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Public Service  
Company of Colorado

March 7, 1996  
Fort St. Vrain  
P-96014

U.S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, D.C. 20555

ATTN: Mr. Michael F. Weber, Chief  
Decommissioning and  
Regulatory Issues Branch

Docket No. 50-267

**SUBJECT: Final Survey Plan for Site Release, Side-By-Side Measurement Data**

**REFERENCE:** PSCo Letter, Borst to Weber, dated November 15, 1995 (P-95102);  
"Final Survey Plan for Site Release, Supplemental Information"

Dear Mr. Weber:

This letter provides radiation survey data taken by the Scientific Ecology Group (SEG), one of Public Service Company of Colorado's decommissioning contractors, during side-by-side measurements with representatives from the Oak Ridge Institute for Science and Education (ORISE). This data was taken during two separate NRC/ORISE on-site inspections at Fort St. Vrain, in September 1995, and in January 1996, and is provided in response to a request from Messrs. Clayton Pittiglio and David Fauver of your staff.

SEG's survey data and supporting explanatory information is provided in three attachments, as follows:

Attachment 1: September 1995 Survey Data

The referenced letter provided side-by-side measurement data taken during the September 27, 1995, NRC/ORISE inspection from three areas: the Battery Room, the Electrical Warehouse, and the Reactor Building Level 3 Resin Changeout Area. The data reflected gross measurements that had not been corrected for background.

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To identify background activity (as discussed in Attachment 3), SEG collected local area background (shielded) measurements subsequent to the ORISE inspection. The locations used during side-by-side comparison measurements were used for background measurements in the Battery Room and Electrical Warehouse; however, the Reactor Building Level 3 Resin Changeout Area was not available for shielded measurements and background correction has not been made for this area.

Attachment 1 includes gross measurements for all three areas as submitted in the referenced letter and, in addition, net total surface activity measurements are provided for the Battery Room and the Electrical Warehouse, corrected for both the local area background and specific material background. Calculational details for converting gross measurement results to net total surface activity values are also provided.

#### Attachment 2: January 1996 Survey Data

Attachment 2 includes survey data taken during the January 22-25, 1996, inspection, for four areas: the Battery Room, the Lube Oil Room, a Reactor Building location at about 2500 dpm/100 cm<sup>2</sup>, and a Reactor Building location at about 5000 dpm/100 cm<sup>2</sup>. This data has been analyzed to correct gross measurement results for material background and local area background, using Battery Room measurements as the material background.

#### Attachment 3: Background Determination

Attachment 3 is a discussion of the two-component background approach used at Fort St. Vrain to account for background during total surface activity measurements.

To facilitate our review of the side-by-side measurements, PSCo requests copies of ORISE's measurement data, both gross measurements and net activity results after correcting for background. It is our understanding that this information will be included in the NRC's inspection reports.

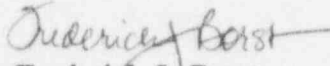
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If you have any questions regarding this information, please contact Mr. M. H. Holmes at (303) 620-1701.

Sincerely,



Frederick J. Borst  
Decommissioning Program Director

FJB/SWC

Attachments

cc: w/ attachments

Regional Administrator, Region IV

Mr. Robert M. Quillin, Director  
Radiation Control Division  
Colorado Department of Public Health and Environment

ATTACHMENT 1

TO P-96014

**SEPTEMBER 1995 SURVEY DATA**

**TURBINE BUILDING - LEVEL 5**  
**BATTERY ROOM - CONCRETE FLOOR**

Sample	(C) Unshielded Result  (cts/15 sec/125cm <sup>2</sup> )	(C*(60/ts)) Unshielded Result  (cpm/125cm <sup>2</sup> )	(Rb) Shielded Result  (cpm/125cm <sup>2</sup> )	((Am)*(E)*(a/100)) Material Bkgd (Concrete)  (cpm/125cm <sup>2</sup> )	(Rb)+((Am)*(E)*(a/100)) Total Bkgd Correction  (cpm/125cm <sup>2</sup> )	Activity Result (Gross) Previously Reported  (dpm/100cm <sup>2</sup> )	Activity Result (Net)  (dpm/100cm <sup>2</sup> )
1	148.0	592.0	364.0	196.5	560.5	2310	123
2	155.0	620.0	348.0	196.5	544.5	2420	294
3	143.0	572.0	356.0	196.5	552.5	2232	76
4	137.0	548.0	376.0	196.5	572.5	2139	-96
5	154.0	616.0	360.0	196.5	556.5	2404	232
6	152.0	608.0	396.0	196.5	592.5	2373	60
7	145.0	580.0	368.0	196.5	564.5	2263	60
8	155.0	620.0	428.0	196.5	624.5	2420	-18
9	135.0	540.0	380.0	196.5	576.5	2107	-143
10	174.0	696.0	408.0	196.5	604.5	2716	357
Mean:						2338	95

Counting Parameters:

- (C) = integrated gross counts  
 (ts) = sample counting interval, 15 seconds  
 (Rb) = local area background count rate  
 (Am) = response of the instrument to the material, 767 dpm/100cm<sup>2</sup>  
 (E) = counting efficiency, 0.205  
 (a) = area of the detector, 125 cm<sup>2</sup>



# **ELECTRICAL WAREHOUSE CONCRETE FLOOR**

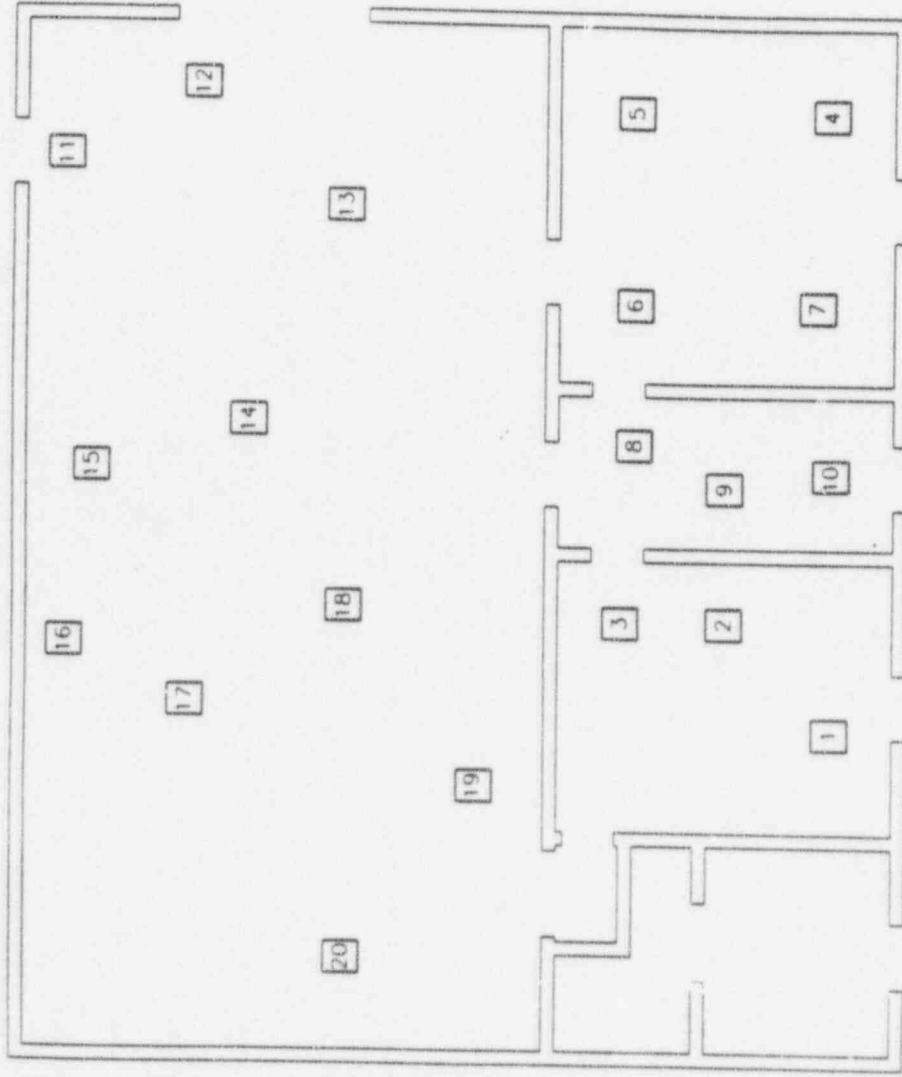
Sample	(C) Unshielded Result  (cts/15 sec/125cm <sup>2</sup> )	(C*(60/ts)) Unshielded Result  (cpm/125cm <sup>2</sup> )	(Rb) Shielded Result  (cpm/125cm <sup>2</sup> )	((Am)*(E)*(a/100)) Material Bkgd (Concrete)  (cpm/125cm <sup>2</sup> )	(Rb)+((Am)*(E)*(a/100)) Total Bkgd Correction  (cpm/125cm <sup>2</sup> )	Activity Result (Gross) (Previously Reported)  (dpm/100cm <sup>2</sup> )	Activity Result (Net)  (dpm/100cm <sup>2</sup> )
1	205.0	820.0	552.0	196.5	748.5	3200	279
2	194.0	776.0	524.0	196.5	720.5	3028	216
3	202.0	808.0	468.0	196.5	664.5	3153	560
4	212.0	848.0	560.0	196.5	756.5	3309	357
5	201.0	804.0	540.0	196.5	736.5	3138	263
6	189.0	756.0	420.0	196.5	616.5	2950	544
7	188.0	752.0	444.0	196.5	640.5	2935	435
8	172.0	688.0	492.0	196.5	688.5	2685	-2
9	158.0	632.0	504.0	196.5	700.5	2466	-267
10	188.0	752.0	476.0	196.5	672.5	2935	310
11	183.0	732.0	492.0	196.5	688.5	2857	170
12	187.0	748.0	428.0	196.5	624.5	2919	482
13	187.0	748.0	516.0	196.5	712.5	2919	138
14	184.0	736.0	476.0	196.5	672.5	2872	248
15	176.0	704.0	476.0	196.5	672.5	2747	123
16	192.0	768.0	484.0	196.5	680.5	2997	341
17	183.0	732.0	524.0	196.5	720.5	2857	45
18	169.0	676.0	528.0	196.5	724.5	2638	-189
19	168.0	672.0	504.0	196.5	700.5	2622	-111
20	168.0	672.0	464.0	196.5	660.5	2622	45
Mean:						2892	199

## Counting Parameters:

- (C) = integrated gross counts
- (ts) = sample counting interval, 15 seconds
- (Rb) = local area background count rate
- (Am) = response of the instrument to the material, 767 dpm/100cm<sup>2</sup>
- (E) = counting efficiency, 0.205
- (a) = area of the detector, 125 cm<sup>2</sup>



ELECTRICAL WAREHOUSE  
MEASUREMENT COMPARISON



Survey/Package #	MEASUREMENT COMPARISON	Marker Drawing #	N/A	Block	ELECTRICAL WAREHOUSE - #14	N/A	N/A
Location Code:	N/A	Description:	CONCRETE FLOOR		Approx. 14'	4/91'	Grid Size N/A
Area Sum	Sum Area	Sum Area	Sum Area	Sum Area	Sum Area	Sum Area	Sum Area
Location Code:	N/A	Description:	N/A		Approx. 14'	N/A	Grid Size N/A
Area Sum	Sum Area	Sum Area	Sum Area	Sum Area	Sum Area	Sum Area	Sum Area
Survey Date/Time							



**REACTOR BUILDING - LEVEL 3  
RESIN CHANGE OUT AREA - CONCRETE FLOOR**

Location #	Sample #	Count Time (sec)	Counts (cts/15sec/125cm <sup>2</sup> )	Counts (cpm/125cm <sup>2</sup> )	Activity (dpm/100 cm <sup>2</sup> )
RESIN CHANGE OUT AREA	1	15	326	1304	5089
RESIN CHANGE OUT AREA	2	15	1008	4032	15735
RESIN CHANGE OUT AREA	3	15	400	1600	6244
RESIN CHANGE OUT AREA	4	15	311	1244	4855
RESIN CHANGE OUT AREA	5	15	366	1464	5713
RESIN CHANGE OUT AREA	6	15	419	1676	6540
RESIN CHANGE OUT AREA	7	15	378	1512	5900
RESIN CHANGE OUT AREA	8	15	1481	5924	23118
RESIN CHANGE OUT AREA	9	15	465	1860	7259
RESIN CHANGE OUT AREA	10	15	337	1348	5260
RESIN CHANGE OUT AREA	11	15	467	1868	7290
RESIN CHANGE OUT AREA	12	15	1989	7956	31048
RESIN CHANGE OUT AREA	13	15	521	2084	8133
RESIN CHANGE OUT AREA	14	15	407	1628	6353
RESIN CHANGE OUT AREA	15	15	1350	5400	21073
RESIN CHANGE OUT AREA	16	15	662	2648	10334
RESIN CHANGE OUT AREA	17	15	335	1340	5229
RESIN CHANGE OUT AREA	18	15	1018	4072	15891
RESIN CHANGE OUT AREA	19	15	665	2660	10380
RESIN CHANGE OUT AREA	20	15	323	1292	5042

**NOTES**

- 1) Instrument Type: Ludlum Model 2350 Data Logger - Serial #95359
- 2) Detector Model Number: 43-68B Gas Flow Proportional Counter - Serial #PR092525
- 3) Instrument Efficiency: .205
- 4) Detector Area: 125cm<sup>2</sup>
- 5) Background : No background value applied
- 6) Technician: Declan Detrick
- 7) Survey Date: 09/27/95

[illegible]

ATTACHMENT 2

TO P-96014

**JANUARY 1996 SURVEY DATA**

## SEG MEASUREMENT COMPARISON

SEG Team 1	* Shielded Meas	Shielded Meas	Shielded Meas	Unshielded Meas	Unshielded Meas	* Unshielded Meas
Download 999	LAB(cpm/125cm2)	LAB(cpm/100cm2)	LAB(dpm/100cm2)	(Gross cpm/125cm2)	(Gross dpm/100cm2)	(Mat'l Bkgd, dpm/100cm2)
Battery Room	416	332.8	1505.9	684.0	2476.0	933.9
(Background)	440	352.0	1592.8	664.0	2403.6	861.5
	376	300.8	1361.1	636.0	2302.3	760.2
	432	345.6	1563.8	588.0	2128.5	586.4
	492	393.6	1781.0	696.0	2519.5	977.4
	400	320.0	1448.0	500.0	1810.0	267.9
				588.0	2128.5	586.4
				668.0	2418.1	876.0
				632.0	2287.8	745.7
				620.0	2244.3	702.3
Std Dev	39.7	31.7	143.6	58.1	210.3	210.3
Mean	426.0	340.8	1542.1	627.6	2271.9	729.8
Efficiency	0.221					
* %Coeff of Var			9.31		9.26	

SEG Team 2	* Shielded Meas	Shielded Meas	Shielded Meas	Unshielded Meas	Unshielded Meas	* Unshielded Meas
Download 1008	LAB(cpm/125cm2)	LAB(cpm/100cm2)	LAB(dpm/100cm2)	(Gross cpm/125cm2)	(Gross dpm/100cm2)	(Mat'l Bkgd, dpm/100cm2)
Battery Room	424	339.2	1378.9	684.0	2224.4	737.1
(Background)	536	428.8	1743.1	724.0	2354.5	867.2
	460	368.0	1495.9	640.0	2081.3	594.0
	432	345.6	1404.9	720.0	2341.5	854.2
	460	368.0	1495.9	576.0	1873.2	385.9
	432	345.6	1404.9	816.0	2653.7	1166.4
				776.0	2523.6	1036.3
				712.0	2315.4	828.2
				808.0	2627.6	1140.4
				664.0	2159.3	672.1
Std Dev	41.5	33.2	134.9	75.4	245.1	245.1
Mean	457.3	365.9	1487.3	712.0	2315.4	828.2
Efficiency	0.246					
* %Coeff of Var			9.07		10.58	
Mean Mat'l Bkgd						779.0

ORISE	Shielded Meas	Shielded Meas	Shielded Meas	Unshielded Meas	Unshielded Meas	Unshielded Meas
Battery Room	LAB(cpm/125cm2)	LAB(cpm/100cm2)	LAB(dpm/100cm2)	(Gross cpm/125cm2)	(Gross dpm/100cm2)	(NET dpm/100cm2)
(Background)						
Std Dev						
Mean						
Efficiency						
%Coeff of Var						

### NOTES

- \* LAB = Local Area Background (Shielded Measurement)
- \* 125 cm2 = Detector Area
- \* % Coefficient of Variability = Standard Deviation / Mean
- \* The above data sets were corrected only for efficiency, detector area, and LAB. Net results define the material background
- \* The Mean Material Background was determined from the above data sets and used to correct subsequent data sets.

### SEG MEASUREMENT COMPARISON

SEG Team 1	Shielded Meas.	Shielded Meas	Shielded Meas	Unshielded Meas	Unshielded Meas	* Net Result
Download 999	LAB(cpm/125cm2)	LAB(cpm/100cm2)	LAB(dpm/100cm2)	(Gross cpm/125cm2)	(Gross dpm/100cm2)	(dpm/100cm2)
Lube Oil Room	384	307.2	1390.0	524.0	1896.8	-298.7
	332	265.6	1201.8	608.0	2200.9	5.3
	316	252.8	1143.9	600.0	2171.9	-23.6
	464	371.2	1679.6	584.0	2114.0	-81.5
	444	355.2	1607.2	624.0	2258.8	63.3
	408	326.4	1476.9	528.0	1911.3	-284.3
				600.0	2171.9	-23.6
				536.0	1940.3	-255.3
				616.0	2229.9	34.3
				476.0	1723.1	-472.5
Std Dev	59.3	47.4	214.7	49.8	180.4	180.4
Mean	391.3	313.1	1416.6	569.6	2061.9	-133.7
Efficiency	0.221					
%Coeff of Var			15.15		8.75	

SEG Team 2	Shielded Meas	Shielded Meas	Shielded Meas	Unshielded Meas	Unshielded Meas	* Net Result
Download 1008	LAB/cpm/125cm2	LAB/cpm/100cm2	LAB(dpm/100cm2)	(Gross cpm/125cm2)	(Gross dpm/100cm2)	(dpm/100cm2)
Lube Oil Room	452	361.6	1469.9	612.0	1990.2	-228.3
	368	294.4	1196.7	716.0	2328.5	109.9
	480	384.0	1561.0	644.0	2094.3	-124.2
	436	348.8	1417.9	608.0	1977.2	-241.3
	396	316.3	1287.8	672.0	2185.4	-33.2
	524	419.2	1704.1	756.0	2458.5	240.0
				668.0	2172.4	-46.2
				612.0	1990.2	-228.3
				636.0	2068.3	-150.3
				644.0	2094.3	-124.2
Std Dev	56.4	45.1	183.3	48.1	156.6	156.6
Mean	442.7	354.1	1439.6	656.8	2135.9	-82.6
Efficiency	0.246					
%Coeff of Var			12.74		7.33	

[illegible]

\* NOTE Net Result = Unshielded Meas (Gross dpm/100cm<sup>2</sup>) - Shielded Meas (LAB. dpm/100cm<sup>2</sup>) - Mean Mat'l Bkgd(dpm/100cm<sup>2</sup>)

### SEG MEASUREMENT COMPARISON

SEG Team 1	Shielded Meas	Shielded Meas	Shielded Meas	Unshielded Meas	Unshielded Meas	* Net Result
Download 993	LAB(cpm/125cm2)	LAB(cpm/100cm2)	LAB(dpm/100cm2)	(Gross cpm/125cm2)	(Gross dpm/100cm2)	(dpm/100cm2)
Rx Bldg - #2500	468	374.4	1694.1	1364.0	4937.6	2370.3
	468	374.4	1694.1	1264.0	4575.6	2008.4
	480	384.0	1737.6	1344.0	4865.2	2297.9
	424	339.2	1534.8	1340.0	4850.7	2283.5
	576	460.8	2085.1	1296.0	4691.4	2124.2
	548	438.4	1983.7	1264.0	4575.6	2008.4
				1356.0	4908.6	2341.4
				1284.0	4648.0	2080.7
				1320.0	4778.3	2211.1
				1336.0	4836.2	2269.0
Std Dev	56.7	45.4	205.3	37.3	134.9	134.9
Mean	494.0	395.2	1788.2	1316.8	4766.7	2199.5
Efficiency	0.221					
%Coeff of Var			11.48		2.83	

SEG Team 2	Shielded Meas	Shielded Meas	Shielded Meas	Unshielded Meas	Unshielded Meas	* Net Result
Download 1008	LAB(cpm/125cm2)	LAB(cpm/100cm2)	LAB(dpm/100cm2)	(Gross cpm/125cm2)	(Gross dpm/100cm2)	(dpm/100cm2)
R= Bldg - #2500	528	422.4	1717.1	1336.0	4344.7	1948
	480	384.0	1561.0	1464.0	4761.0	2364.7
	544	435.2	1769.1	1560.0	5073.2	2676.8
	484	387.2	1574.0	1408.0	4578.9	2182.5
	464	371.2	1508.9	1380.0	4487.8	2091.5
	484	387.2	1574.0	1620.0	5268.3	2872.0
				1544.0	5021.1	2624.8
				1564.0	5086.2	2689.9
				1584.0	5151.2	2754.9
				1524.0	4956.1	2559.8
Std Dev	31.3	25.0	101.7	95.9	311.7	311.7
Mean	497.3	397.9	1617.3	1498.4	4872.8	2476.5
Efficiency	0.246					
%Coeff of Var			6.29		6.40	

[illegible]

\* NOTE: Net Result = Unshielded Meas (Gross dpm/100cm<sup>2</sup>) - Shielded Meas (LAB, dpm/100cm<sup>2</sup>) - Mean Mat'l Bkgd(dpm/100cm<sup>2</sup>)



### SEG MEASUREMENT COMPARISON

SEG Team 1	Shielded Meas	Shielded Meas	Shielded Meas	Unshielded Meas	Unshielded Meas	* Net Result
Download 999	LAB(cpm/125cm2)	LAB(cpm/100cm2)	LAB(dpm/100cm2)	(Gross cpm/125cm2)	(Gross dpm/100cm2)	(dpm/100cm2)
Rx Bldg - #5000	488	390.4	1766.5	1808.0	6544.8	3972.8
	488	390.4	1766.5	1928.0	6979.2	4407.1
	468	374.4	1694.1	2000.0	7239.8	4667.8
	468	374.4	1694.1	1968.0	7124.0	4551.9
	520	418.0	1882.4	1864.0	6747.5	4175.5
	540	432.0	1954.8	1808.0	6544.8	3972.8
				2040.0	7384.6	4812.6
				1844.0	6675.1	4103.1
				2024.0	7326.7	4754.7
				1796.0	6501.4	3929.3
Std Dev	29.0	23.2	105.0	95.4	345.4	345.4
Avg LAB	495.3	396.3	1793.1	1908.0	6906.8	4334.7
Eff	0.221					
%Coeff of Var			5.85		5.00	

SEG Team 2	Shielded Meas	Shielded Meas	Shielded Meas	Unshielded Meas	Unshielded Meas	* Net Result
Download 1008	LAB(cpm/125cm2)	LAB(cpm/100cm2)	Gross dpm/100cm2)	(Gross cpm/125cm2)	(Gross dpm/100cm2)	(dpm/100cm2)
Rx Bldg - #5000	488	390.4	1587.0	2036.0	6621.1	4005.5
	592	473.6	1925.2	2240.0	7284.6	4689.3
	636	508.8	2068.3	2000.0	6504.1	3888.8
	582	473.6	1925.2	2128.0	6920.3	4305.0
	468	374.4	1522.0	2152.0	6998.4	4383.1
	612	489.6	1990.2	2060.0	6699.2	4083.9
				2100.0	6829.3	4214.0
				2128.0	6920.3	4305.0
				2092.0	6603.3	4188.0
				2060.0	6699.2	4083.9
Std Dev	69.3	55.5	225.5	67.7	220.1	220.1
Avg LAB	564.7	451.7	1836.3	2099.6	6828.0	4212.7
Eff	0.246					
%Coeff of Var			12.28		3.22	

[illegible]

\* NOTE: Net Result = Unshielded Meas. (Gross dpm/100cm<sup>2</sup>) - Shielded Meas. (LAB. dpm/100cm<sup>2</sup>) - Mean Mat'l Bkgd(dpm/100cm<sup>2</sup>)



ATTACHMENT 3

TO P-96014

**BACKGROUND DETERMINATION**

## **Background Determination for Total Surface Activity Measurements**

Measurements were collected using a Ludlum Model 2350 Data Logger (M2350) coupled to an LMI 43-68 gas flow proportional detector ( $125 \text{ cm}^2$ ) operated at the alpha-plus-beta voltage.

A minimum of 30 measurement locations were selected for each of the materials used to evaluate the response of the instrument. At each measurement location, a scan survey was performed within 1/2 inch from the surface to identify any discrete area of elevated activity. Shielded and unshielded total surface activity measurements were collected on contact with the surface using a counting time of at least 30 seconds. The shield used for these measurements has a nominal density thickness of  $300 \text{ mg/cm}^2$ . The shielded measurements (local area background) served to define the contribution to the observed response from the instrument background, the detected portion of the gamma component from the material, and the contribution from other local and cosmic influences. The shielded response was then subtracted from the unshielded response to define the characteristic response of the instrument to the surface of the material. The net response of the instrument was converted to standard units of surface activity ( $\text{dpm}/100\text{cm}^2$ ) in accordance with FSV-SC-FRS-I-110. Additional description of this approach, and the method for application of this value is described in the following section.

## **Two-Component Background Correction for Total Surface Activity**

This approach for background correction considers the contribution from two major components of background. The first of these components account for the response of the instrument due primarily to gamma radiation. This includes the gamma response due to the material being measured, other local influences due to gamma response from materials not directly under the detector and from cosmic radiation. This component also includes the small contribution from the instrument noise of the detection system. The second component of the background considers the response of the instrument to beta radiation emitted from the surface of the material. This response is expressed in units of  $\text{dpm}/100\text{cm}^2$  in order that the response can be universally applied during final survey using appropriate corrections for detector area and detection efficiency.

To obtain net measurement results for total surface activity during final survey, several shielded measurements are collected from surfaces to be evaluated during the survey and the mean is calculated. This mean, which represents the instrument background for the detection system and the response of the detection system to local area influences as described above, is expressed in units of counts per minute (cpm) per detector area.

To account for the second component of the background correction, the characteristic response of the instrument to the material as defined above is converted from units of activity ( $\text{dpm}/100\text{cm}^2$ ) into units of counts per minute per detector area. This is done by applying the counting efficiency of the instrument and correcting for the area of the detector.

These two components of background are then summed, and subtracted from the gross measurement result to obtain net counts per detector area. Net activity, in standard reporting units of dpm/100cm<sup>2</sup>, is obtained as follows:

$$A = \frac{\left[ \left( C * \frac{60}{t_s} \right) - \left( R_b + \left( A_m * E * \frac{a}{100} \right) \right) \right]}{E * \left( \frac{a}{100} \right)}$$

Where:

- A = net total surface activity (dpm/100 cm<sup>2</sup>),
- C = integrated gross counts (counts),
- t<sub>s</sub> = sample counting interval (sec),
- R<sub>b</sub> = local area background count rate in counts per minute collected using a detector shield of at least 300 mg/cm<sup>2</sup> (cpm/detector area),
- A<sub>m</sub> = characteristic response of the instrument to the surface of the material (dpm/100 cm<sup>2</sup>),
- E = efficiency of the survey instrument (c/d), and
- a = detector area (cm<sup>2</sup>).