

**TABLE C-10      GAMMA SPECTROSCOPIC ANALYSES OF SOIL  
SUSQUEHANNA STEAM ELECTRIC STATION**

Results in pCi/kg (dry)  $\pm$  2 sigma

SITE	COLLECTION PERIOD	K-40	Cs-134	Cs-137	Ra-226	Ac-228	Th-228
8G1	09/18/13	12980 $\pm$ 1485	< 68	< 73	2644 $\pm$ 1468	1143 $\pm$ 255	1018 $\pm$ 116
	09/18/13	10560 $\pm$ 1215	< 70	< 74	2708 $\pm$ 1346	952 $\pm$ 297	913 $\pm$ 115
	09/18/13	10410 $\pm$ 1261	< 60	< 77	< 1540	806 $\pm$ 252	758 $\pm$ 115
	AVERAGE	11317 $\pm$ 2885	-	-	2676 $\pm$ 91	967 $\pm$ 338	896 $\pm$ 262
12S1	09/18/13	12250 $\pm$ 1276	< 57	< 66	2287 $\pm$ 1261	887 $\pm$ 240	917 $\pm$ 99
	09/18/13	13980 $\pm$ 1491	< 63	131 $\pm$ 72	2648 $\pm$ 1497	1031 $\pm$ 351	1178 $\pm$ 112
	09/18/13	12290 $\pm$ 1189	< 53	< 53	2327 $\pm$ 1104	919 $\pm$ 280	908 $\pm$ 89
	AVERAGE	12840 $\pm$ 1975	-	131 $\pm$ 0	2421 $\pm$ 396	946 $\pm$ 151	1001 $\pm$ 307





TABLE C-11

TRITIUM AND GAMMA SPECTROSCOPIC ANALYSES OF SURFACE WATER  
SUSQUEHANNA STEAM ELECTRIC STATIONResults in pCi/liter  $\pm$  2 sigma

SITE	COLLECTION PERIOD	H-3	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140	Th-228
7S12	02/11/13 - 02/11/13	< 144	< 90	< 9	< 9	< 20	< 9	< 15	< 8	< 14	< 18	< 7	< 7	< 43	< 14	< 10
	05/13/13 - 05/13/13	< 140	< 60	< 6	< 6	< 17	< 6	< 14	< 6	< 12	< 12	< 7	< 7	< 30	< 10	24 $\pm$ 10
	08/01/13 - 08/01/13	< 122	< 40	< 4	< 4	< 10	< 4	< 7	< 4	< 7	< 6	< 4	< 5	< 17	< 5	< 8
	11/04/13 - 11/04/13	< 145	< 53	< 5	< 5	< 18	< 5	< 11	< 7	< 10	< 14	< 5	< 6	< 33	< 13	< 11
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24 $\pm$ 0

TABLE C-12

**GAMMA SPECTROSCOPIC ANALYSIS OF FISH  
SUSQUEHANNA STEAM ELECTRIC STATION**

Results in pCi/kg (wet)  $\pm$  2 sigma

SITE	COLLECTION PERIOD	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Cs-134	Cs-137
<b>2H</b>									
smallmouth bass	05/06/13	3712 $\pm$ 861	< 65	< 63	< 194	< 40	< 120	< 70	< 66
channel catfish	05/06/13	4130 $\pm$ 1047	< 90	< 81	< 192	< 71	< 170	< 88	< 94
shorthead redhorse	05/06/13	3842 $\pm$ 799	< 47	< 48	< 135	< 44	< 115	< 44	< 50
smallmouth bass	10/03/13	3359 $\pm$ 725	< 47	< 50	< 169	< 40	< 102	< 54	< 50
channel catfish	10/03/13	3409 $\pm$ 846	< 54	< 65	< 191	< 42	< 104	< 55	< 56
shorthead redhorse	10/03/13	4069 $\pm$ 930	< 51	< 72	< 185	< 47	< 121	< 56	< 55
shorthead redhorse	10/03/13	3905 $\pm$ 902	< 67	< 70	< 227	< 73	< 131	< 67	< 65
	AVERAGE	3775 $\pm$ 603	-	-	-	-	-	-	-
<b>IND</b>									
smallmouth bass	04/30/13	4687 $\pm$ 1055	< 80	< 69	< 175	< 71	< 132	< 55	< 56
channel catfish	05/01/13	3334 $\pm$ 818	< 74	< 69	< 183	< 51	< 128	< 60	< 63
shorthead redhorse	04/30/13	4917 $\pm$ 1189	< 69	< 63	< 218	< 50	< 124	< 57	< 70
smallmouth bass	10/02/13	3615 $\pm$ 1025	< 70	< 77	< 235	< 70	< 139	< 61	< 67
channel catfish	10/02/13	3261 $\pm$ 918	< 69	< 87	< 226	< 75	< 144	< 67	< 69
shorthead redhorse	10/02/13	3619 $\pm$ 890	< 48	< 65	< 138	< 59	< 87	< 46	< 47
shorthead redhorse	10/02/13	4471 $\pm$ 994	< 61	< 72	< 164	< 72	< 153	< 57	< 58
	AVERAGE	3986 $\pm$ 1370	-	-	-	-	-	-	-
<b>LTAW</b>									
largemouth bass	09/26/13	3925 $\pm$ 786	< 46	< 58	< 190	< 33	< 113	< 47	< 45
	AVERAGE	3925 $\pm$ 0	-	-	-	-	-	-	-

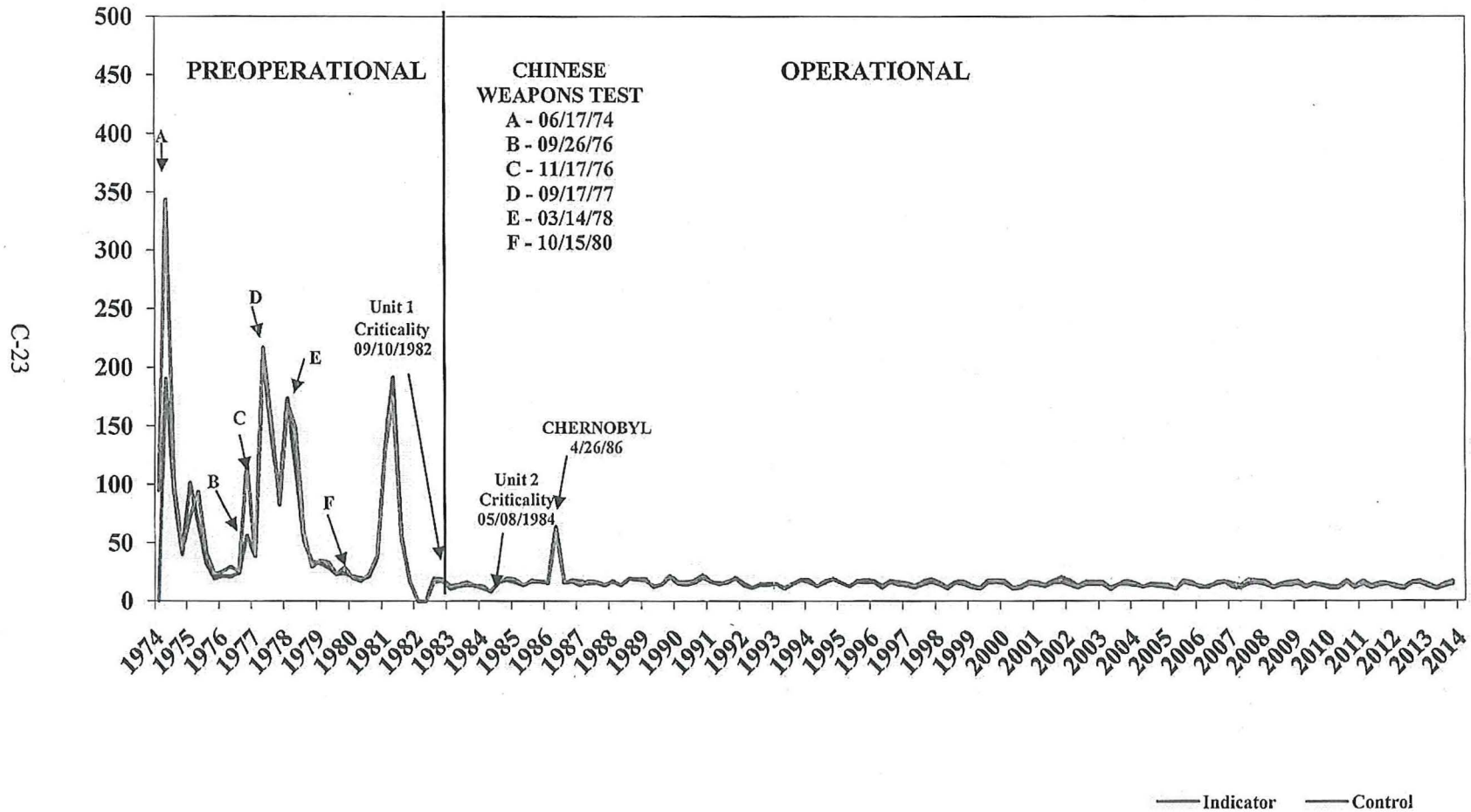
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**TABLE C-13      GAMMA SPECTROSCOPIC ANALYSES OF SHORELINE SEDIMENT  
SUSQUEHANNA STEAM ELECTRIC STATION**

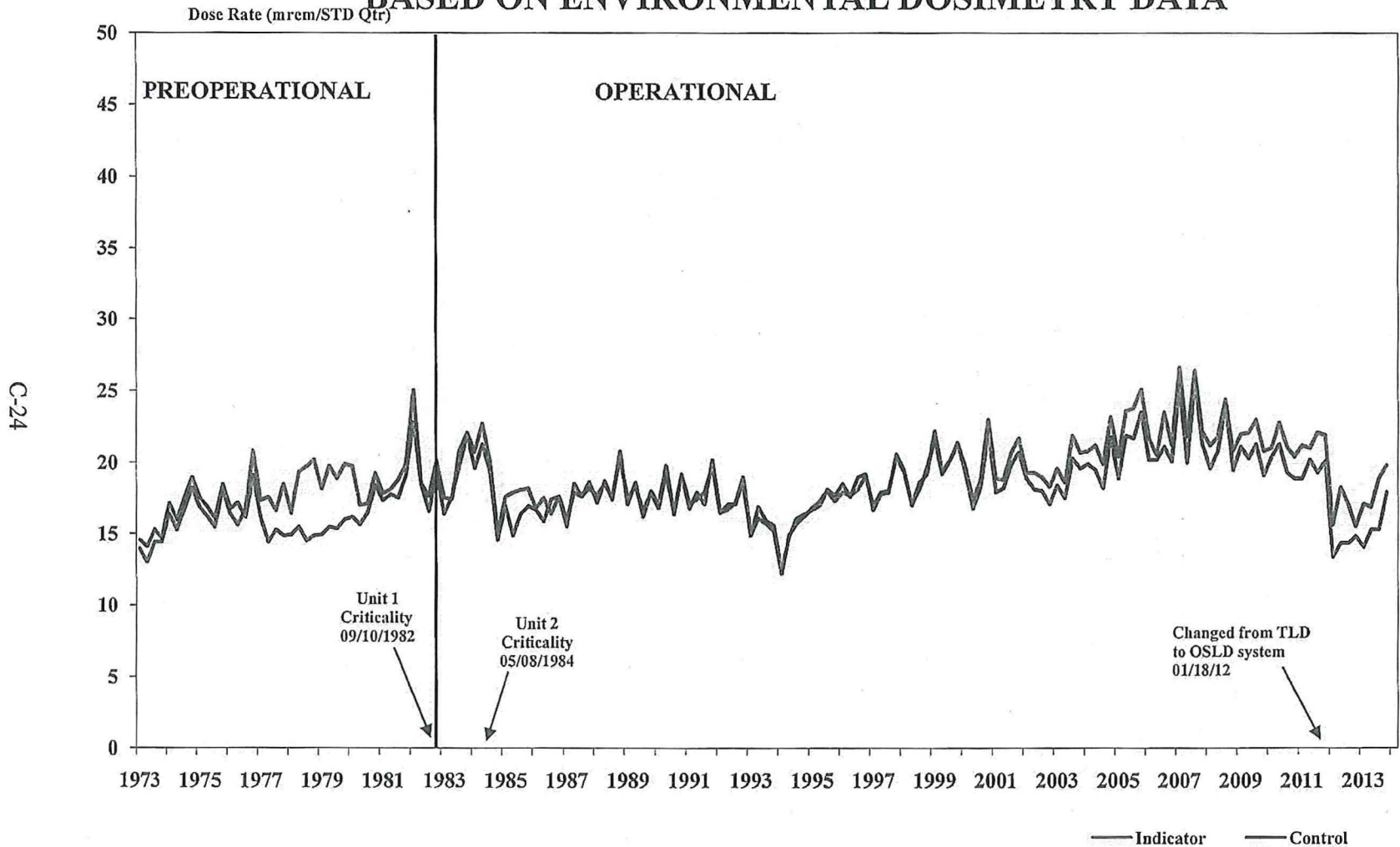
Results in pCi/kg (dry)  $\pm$  2 sigma

SITE	COLLECTION PERIOD	K-40	Cs-134	Cs-137	Ra-226	Ac-228	Th-228
2B	05/06/13	18280 $\pm$ 1643	< 64	< 79	3334 $\pm$ 1428	1211 $\pm$ 307	1507 $\pm$ 114
	10/14/13	19070 $\pm$ 1832	< 67	< 73	3692 $\pm$ 1531	< 560	1521 $\pm$ 125
	AVERAGE	18675 $\pm$ 1117	-	-	3513 $\pm$ 506	1211 $\pm$ 0	1514 $\pm$ 20
7B	05/06/13	12780 $\pm$ 1610	< 65	< 89	2300 $\pm$ 1305	1295 $\pm$ 353	1326 $\pm$ 125
	10/14/13	15740 $\pm$ 1572	< 70	< 73	2399 $\pm$ 1250	1224 $\pm$ 306	1349 $\pm$ 115
	AVERAGE	14260 $\pm$ 4186	-	-	2350 $\pm$ 140	1260 $\pm$ 100	1338 $\pm$ 33
12F	05/06/13	11740 $\pm$ 1226	< 46	< 49	2074 $\pm$ 1207	1104 $\pm$ 274	1238 $\pm$ 112
	05/06/13	8239 $\pm$ 901	< 39	< 45	1415 $\pm$ 811	748 $\pm$ 187	790 $\pm$ 70
	10/14/13	12690 $\pm$ 1410	< 64	< 77	2053 $\pm$ 1163	997 $\pm$ 354	1368 $\pm$ 121
	AVERAGE	10890 $\pm$ 4688	-	-	1847 $\pm$ 749	950 $\pm$ 365	1132 $\pm$ 606

FIGURE C-1 - GROSS BETA ACTIVITY (E-03 pCi/m<sup>3</sup>) IN AIR PARTICULATES

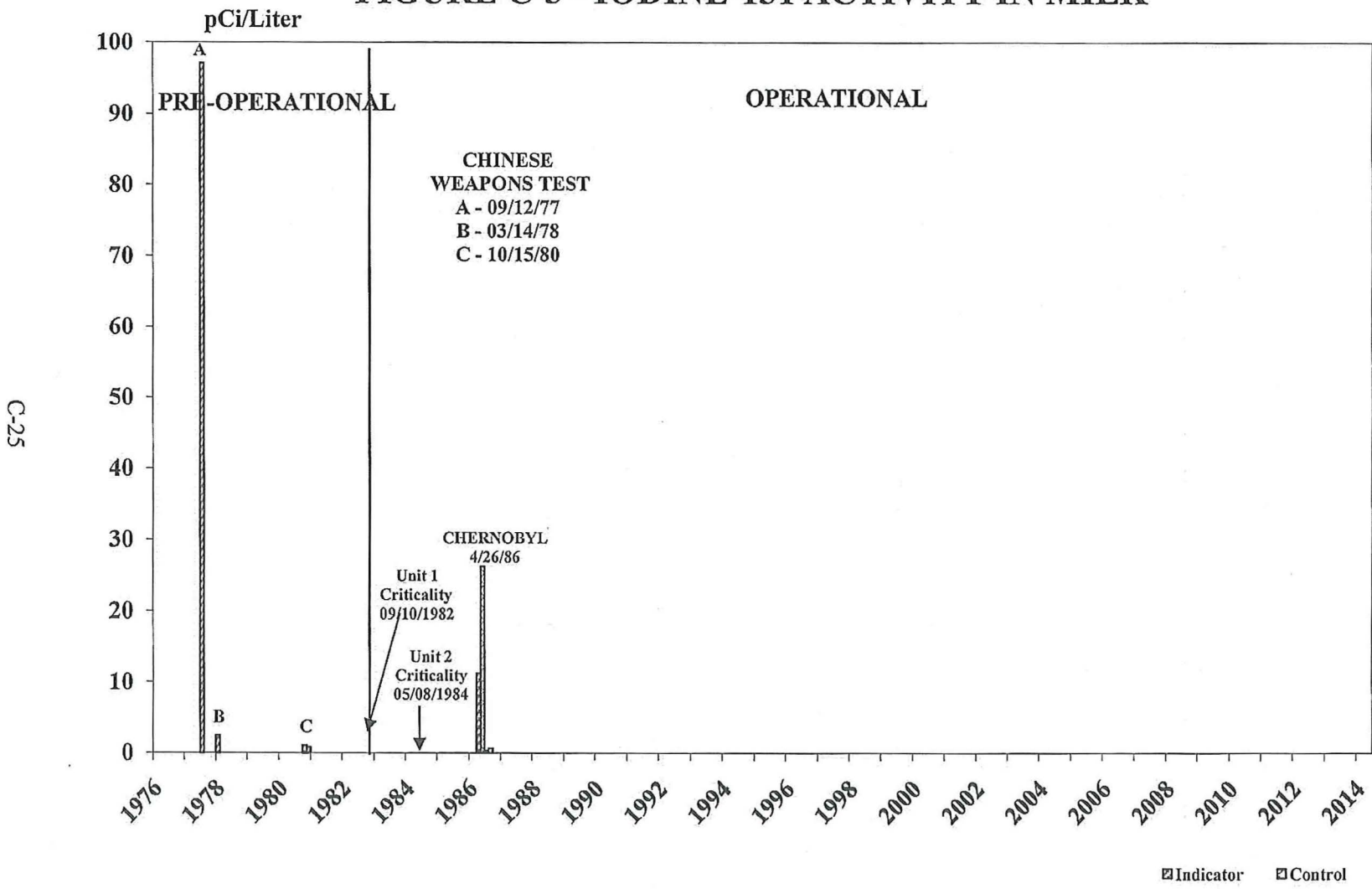


**FIGURE C-2 - AMBIENT RADIATION LEVELS  
BASED ON ENVIRONMENTAL DOSIMETRY DATA**





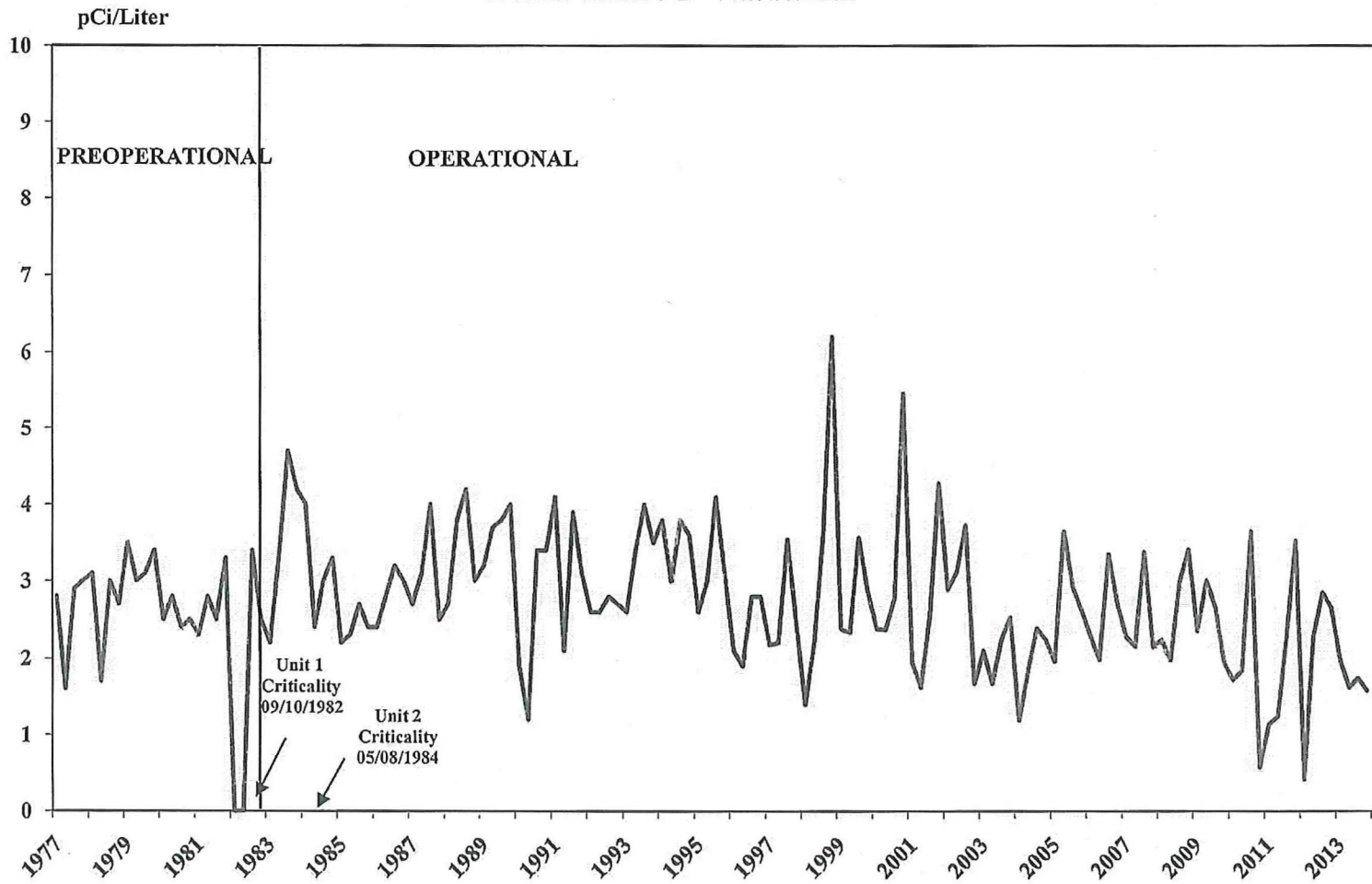
# FIGURE C-3 - IODINE-131 ACTIVITY IN MILK



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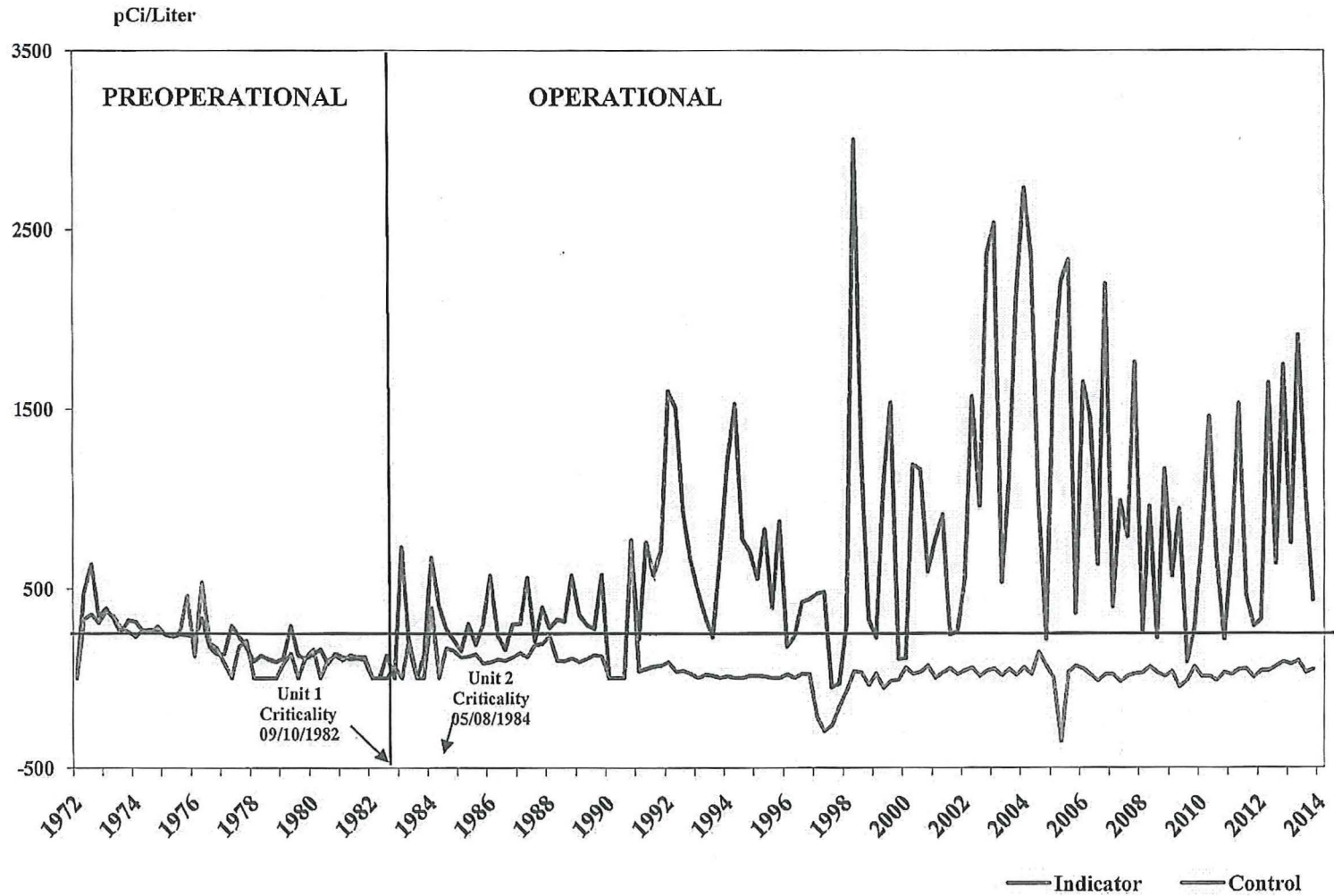


**FIGURE C-5 - GROSS BETA ACTIVITY IN DRINKING WATER**



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# FIGURE C-6 - TRITIUM ACTIVITY IN SURFACE WATER



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## **APPENDIX D**

### **SUMMARY OF RESULTS FROM ANALYTICS, ENVIRONMENTAL RESOURCE ASSOCIATES (ERA), DEPARTMENT OF ENERGY (DOE) – MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP), AND PPL REMP LABORATORY QUALITY CONTROL SPIKE PROGRAM**

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**TABLE D-1**  
**ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM**  
**TELEDYNE BROWN ENGINEERING**  
(PAGE 1 OF 3)

Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)			
March 2013	E10477	Milk	Sr-89	pCi/L	120	99.7	1.20	A			
			Sr-90	pCi/L	9.21	11.0	0.84	A			
March 2013	E10478	Milk	I-131	pCi/L	87.1	100	0.87	A			
			Ce-141	pCi/L	186	187	0.99	A			
			Cr-51	pCi/L	463	472	0.98	A			
			Cs-134	pCi/L	201	214	0.94	A			
			Cs-137	pCi/L	262	266	0.98	A			
			Co-58	pCi/L	200	208	0.96	A			
			Mn-54	pCi/L	215	208	1.03	A			
			Fe-59	pCi/L	266	252	1.06	A			
			Zn-65	pCi/L	311	301	1.03	A			
			Co-60	pCi/L	384	400	0.96	A			
			March 2013	E10480	AP	Ce-141	pCi	95.3	95.6	1.00	A
						Cr-51	pCi	264	241	1.10	A
						Cs-134	pCi	123	109	1.13	A
						Cs-137	pCi	142	136	1.04	A
Co-58	pCi	112				106	1.06	A			
Mn-54	pCi	115				106	1.08	A			
Fe-59	pCi	139				129	1.08	A			
Zn-65	pCi	163				153	1.07	A			
Co-60	pCi	212	204	1.04	A						
March 2013	E10479	Charcoal	I-131	pCi	90.1	92.6	0.97	A			
March 2013	E10481	Water	Fe-55	pCi/L	1840	1890	0.97	A			
June 2013	E10564	Milk	Sr-89	pCi/L	110	95.0	1.16	A			
			Sr-90	pCi/L	15.8	17.0	0.93	A			
June 2013	E10545	Milk	I-131	pCi/L	92.6	95.5	0.97	A			
			Ce-141	pCi/L	83.1	90.4	0.92	A			
			Cr-51	pCi/L	253	250	1.01	A			
			Cs-134	pCi/L	118	125	0.94	A			
			Cs-137	pCi/L	143	151	0.95	A			
			Co-58	pCi/L	87.1	94.0	0.93	A			
			Mn-54	pCi/L	171	172	0.99	A			
			Fe-59	pCi/L	125	120	1.04	A			
			Zn-65	pCi/L	220	217	1.01	A			
			Co-60	pCi/L	169	175	0.97	A			
			June 2013	E10547	AP	Ce-141	pCi	56.8	56.7	1.00	A
						Cr-51	pCi	168	157	1.07	A
						Cs-134	pCi	85.2	78.4	1.09	A
						Cs-137	pCi	101	94.6	1.07	A
Co-58	pCi	62.7				58.9	1.06	A			
Mn-54	pCi	125				108	1.16	A			
Fe-59	pCi	85.7				75.0	1.14	A			
Zn-65	pCi	169				136	1.24	W			
Co-60	pCi	116	110	1.05	A						
June 2013	E10546	Charcoal	I-131	pCi	86.5	89.7	0.96	A			

**TABLE D-1**  
**ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM**  
**TELEDYNE BROWN ENGINEERING**  
(PAGE 2 OF 3)

Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)			
June 2013	E10549	Water	Fe-55	pCi/L	1610	1610	1.00	A			
September 2013	E10646	Milk	Sr-89	pCi/L	63.9	96.0	0.67	N (1)			
			Sr-90	pCi/L	8.88	13.2	0.67	N (1)			
	E10647	Milk	I-131	pCi/L	93.9	98.3	0.96	A			
			Ce-141	pCi/L				NA (2)			
			Cr-51	pCi/L	272	277	0.98	A			
			Cs-134	pCi/L	150	172	0.87	A			
			Cs-137	pCi/L	125	131	0.95	A			
			Co-58	pCi/L	105	108	0.97	A			
			Mn-54	pCi/L	138	139	0.99	A			
			Fe-59	pCi/L	125	130	0.96	A			
			Zn-65	pCi/L	264	266	0.99	A			
			Co-60	pCi/L	187	196	0.95	A			
			E10672	AP	Ce-141	pCi					NA (2)
					Cr-51	pCi	208	223	0.93	A	
					Cs-134	pCi	143	139	1.03	A	
Cs-137	pCi	106			105	1.01	A				
Co-58	pCi	97.0			86.5	1.12	A				
Mn-54	pCi	116			112	1.04	A				
Fe-59	pCi	98.6			105	0.94	A				
Zn-65	pCi	219			214	1.02	A				
Co-60	pCi	166			158	1.05	A				
E10648	Charcoal	I-131	pCi	76.3	71.7	1.06	A				
E10673	Water	Fe-55	pCi/L	1790	1690	1.06	A				
December 2013	E10774	Milk	Sr-89	pCi/L	97.3	93.8	1.04	A			
			Sr-90	pCi/L	13.3	12.9	1.03	A			
	E10775	Milk	I-131	pCi/L	89.7	96.1	0.93	A			
			Ce-141	pCi/L	99.8	110	0.91	A			
			Cr-51	pCi/L	297	297	1.00	A			
			Cs-134	pCi/L	129	142	0.91	A			
			Cs-137	pCi/L	126	126	1.00	A			
			Co-58	pCi/L	116	112	1.04	A			
			Mn-54	pCi/L	167	168	0.99	A			
			Fe-59	pCi/L	117	110	1.06	A			
			Zn-65	pCi/L	757	741	1.02	A			
			Co-60	pCi/L	141	147	0.96	A			
			E10777	AP	Ce-141	pCi	85.1	88.0	0.97	A	
					Cr-51	pCi	278	238	1.17	A	
					Cs-134	pCi	123	114	1.08	A	
Cs-137	pCi	102			101	1.01	A				
Co-58	pCi	84.4			89.9	0.94	A				
Mn-54	pCi	132			135	0.98	A				
Fe-59	pCi	101			88.3	1.14	A				
Zn-65	pCi	506			595	0.85	A				
Co-60	pCi	118			118	1.00	A				



**TABLE D-1**  
**ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM**  
**TELEDYNE BROWN ENGINEERING**  
(PAGE 3 OF 3)

Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)
December 2013	E10776	Charcoal	I-131	pCi	84.7	80.5	1.05	A
	E10778	Water	Fe-55	pCi/L	2010	1910	1.05	A

(1) Milk, Sr-89/90 - The failure was due to analyst error. No client samples were affected by this failure. NCR 13-15

(2) The sample was not spiked with Ce-141.

(a) Teledyne Brown Engineering reported result.

(b) The Analytics known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation.

(c) Ratio of Teledyne Brown Engineering to Analytics results.

(d) Analytics evaluation based on TBE internal QC limits: A= Acceptable, reported result falls within ratio limits of 0.80-1.20. W-Acceptable with warning, reported result falls within 0.70-0.80 or 1.20-1.30. N = Not Acceptable, reported result falls outside the ratio limits of < 0.70 and > 1.30.

**TABLE D-2**  
**ERA ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM**  
**TELEDYNE BROWN ENGINEERING**  
(PAGE 1 OF 1)

Month/Year	Identification Number	Media	Nuclide	Units	Reported Value (a)	Known Value (b)	Acceptance Limits	Evaluation (c)
May 2013	RAD-93	Water	Sr-89	pCi/L	48.3	41.3	31.6 - 48.4	A
			Sr-90	pCi/L	19.3	23.9	17.2 - 28.0	A
			Ba-133	pCi/L	81.9	82.1	69.0 - 90.3	A
			Cs-134	pCi/L	40.9	42.8	34.2 - 47.1	A
			Cs-137	pCi/L	44.0	41.7	37.0 - 48.8	A
			Co-60	pCi/L	61.9	65.9	59.3 - 75.0	A
			Zn-65	pCi/L	202	189	170 - 222	A
			Gr-A	pCi/L	34.2	40.8	21.1 - 51.9	A
			Gr-B	pCi/L	18.0	21.6	13.0 - 29.7	A
			I-131	pCi/L	23.8	23.8	19.7 - 28.3	A
			U-Nat	pCi/L	60.4	61.2	49.8 - 67.9	A
			H-3	pCi/L	3970	4050	3450 - 4460	A
				MRAD-18	Filter	Gr-A	pCi/filter	Lost during processing
November 2013	RAD-95	Water	Sr-89	pCi/L	25.5	21.9	14.4 - 28.2	A
			Sr-90	pCi/L	14.3	18.1	12.8 - 21.5	A
			Ba-133	pCi/L	57.2	54.2	44.7 - 59.9	A
			Cs-134	pCi/L	83.3	86.7	71.1 - 95.4	A
			Cs-137	pCi/L	201	206	185 - 228	A
			Co-60	pCi/L	104	102	91.8 - 114	A
			Zn-65	pCi/L	361	333	300 - 389	A
			Gr-A	pCi/L	29.5	42.8	22.2 - 54.3	A
			Gr-B	pCi/L	30.1	32.2	20.8 - 39.9	A
			I-131	pCi/L	23.1	23.6	19.6 - 28.0	A
			U-Nat	pCi/L	5.53	6.24	4.70 - 7.44	A
			H-3	pCi/L	17650	17700	15500 - 19500	A
				MRAD-19	Filter	Gr-A	pCi/filter	33.0

(a) Teledyne Brown Engineering reported result.

(b) The ERA known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation.

(c) ERA evaluation: A=acceptable. Reported result falls within the Warning Limits. NA=not acceptable. Reported result falls outside of the Control Limits. CE=check for Error. Reported result falls within the Control Limits and outside of the Warning Limit.

**TABLE D-3**  
**DOE'S MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP)**  
**TELEDYNE BROWN ENGINEERING**  
(PAGE 1 OF 2)

Month/Year	Identification Number	Media	Nuclide	Units	Reported Value (a)	Known Value (b)	Acceptance Range	Evaluation (c)
March 2013	13-MaW28	Water	Cs-134	Bq/L	21.0	24.4	17.1 - 31.7	A
			Cs-137	Bq/L	0.0446		(1)	A
			Co-57	Bq/L	28.3	30.9	21.6 - 40.2	A
			Co-60	Bq/L	18.2	19.56	13.69 - 25.43	A
			H-3	Bq/L	506	507	355 - 659	A
			Mn-54	Bq/L	25.7	27.4	19.2 - 35.6	A
			K-40	Bq/L	2.09		(1)	A
			Sr-90	Bq/L	10.5	10.5	7.4 - 13.7	A
			Zn-65	Bq/L	29.2	30.4	21.3 - 39.5	A
	13-GrW28	Water	Gr-A	Bq/L	2.74	2.31	0.69 - 3.93	A
			Gr-B	Bq/L	15.6	13.0	6.5 - 19.5	A
	13-MaS28	Soil	Cs-134	Bq/kg	859	887	621 - 1153	A
			Cs-137	Bq/kg	633	587	411 - 763	A
			Co-57	Bq/kg	0.256		(1)	A
			Co-60	Bq/kg	738	691	484 - 898	A
			Mn-54	Bq/kg	0.671		(1)	A
			K-40	Bq/kg	714	625.3	437.7 - 812.9	A
			Sr-90	Bq/kg	442	628	440 - 816	W
			Zn-65	Bq/kg	1057	995	697 - 1294	A
	13-RdF28	AP	Cs-134	Bq/sample	1.73	1.78	1.25 - 2.31	A
			Cs-137	Bq/sample	2.73	2.60	1.82 - 3.38	A
			Co-57	Bq/sample	2.38	2.36	1.65 - 3.07	A
			Co-60	Bq/sample	0.0302		(1)	A
			Mn-54	Bq/sample	4.36	4.26	2.98 - 5.54	A
			Sr-90	Bq/sample	1.43	1.49	1.04 - 1.94	A
			Zn-65	Bq/sample	3.14	3.13	2.19 - 4.07	A
	13-GrF28	AP	Gr-A	Bq/sample	0.767	1.20	0.36 - 2.04	A
			Gr-B	Bq/sample	0.871	0.85	0.43 - 1.28	A
13-RdV28	Vegetation	Cs-134	Bq/sample	-0.197		(1)	A	
		Cs-137	Bq/sample	7.39	6.87	4.81 - 8.93	A	
		Co-57	Bq/sample	9.87	8.68	6.08 - 11.28	A	
		Co-60	Bq/sample	6.08	5.85	4.10 - 7.61	A	
		Mn-54	Bq/sample	-0.0104		(1)	A	
		Sr-90	Bq/sample	1.28	1.64	1.15 - 2.13	W	
		Zn-65	Bq/sample	6.84	6.25	4.38 - 8.13	A	
September 2013	13-MaW29	Water	Cs-134	Bq/L	29.1	30.0	21.0 - 39.0	A
			Cs-137	Bq/L	34.5	31.6	22.1 - 41.1	A
			Co-57	Bq/L	0.0358		(1)	A
			Co-60	Bq/L	24.6	23.58	16.51 - 30.65	A
			H-3	Bq/L	2.45		(1)	A
			Mn-54	Bq/L	0.0337		(1)	A
			K-40	Bq/L	0.193		(1)	A
			Sr-90	Bq/L	9.12	7.22	5.05 - 9.39	W
			Zn-65	Bq/L	38.1	34.6	24.2 - 45.0	A
	13-GrW29	Water	Gr-A	Bq/L	1.13	0.701	0.210 - 1.192	A
			Gr-B	Bq/L	7.61	5.94	2.97 - 8.91	A

**TABLE D-3**  
**DOE'S MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP)**  
**TELEDYNE BROWN ENGINEERING**  
(PAGE 2 OF 2)

Month/Year	Identification Number	Media	Nuclide	Units	Reported Value (a)	Known Value (b)	Acceptance Range	Evaluation (c)
September 2013	13-MaS29	Soil	Cs-134	Bq/kg	1150	1172	820 - 1524	A
			Cs-137	Bq/kg	1100	977	684 - 1270	A
			Co-57	Bq/kg	670	(1)	(1)	N (2)
			Co-60	Bq/kg	502	451	316 - 586	A
			Mn-54	Bq/kg	758	674	472 - 876	A
			K-40	Bq/kg	796	633	443 - 823	W
			Sr-90	Bq/kg	664	460	322 - 598	N (2)
			Zn-65	Bq/kg	210	(1)	(1)	N (2)
	13-RdF29	AP	Cs-134	Bq/sample	-0.570		(1)	N (2)
			Cs-137	Bq/sample	2.85	2.7	1.9 - 3.5	A
			Co-57	Bq/sample	3.30	3.4	2.4 - 4.4	A
			Co-60	Bq/sample	2.41	2.3	1.6 - 3.0	A
			Mn-54	Bq/sample	3.65	3.5	2.5 - 4.6	A
			Sr-90	Bq/sample	1.40	1.81	1.27 - 2.35	W
			Zn-65	Bq/sample	2.90	2.7	1.9 - 3.5	A
	13-GrF29	AP	Gr-A	Bq/sample	0.872	0.9	0.3 - 1.5	A
			Gr-B	Bq/sample	1.57	1.63	0.82 - 2.45	A
	13-RdV29	Vegetation	Cs-134	Bq/sample	5.29	5.20	3.64 - 6.76	A
			Cs-137	Bq/sample	7.48	6.60	4.62 - 8.58	A
			Co-57	Bq/sample	0.0129		(1)	A
			Co-60	Bq/sample	0.0523		(1)	A
			Mn-54	Bq/sample	8.78	7.88	5.52 - 10.24	A
			Sr-90	Bq/sample	1.63	2.32	1.62 - 3.02	W (2)
			Zn-65	Bq/sample	3.18	2.63	1.84 - 3.42	W

(1) False positive test.

(2) Soil, Co-57 & Zn-65 identified by gamma software as not detected, MAPEP evaluated as failing the false positive test. A large concentration of Eu-152 was spiked into the sample, causing interference in the analysis. Gamma software recognized the interference and identified them as not detected. MAPEP does not allow clients to enter non-detect designation. NCR 13-14

Soil, Sr-90 - incorrect results were submitted to MAPEP. Should have been 332 bq/kg, which would have passed. NCR 13-14

AP, Cs-134 - MAPEP evaluated the -0.570 as a failed false positive test. No client samples were affected by these failures. NCR 13-14

Vegetation, Sr-90 - it appears that the carrier was double spiked into the sample, resulting in the low activity for this sample. NCR 13-14

(a) Teledyne Brown Engineering reported result.

(b) The MAPEP known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation.

(c) DOE/MAPEP evaluation: A=acceptable, W=acceptable with warning, N=not acceptable.

TABLE D-4  
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Month/Year	Identification		Nuclide	Units	Analytics	TBE	TBE/Analytics
	Number	Matrix			Calculated Results (a)	Results (a)	Ratio
March 2013	E10447	Milk	I-131	pCi/L	99.9 ± 3	101 ± 2	1.01
			Ce-141	pCi/L	145 ± 5	139 ± 12	0.96
			Cr-51	pCi/L	366 ± 12	334 ± 55	0.91
			Cs-134	pCi/L	166 ± 6	157 ± 6	0.95
			Cs-137	pCi/L	206 ± 7	196 ± 12	0.95
			Co-58	pCi/L	162 ± 5	158 ± 10	0.98
			Mn-54	pCi/L	162 ± 5	165 ± 10	1.02
			Fe-59	pCi/L	196 ± 7	194 ± 16	0.99
			Zn-65	pCi/L	233 ± 8	235 ± 22	1.01
			Co-60	pCi/L	310 ± 10	293 ± 9	0.95
June 2013	E10585	Milk	I-131	pCi/L	90.8 ± 3	85 ± 4	0.94
			Ce-141	pCi/L	127 ± 4	111 ± 10	0.87
			Cr-51	pCi/L	353 ± 12	337 ± 50	0.95
			Cs-134	pCi/L	176 ± 6	163 ± 6	0.93
			Cs-137	pCi/L	213 ± 7	194 ± 10	0.91
			Co-58	pCi/L	132 ± 4	121 ± 9	0.92
			Mn-54	pCi/L	242 ± 8	233 ± 10	0.96
			Fe-59	pCi/L	169 ± 6	169 ± 13	1.00
			Zn-65	pCi/L	306 ± 10	297 ± 19	0.97
			Co-60	pCi/L	247 ± 8	235 ± 8	0.95
September 2013	E10655	Milk	I-131	pCi/L	98 ± 3	82 ± 2	0.83
			Ce-141	pCi/L	not present		
			Cr-51	pCi/L	394 ± 13	419 ± 81	1.06
			Cs-134	pCi/L	245 ± 8	213 ± 7	0.87
			Cs-137	pCi/L	186 ± 6	170 ± 10	0.91
			Co-58	pCi/L	153 ± 5	142 ± 11	0.93
			Mn-54	pCi/L	197 ± 7	182 ± 11	0.92
			Fe-59	pCi/L	185 ± 6	172 ± 17	0.93
			Zn-65	pCi/L	379 ± 13	353 ± 21	0.93
			Co-60	pCi/L	279 ± 9	264 ± 9	0.95
December 2013	E10741	Milk	I-131	pCi/L	77.2 ± 3	69 ± 2	0.89
			Ce-141	pCi/L	158 ± 5	141 ± 12	0.89
			Cr-51	pCi/L	427 ± 14	373 ± 73	0.87
			Cs-134	pCi/L	204 ± 7	176 ± 7	0.86
			Cs-137	pCi/L	182 ± 6	166 ± 12	0.91
			Co-58	pCi/L	161 ± 5	139 ± 12	0.86
			Mn-54	pCi/L	242 ± 8	226 ± 13	0.93
			Fe-59	pCi/L	159 ± 5	154 ± 17	0.97
			Zn-65	pCi/L	1070 ± 36	1010 ± 39	0.94
			Co-60	pCi/L	211 ± 7	199 ± 8	0.94

(a) Counting error is two standard deviations.

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Month/Year	Identification		Nuclide	Units	Analytics	TBE	TBE/Analytics
	Number	Matrix			Calculated Results (a)	Results (a)	Ratio
March 2013	E10448	Ap Filter	Ce-141	pCi/L	111 ± 4	121 ± 15	1.09
			Cr-51	pCi/L	280 ± 10	316 ± 20	1.13
			Cs-134	pCi/L	127 ± 4	128 ± 7	1.01
			Cs-137	pCi/L	158 ± 6	165 ± 14	1.04
			Co-58	pCi/L	123 ± 4	131 ± 14	1.07
			Mn-54	pCi/L	123 ± 4	113 ± 13	0.92
			Fe-59	pCi/L	150 ± 5	166 ± 21	1.11
			Zn-65	pCi/L	178 ± 6	190 ± 23	1.07
			Co-60	pCi/L	237 ± 8	238 ± 12	1.00
March 2013	E10449	Ap Filter	Ce-141	pCi	115 ± 4	114 ± 13	0.99
			Cr-51	pCi	290 ± 10	308 ± 18	1.06
			Cs-134	pCi	132 ± 5	134 ± 9	1.02
			Cs-137	pCi	163 ± 6	161 ± 13	0.99
			Co-58	pCi	128 ± 4	127 ± 15	0.99
			Mn-54	pCi	128 ± 4	128 ± 15	1.00
			Fe-59	pCi	155 ± 5	156 ± 21	1.01
			Zn-65	pCi	185 ± 6	183 ± 24	0.99
			Co-60	pCi	246 ± 9	240 ± 11	0.98
March 2013	E10450	Ap Filter	Ce-141	pCi	105 ± 4	115 ± 15	1.10
			Cr-51	pCi	265 ± 9	286 ± 17	1.08
			Cs-134	pCi	120 ± 4	132 ± 8	1.10
			Cs-137	pCi	149 ± 5	150 ± 14	1.01
			Co-58	pCi	117 ± 4	122 ± 13	1.04
			Mn-54	pCi	117 ± 4	117 ± 12	1.00
			Fe-59	pCi	142 ± 5	150 ± 20	1.06
			Zn-65	pCi	169 ± 6	163 ± 26	0.96
			Co-60	pCi	224 ± 8	221 ± 11	0.99
June 2013	E10586	Ap Filter	Ce-141	pCi	61.6 ± 2	63 ± 2	1.02
			Cr-51	pCi	171 ± 6	170 ± 14	0.99
			Cs-134	pCi	85.2 ± 3	90 ± 12	1.06
			Cs-137	pCi	103 ± 4	100 ± 9	0.97
			Co-58	pCi	64 ± 2	58 ± 8	0.91
			Mn-54	pCi	117 ± 4	118 ± 10	1.01
			Fe-59	pCi	81.6 ± 3	79 ± 13	0.97
			Zn-65	pCi	148 ± 5	150 ± 18	1.01
			Co-60	pCi	120 ± 4	110 ± 8	0.92

(a) Counting error is two standard deviations.

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Month/Year	Identification Number	Matrix	Nuclide	Units	Analytics Calculated Results (a)	TBE Results (a)	TBE/Analytics Ratio
June 2013	E10587	Ap Filter	Ce-141	pCi	60.1 ± 2	64.7 ± 2	1.08
			Cr-51	pCi	167 ± 6	178 ± 13	1.07
			Cs-134	pCi	83.1 ± 3	103 ± 11	1.24
			Cs-137	pCi	100 ± 4	96.8 ± 11	0.97
			Co-58	pCi	62.5 ± 2	60.8 ± 9	0.97
			Mn-54	pCi	114 ± 4	120 ± 11	1.05
			Fe-59	pCi	79.6 ± 3	87.8 ± 15	1.10
			Zn-65	pCi	145 ± 5	152 ± 19	1.05
			Co-60	pCi	117 ± 4	118 ± 8	1.01
June 2013	E10588	Ap Filter	Ce-141	pCi	78.1 ± 3	80.9 ± 2	1.04
			Cr-51	pCi	216 ± 8	237 ± 15	1.10
			Cs-134	pCi	108 ± 4	125 ± 12	1.16
			Cs-137	pCi	130 ± 5	130 ± 12	1.00
			Co-58	pCi	81.2 ± 3	75 ± 10	0.92
			Mn-54	pCi	149 ± 5	146 ± 15	0.98
			Fe-59	pCi	103 ± 4	115 ± 17	1.12
			Zn-65	pCi	188 ± 7	170 ± 22	0.90
			Co-60	pCi	152 ± 5	146 ± 10	0.96
December 2013	E10742	Ap Filter	Ce-141	pCi	93.3 ± 3	106 ± 13	1.14
			Cr-51	pCi	252 ± 9	290 ± 85	1.15
			Cs-134	pCi	121 ± 4	126 ± 7	1.04
			Cs-137	pCi	107 ± 4	106 ± 11	0.99
			Co-58	pCi	95.3 ± 3	99.8 ± 11	1.05
			Mn-54	pCi	143 ± 5	152 ± 11	1.06
			Fe-59	pCi	93.7 ± 3	87.8 ± 17	0.94
			Zn-65	pCi	631 ± 22	636 ± 29	1.01
			Co-60	pCi	125 ± 4	138 ± 8	1.10
December 2013	E10743	Ap Filter	Ce-141	pCi	83.2 ± 3	87.7 ± 13	1.05
			Cr-51	pCi	225 ± 8	294 ± 70	1.31
			Cs-134	pCi	108 ± 4	109 ± 6	1.01
			Cs-137	pCi	95.7 ± 3	97.6 ± 10	1.02
			Co-58	pCi	85 ± 3	82.2 ± 11	0.97
			Mn-54	pCi	127 ± 4	132 ± 12	1.04
			Fe-59	pCi	83.6 ± 3	95.9 ± 16	1.15
			Zn-65	pCi	563 ± 20	574 ± 28	1.02
			Co-60	pCi	111 ± 4	111 ± 7	1.00

(1) NCR 14-01 was initiated to address the failure.

(a) Counting error is two standard deviations.

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Month/Year	Identification Number	Matrix	Nuclide	Units	Analytics Calculated Results (a)	TBE Results (a)	TBE/Analytics Ratio
December 2013	E10744	Ap Filter	Ce-141	pCi	88 ± 3	101 ± 4	1.15
			Cr-51	pCi	238 ± 8	280 ± 30	1.18
			Cs-134	pCi	114 ± 4	110 ± 7	0.96
			Cs-137	pCi	101 ± 4	105 ± 10	1.04
			Co-58	pCi	89.8 ± 3	93.3 ± 11	1.04
			Mn-54	pCi	135 ± 5	135 ± 13	1.00
			Fe-59	pCi	88.3 ± 3	82.3 ± 21	0.93
			Zn-65	pCi	594 ± 21	576 ± 32	0.97
			Co-60	pCi	117 ± 4	109 ± 8	0.93
March 2013	E10451	Charcoal	I-131	pCi	92.4 ± 3	90.3 ± 7	0.98
March 2013	E10452	Charcoal	I-131	pCi	92.3 ± 3	83.1 ± 10	0.90
March 2013	E10453	Charcoal	I-131	pCi	92.4 ± 3	89.5 ± 9	0.97
September 2013	E10656	Charcoal	I-131	pCi	79.7 ± 3	77.2 ± 8	0.97
September 2013	E10658	Charcoal	I-131	pCi	80.1 ± 3	82.2 ± 10	1.03
September 2013	E10659	Charcoal	I-131	pCi	79.7 ± 3	76.3 ± 8	0.96
December 2013	E10745	Charcoal	I-131	pCi	75.5 ± 3	77 ± 5	1.02
December 2013	E10746	Charcoal	I-131	pCi	75.6 ± 3	72.8 ± 6	0.96
December 2013	E10747	Charcoal	I-131	pCi	75.6 ± 3	81 ± 5	1.07
March 2013	E10454	Water	H-3	pCi/L	14000 ± 467	13900 ± 1140	0.99
June 2013	E10589	Water	H-3	pCi/L	975 ± 33	953 ± 152	0.98
September 2013	E10661	Water	H-3	pCi/L	965 ± 32	929 ± 166	0.96
December 2013	E10748	Water	H-3	pCi/L	549 ± 18	598 ± 122	1.09

(a) Counting error is two standard deviations.



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Month/Year	Identification		Nuclide	Units	Analytics	TBE	TBE/Analytics
	Number	Matrix			Calculated Results (a)	Results (a)	Ratio
June 2013	E10660	Soil	Ce-141	pCi/kg	not present		
			Cr-51	pCi/kg	483 ± 16	494 ± 155	1.02
			Cs-134	pCi/kg	300 ± 10	302 ± 16	1.01
			Cs-137	pCi/kg	312 ± 10	321 ± 18	1.03
			Co-58	pCi/kg	188 ± 6	192 ± 18	1.02
			Mn-54	pCi/kg	242 ± 8	279 ± 18	1.15
			Fe-59	pCi/kg	227 ± 8	272 ± 30	1.20
			Zn-65	pCi/kg	464 ± 16	543 ± 33	1.17
		Co-60	pCi/kg	341 ± 11	366 ± 13	1.07	

(a) Counting error is two standard deviations.

# **APPENDIX E**

## **REMP SAMPLE EQUIPMENT OPERABILITY TRENDING**

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