0.099	<0.046	0.26
Zr-Nb-95	<0.047	<0.034	0.1
Cs-134	<0.039	<0.021	0.13
Cs-137	<0.045	<0.020	0.15
Ba-La-140	<0.040	<0.010	0.1

BIG ROCK POINT

Table 15. Bottom Sediments
Collection: Semiannually
Units: pCi/g dry

Sample Description and Concentration			Required LLD
Location	Ludington (Control)		
	50 ft. North of North Jetty	300 ft. North of North Jetty	
Date Collected	04-10-87	04-10-87	
Lab Code	PABS-189	PABS-190	
Gross Beta	5.6±1.6	7.8±1.6	1.0
Sr-89	<0.011	<0.016	0.025
Sr-90	0.013±0.005	0.028±0.006	0.005
Mn-54	<0.011	<0.014	0.08
Co-58	<0.012	<0.015	0.08
Co-60	<0.011	<0.015	0.05
Fe-59	<0.027	<0.041	0.1
Zn-65	<0.032	<0.044	0.1
Zr-Nb-95	<0.012	<0.017	0.1
Cs-134	<0.012	<0.016	0.15
Cs-137	<0.009	<0.014	0.18
Ba-La-140	<0.016	<0.017	0.1
Location	50 ft. North of North Jetty	150 ft. North of North Jetty	300 ft. North of North Jetty
Date Collected	10-15-87	10-15-87	10-15-87
Lab Code	PABS-277	PABS-278	PABS-279
Gross Beta	7.6±2.6	14.3±3.0	11.1±2.8
Sr-89	<0.007	<0.007	<0.006
Sr-90	0.002±0.002	0.003±0.002	<0.003
Mn-54	<0.018	<0.016	<0.019
Co-58	<0.021	<0.020	<0.023
Co-60	<0.024	<0.023	<0.027
Fe-59	<0.061	<0.066	<0.078
Zn-65	<0.050	<0.050	<0.052
Zr-Nb-95	<0.024	<0.033	<0.028
Cs-134	<0.014	<0.018	<0.014
Cs-137	<0.019	<0.015	<0.019
Ba-La-140	<0.008	<0.022	<0.012

BIG ROCK POINT

Table 15. Bottom Sediments (continued)

Sample Description and Concentration			Required LLD
Location	<u>Discharge</u>		
Date Collected	06-11-87	09-26-87	
Lab Code	BRBS-225	BRBS-247	
Gross Beta	7.9±0.2	17.5±3.0	1.0
Sr-89	<0.008	<0.027 ^a	0.025
Sr-90	0.005±0.002	0.007±0.005	0.005
Mn-54	<0.027	0.65±0.05	0.08
Co-58	<0.022	<0.048	0.08
Co-60	0.14±0.04 ^a	0.78±0.06	0.05
Fe-59	<0.063	<0.14	0.1
Zn-65	<0.051	<0.073	0.1
Zr-Nb-95	<0.024	<0.051	0.1
Cs-134	<0.026	<0.026	0.15
Cs-137	0.59±0.04 ^a	0.17±0.03	0.18
Ba-La-140	<0.030	<0.40	0.1
Location	<u>9 Mi. Point</u>		
Date Collected	06-10-87	09-26-87	
Lab Code	BRBS-226	BRBS-248	
Gross Beta	4.3±0.2	5.1±2.7	1.0
Sr-89	<0.007	<0.017	0.025
Sr-90	0.006±0.003	<0.005	0.005
Mn-54	<0.015	<0.029	0.08
Co-58	<0.015	<0.034	0.08
Co-60	<0.023	<0.029	0.05
Fe-59	<0.046	<0.097	0.1
Zn-65	<0.038	<0.067	0.1
Zr-Nb-95	<0.019	<0.037	0.1
Cs-134	<0.012	<0.028	0.15
Cs-137	0.087±0.021	0.064±0.028	0.18
Ba-La-140	<0.025	<0.018	0.1

^a Required LLD not reached due to small sample size.

BIG ROCK POINT

Table 16.1. Liquid Radwaste
Collection: Monthly Composite
Units: $\mu\text{Ci/ml}$, except Pu-239 (pCi/l)

Collection Period	Lab Code	Gross Alpha	Tritium	Sr-89	Sr-90	Pu-239 (pCi/l)
January	BRRW-97	$<1.3 \text{ E-08}$	$7.5 \pm 0.1 \text{ E-04}$	$<5.7 \text{ E-08}$	$1.5 \pm 0.5 \text{ E-07}$	2.1 ± 0.3
February	99	$<0.4 \text{ E-08}$	$15.2 \pm 0.1 \text{ E-04}$	$1.5 \pm 0.2 \text{ E-06}$	$3.2 \pm 0.7 \text{ E-07}$	2.3 ± 0.4
March	103	$<0.5 \text{ E-08}$	$4.7 \pm 0.4 \text{ E-04}$	$1.1 \pm 0.2 \text{ E-06}$	$4.7 \pm 0.8 \text{ E-07}$	2.2 ± 0.4
April	119	$<0.4 \text{ E-08}$	$14.4 \pm 0.8 \text{ E-04}$	$4.3 \pm 0.3 \text{ E-06}$	$7.8 \pm 0.8 \text{ E-07}$	2.2 ± 0.4
May	121	$<0.5 \text{ E-08}$	$9.21 \pm 0.6 \text{ E-04}$	$5.8 \pm 0.3 \text{ E-07}$	$3.9 \pm 0.2 \text{ E-07}$	1.8 ± 0.3
June	127	$<0.6 \text{ E-08}$	$8.89 \pm 0.6 \text{ E-04}$	$8.2 \pm 0.1 \text{ E-07}$	$5.9 \pm 0.6 \text{ E-07}$	3.3 ± 0.3
July	135	$<0.9 \text{ E-08}$	$87 \pm 0.1 \text{ E-03}$	$1.3 \pm 0.1 \text{ E-07}$	$3.7 \pm 0.2 \text{ E-06}$	2.6 ± 0.5
August	138	$<7.6 \text{ E-08}$	$1.22 \pm 0.7 \text{ E-03}$	$9.2 \pm 0.2 \text{ E-06}$	$7.7 \pm 0.8 \text{ E-06}$	1.6 ± 0.2
September	ND ^a					
October	146	$<6.8 \text{ E-09}$	$7.90 \pm 0.1 \text{ E-04}$	$<8.2 \text{ E-08}$	$1.1 \pm 0.1 \text{ E-06}$	1.7 ± 0.2
November	ND ^a					
December	157	$<1.6 \text{ E-07}$	$3.1 \pm 0.1 \text{ E-04}$	$1.3 \pm 0.1 \text{ E-06}$	$9.7 \pm 0.3 \text{ E-07}$	2.7 ± 0.5

Collection Period	Cr-51	Mn-54	Fe-59	Co-58	Co-60
January	$1.2 \pm 0.2 \text{ E-05}$	$9.5 \pm 0.2 \text{ E-06}$	$<9.6 \text{ E-07}$	$7.8 \pm 1.6 \text{ E-07}$	$2.6 \pm 0.1 \text{ E-05}$
February	$<7.0 \text{ E-06}$	$9.9 \pm 0.4 \text{ E-06}$	$<1.7 \text{ E-06}$	$<8.6 \text{ E-07}$	$3.0 \pm 0.1 \text{ E-05}$
March	$<4.3 \text{ E-06}$	$1.6 \pm 0.0 \text{ E-06}$	$<1.2 \text{ E-06}$	$1.1 \pm 0.4 \text{ E-06}$	$2.8 \pm 0.8 \text{ E-06}$
April	$<7.2 \text{ E-06}$	$9.1 \pm 0.8 \text{ E-06}$	$<1.3 \text{ E-06}$	$<5.4 \text{ E-07}$	$1.6 \pm 0.1 \text{ E-06}$
May	$<3.7 \text{ E-06}$	$4.7 \pm 0.4 \text{ E-06}$	$<1.1 \text{ E-06}$	$<4.4 \text{ E-07}$	$1.7 \pm 0.8 \text{ E-06}$
June	$9.9 \pm 0.5 \text{ E-06}$	$7.2 \pm 0.7 \text{ E-06}$	$<1.1 \text{ E-06}$	$<4.7 \text{ E-07}$	$1.6 \pm 0.9 \text{ E-05}$
July	$<1.9 \text{ E-05}$	$6.5 \pm 0.2 \text{ E-05}$	$<4.5 \text{ E-06}$	$6.2 \pm 2.0 \text{ E-06}$	$1.1 \pm 0.3 \text{ E-04}$
August	$<3.8 \text{ E-06}$	$8.8 \pm 2.6 \text{ E-07}$	$<1.1 \text{ E-06}$	$<5.0 \text{ E-07}$	$1.4 \pm 0.7 \text{ E-06}$
September	ND ^a				
October	$<3.6 \text{ E-06}$	$1.0 \pm 0.1 \text{ E-05}$	$<8.8 \text{ E-07}$	$<4.0 \text{ E-07}$	$7.6 \pm 0.5 \text{ E-06}$
November	ND ^a				
December	$<1.0 \text{ E-05}$	$3.9 \pm 0.1 \text{ E-05}$	$<2.7 \text{ E-06}$	$<1.1 \text{ E-06}$	$8.9 \pm 0.2 \text{ E-05}$

^a ND = No data; sample not sent to lab.

BIG ROCK POINT NGP

Table 16.1 Liquid Radwaste (continued)

Collection Period	Zn-65	Zr-95	Nb-95	Ag-110m	Sb-124	Cs-134
January	4.5±0.4 E-06	<6.6 E-07	<3.8 E-07	1.0±0.1 E-06	<2.2 E-07	8.1±0.2 E-06
February	6.5±0.9 E-06	<1.3 E-06	<7.0 E-07	<1.5 E-06	<4.0 E-07	1.9±0.1 E-05
March	3.8±1.1 E-06	<8.7 E-07	<4.8 E-07	<1.0 E-06	<3.0 E-07	1.2±0.6 E-06
April	1.8±0.8 E-06	<2.9 E-06	<5.9 E-07	<4.7 E-07	<4.4 E-07	9.9±0.8 E-06
May	<9.0 E-07	<7.9 E-07	<5.1 E-07	<1.4 E-06	<5.6 E-07	9.7±0.5 E-06
June	2.2±0.9 E-06	<7.4 E-07	<5.2 E-07	<4.9 E-07	<3.2 E-07	6.5±0.5 E-06
July	<4.3 E-06	<3.1 E-06	<1.7 E-06	<6.2 E-06	<1.2 E-06	2.0±0.2 E-05
August	<8.8 E-07	<6.8 E-07	<4.9 E-07	<1.4 E-06	<5.0 E-07	6.0±0.4 E-06
September	ND ^a					
October	<7.6 E-07	<5.7 E-07	<3.9 E-07	<1.5 E-06	<4.8 E-07	5.7±0.4 E-06
November	ND ^a					
December	<2.1 E-06	<1.8 E-06	<1.0 E-06	<9.5 E-07	<5.9 E-07	1.3±0.1 E-05

Collection Period	Cs-137	Ba-140	La-140	Ce-141	Ce-144
January	1.6±0.1 E-05	<1.9 E-06	<1.9 E-07	<4.4 E-07	<1.6 E-06
February	3.5±0.1 E-05	<3.9 E-06	<3.9 E-07	<6.6 E-07	<1.9 E-06
March	2.6±0.9 E-06	<1.9 E-06	<2.8 E-07	<3.7 E-07	<1.3 E-06
April	3.8±0.1 E-05	<5.9 E-06	<8.2 E-07	<8.1 E-07	<2.1 E-06
May	3.7±0.1 E-05	<4.2 E-06	<4.8 E-07	<4.2 E-07	<1.2 E-06
June	4.5±0.1 E-05	<4.2 E-06	<5.5 E-07	<6.4 E-07	<1.8 E-06
July	3.3±0.4 E-04	<1.0 E-05	<1.2 E-06	<1.7 E-06	<5.5 E-06
August	4.0±0.1 E-05	<4.4 E-06	<3.9 E-07	<4.2 E-07	<1.2 E-06
September	ND ^a				
October	5.4±0.1 E-05	<3.3 E-06	<3.6 E-07	<3.5 E-07	<1.1 E-06
November	ND ^a				
December	1.2±0.1 E-04	<8.9 E-06	<9.5 E-07	<1.1 E-06	<3.1 E-06

^a ND = No data - sample not sent to lab.

BIG ROCK POINT

Table 16.2. Stack Filters
 Collection: Monthly composite
 Units: pCi/composite

Collection Period	Lab Code	Gross Alpha	Sr-89	Sr-90	Pu-239
January, 1987	BRSP-98	2.8±1.8	187±17	41±7	2.6±0.6
February, 1987	100	5.8±1.3	542±21	69±6	4.4±1.1
March, 1987	104	3.1±1.1	1514±32	25±4	3.6±1.0
April, 1987	120	4.8±1.5	1025±32	137±8	3.8±0.6
May, 1987	122	4.0±1.4	1735±29	45±5	6.6±1.3
June, 1987	128	2.8±1.2	460±10	9.1±1.6	2.7±0.4
July, 1987	134	8.5±4.2	272±14	7.1±2.4	3.3±0.4
August, 1987	139	2.8±1.2	4854±51	48±5	3.3±0.7
September, 1987	142	4.9±1.4	2361±48	30±4	3.6±0.4
October, 1987	145	7.0±1.7	2706±48	46±5	3.7±0.6
November, 1987	149	9.5±2.9	881±9	20±1	3.4±0.4
December, 1987	156	10.0±2.9	2774±13	35±1	3.5±0.8

NOTE: Pages 41 and 42 are intentionally left out.

Appendix A

Interlaboratory Comparison Program Results

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 June 1987. 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.

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 1987.^a

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

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/lb		
				TIML Result $\pm 2\sigma^C$	EPA Result ^D	
					Is, N=1	Control Limits
STM-382	Milk	Oct 1984	Sr-89	15.7 $\pm$ 4.2	22 $\pm$ 5.0	13.3-30.7
			Sr-90	12.7 $\pm$ 1.2	16 $\pm$ 1.5	13.4-18.6
			I-131	41.7 $\pm$ 3.1	42 $\pm$ 6.0	31.6-42.4
			Cs-137	31.3 $\pm$ 6.1	32 $\pm$ 5.0	23.3-40.7
			K-40	1447 $\pm$ 66	1517 $\pm$ 76	1386-1648
STW-384	Water (Blind)	Oct 1984 Sample A	Gr. alpha	9.7 $\pm$ 1.2	14 $\pm$ 5.0	5.3-22.7
			Ra-226	3.3 $\pm$ 0.2	3.0 $\pm$ 0.5	2.2-3.8
			Ra-228	3.4 $\pm$ 1.6	2.1 $\pm$ 0.3	1.6-2.6
			Uranium	NA ^E		
		Sample B	Gr. beta	48.3 $\pm$ 5.0	64 $\pm$ 5.0	55.3-72.7
			Sr-89	10.7 $\pm$ 4.6	11 $\pm$ 5.0	2.3-19.7
			Sr-90	7.3 $\pm$ 1.2	12 $\pm$ 1.5	9.4-14.6
			Co-60	16.3 $\pm$ 1.2	14 $\pm$ 5.0	5.3-22.7
			Cs-134	<2	2 $\pm$ 5.0	0.0-10.7
			Cs-137	16.7 $\pm$ 1.2	14 $\pm$ 5.0	5.3-22.7
STAF-387	Air Filter	Nov 1984	Gr. alpha	18.7 $\pm$ 1.2	15 $\pm$ 5.0	6.3-23.7
			Gr. beta	59.0 $\pm$ 5.3	52 $\pm$ 5.0	43.3-60.7
			Sr-90	18.3 $\pm$ 1.2	21 $\pm$ 1.5	18.4-23.6
			Cs-137	10.3 $\pm$ 1.2	10 $\pm$ 5.0	1.3-18.7
STW-388	Water	Dec 1984	I-131	28.0 $\pm$ 2.0	36 $\pm$ 6.0	25.6-36.4
STW-389	Water	Dec 1984	H-3	3583 $\pm$ 110	3182 $\pm$ 360	2558-3806
STW-391	Water	Dec 1984	Ra-226	8.4 $\pm$ 1.7	8.6 $\pm$ 1.3	6.4-10.8
			Ra-228	3.1 $\pm$ 0.2	4.1 $\pm$ 0.6	3.0-5.2
STW-392	Water	Jan 1985	Sr-89	<3.0	3.0 $\pm$ 5.0	0.0-11.7
			Sr-90	27.3 $\pm$ 5.2	30.0 $\pm$ 1.5	27.4-32.6
STW-393	Water	Jan 1985	Gr. alpha	3.3 $\pm$ 1.2	5 $\pm$ 5.0	0.0-13.7
			Gr. beta	17.3 $\pm$ 3.0	15 $\pm$ 5.0	6.3-23.7
STS-395	Food	Jan 1985	Gr. alpha	4.7 $\pm$ 2.3	6.0 $\pm$ 5.0	0.0-14.7
			Gr. beta	11.3 $\pm$ 1.2	15.0 $\pm$ 5.0	6.3-23.7
			Sr-89	25.3 $\pm$ 6.4	34.0 $\pm$ 5.0	25.3-42.8
			Sr-90	27.0 $\pm$ 8.8	26.0 $\pm$ 1.5	23.4-28.6
			I-131	38.0 $\pm$ 2.0	35.0 $\pm$ 6.0	24.6-45.4
			Cs-137	32.7 $\pm$ 2.4	29.0 $\pm$ 5.0	20.3-37.7
			K-40	1410 $\pm$ 212	1382 $\pm$ 120	1174-1590

Table A-1. (continued)

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

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/lb		
				TIML Result $\pm 2\sigma^C$	EPA Result ^d 1s, N=1	Control Limits
STW-413	Water	May 1985	Sr-89	36.0 $\pm$ 12.4	39.0 $\pm$ 5.0	30.3-47.7
			Sr-90	14.3 $\pm$ 4.2	15.0 $\pm$ 1.5	12.4-17.6
STW-414	Water	May 1985	Gr. alpha	8.3 $\pm$ 4.1	12.0 $\pm$ 5.0	3.3-20.7
			Gr. beta	8.7 $\pm$ 1.2	11.0 $\pm$ 5.0	2.3-19.7
STW-416	Water	June 1985	Cr-51	44.7 $\pm$ 6.0	44.0 $\pm$ 5.0	45.3-52.7
			Co-60	14.3 $\pm$ 1.2	14.0 $\pm$ 5.0	5.3-22.7
			Zn-65	50.3 $\pm$ 7.0	47.0 $\pm$ 5.0	38.3-55.7
			Ru-106	55.3 $\pm$ 5.8	62.0 $\pm$ 5.0	53.3-70.7
			Cs-134	32.7 $\pm$ 1.2	35.0 $\pm$ 5.0	26.3-43.7
			Cs-137	22.7 $\pm$ 2.4	20.0 $\pm$ 5.0	11.3-28.7
STW-418	Water	June 1985	H-3	2446 $\pm$ 137	2416 $\pm$ 351	1807-3025
STM-421	Milk	June 1985	Sr-89	10.3 $\pm$ 4.6	11.0 $\pm$ 5.0	2.3-19.7
			Sr-90	9.0 $\pm$ 2.0	11.0 $\pm$ 1.5	8.4-13.6
			I-131	11.7 $\pm$ 1.2	11.0 $\pm$ 6.0	0.6-21.4
			Cs-137	12.7 $\pm$ 1.2	11.0 $\pm$ 5.0	2.3-19.7
			K-40	1512 $\pm$ 62	1525 $\pm$ 132	1393-1657
STW-423	Water	July 1985	Gr. alpha	5.0 $\pm$ 0.0	11.0 $\pm$ 5.0	2.3-19.7
			Gr. beta	5.0 $\pm$ 2.0	8.0 $\pm$ 5.0	0.0-16.7
STW-425	Water	August 1985	I-131	25.7 $\pm$ 3.0	33.0 $\pm$ 6.0	22.6-43.4
STW-426	Water	August 1985	H-3	4363 $\pm$ 83	4480 $\pm$ 447	3704-5256
STAF-427	Air Filter	August 1985	Gr. alpha	11.3 $\pm$ 0.6	13.0 $\pm$ 5.0	4.3-21.7
			Gr. beta	46.0 $\pm$ 1.0	44.0 $\pm$ 5.0	35.3-52.7
			Sr-90	17.7 $\pm$ 0.6	18.0 $\pm$ 1.5	15.4-20.6
			Cs-137	10.3 $\pm$ 0.6	8.0 $\pm$ 5.0	0.0-16.7
STW-429	Water	Sept 1985	Sr-89	15.7 $\pm$ 0.6	20.0 $\pm$ 5.0	11.3-28.7
			Sr-90	7.0 $\pm$ 0.0	7.0 $\pm$ 1.5	4.4-9.6
STW-430	Water	Sept 1985	Ra-226	8.2 $\pm$ 0.3	8.9 $\pm$ 1.3	6.6-11.1
			Ra-228	4.1 $\pm$ 0.3	4.6 $\pm$ 0.7	3.4-5.8
STW-431	Water	Sept 1985	Gr. alpha	4.7 $\pm$ 0.6	8.0 $\pm$ 5.0	0.0-16.7
			Gr. beta	4.7 $\pm$ 1.2	8.0 $\pm$ 5.0	0.0-16.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l ^D		
				TIML Result $\pm 2\sigma^C$	EPA Result ^E 1s, N=1	Control Limits
STW-433	Water	Oct 1985	Cr-51	<13	21.0 $\pm$ 5.0	12.3-29.7
			Co-60	19.3 $\pm$ 0.6	20.0 $\pm$ 5.0	11.3-28.7
			Zn-65	19.7 $\pm$ 0.6	19.0 $\pm$ 5.0	10.3-27.7
			Ku-106	<19	20.0 $\pm$ 5.0	11.3-28.7
			Cs-134	17.0 $\pm$ 1.0	20.0 $\pm$ 5.0	11.3-28.7
			Cs-137	19.3 $\pm$ 1.2	20.0 $\pm$ 5.0	11.3-28.7
STW-435	Water	Oct 1985	H-3	1957 $\pm$ 50	1974 $\pm$ 345	1376-2572
STW-436 437	Water (Blind)	Oct 1985				
	Sample A		Gr. alpha	53.0 $\pm$ 1.0	52.0 $\pm$ 13	29.4-74.6
			Ra-226	5.9 $\pm$ 0.1	6.3 $\pm$ 1.0	4.1-7.9
			Ra-228	8.2 $\pm$ 0.1	10.1 $\pm$ 1.5	7.5-12.7
			Uranium	NA ^e	8.0 $\pm$ 10.4	0.0-18.4
	Sample B		Gr. beta	85.7 $\pm$ 2.5	75.0 $\pm$ 5.0	76.3-83.7
			Sr-89	21.3 $\pm$ 1.5	27.0 $\pm$ 5.0	18.3-35.7
			Sr-90	10.3 $\pm$ 0.6	9.0 $\pm$ 1.5	6.4-11.6
			Co-60	18.3 $\pm$ 1.2	18.0 $\pm$ 5.0	9.3-26.7
			Cs-134	16.3 $\pm$ 1.2	18.0 $\pm$ 5.0	9.3-26.7
			Cs-137	19.0 $\pm$ 1.0	18.0 $\pm$ 5.0	9.3-26.7
STM-439	Milk	Oct 1985	Sr-89	50.3 $\pm$ 0.6	48.0 $\pm$ 5.0	39.3-56.7
			Sr-90	23.3 $\pm$ 0.6	26.0 $\pm$ 1.5	23.4-28.6
			I-131	45.7 $\pm$ 3.2	42.0 $\pm$ 6.0	31.6-52.4
			Cs-137	60.7 $\pm$ 0.6	56.0 $\pm$ 5.0	47.3-64.7
			K-40	1547 $\pm$ 29	1540 $\pm$ 77	1406-1674
STW-441	Water	Nov 1985	Gr. alpha	5.3 $\pm$ 0.6	10.0 $\pm$ 5.0	1.3-18.7
			Gr. beta	11.7 $\pm$ 1.2	13.0 $\pm$ 5.0	4.3-21.7
STW-443	Water	Dec 1985	I-131	46.7 $\pm$ 2.1	45.0 $\pm$ 6.0	34.6-55.4
STW-444	Water	Dec 1985	Ra-226	6.5 $\pm$ 0.1	7.1 $\pm$ 1.1	5.2-9.0
			Ra-228	6.1 $\pm$ 0.1	7.3 $\pm$ 1.1	5.4-9.2
STW-445	water	Jan 1986	Sr-89	29.7 $\pm$ 2.5	31.0 $\pm$ 5.0	22.3-39.7
			Sr-90	13.7 $\pm$ 0.6	15.0 $\pm$ 1.5	12.4-17.6
STW-446	water	Jan 1986	Gr. alpha	3.0 $\pm$ 0.0	3.0 $\pm$ 5.0	0.0-11.7
			Gr. beta	5.3 $\pm$ 0.6	7.0 $\pm$ 5.0	0.0-15.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l ^D		
				TIML Result $\pm 2\sigma^C$	EPA Result ^D Is, N=1	Control Limits
STW-447	Food	Jan 1986	Sr-89	24.3 $\pm$ 2.5	25.0 $\pm$ 5.0	16.3-33.7
			Sr-90	17.3 $\pm$ 0.6	10.0 $\pm$ 1.5	7.4-12.6
			I-131	22.7 $\pm$ 2.3	20.0 $\pm$ 6.0	9.6-30.4
			Cs-137	16.3 $\pm$ 0.6	15.0 $\pm$ 5.0	6.3-23.7
			K-40	927 $\pm$ 46	950 $\pm$ 144	701-1199
STW-448	Water	Feb 1986	Cr-51	45.0 $\pm$ 3.6	38.0 $\pm$ 5.0	29.3-46.7
			Co-60	19.7 $\pm$ 1.5	18.0 $\pm$ 5.0	9.3-26.7
			Zn-65	44.0 $\pm$ 3.5	40.0 $\pm$ 5.0	31.3-48.7
			Ru-106	<9.0	0.0 $\pm$ 5.0	0.0-8.7
			Cs-134	28.3 $\pm$ 2.3	30.0 $\pm$ 5.0	21.3-38.7
			Cs-137	23.7 $\pm$ 0.6	22.0 $\pm$ 5.0	13.3-30.7
STW-449	Water	Feb 1986	H-3	5176 $\pm$ 48	5227 $\pm$ 525	4317-6137
STW-450	Water	Feb 1986	U total	8.0 $\pm$ 0.0	9.0 $\pm$ 6.0	0.0-19.4
STW-451	Milk	Feb 1986	I-131	7.0 $\pm$ 0.0	9.0 $\pm$ 6.0	0.0-19.4
STW-452	Water	March 1986	Ra-226	3.8 $\pm$ 0.1	4.1 $\pm$ 0.6	3.0-5.2
			Ra-228	11.0 $\pm$ 0.5	12.4 $\pm$ 1.8	9.2-15.5
STW-453	Water	March 1986	Gr. alpha	6.7 $\pm$ 0.6	15.0 $\pm$ 5.0	6.3-23.7
			Gr. beta	7.3 $\pm$ 0.6	8.0 $\pm$ 5.0	0.0-16.7
STW-454	Water	April 1986	I-131	7.0 $\pm$ 0.0	9.0 $\pm$ 6.0	0.0-19.4
STW-455 456	Water (Blind)	April 1986				
	Sample A		Gr. alpha	15.0 $\pm$ 1.0	17.0 $\pm$ 5.0	8.3-25.7
			Ra-226	3.1 $\pm$ 0.1	2.9 $\pm$ 0.4	2.1-3.7
			Ra-228	1.5 $\pm$ 0.2	2.0 $\pm$ 0.3	1.5-2.5
			Uranium	4.7 $\pm$ 0.6	5.0 $\pm$ 6.0	0.0-15.4
	Sample B		Gr. beta	28.7 $\pm$ 1.2	35.0 $\pm$ 5.0	26.3-43.7
			Sr-89	5.7 $\pm$ 0.6	7.0 $\pm$ 5.0	0.0-15.7
			Sr-90	7.0 $\pm$ 0.0	7.0 $\pm$ 1.5	4.4-9.6
			Co-60	10.7 $\pm$ 1.5	10.0 $\pm$ 5.0	1.3-18.7
			Cs-134	4.0 $\pm$ 1.7	5.0 $\pm$ 5.0	0.0-13.7
			Cs-137	5.3 $\pm$ 0.6	5.0 $\pm$ 5.0	0.0-13.7

Table A-1. (continued)

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/lb		
				TLM Result $\pm 2\sigma^C$	EPA Result ^a Is, N=1	Control Limits
STAF-457	Air Filter	April 1986	Gr. alpha	13.7 $\pm$ 0.6	15.0 $\pm$ 5.0	6.3-23.7
			Gr. beta	46.3 $\pm$ 0.6	47.0 $\pm$ 5.0	38.3-55.7
			Sr-90	14.7 $\pm$ 0.6	18.0 $\pm$ 1.5	15.4-20.6
			Cs-137	10.7 $\pm$ 0.6	10.0 $\pm$ 5.0	1.3-18.7
STU-458	Urine	April 1986	Tritium	4313 $\pm$ 70	4423 $\pm$ 189	4096-4750
STW-459	Water	May 1986	Sr-89	4.3 $\pm$ 0.6	5.0 $\pm$ 5.0	0.0-13.7
			Sr-90	5.0 $\pm$ 0.0	5.0 $\pm$ 1.5	2.4-7.6
STW-460	Water	May 1986	Gr. alpha	5.3 $\pm$ 0.6	8.0 $\pm$ 5.0	0.0-16.7
			Gr. beta	11.3 $\pm$ 1.2	15.0 $\pm$ 5.0	6.3-23.7
STW-461	Water	June 1986	Cr-51	<9.0	0.0 $\pm$ 5.0	0.0-8.7
			Co-60	66.0 $\pm$ 1.0	66.0 $\pm$ 5.0	57.3-74.7
			Zn-65	87.3 $\pm$ 1.5	85.0 $\pm$ 5.0	77.3-94.7
			Ru-106	39.7 $\pm$ 2.5	50.0 $\pm$ 5.0	41.3-58.7
			Cs-134	49.3 $\pm$ 2.5	49.0 $\pm$ 5.0	40.3-57.7
			Cs-137	10.3 $\pm$ 1.5	10.0 $\pm$ 5.0	1.3-18.7
STW-462	Water	June 1986	Tritium	3427 $\pm$ 25	3125 $\pm$ 361	2499-3751
STM-464	Milk	June 1986	Sr-89	<1.0	0.0 $\pm$ 5.0	0.0-8.7
			Sr-90	15.3 $\pm$ 0.6	16.0 $\pm$ 1.5	13.4-18.6
			I-131	48.3 $\pm$ 2.3	41.0 $\pm$ 6.0	30.6-51.4
			Cs-137	43.7 $\pm$ 1.5	31.0 $\pm$ 5.0	22.3-39.7
			K-40	1567 $\pm$ 114	1600 $\pm$ 80	1461-1739
STW-465	Water	July 1986	Gr. alpha	4.7 $\pm$ 0.6	6.0 $\pm$ 5.0	0.0-14.7
			Gr. beta	18.7 $\pm$ 1.2	18.0 $\pm$ 5.0	9.3-26.7
STW-467	Water	August 1986	I-131	30.3 $\pm$ 0.6	45.0 $\pm$ 6.0	34.4-55.4
STW-468	Water	August 1986	Pu-239	11.3 $\pm$ 0.6	10.1 $\pm$ 1.0	8.3-11.9
STW-469	Water	August 1986	Uranium	4.0 $\pm$ 0.0	4.0 $\pm$ 6.0	0.0-14.4
STAF-470 471 472	Air Filter	Sept 1986	Gr. alpha	19.3 $\pm$ 1.5	22.0 $\pm$ 5.0	13.3-30.7
			Gr. beta	64.0 $\pm$ 2.6	66.0 $\pm$ 5.0	57.3-74.7
			Sr-90	22.0 $\pm$ 1.0	22.0 $\pm$ 5.0	19.4-24.6
			Cs-137	25.7 $\pm$ 1.5	22.0 $\pm$ 5.0	13.3-30.7
STW-473	Water	Sept 1986	Ra-226	6.0 $\pm$ 0.1	6.1 $\pm$ 0.9	4.5-7.7
			Ra-228	8.7 $\pm$ 1.1	9.1 $\pm$ 1.4	6.7-11.5

Table A-1. (continued).

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/lb		
				TIML Result $\pm 2\sigma$	EPA Result 1s, N=1	Control Limits
STW-474	Water	Sept 1986	Gr. alpha	16.3 $\pm$ 3.2	15.0 $\pm$ 5.0	6.3-23.7
			Gr. beta	9.0 $\pm$ 1.0	8.0 $\pm$ 5.0	0.0-16.7
STW-475	Water	Oct 1986	Cr-51	63.3 $\pm$ 5.5	59.0 $\pm$ 5.0	50.3-67.7
			Co-60	31.0 $\pm$ 2.0	31.0 $\pm$ 5.0	22.3-39.7
			Zn-65	87.3 $\pm$ 5.9	85.0 $\pm$ 5.0	76.3-93.7
			Ru-106	74.7 $\pm$ 7.4	74.0 $\pm$ 5.0	65.3-82.7
			Cs-134	25.7 $\pm$ 0.6	28.0 $\pm$ 5.0	19.3-36.7
			Cs-137	46.3 $\pm$ 1.5	44.0 $\pm$ 5.0	35.3-52.7
STW-476	Water	Oct 1986	H-3	5918 $\pm$ 60	5973 $\pm$ 597	4938-7008
SPW-477 478	Water (Blind)	Oct 1986				
	Sample A		Gr. alpha	34.0 $\pm$ 6.0	40.0 $\pm$ 5.0	31.3-48.7
			Ra-226	5.8 $\pm$ 0.2	6.0 $\pm$ 0.9	4.4-7.6
			Ra-228	2.7 $\pm$ 1.0	5.0 $\pm$ 0.8	3.7-6.3
			Uranium	11.0 $\pm$ 0.0	10.0 $\pm$ 6.0	0.0-20.4
	Sample B		Gr. beta	38.7 $\pm$ 1.2	51.0 $\pm$ 5.0	42.3-59.7
			Sr-89	5.0 $\pm$ 0.0	10.0 $\pm$ 5.0	1.3-18.7
			Sr-90	3.0 $\pm$ 0.0	4.0 $\pm$ 1.5	1.4-6.6
			Co-60	24.7 $\pm$ 1.2	24.0 $\pm$ 5.0	15.3-32.7
			Cs-134	11.0 $\pm$ 2.0	12.0 $\pm$ 5.0	3.3-20.7
			Cs-137	9.3 $\pm$ 1.2	8.0 $\pm$ 5.0	0.0-16.7
STM-479	Milk	Nov 1986	Sr-89	7.7 $\pm$ 1.2	9.0 $\pm$ 5.0	0.3-17.7
			Sr-90	1.0 $\pm$ 0.0	0.0 $\pm$ 1.5	0.0-2.6
			I-131	52.3 $\pm$ 3.1	49.0 $\pm$ 6.0	38.6-59.4
			Cs-137	45.7 $\pm$ 3.1	39.0 $\pm$ 5.0	30.3-47.7
			K-40	1489 $\pm$ 104	1565 $\pm$ 78	1430-1700
STU-480	Urine	Nov 1986	H-3	5540 $\pm$ 26	5257 $\pm$ 912	4345-6169
STW-481	Water	Nov 1986	Gr. alpha	12.0 $\pm$ 4.0	20.0 $\pm$ 5.0	11.3-28.7
			Gr. beta	20.0 $\pm$ 3.5	20.0 $\pm$ 5.0	11.3-28.7
STW-482	Water	Dec 1986	Ra-226	6.7 $\pm$ 0.2	6.8 $\pm$ 1.0	5.0-8.6
			Ra-228	5.2 $\pm$ 0.2	11.1 $\pm$ 1.7	8.2-14.0
STW-483	Water	Jan 1987	Sr-89	19.7 $\pm$ 5.0	25.0 $\pm$ 5.0	16.3-33.7
			Sr-90	21.0 $\pm$ 2.0	25.0 $\pm$ 1.5	22.4-27.6

Table A-1. (continued).

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/lb		
				TIML Result $\pm 2\sigma^C$	EPA Result Is, N=1	Control Limits
STW-484	Water	Jan 1987	Pu-239	17.0 $\pm$ 2.3	16.7 $\pm$ 1.7	13.8-19.6
STF-486	Food	Jan 1987	Sr-90	36.0 $\pm$ 4.0	49.0 $\pm$ 10.0	31.7-66.3
			I-131	78.0 $\pm$ 3.4	78.0 $\pm$ 8.0	64.1-91.9
			Cs-137	89.7 $\pm$ 3.0	84.0 $\pm$ 5.0	75.3-92.7
			K-40	942 $\pm$ 56	980 $\pm$ 49	895-1065
STF-487	Food (Blank)	Jan 1987	SR-90	2.0 $\pm$ 0.0	---	---
			I-131	<3	---	---
			Cs-137	<2	---	---
			K-40	993 $\pm$ 102	---	---
STW-488	Water	Feb 1987	Co-60	49.0 $\pm$ 0.0	50.0 $\pm$ 5.0	41.3-58.7
			Zn-65	96.0 $\pm$ 7.2	91.0 $\pm$ 5.0	82.3-99.7
			Ru-106	92.0 $\pm$ 20.2	100.0 $\pm$ 5.0	91.3-108.7
			Cs-134	53.0 $\pm$ 3.4	59.0 $\pm$ 5.0	50.3-67.7
			Cs-137	89.3 $\pm$ 4.6	37.0 $\pm$ 5.0	78.3-95.7
STW-489	Water	Feb 1987	H-3	4130 $\pm$ 140	4209 $\pm$ 420	3479-4939
STW-490	Water	Feb 1987	Uranium	8.3 $\pm$ 1.2	8.0 $\pm$ 6.0	0.0-18.4
STM-491	Milk	Feb 1987	I-131	10.0 $\pm$ 0.0	9.0 $\pm$ 0.9	7.4-10.6
STW-492	Water	Mar 1987	Gr. alpha	3.7 $\pm$ 1.2	3.0 $\pm$ 5.0	0.0-11.7
			Gr. beta	11.3 $\pm$ 1.2	13.0 $\pm$ 5.0	4.3-21.7
STW-493	Water	Mar 1987	Ra-226	7.0 $\pm$ 0.1	7.3 $\pm$ 1.1	5.4-9.2
			Ra-228	7.1 $\pm$ 2.3	7.5 $\pm$ 1.1	5.5-9.5
STW-494	Water	Apr 1987	I-131	8.0 $\pm$ 0.0	7.0 $\pm$ 0.7	5.8-8.2
STAF-495	Air Filter	Apr 1987	Gr. alpha	15.0 $\pm$ 0.0	14.0 $\pm$ 5.0	5.3-22.7
			Gr. beta	41.0 $\pm$ 2.0	43.0 $\pm$ 5.0	34.3-51.7
			Sr-90	16.3 $\pm$ 1.2	17.0 $\pm$ 1.5	14.4-19.6
			Cs-137	7.0 $\pm$ 0.0	8.0 $\pm$ 5.0	0.0-16.7
STW-496 497	Water (Blind)	Apr 1987				
	Sample A		Gr. alpha	30.7 $\pm$ 1.2	30.0 $\pm$ 8.0	16.1-43.9
			Ra-226	3.9 $\pm$ 0.2	3.9 $\pm$ 0.6	2.9-4.9
			Ra-228	4.9 $\pm$ 0.9	4.0 $\pm$ 0.6	3.0-5.0
			Uranium	5.0 $\pm$ 0.0	5.0 $\pm$ 5.0	0.0-15.4

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-496 497	Water (Blind)	Apr 1987				
	Sample B		Gr. Beta	69.3 $\pm$ 9.4	66.0 $\pm$ 5.0	57.3-74.7
			Sr-89	16.3 $\pm$ 3.0	19.0 $\pm$ 5.0	10.3-27.7
			Sr-90	10.0 $\pm$ 0.0	10.0 $\pm$ 1.5	7.4-12.6
			Co-60	8.3 $\pm$ 3.0	8.0 $\pm$ 5.0	0.0-16.7
			Cs-134	19.0 $\pm$ 2.0	20.0 $\pm$ 5.0	11.3-28.7
			Cs-137	14.7 $\pm$ 1.2	15.0 $\pm$ 5.0	6.3-23.7
STU-498	Urine	Apr 1987	H-3	6017 $\pm$ 494	5620 $\pm$ 795	4647-6593
STW-499	Water	May 1987	Sr-89	38.0 $\pm$ 6.0	41.0 $\pm$ 5.0	32.3-49.7
			Sr-90	21.0 $\pm$ 2.0	20.0 $\pm$ 1.5	17.4-22.6
STW-500	Water	May 1987	Gr. alpha	9.0 $\pm$ 3.4	11.0 $\pm$ 5.0	2.3-19.7
			Gr. beta	10.3 $\pm$ 1.2	7.0 $\pm$ 5.0	0.0-15.7
STW-501	Water	June 1987	Cr-51	40.0 $\pm$ 8.0	41.0 $\pm$ 5.0	32.3-49.7
			Co-60	60.3 $\pm$ 3.0	64.0 $\pm$ 5.0	55.3-72.7
			Zn-65	11.3 $\pm$ 5.0	10.0 $\pm$ 5.0	1.3-18.7
			Ru-106	78.3 $\pm$ 6.4	75.0 $\pm$ 5.0	66.3-83.7
			Cs-134	36.7 $\pm$ 3.0	40.0 $\pm$ 5.0	31.3-48.7
			Cs-137	80.3 $\pm$ 4.2	80.0 $\pm$ 5.0	71.3-88.7
STW-502	Water	June 1987	H-3	2906 $\pm$ 86	2895 $\pm$ 357	2277-3513

^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, which are in mg/l; air filter samples, which are in pCi/filter; and food, which is in pCi/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.

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

Lab Code	TLD Type	Measurement	mR		
			Teledyne Result $\pm 2\sigma^a$	Known Value ^c	Average $\pm 2\sigma^d$ (all participants)
<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

Table A-2. (continued)

Lab Code	TLD Type	Measurement	Teledyne	mR	Average $\pm 2\sigma^d$
			Result $\pm 2\sigma^a$	Known Value ^c	(all participants)
115-58	LiF-100 Chips	Field	30.3 $\pm$ 4.8	30.0 $\pm$ 6.0	30.2 $\pm$ 14.6
		Lab 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 Intercomparison^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	77.9 $\pm$ 27.6
		Lab (Cs-137)	66.6 $\pm$ 2.5	75.0 $\pm$ 3.8	73.0 $\pm$ 22.2
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

Table A-2. (Continued)

Lab Code	TLD Type	Measurement	mR		
			Teledyne Result $\pm 2\sigma^a$	Known Value ^c	Average $\pm 2\sigma^d$ (all participants)
8th International Intercomparison ¹					
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 $\pm$ 9.0 ^b
		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	32.3 $\pm$ 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

^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	1.6±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	3.7
			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±1.9	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

^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)	Acceptance Criteria (4.66σ)
BL-1	D.I. Water	Nov. 1985	Gross alpha Gross beta	<0.1 <0.4	<1 <4
BL-2	D.I. Water	Nov. 1985	Cs-137 (gamma)	<1.9	<10
BL-3	D.I. Water	Nov. 1985	Sr-89 Sr-90	<0.5 <0.6	<5 <1
BL-5	D.I. Water	Nov. 1985	Ra-226 Ra-228	<0.4 <0.4	<1 <1
SPW-2265	D.I. Water	Apr. 1985	Gross alpha Gross beta Sr-89 Sr-90 I-131 Cs-137 (gamma)	<0.6 <2.2 <0.2 <0.4 <0.2 <7.4	<1 <4 <5 <1 <1 <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
SPS-3292	Milk	Jan 1987	I-131 Cs-134 Cs-137	<0.1 <6.2 <6.4	<1 <10 <10
SPW-3554	D.I. Water	Feb 1987	H-3 Gross beta	<180 <2.6	<300 <4
SPS-3555	Milk	Feb 1987	Sr-89 Sr-90	<0.6 1.9±0.4 ^a	<5 <1
SPS-3731	Milk	Mar 1987	Cs-134 Cs-137	<2.2 <2.5	<10 <10

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

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/l	
				Results (4.66 σ)	Acceptance Criteria (4.66 σ)
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(G)	<2.2	<10
			Cs-137(G)	<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 $\pm$ 0.6 ^a	<1
SPS-4390	Milk	June 1987	Cs-134	<4.7	<10
			Cs-137	<5.2	<10
SPS-4391	D.I. Water	June 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

^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 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, 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.

Appendix B
Data Reporting Conventions

Data Reporting Conventions

1.0. All activities are decay corrected to collection time.

2.0. Single Measurements

Each single measurement is reported as follows:

$$x \pm s$$

where x = value of the measurement;

s = 2σ 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 $x_1, x_2, \dots, x_n$ are defined as follows:

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

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

- 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.



4 Leash
Squares
100-100
100



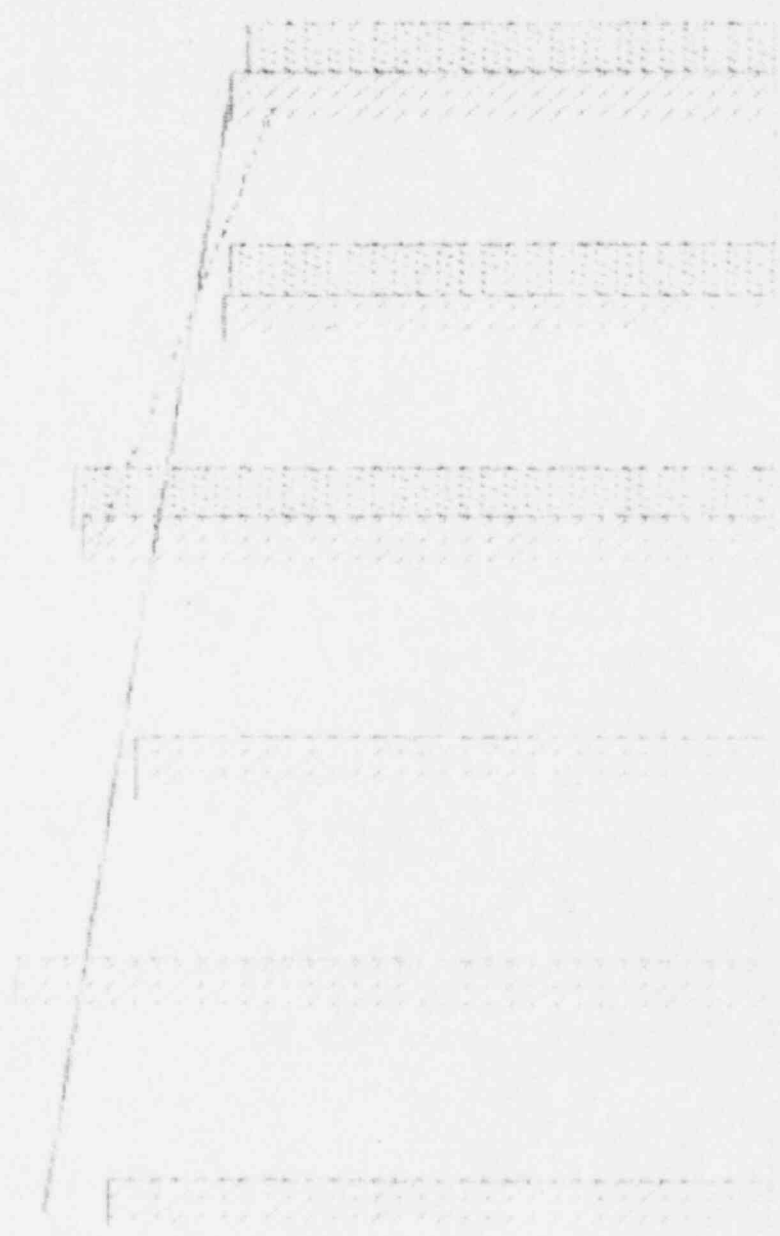
100

100

100

100

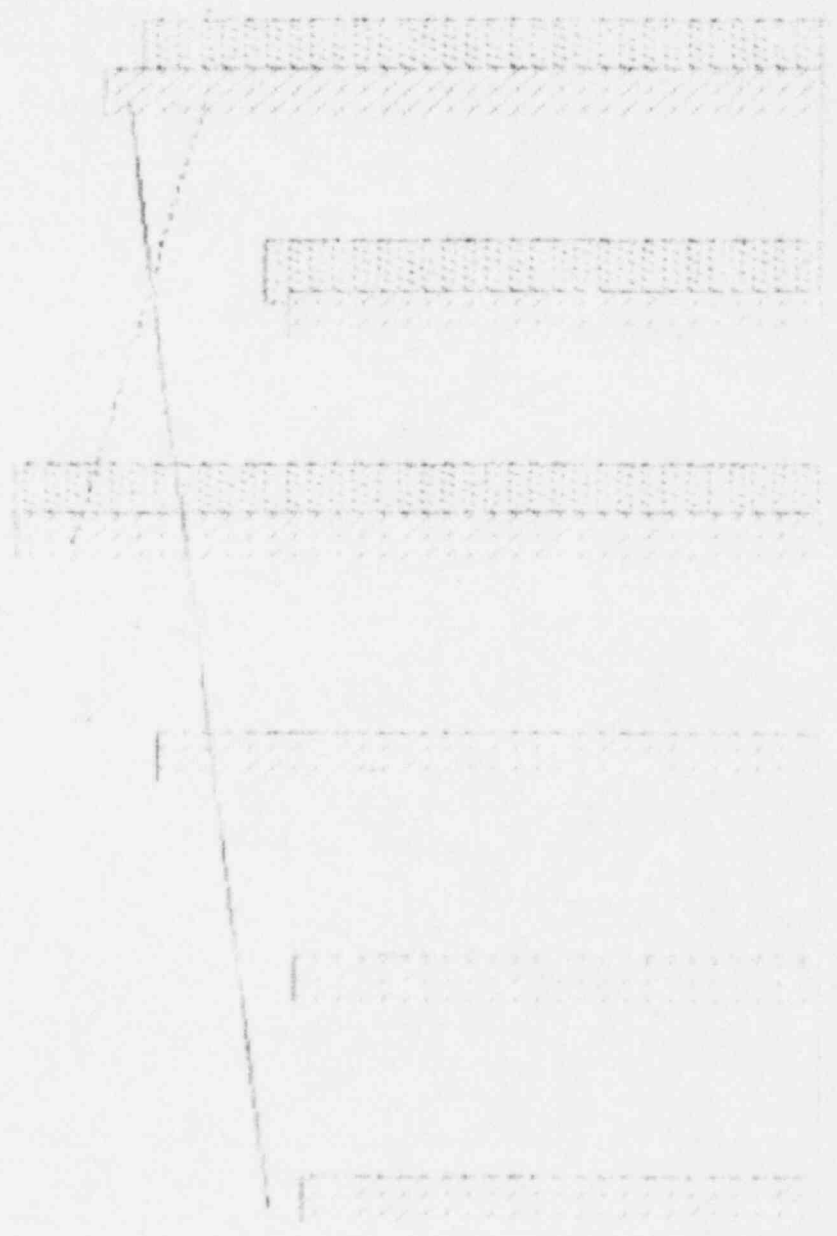
1600
SQUID
1954-1955
1956



1

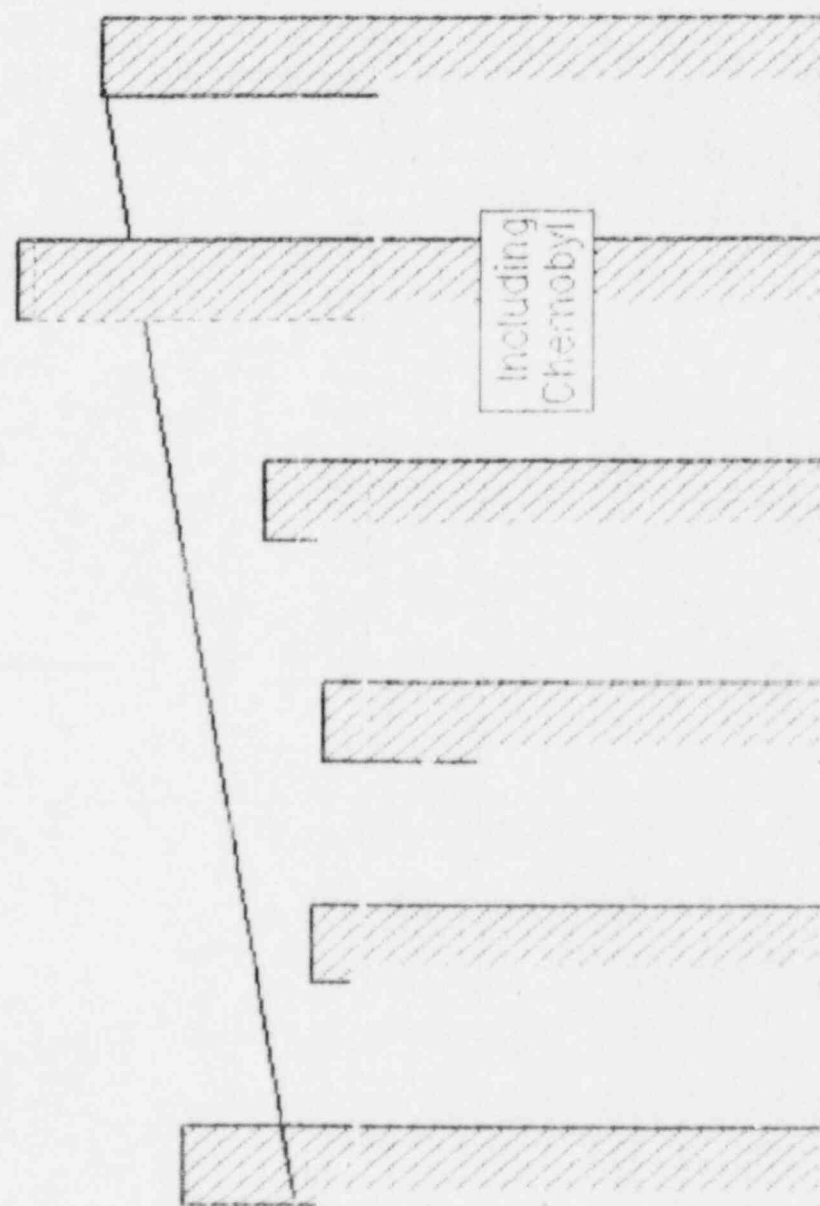
2

Lead
Squid
Light
Fire





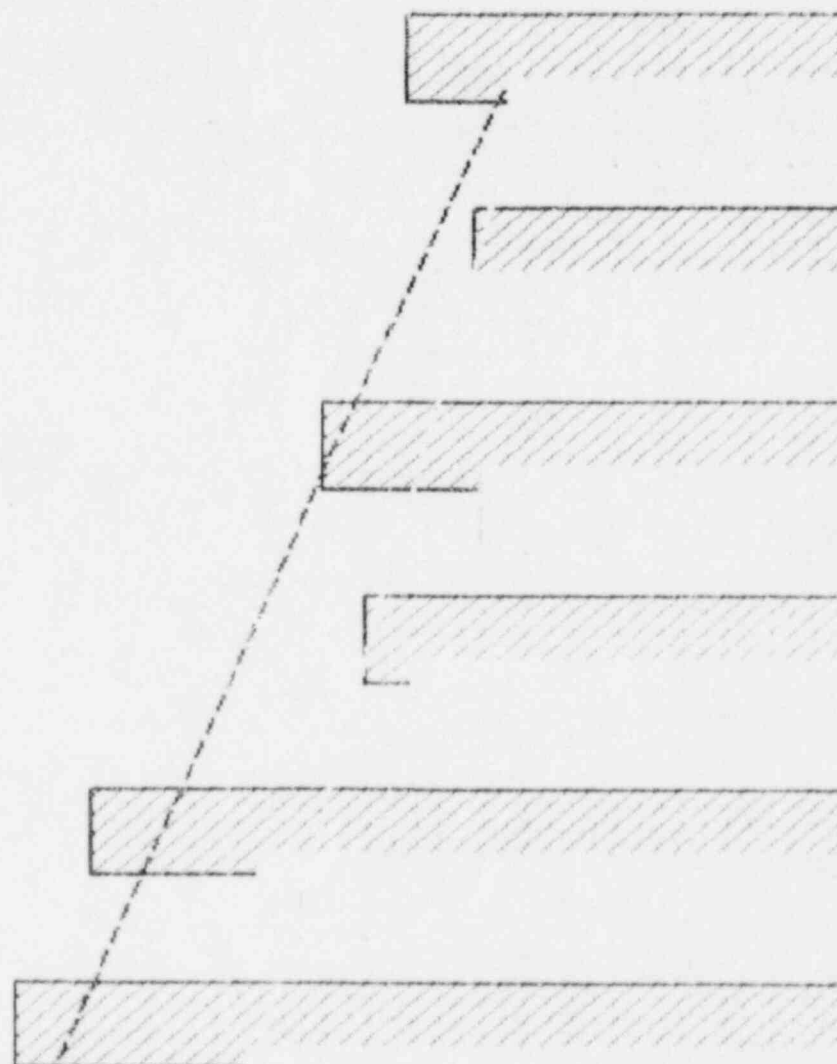
POLYMER
 ANALYSIS
 BY
 INFRARED SPECTROSCOPY



Including
 Chernobyl

* Least
 Squares
 Best-Fit
 line





* Least
Squares
Best-Fit
line

*



Bar/Line

Action Level



0 10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90 100

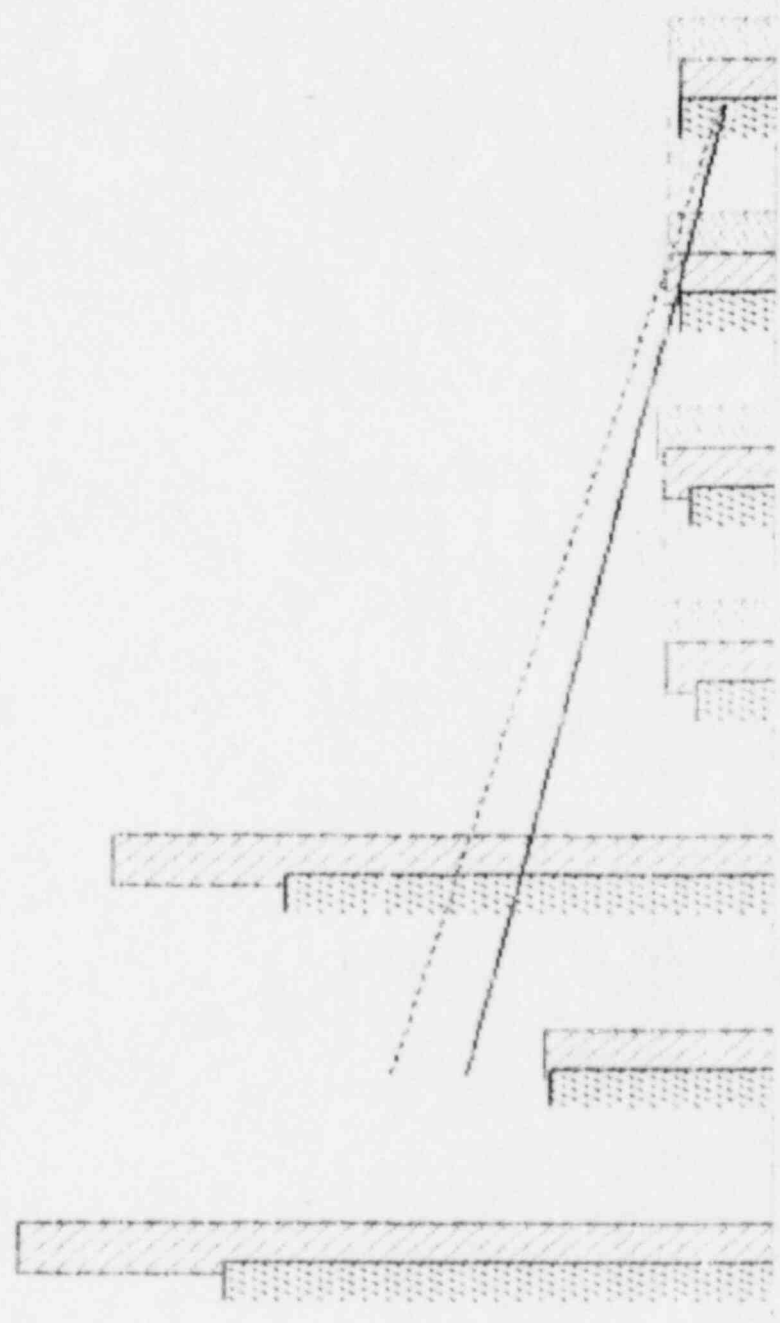
0 10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90 100

PCL/gm (wt)



* Least
Squares
Best-Fit
line

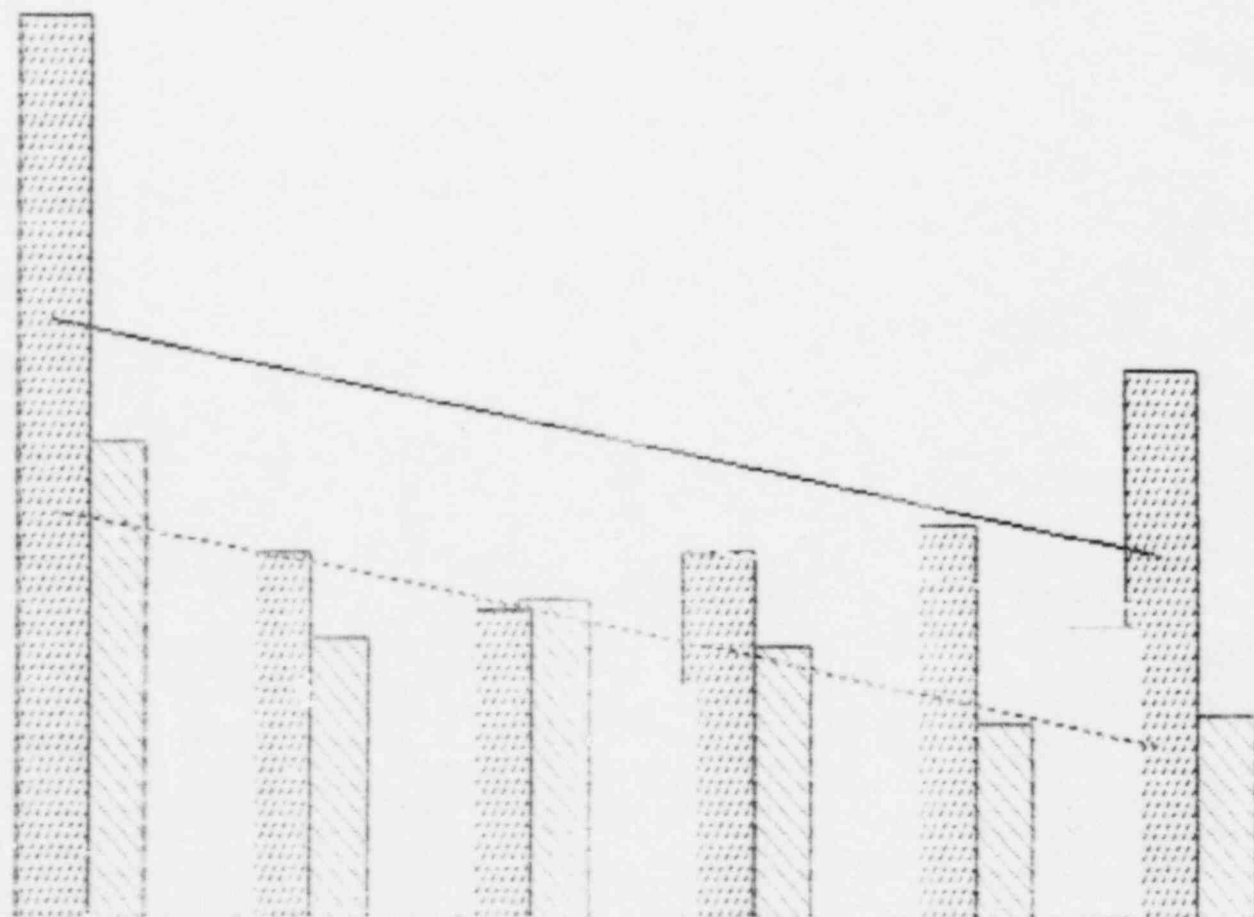
Legend symbols: a box with diagonal lines, a box with dots, a box with cross-hatching, a solid line, a dashed line, and a star symbol.

Action Level



DOI/200 (2001)

PCI/RAI (wet)

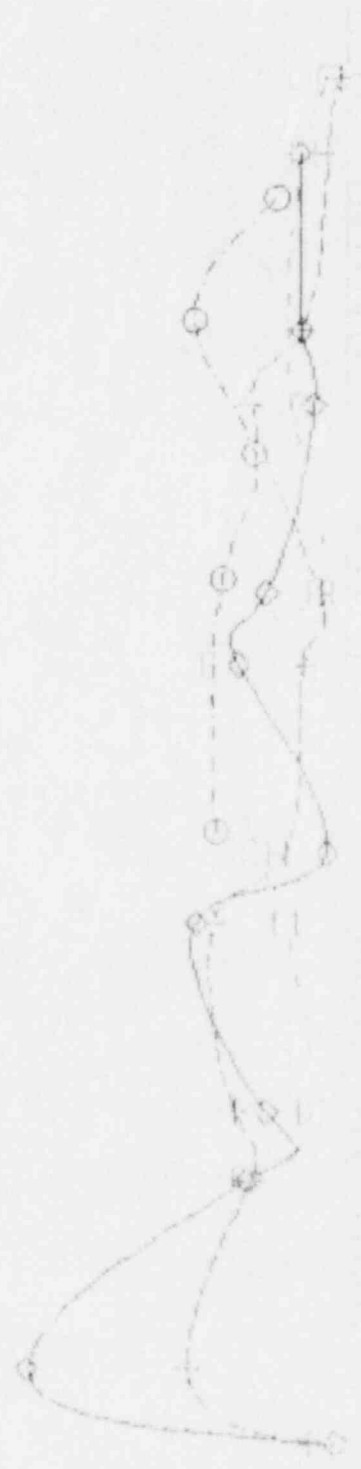


* Least
Squares
Best-Fit
line



Action Level

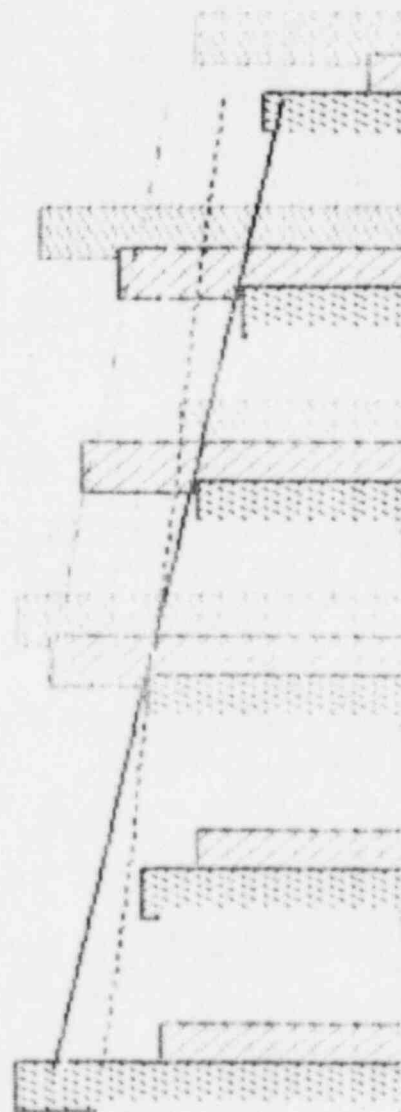
PCI/EMI (WGL)



Legend:
 - - - - - PCI/EMI (WGL)
 - - - - - PCI/EMI (WGL)

49.8
116.4

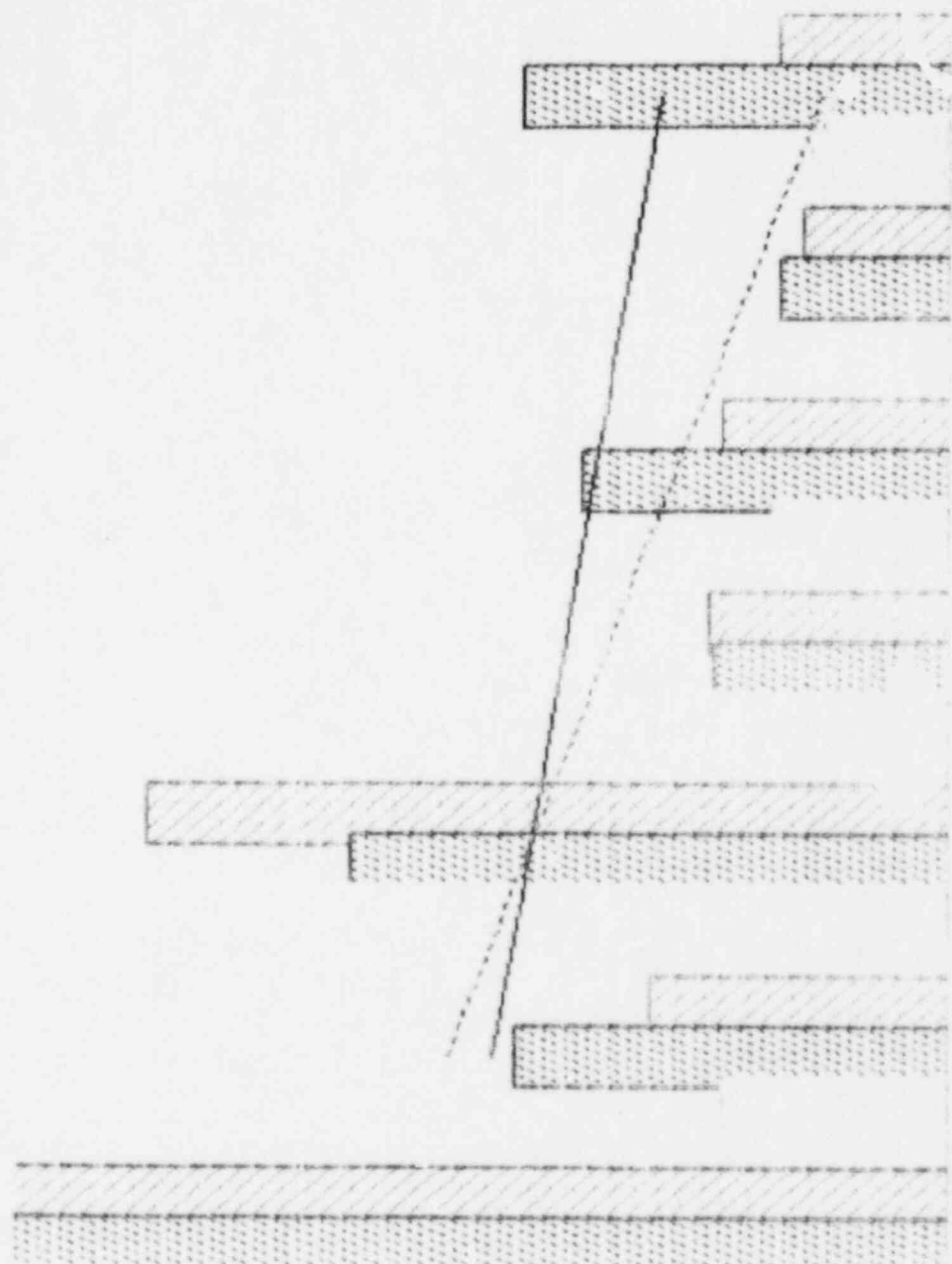
PCF/STC (WGL)



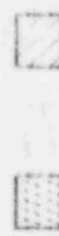
* Least
Squares
Best-Fit
line

Line Type *

24.1
25.8



* Least
Squares
Best-Fit
line

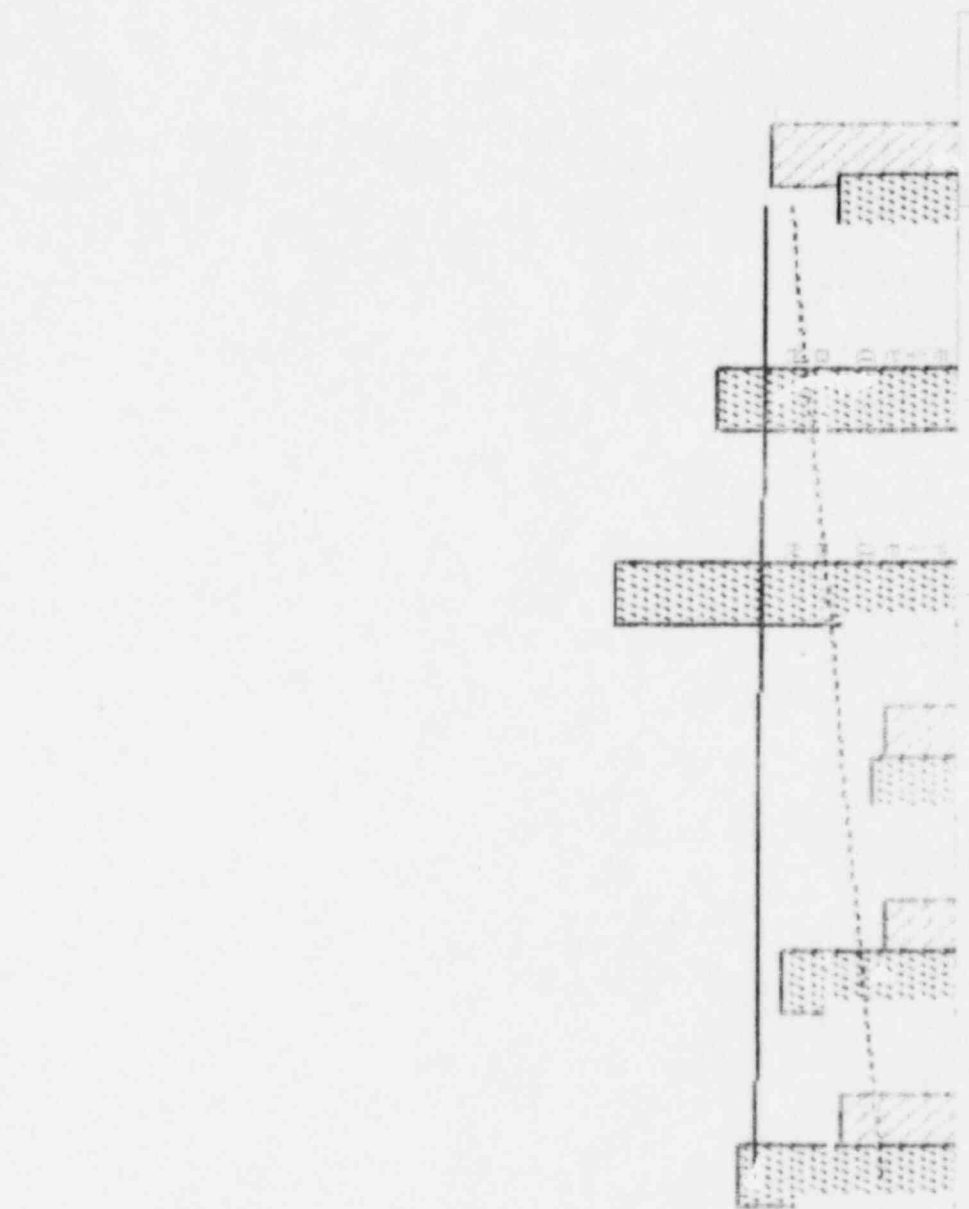




1

2

79.4
45.8



* Least
Squares
Best-Fit
line



* --- * --- *