

STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

SITE: GKP **Date:** 1/27/2014

Instrument Information		Source Information	Alpha	Beta
Type/Serial #:	Ludlum 3030/217607	Source Isotope	Th-230	Tc-99
Probe/Serial #:	43-10-1/229364	Source ID	A2-743	A2-771
Calibration Due Date:	April 30 2014			
Mode (count or dose)	Count			
Data Type (Src, Bkg)	Background			

If data type is a background for a specific material, list the material type =

Rm 321 desk

ALPHA			
D	C	C-(M)	[C-(M)] ²
1	0	-0.25	0.0625
2	0	-0.25	0.0625
3	0	-0.25	0.0625
4	0	-0.25	0.0625
5	1	0.75	0.5625
6	0	-0.25	0.0625
7	0	-0.25	0.0625
8	0	-0.25	0.0625
9	0	-0.25	0.0625
10	2	1.75	3.0625
11	0	-0.25	0.0625
12	0	-0.25	0.0625
13	0	-0.25	0.0625
14	0	-0.25	0.0625
15	0	-0.25	0.0625
16	2	1.75	3.0625
17	0	-0.25	0.0625
18	0	-0.25	0.0625
19	0	-0.25	0.0625
20	0	-0.25	0.0625

BETA			
D	C	C-(M)	[C-(M)] ²
1	35	-2.55	6.5025
2	34	-3.55	12.6025
3	42	4.45	19.8025
4	38	0.45	0.2025
5	43	-6.55	42.9025
6	31	6.45	41.6025
7	44	0.45	0.2025
8	38	-1.55	2.4025
9	36	11.45	131.1025
10	49	-3.55	12.6025
11	34	-5.55	30.8025
12	32	-11.55	133.4025
13	26	-7.55	57.0025
14	30	3.45	11.9025
15	41	-0.55	0.3025
16	37	8.45	71.4025
17	46	-0.55	0.3025
18	37	6.45	41.6025
19	44	-3.55	12.6025
20	34	-37.55	1410.003

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	5	0.25	7.75

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	751	37.55	2039.25

Standard Deviation	
SD	0.64
2 x SD	1.28
3 x SD	1.92

Standard Deviation	
SD	5.89
2 x SD	11.78
3 x SD	17.67

ALPHA				BETA			
MDCR and MDC Calculations				MDCR and MDC Calculations			
Survey Speed:		MDCR =		Survey Speed:		MDCR =	
Probe Width:	N/A	MDC =	7.18	Probe Width:	N/A	MDC =	44.50

Performed by: _____

Date: _____

Reviewed by: _____

Date: _____

STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

SITE: GKP **Date:** 1/27/2014

Instrument Information		Source Information	Alpha	Beta
Type/Serial #:	Ludlum 2929/176108	Source Isotope	Th-230	Tc-99
Probe/Serial #:	43-10-1/181905	Source ID	A2-743	A2-771
Calibration Due Date:	April 30 2014			
Mode (count or dose)	Count			
Data Type (Src, Bkg)	Source			

If data type is a background for a specific material, list the material type =

ALPHA			
D	C	C-(M)	[C-(M)] ²
1	13873	82.4	6789.76
2	13838	47.4	2246.76
3	13901	110.4	12188.16
4	14037	246.4	60712.96
5	13524	70.4	4956.16
6	13861	-104.6	10941.16
7	13686	-69.6	4844.16
8	13721	55.4	3069.16
9	13846	91.4	8353.96
10	13882	-184.6	34077.16
11	13606	-67.6	4569.76
12	13723	7.4	54.76
13	13798	-54.6	2981.16
14	13736	69.4	4816.36
15	13860	125.4	15725.16
16	13916	146.4	21432.96
17	13937	-21.6	466.56
18	13769	-151.6	22982.56
19	13639	-131.6	17318.56
20	13659	-13790.6	1.9E+08

BETA			
D	C	C-(M)	[C-(M)] ²
1	11178	-35	1225
2	11220	7	49
3	11446	233	54289
4	11212	-1	1
5	11266	166	27556
6	11379	66	4356
7	11279	-29	841
8	11184	-99	9801
9	11114	103	10609
10	11316	27	729
11	11240	-175	30625
12	11038	-147	21609
13	11066	-153	23409
14	11060	148	21904
15	11361	5	25
16	11218	-134	17956
17	11079	136	18496
18	11349	-63	3969
19	11150	-108	11664
20	11105	-11213	1.26E+08

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	275812	13790.6	1.9E+08

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	224260	11213	1.26E+08

Standard Deviation	
SD	127.65
2 x SD	255.30
3 x SD	382.95

Standard Deviation	
SD	117.41
2 x SD	234.82
3 x SD	352.23

ALPHA				BETA			
MDCR and MDC Calculations				MDCR and MDC Calculations			
Survey Speed:		MDCR =		Survey Speed:		MDCR =	
Probe Width:	N/A	MDC =	N/A	Probe Width:	N/A	MDC =	N/A

Performed by: _____

Date: _____

Reviewed by: _____

Date: _____

INSTRUMENT EFFICIENCY CALCULATION
Form RS-013.0-2

SITE: GKP **Date:** 1/27/2014

Instrument Information		Source Information	Alpha	Beta
Type/Serial #:	Ludlum 2929/176108	Initial Source Activity (A _o) (dpm)	17610	28510
Probe/Serial #:	43-10-1/181905	Source ID	A2-743	A2-771
Calibration Due Date:	April 30 2014	Source Isotope	Th-230	Tc-99
		Date Source was prepared	10/15/01	10/15/01
		Scaler Instrument Check Date	05/07/13	05/07/13
		Time since src prepared (T) (yrs):	1.16E+01	1.16E+01
		Half-Life of Source (t _{1/2}) (yrs)	7.54E+04	2.13E+05
		Current 2π emission rate (dpm)	17,608	28,509

ALPHA		
Count #	Bkgrd Counts/minute	Srcce Counts/minute
1	0	13873
2	0	13838
3	0	13901
4	0	14037
5	1	13524
6	0	13861
7	0	13686
8	0	13721
9	0	13846
10	2	13882
11	0	13606
12	0	13723
13	0	13798
14	0	13736
15	0	13860
16	2	13916
17	0	13937
18	0	13769
19	0	13639
20	0	13659
SUM	5	275812
Average	0.25	13790.60

BETA	
Bkgrd Counts/minute	Srcce Counts/minute
35	11178
34	11281
42	11589
38	11390
43	11375
31	11500
44	11529
38	11184
36	11114
49	11316
34	11240
32	11038
26	11066
30	11060
41	11361
37	11218
46	11079
37	11349
44	11150
34	11105
751	225122
37.55	11256.10

Inst. Eff = $\frac{\text{Avg Source CPM} - \text{Avg Bkgrd CPM}}{\text{Source } 2\pi \text{ emission rate (dpm)}}$

Inst Efficiency Alpha = 78.3%

Inst Efficiency Beta = 39.4%

Performed by: _____

Date: _____

Reviewed by: _____

Date: _____

DAILY INSTRUMENT RESPONSE CHECK
Form RS-013.0-3

SITE: GKP **Date:** 1/27/2014

Instrument Information	
Type/Serial #:	Ludlum 2929/176108
Probe/Serial #:	43-10-1/181905
Calibration Due Date:	April 30 2014

Source Information	Alpha	Beta
Isotope	Th-230	Tc-99
Serial Number	A2-743	A2-771
2 π emission rate	17,608	28,509

DATE	TIME	BKG CPM	Alpha Beta	SOURCE CPM	Alpha Beta	COMMENTS	Tech Initials
1/27/2014	7:00:00 AM	0	45	13758	11091		AM
1/28/2014	7:00:00 AM	0	36	13661	11354		AM
1/29/2014	7:00:00 AM	0	37	14501	11086		AM
1/30/2014	7:00:00 AM	0	42	13249	11495		AM
1/31/2014	7:00:00 AM	0	38	14659	11752		AM
2/3/2014	7:00:00 AM	0	35	14875	11452		AM
2/4/2014	7:00:00 AM	0	42	13572	11895		AM
2/5/2014	7:00:00 AM	0	37	14736	10652		AM
2/6/2014	7:00:00 AM	0	34	14223	11349		AM
2/7/2014	7:00:00 AM	0	37	13542	10249		SR
2/10/2014	7:00:00 AM	0	40	14874	11210		SR
2/11/2014	7:00:00 AM	0	33	14236	11895		SR
2/12/2014	7:00:00 AM	1	37	13457	11987		SR
2/13/2014	7:00:00 AM	0	39	14745	11365		SR
2/14/2014	7:00:00 AM	0	37	13258	11753		SR
2/17/2014	7:00:00 AM	0	40	14965	10236		SR
2/18/2014	7:00:00 AM	0	38	15345	11465		SR
2/19/2014	7:00:00 AM	0	32	14546	10254		SR
2/20/2014	7:00:00 AM	0	40	15201	11476		SR
2/21/2014	7:00:00 AM	0	42	13125	11989		SR
2/24/2014	7:00:00 AM	0	45	13612	11301		AM
2/25/2014	7:00:00 AM	0	38	14258	10452		AM
2/26/2014	7:00:00 AM	1	36	13882	11248		AM
2/27/2014	7:00:00 AM	0	35	14201	10244		AM
3/3/2014	7:00:00 AM	0	47	13773	11276		AM

Mean from form RS-013.0-1
Background

0	Alpha
37.55	Beta

Mean from form RS-013.0-1
Source

13790.6	Alpha
11213	Beta

Background Acceptance Limits

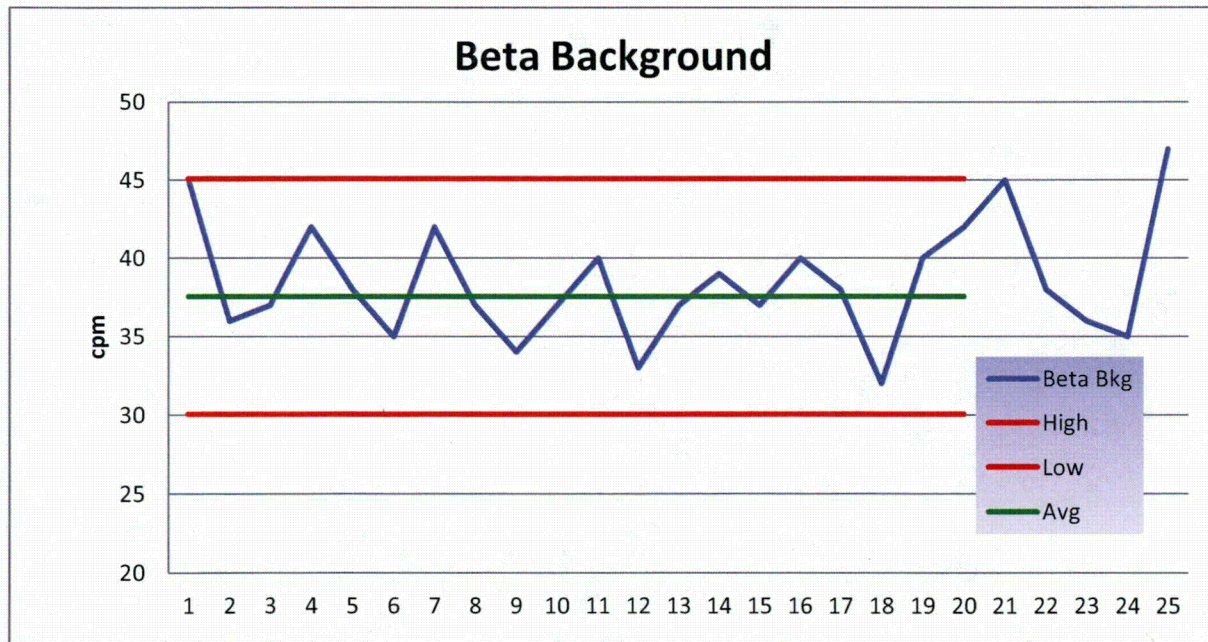
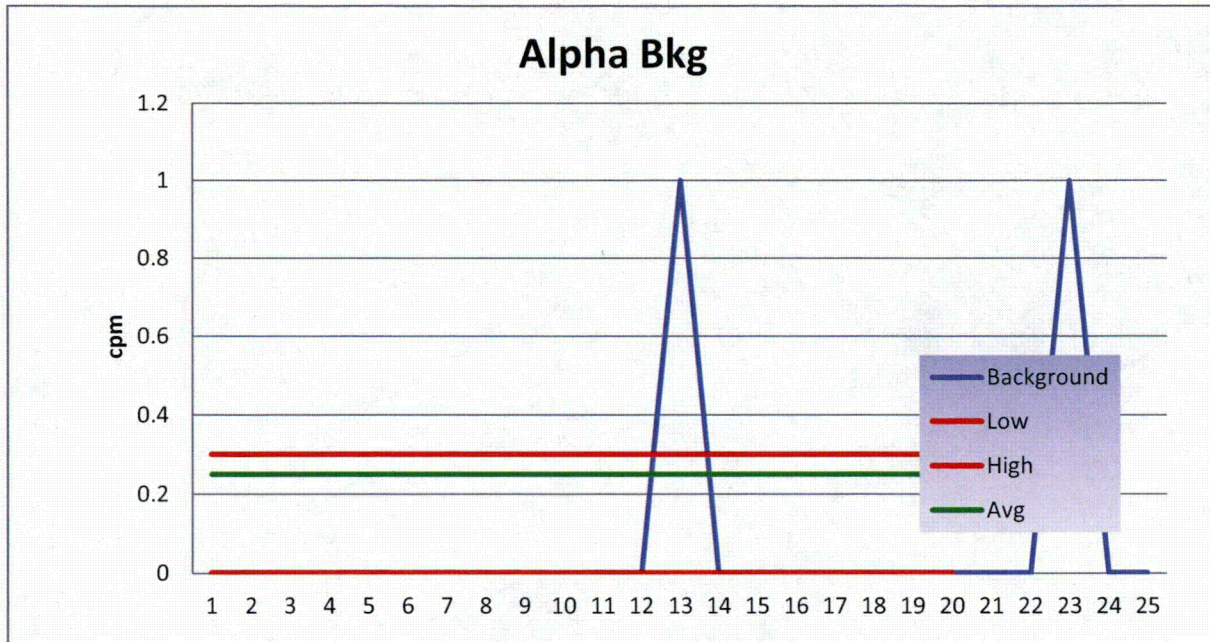
M-20%	0.2	M+20%	0.3	Alpha
M-20%	30	M+20%	45	Beta

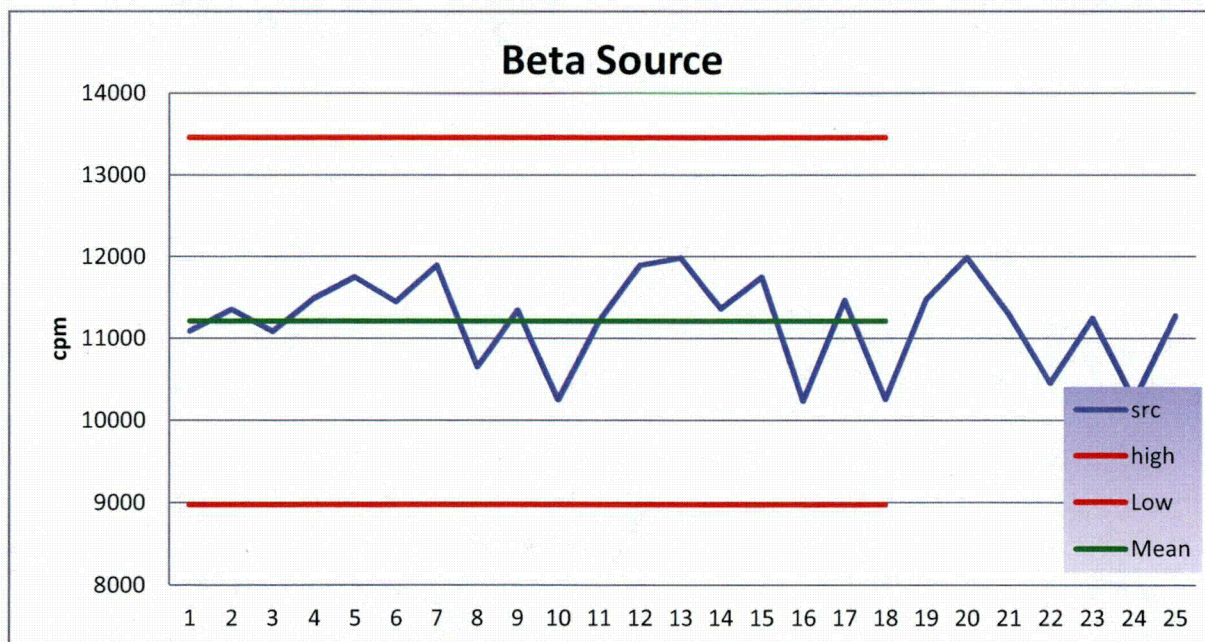
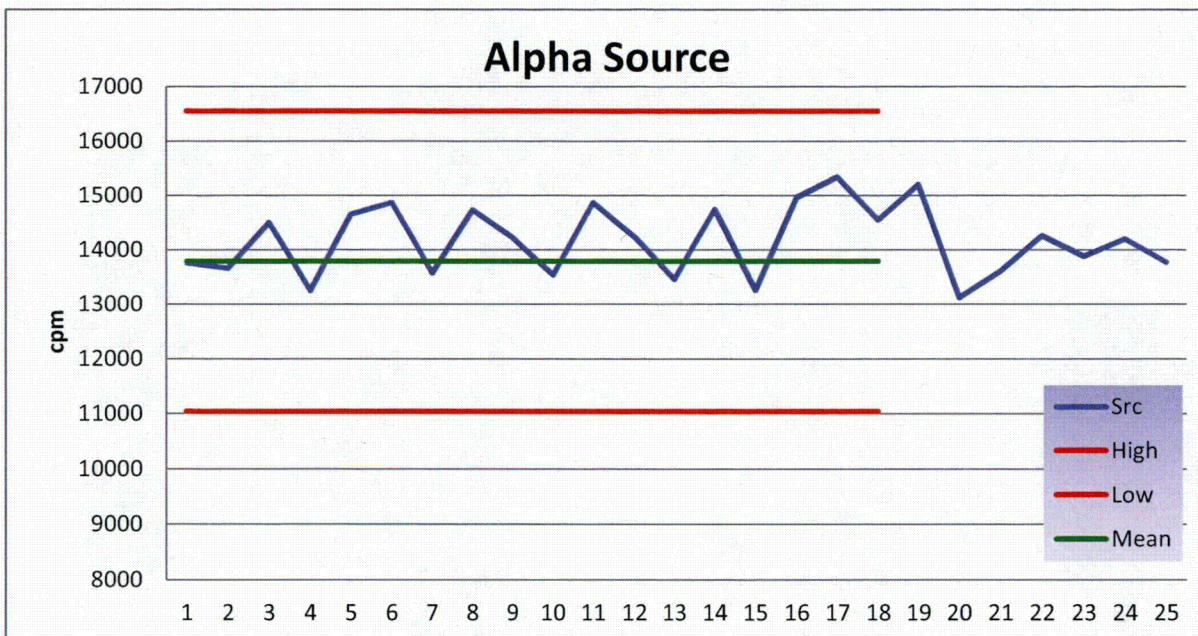
Source Acceptance Limits

M-20%	11032	M+20%	16549	Alpha
M-20%	8970	M+20%	13456	Beta

Reviewed by: _____

Date: _____





STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

SITE: GKP

Date: 12/17/13

For period: 12/14-1/14

Instrument Information		Source Information	Gamma
Type/Serial #:	URSA / 200124	Source Isotope	N/A
Probe/Serial #:	3X3/081107-2	Source ID	N/A
Calibration Due Date:	20-Nov-14		
Mode (count or dose)	Count		
Data Type (Src, Bkg)	Background		

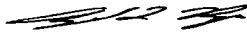
If data type is a background for a specific material, list the material type =

GAMMA			
D	C	C-(M)	[C-(M)] ²
1	11375	-1.45	2.10E+00
2	11332	-44.45	1.98E+03
3	11336	-40.45	1.64E+03
4	11350	-26.45	7.00E+02
5	11334	-42.45	1.80E+03
6	11665	288.55	8.33E+04
7	11497	120.55	1.45E+04
8	11263	-113.45	1.29E+04
9	11388	11.55	1.33E+02
10	11182	-194.45	3.78E+04
11	11296	-80.45	6.47E+03
12	11167	-209.45	4.39E+04
13	11498	121.55	1.48E+04
14	11132	-244.45	5.98E+04
15	11385	8.55	7.31E+01
16	11661	284.55	8.10E+04
17	11469	92.55	8.57E+03
18	11573	196.55	3.86E+04
19	11149	-227.45	5.17E+04
20	11477	100.55	1.01E+04

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	227529	11376.45	469679

Standard Deviation	
SD	157.23
2 x SD	314.45
3 x SD	471.68

Gamma			
MDCR and MDC Calculations			
Survey Speed:		MDCR =	
Probe Width:		MDC =	#REF!

Performed by: 

Date: 12/17/2013

Reviewed by: _____

Date: _____

STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

SITE: GKP

Date: 12/17/13

For period: 12/14-1/14

Instrument Information		Source Information	Gamma
Type/Serial #:	URSA / 200124	Source Isotope	Cs-137
Probe/Serial #:	3X3/081107-2	Source ID	101
Calibration Due Date	20-Nov-14		
Mode (count or dose)	Count		
Data Type (Src, Bkg)	Source		

If data type is a background for a specific material, list the material type =

Gamma			
D	C	C-(M)	[C-(M)] ²
1	605009	-5831.8	3.40E+07
2	606381	-4459.8	1.99E+07
3	614172	3331.2	1.11E+07
4	608093	-2747.8	7.55E+06
5	608583	-2257.8	5.10E+06
6	605749	-5091.8	2.59E+07
7	617493	6652.2	4.43E+07
8	611170	329.2	1.08E+05
9	608584	-2256.8	5.09E+06
10	612787	1946.2	3.79E+06
11	614321	3480.2	1.21E+07
12	605528	-5312.8	2.82E+07
13	606413	-4427.8	1.96E+07
14	616000	5159.2	2.66E+07
15	615154	4313.2	1.86E+07
16	615561	4720.2	2.23E+07
17	610026	-814.8	6.64E+05
18	606718	-4122.8	1.70E+07
19	611496	655.2	4.29E+05
20	617578	6737.2	4.54E+07

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	12216816	610840.8	3.48E+08

Standard Deviation	
SD	4278.08
2 x SD	8556.15
3 x SD	12834.23

BETA			
MDCR and MDC Calculations			
Survey Speed:		MDCR =	
Probe Width:		MDC =	N/A

Performed by: 

Date: 12/17/2013

Reviewed by: _____

Date: _____

DAILY INSTRUMENT RESPONSE CHECK
Form RS-013.0-3

SITE: GKP

Date: 12/17/13

For period: 1/14-2/14

Instrument Information	
Type/Serial #:	URSA / 200124
Probe/Serial #:	3X3/081107-2
Calibration Due Date:	20-Nov-14

Source Information	
Isotope	Cs-137
Serial Number	101
Activity	1 uCi

DATE	TIME	BACKGROUND CPM Gamma	SOURCE CPM Gamma	COMMENTS	Tech Initials
1/27/2014	7:00	11469	630379		HPO
1/28/2014	7:00	11593	617202		HPO
1/29/2014	7:00	11640	617367		HPO
1/30/2014	7:00	11368	605038		HPO
1/31/2014	7:00	11508	607014		HPO
2/3/2014	7:00	12924	500980		HPO
2/4/2014	7:00	11480	551547		HPO
2/5/2014	7:00	11984	583007		HPO
2/6/2014	7:00	13486	554786		HPO
2/7/2014	7:00	11360	601601		HPO
2/10/2014	7:00	10837	611050		HPO
2/11/2014	7:00	10542	610845		SRR
2/12/2014	7:00	10670	605637		HPO
2/14/2014	7:00	10433	608279		HPO
2/17/2014	7:00	10522	595137		HPO
2/18/2014	7:00	10748	598408		HPO
2/19/2014	7:00	10423	606300		HPO
2/20/2014	7:00	10543	604209		HPO
2/21/2014	7:00	10310	597266		HPO
2/24/2014	7:00	10729	605783		HPO
2/25/2014	7:00	10867	567288		HPO
2/26/2014	7:00	10904	586405		HPO
2/27/2014	7:00	10412	567225		HPO
3/3/2014	7:00	10160	587548		HPO

Mean from form RS-013.0-1
Background

0
11376.45 gamma

Mean from form RS-013.0-1
Source

0
610840.8 gamma

Background Acceptance Limits

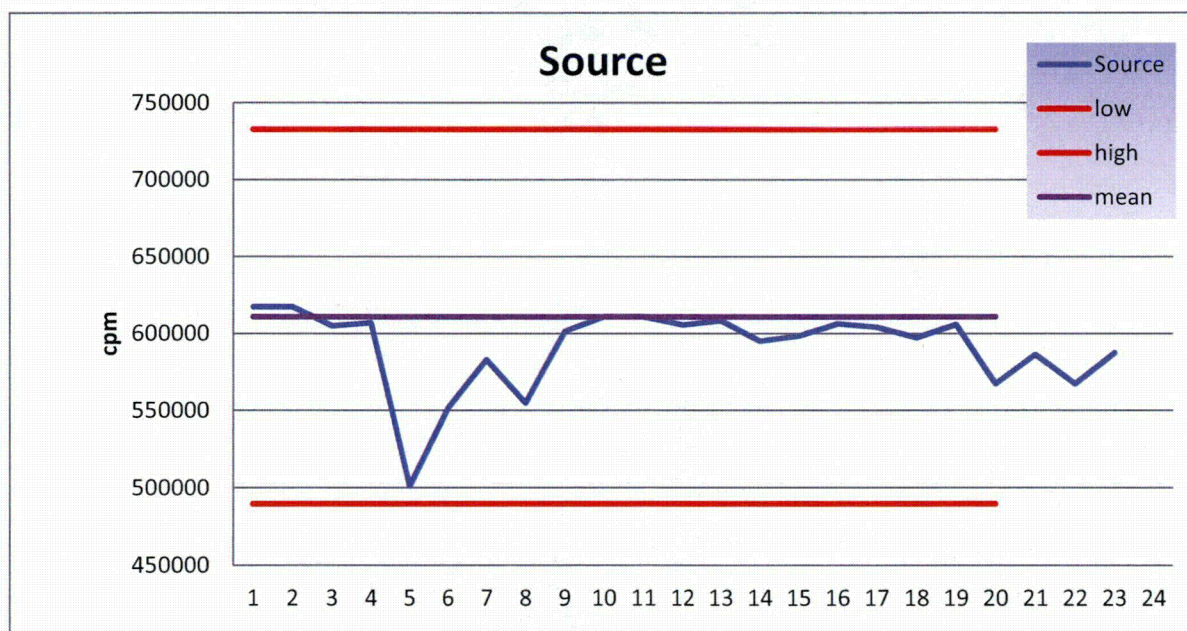
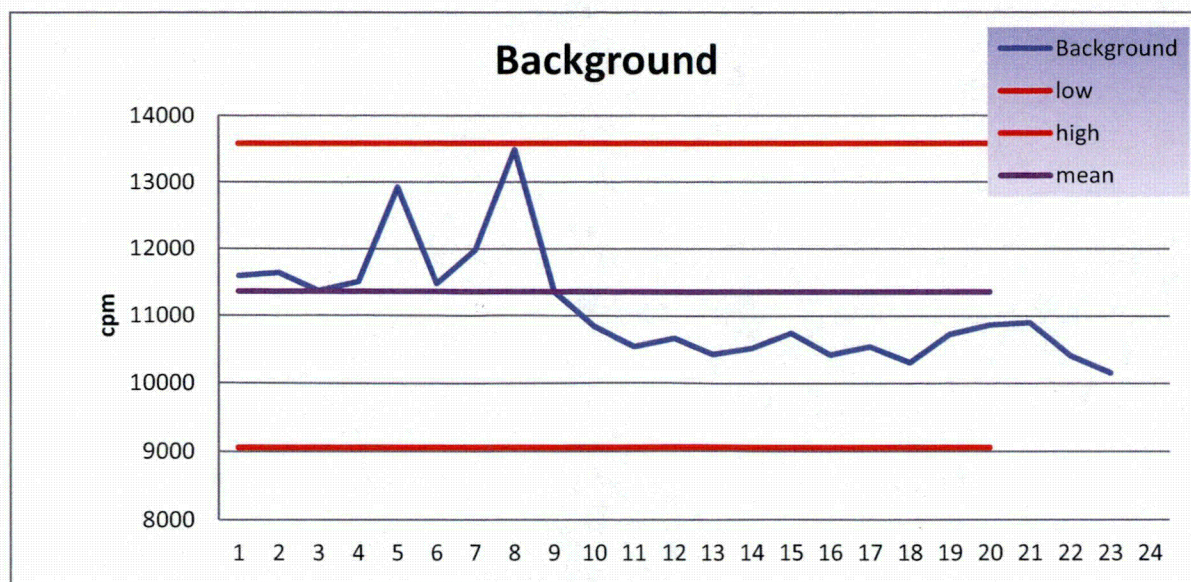
M-20%	0	M+20%	0	Alpha
M-20%	9101	M+20%	13652	Beta

Source Acceptance Limits

M-20%	0	M+20%	0	Alpha
M-20%	488673	M+20%	733009	Beta

Reviewed by: _____

Date: _____



STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

SITE: GKP

Date: 12/17/13

For period: 12/14-1/14

Instrument Information		Source Information	Gamma
Type/Serial #:	URSA / 200130	Source Isotope	N/A
Probe/Serial #:	3X3/081107-1	Source ID	N/A
Calibration Due Date:	20-Nov-14		
Mode (count or dose)	Count		
Data Type (Src, Bkg)	Background		


If data type is a background for a specific material, list the material type =

GAMMA			
D	C	C-(M)	[C-(M)] ²
1	10669	30.5	9.30E+02
2	10768	129.5	1.68E+04
3	10692	53.5	2.86E+03
4	10630	-8.5	7.23E+01
5	10711	72.5	5.26E+03
6	10714	75.5	5.70E+03
7	10494	-144.5	2.09E+04
8	10615	-23.5	5.52E+02
9	10563	-75.5	5.70E+03
11	10684	45.5	2.07E+03
12	10518	-120.5	1.45E+04
13	10636	-2.5	6.25E+00
14	10636	-2.5	6.25E+00
15	10643	4.5	2.03E+01
16	10692	53.5	2.86E+03
17	10574	-64.5	4.16E+03
18	10645	6.5	4.23E+01
19	10700	61.5	3.78E+03
20	10641	2.5	6.25E+00

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	212770	10638.5	94943

Standard Deviation	
SD	70.69
2 x SD	141.38
3 x SD	212.07

Gamma			
MDCR and MDC Calculations			
Survey Speed:		MDCR =	
Probe Width:		MDC =	#DIV/0!

Performed by: 

Date: 12/17/2013

Reviewed by: _____

Date: _____

STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

SITE: GKP

Date: 12/17/13

For period: 12/14-1/14

Instrument Information		Source Information	Gamma
Type/Serial #:	URSA / 200130	Source Isotope	Cs-137
Probe/Serial #:	3X3/081107-1	Source ID	101
Calibration Due Date	20-Nov-14		
Mode (count or dose)	Count		
Data Type (Src, Bkg)	Source		

If data type is a background for a specific material, list the material type =

Gamma			
D	C	C-(M)	[C-(M)] ²
1	442063	-42845.9	1.84E+09
2	497459	12550.15	1.58E+08
3	508476	23567.15	5.55E+08
4	500048	15139.15	2.29E+08
5	508885	23976.15	5.75E+08
6	508085	23176.15	5.37E+08
7	510788	25879.15	6.70E+08
8	470510	-14398.9	2.07E+08
9	473237	-11671.9	1.36E+08
11	493868	8959.15	8.03E+07
12	466288	-18620.9	3.47E+08
13	494348	9439.15	8.91E+07
14	487546	2637.15	6.95E+06
15	478818	-6090.85	3.71E+07
16	490328	5419.15	2.94E+07
17	499298	14389.15	2.07E+08
18	461412	-23496.9	5.52E+08
19	446081	-38827.9	1.51E+09
20	502003	17094.15	2.92E+08

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	9698177	484908.9	8.74E+09

Standard Deviation	
SD	21449.94
2 x SD	42899.89
3 x SD	64349.83

BETA			
MDCR and MDC Calculations			
Survey Speed:		MDCR =	
Probe Width:		MDC =	N/A

Performed by: 

Date: 12/17/2013

Reviewed by: _____

Date: _____

Date: _____

DAILY INSTRUMENT RESPONSE CHECK
Form RS-013.0-3

SITE: GKP

Date: 12/17/13

For period: 12/14-1/14

Instrument Information	
Type/Serial #:	URSA / 200130
Probe/Serial #:	3X3/081107-1
Calibration Due Date:	20-Nov-14

Source Information	
Isotope	Cs-137
Serial Number	101
Activity	1 uCi

DATE	TIME	BACKGROUND CPM Gamma	SOURCE CPM Gamma	COMMENTS	Tech Initials
1/9/2014	7:00	11022	501249		ALR
1/13/2014	7:00	9849	410284		SRR
1/14/2014	7:00	9305	430872		SRR
1/15/2014	7:00	9895	445126		SRR
1/16/2014	7:00	9856	488558		SRR
1/17/2014	7:00	11658	500557		SRR
1/20/2014	7:00	10510	457286		SRR
1/21/2014	7:00	11159	493063		SRR
1/22/2014	7:00	10550	560052		SRR
1/23/2014	7:00	9991	466050		HPO
1/24/2014	7:00	9638	510818		HPO
1/27/2014	7:00	9505	477964		HPO
1/28/2014	7:00	10815	504714		AO
1/29/2014	7:00	10061	547119		AO
1/30/2014	7:00	10252	551418		AO
1/31/2014	7:00	9847	547962		AO
2/3/2014	7:00	10981	545248		AO
2/4/2014	7:00	9725	532413		AO
2/5/2014	7:00	10125	540041		AO
2/6/2014	7:00	11460	499875		AO
2/7/2014	7:00	10739	413816		AO
2/10/2014	7:00	10446	547983		AO
2/11/2014	7:00	10410	534102		SRR
2/12/2014	7:00	10048	490050		AO

Mean from form RS-013.0-1
Background

0	Alpha
10638.5	Gamma

Mean from form RS-013.0-1
Source

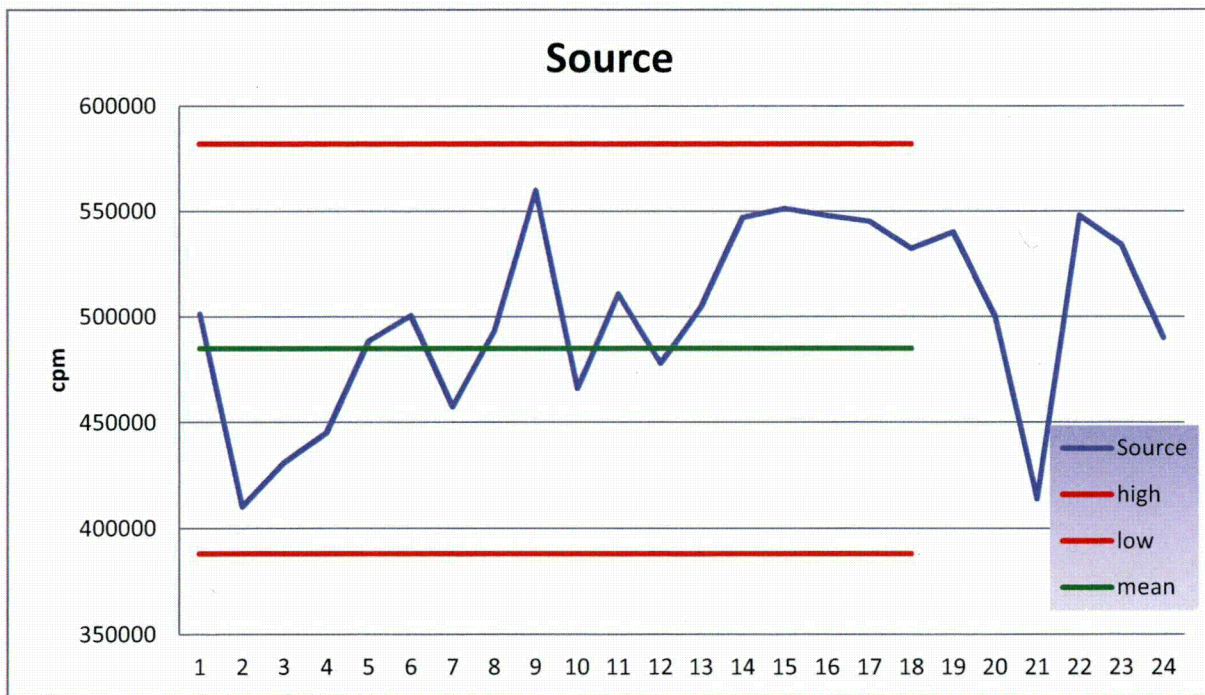
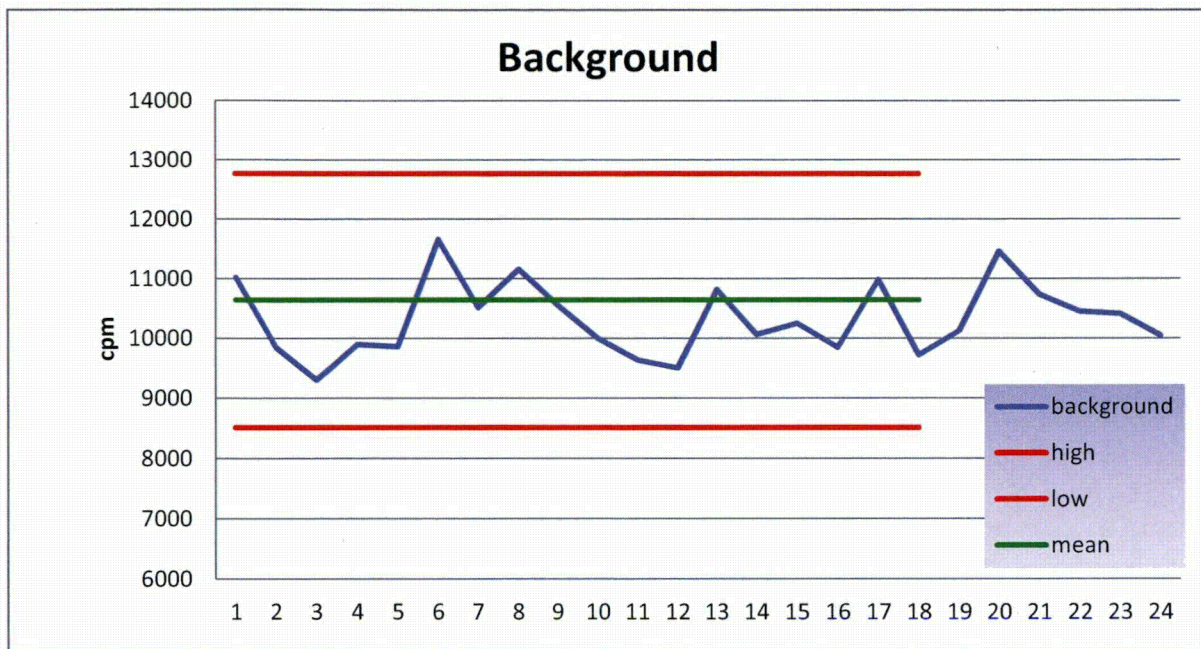
0	Alpha
484908.9	Gamma

Background Acceptance Limits				
M-20%	0	M+20%	0	Alpha
M-20%	8511	M+20%	12766	Gamma

Source Acceptance Limits				
M-20%	0	M+20%	0	Alpha
M-20%	387927	M+20%	581891	Gamma

Reviewed by: _____

Date: _____



STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

SITE: GKP

Date: 12/17/13

For period: 12/14-1/14

Instrument Information		Source Information	Gamma
Type/Serial #:	URSA / 200130	Source Isotope	N/A
Probe/Serial #:	3X3/081107-1	Source ID	N/A
Calibration Due Date:	20-Nov-14		
Mode (count or dose)	Count		
Data Type (Src, Bkg)	Background		

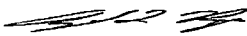
If data type is a background for a specific material, list the material type =

GAMMA			
D	C	C-(M)	[C-(M)] ²
1	10669	30.5	9.30E+02
2	10768	129.5	1.68E+04
3	10692	53.5	2.86E+03
4	10630	-8.5	7.23E+01
5	10711	72.5	5.26E+03
6	10714	75.5	5.70E+03
7	10494	-144.5	2.09E+04
8	10615	-23.5	5.52E+02
9	10563	-75.5	5.70E+03
11	10684	45.5	2.07E+03
12	10518	-120.5	1.45E+04
13	10636	-2.5	6.25E+00
14	10636	-2.5	6.25E+00
15	10643	4.5	2.03E+01
16	10692	53.5	2.86E+03
17	10574	-64.5	4.16E+03
18	10645	6.5	4.23E+01
19	10700	61.5	3.78E+03
20	10641	2.5	6.25E+00

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	212770	10638.5	94943

Standard Deviation	
SD	70.69
2 x SD	141.38
3 x SD	212.07

Gamma			
MDCR and MDC Calculations			
Survey Speed:		MDCR =	
Probe Width:		MDC =	#DIV/0!

Performed by: 

Date: 12/17/2013

Reviewed by: _____

Date: _____

STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

SITE: GKP

Date: 12/17/13

For period: 12/14-1/14

Instrument Information		Source Information	Gamma
Type/Serial #:	URSA / 200130	Source Isotope	Cs-137
Probe/Serial #:	3X3/081107-1	Source ID	101
Calibration Due Date	20-Nov-14		
Mode (count or dose)	Count		
Data Type (Src, Bkg)	Source		

If data type is a background for a specific material, list the material type =

Gamma			
D	C	C-(M)	[C-(M)] ²
1	442063	-42845.9	1.84E+09
2	497459	12550.15	1.58E+08
3	508476	23567.15	5.55E+08
4	500048	15139.15	2.29E+08
5	508885	23976.15	5.75E+08
6	508085	23176.15	5.37E+08
7	510788	25879.15	6.70E+08
8	470510	-14398.9	2.07E+08
9	473237	-11671.9	1.36E+08
11	493868	8959.15	8.03E+07
12	466288	-18620.9	3.47E+08
13	494348	9439.15	8.91E+07
14	487546	2637.15	6.95E+06
15	478818	-6090.85	3.71E+07
16	490328	5419.15	2.94E+07
17	499298	14389.15	2.07E+08
18	461412	-23496.9	5.52E+08
19	446081	-38827.9	1.51E+09
20	502003	17094.15	2.92E+08

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	9698177	484908.9	8.74E+09

Standard Deviation	
SD	21449.94
2 x SD	42899.89
3 x SD	64349.83

BETA			
MDCR and MDC Calculations			
Survey Speed:		MDCR =	
Probe Width:		MDC =	N/A

Performed by: 

Date: 12/17/2013

Reviewed by: _____

Date: _____

INSTRUMENT EFFICIENCY CALCULATION
Form RS-013.0-2

SITE: GKP

Date: 12/17/13

For period: 12/14-1/14

Instrument Information		Source Information		Gamma
Type/Serial #:	URSA / 200130	Initial Source Activity (A_0) (dpm)		
Probe/Serial #:	3X3/081107-1	Source ID		
Calibration Due Date:	20-Nov-14	Source Isotope		
		Date Source was prepared		
		Scaler Instrument Check Date		
		Time since src prepared (T) (yrs):		
		Half-Life of Source ($t_{1/2}$) (yrs)		
		Current 2π emission rate (dpm)		

GAMMA		
Count #	Bkgrd Counts/minute	Src Counts/minute
1	N/A	N/A
2		
3		
4		
5		
6		
7		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
SUM	0	0
Average	#DIV/0!	#DIV/0!

BETA	
Bkgrd Counts/minute	Src Counts/minute
N/A	N/A
0	0
#DIV/0!	#DIV/0!

Inst. Eff = $\frac{\text{Avg Source CPM} - \text{Avg Bkgrd CPM}}{\text{Source } 2\pi \text{ emission rate (dpm)}}$

Inst Efficiency Alpha = #DIV/0!

Inst Efficiency Beta = #DIV/0!

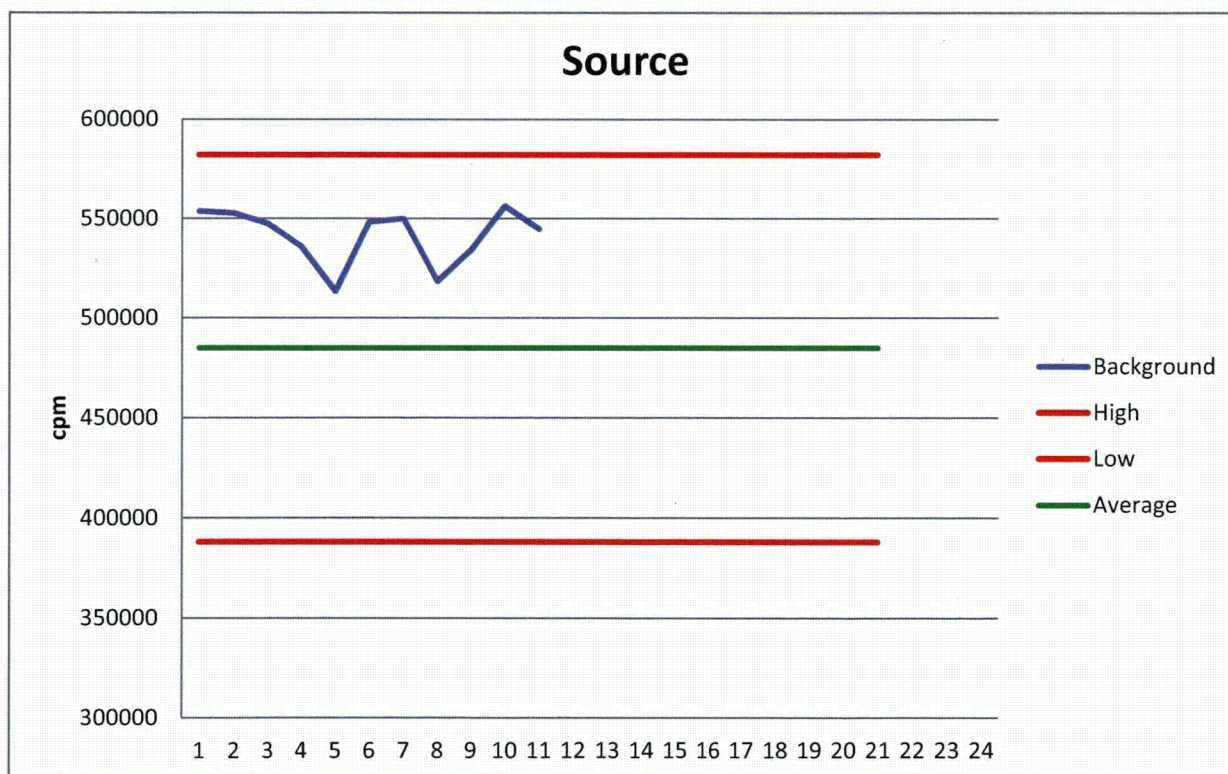
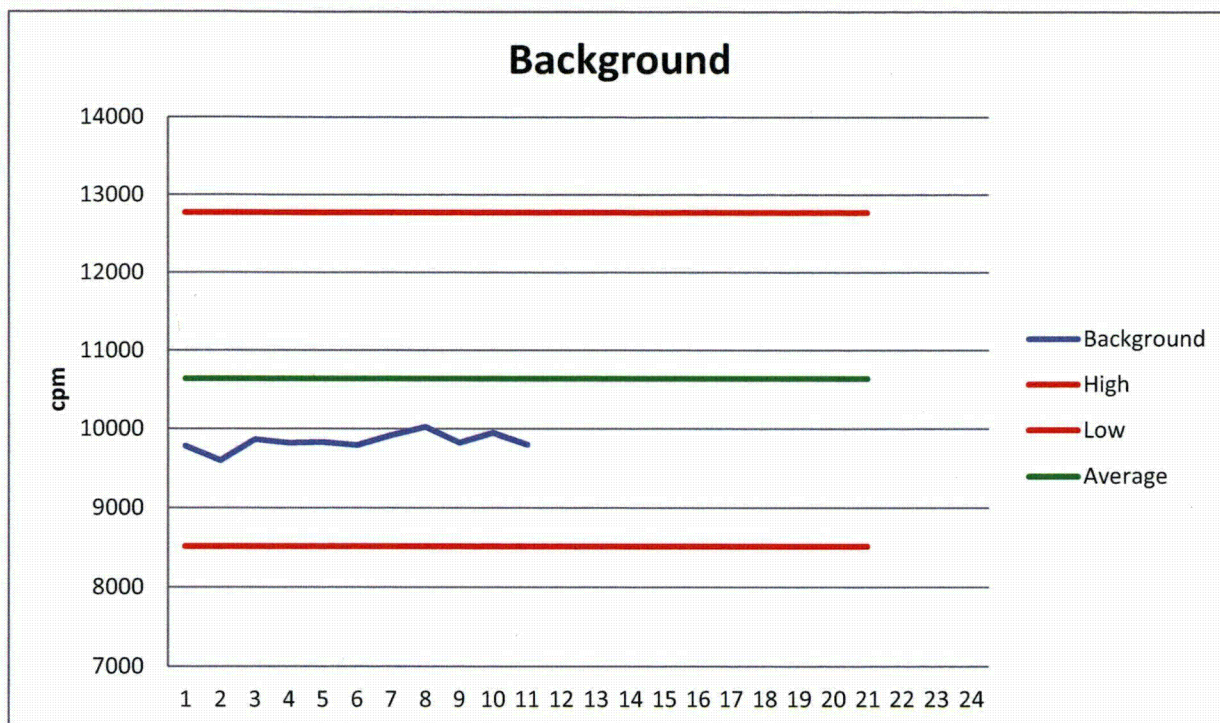
Performed by: _____

Date: _____

Reviewed by: _____

Date: _____

Date: _____



URSA II – 124 (Rexon 3x3 NaI)

STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

SITE: GKP

Date: 12/17/13

For period: 12/14-1/14

Instrument Information		Source Information	Gamma
Type/Serial #:	URSA / 200124	Source Isotope	N/A
Probe/Serial #:	3X3/081107-2	Source ID	N/A
Calibration Due Date:	20-Nov-14		
Mode (count or dose)	Count		
Data Type (Src, Bkg)	Background		

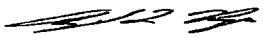
If data type is a background for a specific material, list the material type =

GAMMA			
D	C	C-(M)	[C-(M)] ²
1	14023	222.3	4.94E+04
2	13825	24.3	5.90E+02
3	12962	-838.7	7.03E+05
4	12669	-1131.7	1.28E+06
5	13632	-168.7	2.85E+04
6	14381	580.3	3.37E+05
7	13363	-437.7	1.92E+05
8	13707	-93.7	8.78E+03
9	13187	-613.7	3.77E+05
10	13938	137.3	1.89E+04
11	14179	378.3	1.43E+05
12	15851	2050.3	4.20E+06
13	14014	213.3	4.55E+04
14	13807	6.3	3.97E+01
15	14247	446.3	1.99E+05
16	13802	1.3	1.69E+00
17	13830	29.3	8.58E+02
18	14185	384.3	1.48E+05
19	13478	-322.7	1.04E+05
20	12934	-866.7	7.51E+05

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	276014	13800.7	8590630

Standard Deviation	
SD	672.41
2 x SD	1344.82
3 x SD	2017.24

Gamma			
MDCR and MDC Calculations			
Survey Speed:		MDCR =	
Probe Width:		MDC =	#DIV/0!

Performed by: 

Date: 12/17/2013

Reviewed by: _____

Date: _____

STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

SITE: GKP

Date: 12/17/13

For period: 12/14-1/14

Instrument Information		Source Information	Gamma
Type/Serial #:	URSA / 200124	Source Isotope	Cs-137
Probe/Serial #:	3X3/081107-2	Source ID	101
Calibration Due Date	20-Nov-14		
Mode (count or dose)	Count		
Data Type (Src, Bkg)	Source		

If data type is a background for a specific material, list the material type =

Gamma			
D	C	C-(M)	[C-(M)] ²
1	410510	805.15	6.48E+05
2	408874	-830.85	6.90E+05
3	408823	-881.85	7.78E+05
4	410843	1138.15	1.30E+06
5	409489	-215.85	4.66E+04
6	411525	1820.15	3.31E+06
7	411314	1609.15	2.59E+06
8	409775	70.15	4.92E+03
9	409382	-322.85	1.04E+05
10	410502	797.15	6.35E+05
11	410190	485.15	2.35E+05
12	408919	-785.85	6.18E+05
13	409541	-163.85	2.68E+04
14	409048	-656.85	4.31E+05
15	410584	879.15	7.73E+05
16	408363	-1341.85	1.80E+06
17	408590	-1114.85	1.24E+06
18	409010	-694.85	4.83E+05
19	409616	-88.85	7.89E+03
20	409199	-505.85	2.56E+05

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	8194097	409704.9	15979307

Standard Deviation	
SD	917.07
2 x SD	1834.14
3 x SD	2751.21

BETA			
MDCR and MDC Calculations			
Survey Speed:		MDCR =	
Probe Width:		MDC =	N/A

Performed by: 

Date: 12/17/2013

Reviewed by: _____

Date: _____

For period: 12/14-1/14

Instrument Information		Source Information		Beta
Type/Serial #:	URSA / 200124	Initial Source Activity (A_0) (dpm)		
Probe/Serial #:	3X3/081107-2	Source ID		
Calibration Due Date:	20-Nov-14	Source Isotope		
		Date Source was prepared		
		Scaler Instrument Check Date		
		Time since src prepared (T) (yrs):		
		Half-Life of Source ($t_{1/2}$) (yrs)		
		Current 2π emission rate (dpm)		

	ALPHA	
Count #	Bkgrd Counts/minute	Srcce Counts/minute
1	N/A	N/A
2	N/A	N/A
3	N/A	N/A
4	N/A	N/A
5	N/A	N/A
6	N/A	N/A
7	N/A	N/A
8	N/A	N/A
9	N/A	N/A
10	N/A	N/A
11	N/A	N/A
12	N/A	N/A
13	N/A	N/A
14	N/A	N/A
15	N/A	N/A
16	N/A	N/A
17	N/A	N/A
18	N/A	N/A
19	N/A	N/A
20	N/A	N/A
SUM	0	0
Average	#DIV/0!	#DIV/0!

BETA	
Bkgrd Counts/minute	Srce Counts/minute
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
N/A	N/A
0	0
#DIV/0!	#DIV/0!

$$\text{Inst. Eff} = \frac{\text{Avg Source CPM} - \text{Avg Bkgrd CPM}}{\text{Source } 2\pi \text{ emission rate (dpm)}}$$

Inst Efficiency Alpha = #DIV/0!

Inst Efficiency Beta = #DIV/0!

Performed by:

Date:

Reviewed by:

Date: _____

For period: 12/14-1/14

Instrument Information	
Type/Serial #:	URSA / 200124
Probe/Serial #:	3X3/081107-2
Calibration Due Date:	20-Nov-14

Source Information		
Isotope		Cs-137
Serial Number		101
Activity		1 uCi

[illegible]

Mean from form RS-013.0-1
Background

0	Alpha
13800.7	gamma

Mean from form RS-013.0-1
Source

0	Alpha
409704.9	gamma

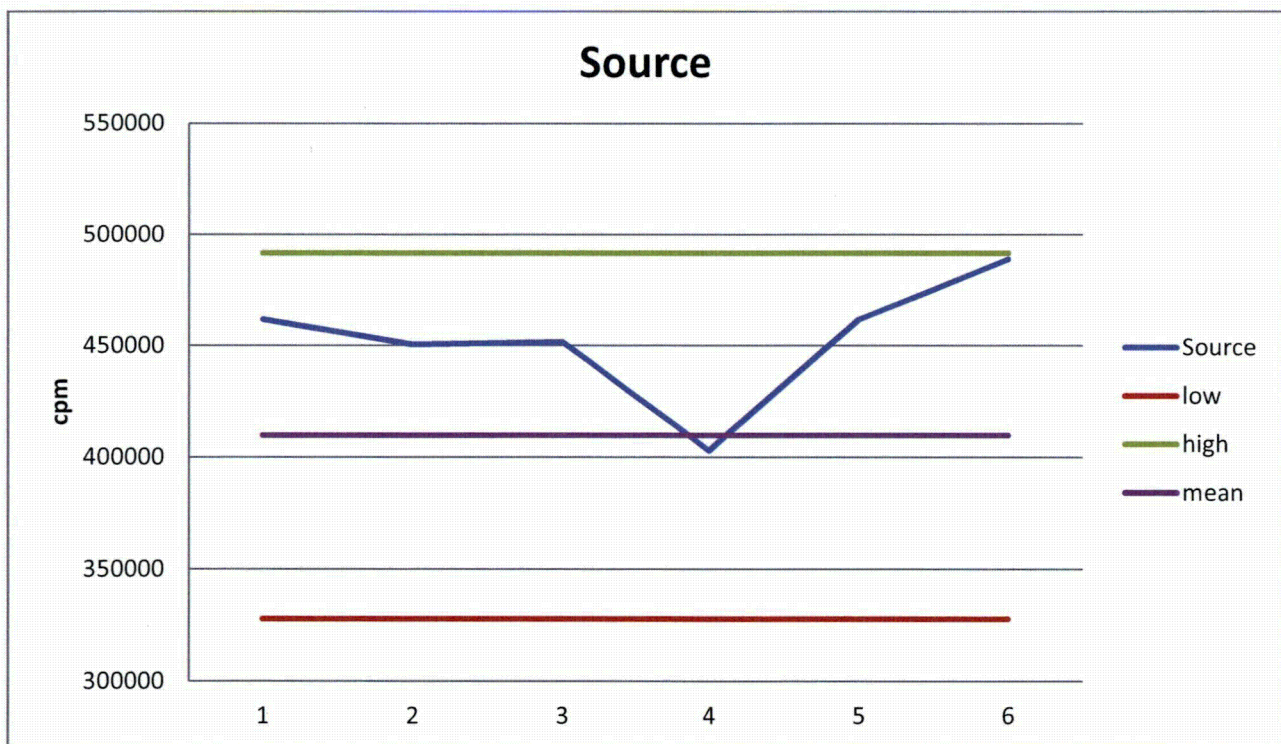
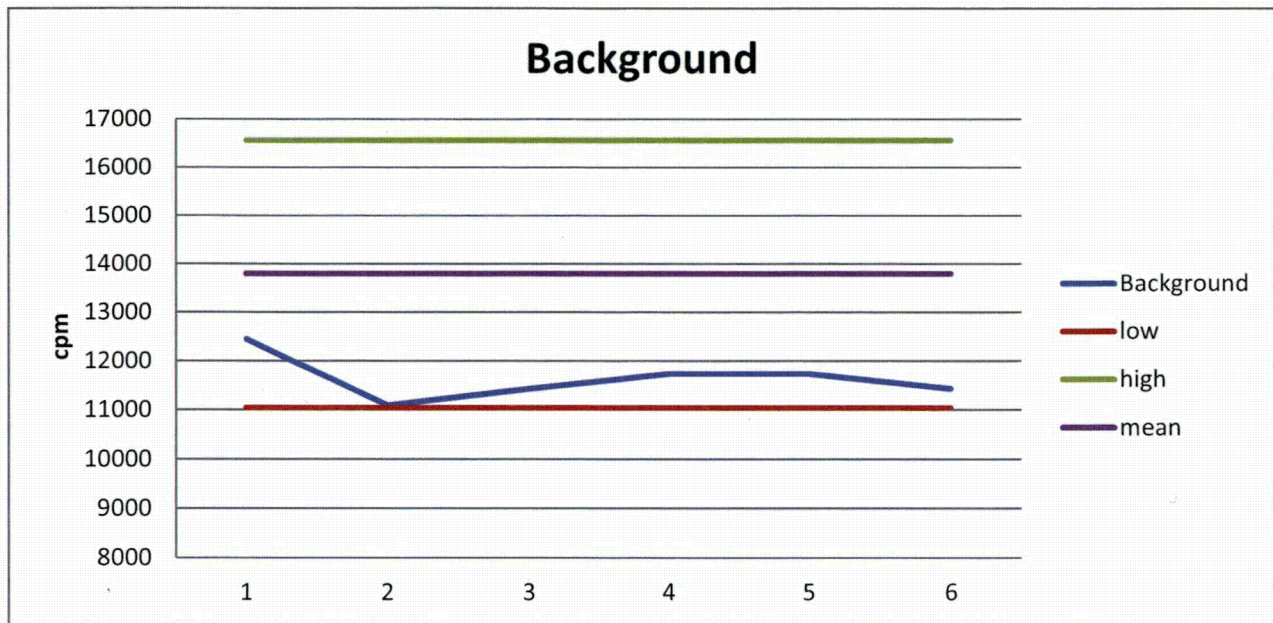
Background Acceptance Limits			
M-20%	0	M+20%	0
M-20%	11041	M+20%	16561

Alpha
gamma

Source Acceptance Limits				
M-20%	0	M+20%	0	Alpha gamma
M-20%	327764	M+20%	491646	

Reviewed by: _____

Date: _____



[illegible]

URSA II – 124 (Ludlum 44-20)

STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

SITE: GKP

Date: 12/17/13

For period: 12/14-1/14

Instrument Information		Source Information	Gamma
Type/Serial #:	URSA / 200124	Source Isotope	N/A
Probe/Serial #:	3X3/081107-2	Source ID	N/A
Calibration Due Date:	20-Nov-14		
Mode (count or dose)	Count		
Data Type (Src, Bkg)	Background		

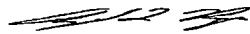
If data type is a background for a specific material, list the material type =

GAMMA			
D	C	C-(M)	[C-(M)] ²
1	11265	-126.05	1.59E+04
2	11509	117.95	1.39E+04
3	11520	128.95	1.66E+04
4	11545	153.95	2.37E+04
5	11645	253.95	6.45E+04
6	11609	217.95	4.75E+04
7	11552	160.95	2.59E+04
8	11430	38.95	1.52E+03
9	11486	94.95	9.02E+03
10	11438	46.95	2.20E+03
11	11269	-122.05	1.49E+04
12	11216	-175.05	3.06E+04
13	11338	-53.05	2.81E+03
14	11389	-2.05	4.20E+00
15	11108	-283.05	8.01E+04
16	11275	-116.05	1.35E+04
17	11195	-196.05	3.84E+04
18	11209	-182.05	3.31E+04
19	11647	255.95	6.55E+04
20	11176	-215.05	4.62E+04

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	227821	11391.05	546041

Standard Deviation	
SD	169.53
2 x SD	339.05
3 x SD	508.58

Gamma			
MDCR and MDC Calculations			
Survey Speed:		MDCR =	
Probe Width:		MDC =	#REF!

Performed by: 

Date: 12/17/2013

Reviewed by: _____

Date: _____

STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

SITE: GKP

Date: 12/17/13

For period: 12/14-1/14

Instrument Information		Source Information	Gamma
Type/Serial #:	URSA / 200124	Source Isotope	Cs-137
Probe/Serial #:	3X3/081107-2	Source ID	101
Calibration Due Date	20-Nov-14		
Mode (count or dose)	Count		
Data Type (Src, Bkg)	Source		

If data type is a background for a specific material, list the material type =

Gamma			
D	C	C-(M)	[C-(M)] ²
1	605009	-6951.25	4.83E+07
2	615037	3076.75	9.47E+06
3	608198	-3762.25	1.42E+07
4	612490	529.75	2.81E+05
5	615982	4021.75	1.62E+07
6	613537	1576.75	2.49E+06
7	607832	-4128.25	1.70E+07
8	615242	3281.75	1.08E+07
9	608354	-3606.25	1.30E+07
10	611924	-36.25	1.31E+03
11	616948	4987.75	2.49E+07
12	605117	-6843.25	4.68E+07
13	611270	-690.25	4.76E+05
14	607847	-4113.25	1.69E+07
15	612942	981.75	9.64E+05
16	616925	4964.75	2.46E+07
17	607715	-4245.25	1.80E+07
18	613649	1688.75	2.85E+06
19	615609	3648.75	1.33E+07
20	617578	5617.75	3.16E+07

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	12239205	611960.3	3.12E+08

Standard Deviation	
SD	4053.35
2 x SD	8106.69
3 x SD	12160.04

BETA			
MDCR and MDC Calculations			
Survey Speed:		MDCR =	
Probe Width:		MDC =	N/A

Performed by: 

Date: 12/17/2013

Reviewed by: _____

Date: _____

SITE: GKP **Date:** 12/17/13 **For period:** 12/14-1/14

Source Information		
Isotope		Cs-137
Serial Number		101
Activity		1 uCi

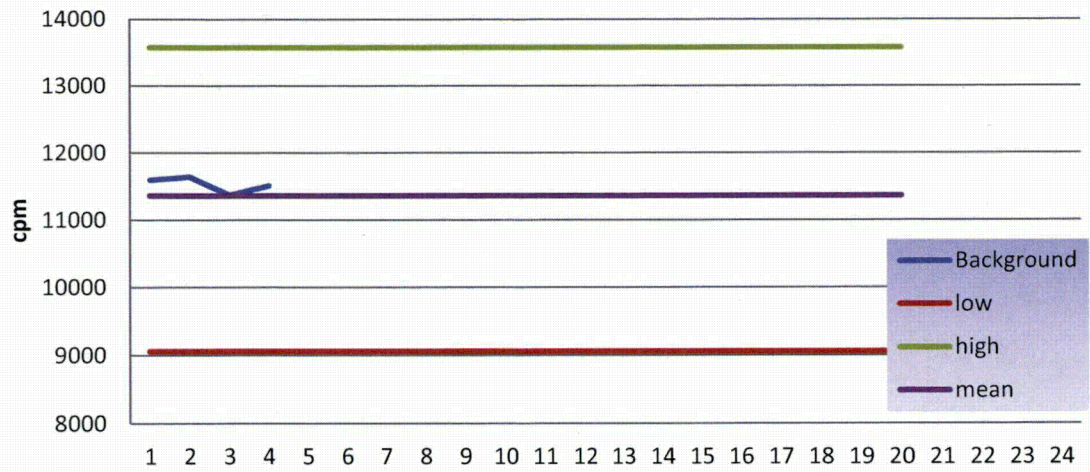
[illegible]

Mean from form RS-013.0-1	0
Source	611960.3 gamma

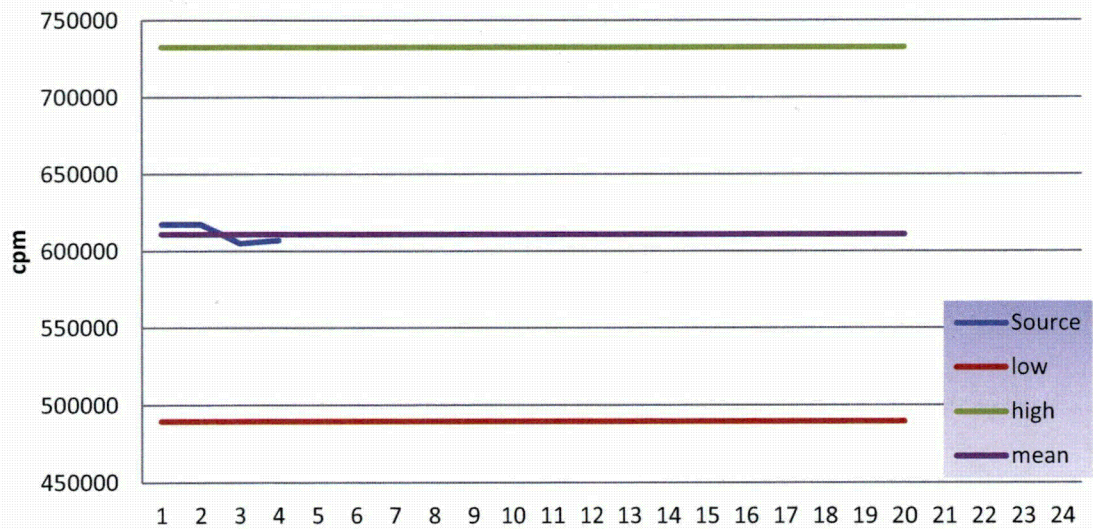
Source Acceptance Limits				
M-20%	0	M+20%	0	Alpha
M-20%	489568	M+20%	734352	Beta

Date:

Background



Source



URSA II - 130

STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

SITE: GKP

Date: 12/17/13

For period: 12/14-1/14

Instrument Information		Source Information		Gamma
Type/Serial #:	URSA / 200130	Source Isotope		N/A
Probe/Serial #:	3X3/081107-1	Source ID		N/A
Calibration Due Date:	20-Nov-14			
Mode (count or dose)	Count			
Data Type (Src, Bkg)	Background			

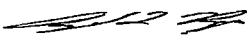
If data type is a background for a specific material, list the material type =

GAMMA			
D	C	C-(M)	[C-(M)] ²
1	10669	30.5	9.30E+02
2	10768	129.5	1.68E+04
3	10692	53.5	2.86E+03
4	10630	-8.5	7.23E+01
5	10711	72.5	5.26E+03
6	10714	75.5	5.70E+03
7	10494	-144.5	2.09E+04
8	10615	-23.5	5.52E+02
9	10563	-75.5	5.70E+03
11	10684	45.5	2.07E+03
12	10518	-120.5	1.45E+04
13	10636	-2.5	6.25E+00
14	10636	-2.5	6.25E+00
15	10643	4.5	2.03E+01
16	10692	53.5	2.86E+03
17	10574	-64.5	4.16E+03
18	10645	6.5	4.23E+01
19	10700	61.5	3.78E+03
20	10641	2.5	6.25E+00

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	212770	10638.5	94943

Standard Deviation	
SD	70.69
2 x SD	141.38
3 x SD	212.07

Gamma			
MDCR and MDC Calculations			
Survey Speed:		MDCR =	
Probe Width:		MDC =	#DIV/0!

Performed by: 

Date: 12/17/2013

Reviewed by: _____

Date: _____

STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

SITE: GKP

Date: 12/17/13

For period: 12/14-1/14

Instrument Information		Source Information	Gamma
Type/Serial #:	URSA / 200130	Source Isotope	Cs-137
Probe/Serial #:	3X3/081107-1	Source ID	101
Calibration Due Date	20-Nov-14		
Mode (count or dose)	Count		
Data Type (Src, Bkg)	Source		

If data type is a background for a specific material, list the material type =

Gamma			
D	C	C-(M)	[C-(M)] ²
1	442063	-42845.9	1.84E+09
2	497459	12550.15	1.58E+08
3	508476	23567.15	5.55E+08
4	500048	15139.15	2.29E+08
5	508885	23976.15	5.75E+08
6	508085	23176.15	5.37E+08
7	510788	25879.15	6.70E+08
8	470510	-14398.9	2.07E+08
9	473237	-11671.9	1.36E+08
11	493868	8959.15	8.03E+07
12	466288	-18620.9	3.47E+08
13	494348	9439.15	8.91E+07
14	487546	2637.15	6.95E+06
15	478818	-6090.85	3.71E+07
16	490328	5419.15	2.94E+07
17	499298	14389.15	2.07E+08
18	461412	-23496.9	5.52E+08
19	446081	-38827.9	1.51E+09
20	502003	17094.15	2.92E+08

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	9698177	484908.9	8.74E+09

Standard Deviation	
SD	21449.94
2 x SD	42899.89
3 x SD	64349.83

BETA			
MDCR and MDC Calculations			
Survey Speed:		MDCR =	
Probe Width:		MDC =	N/A

Performed by: 

Date: 12/17/2013

Reviewed by: _____

Date: _____

INSTRUMENT EFFICIENCY CALCULATION
Form RS-013.0-2

SITE: GKP

Date: 12/17/13

For period: 12/14-1/14

Instrument Information		Source Information		Gamma
Type/Serial #:	URSA / 200130	Initial Source Activity (A_0) (dpm)		
Probe/Serial #:	3X3/081107-1	Source ID		
Calibration Due Date:	20-Nov-14	Source Isotope		
		Date Source was prepared		
		Scaler Instrument Check Date		
		Time since src prepared (T) (yrs):		
		Half-Life of Source ($t_{1/2}$) (yrs)		
		Current 2π emission rate (dpm)		

GAMMA		
Count #	Bkgrd Counts/minute	Src Counts/minute
1	N/A	N/A
2		
3		
4		
5		
6		
7		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
SUM	0	0
Average	#DIV/0!	#DIV/0!

BETA	
Bkgrd Counts/minute	Src Counts/minute
N/A	N/A
0	0
#DIV/0!	#DIV/0!

Inst. Eff = $\frac{\text{Avg Source CPM} - \text{Avg Bkgrd CPM}}{\text{Source } 2\pi \text{ emission rate (dpm)}}$

Inst Efficiency Alpha = #DIV/0!

Inst Efficiency Beta = #DIV/0!

Performed by: _____

Date: _____

Reviewed by: _____

Date: _____

DAILY INSTRUMENT RESPONSE CHECK
Form RS-013.0-3

SITE: GKP

Date: 12/17/13

For period: 12/14-1/14

Instrument Information	
Type/Serial #:	URSA / 200130
Probe/Serial #:	3X3/081107-1
Calibration Due Date:	20-Nov-14

Source Information	
Isotope	Cs-137
Serial Number	101
Activity	1 uCi

DATE	TIME	BACKGROUND CPM Gamma	SOURCE CPM Gamma	COMMENTS	Tech Initials
1/9/2014	7:00	11022	501249		ALR
1/13/2014	7:00	9849	410284		SRR
1/14/2014	7:00	9305	430872		SRR
1/15/2014	7:00	9895	445126		SRR
1/16/2014	7:00	9856	488558		SRR
1/17/2014	7:00	11658	500557		SRR
1/20/2014	7:00	10510	457286		SRR
1/21/2014	7:00	11159	493063		SRR
1/22/2014	7:00	10550	560052		SRR
1/23/2014	7:00	9991	466050		HPO
1/24/2014	7:00	9638	510818		HPO
1/27/2014	7:00	9505	477964		HPO
1/28/2014	7:00	10815	504714		AO
1/29/2014	7:00	10061	547119		AO
1/30/2014	7:00	10252	551418		AO

Mean from form RS-013.0-1
Background

0	Alpha
10638.5	Gamma

Mean from form RS-013.0-1
Source

0	Alpha
484908.9	Gamma

Background Acceptance Limits

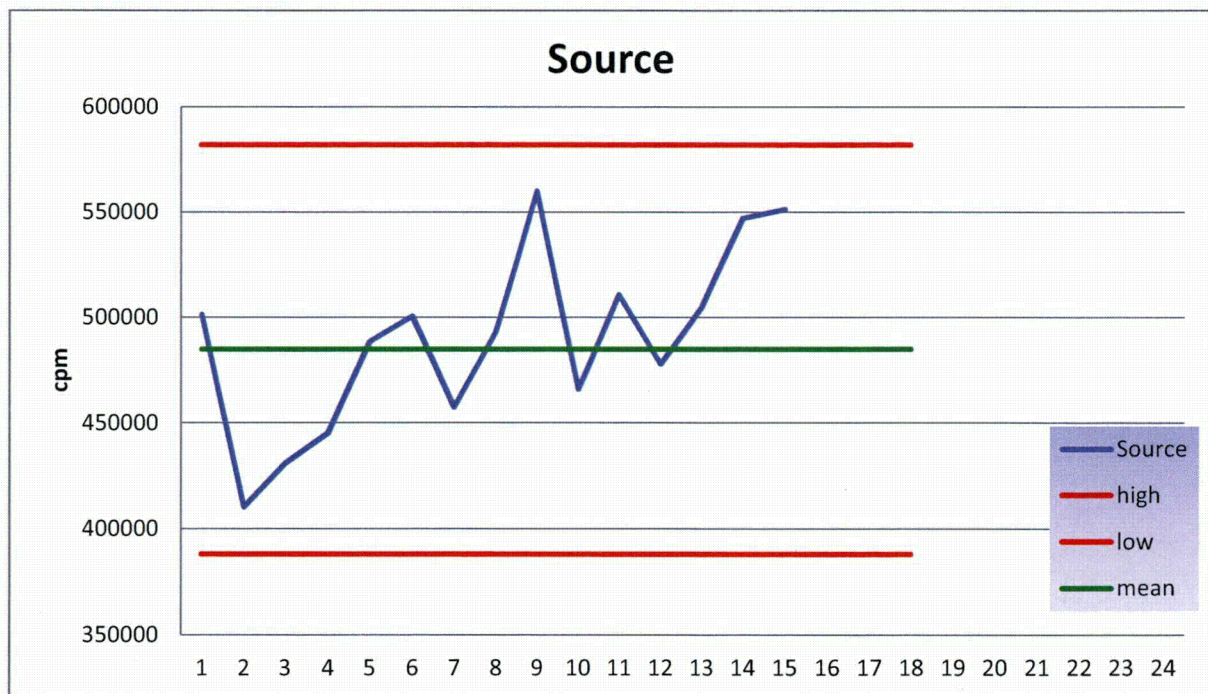
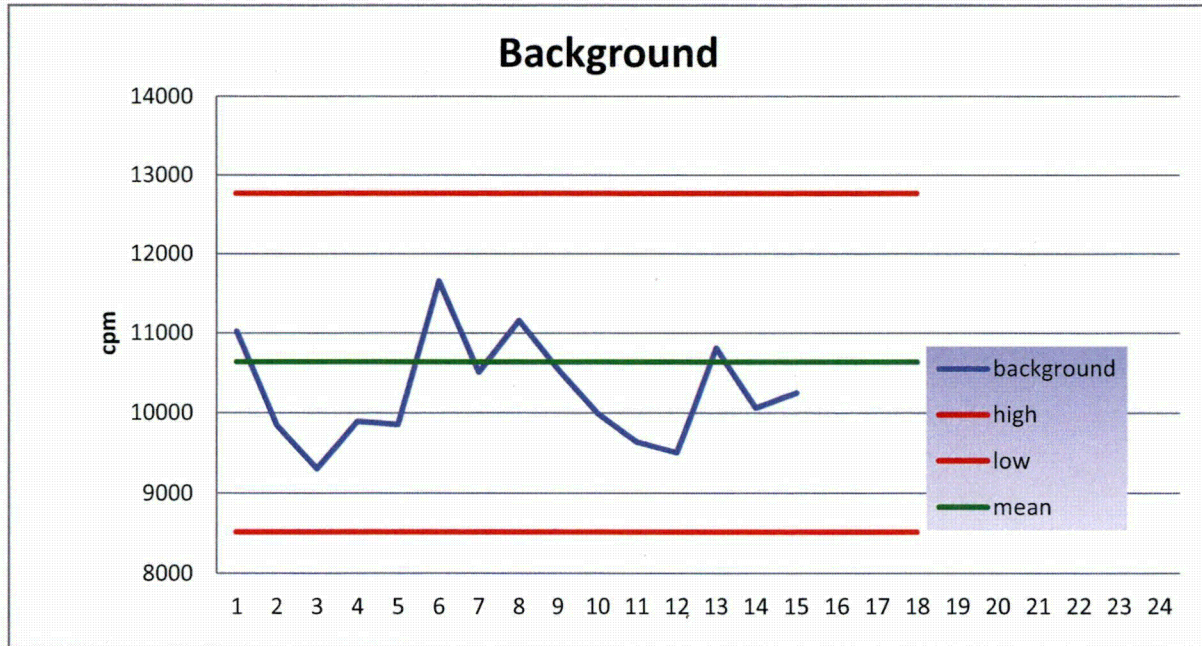
M-20%	0	M+20%	0	Alpha
M-20%	8511	M+20%	12766	Gamma

Source Acceptance Limits

M-20%	0	M+20%	0	Alpha
M-20%	387927	M+20%	581891	Gamma

Reviewed by: _____

Date: _____



3030e

STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

SITE: GKP

Date: 1/27/2014

Instrument Information		Source Information	Alpha	Beta
Type/Serial #:	Ludlum 3030/217607	Source Isotope	Th-230	Tc-99
Probe/Serial #:	43-10-1/229364	Source ID	A2-743	A2-771
Calibration Due Date:	April 30 2014			
Mode (count or dose)	Count			
Data Type (Src, Bkg)	Background			

If data type is a background for a specific material, list the material type =

Rm 321 desk

ALPHA			
D	C	C-(M)	[C-(M)] ²
1	0	-0.25	0.0625
2	0	-0.25	0.0625
3	0	-0.25	0.0625
4	0	-0.25	0.0625
5	1	0.75	0.5625
6	0	-0.25	0.0625
7	0	-0.25	0.0625
8	0	-0.25	0.0625
9	0	-0.25	0.0625
10	2	1.75	3.0625
11	0	-0.25	0.0625
12	0	-0.25	0.0625
13	0	-0.25	0.0625
14	0	-0.25	0.0625
15	0	-0.25	0.0625
16	2	1.75	3.0625
17	0	-0.25	0.0625
18	0	-0.25	0.0625
19	0	-0.25	0.0625
20	0	-0.25	0.0625

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	5	0.25	7.75

Standard Deviation	
SD	0.64
2 x SD	1.28
3 x SD	1.92

BETA			
D	C	C-(M)	[C-(M)] ²
1	35	-2.55	6.5025
2	34	-3.55	12.6025
3	42	4.45	19.8025
4	38	0.45	0.2025
5	43	-6.55	42.9025
6	31	6.45	41.6025
7	44	0.45	0.2025
8	38	-1.55	2.4025
9	36	11.45	131.1025
10	49	-3.55	12.6025
11	34	-5.55	30.8025
12	32	-11.55	133.4025
13	26	-7.55	57.0025
14	30	3.45	11.9025
15	41	-0.55	0.3025
16	37	8.45	71.4025
17	46	-0.55	0.3025
18	37	6.45	41.6025
19	44	-3.55	12.6025
20	34	-37.55	1410.003

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	751	37.55	2039.25

Standard Deviation	
SD	5.89
2 x SD	11.78
3 x SD	17.67

ALPHA				BETA			
MDCR and MDC Calculations				MDCR and MDC Calculations			
Survey Speed:		MDCR =		Survey Speed:		MDCR =	
Probe Width:	N/A	MDC =	7.18	Probe Width:	N/A	MDC =	44.50

Performed by: _____

Date: _____

Reviewed by: _____

Date: _____

STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

SITE: GKP

Date: 1/27/2014

Instrument Information		Source Information	Alpha	Beta
Type/Serial #:	Ludlum 2929/176108	Source Isotope	Th-230	Tc-99
Probe/Serial #:	43-10-1/181905	Source ID	A2-743	A2-771
Calibration Due Date:	April 30 2014			
Mode (count or dose)	Count			
Data Type (Src, Bkg)	Source			

If data type is a background for a specific material, list the material type =

ALPHA			
D	C	C-(M)	[C-(M)] ²
1	13873	82.4	6789.76
2	13838	47.4	2246.76
3	13901	110.4	12188.16
4	14037	246.4	60712.96
5	13524	70.4	4956.16
6	13861	-104.6	10941.16
7	13686	-69.6	4844.16
8	13721	55.4	3069.16
9	13846	91.4	8353.96
10	13882	-184.6	34077.16
11	13606	-67.6	4569.76
12	13723	7.4	54.76
13	13798	-54.6	2981.16
14	13736	69.4	4816.36
15	13860	125.4	15725.16
16	13916	146.4	21432.96
17	13937	-21.6	466.56
18	13769	-151.6	22982.56
19	13639	-131.6	17318.56
20	13659	-13790.6	1.9E+08

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	275812	13790.6	1.9E+08

Standard Deviation	
SD	127.65
2 x SD	255.30
3 x SD	382.95

BETA			
D	C	C-(M)	[C-(M)] ²
1	11178	-35	1225
2	11220	7	49
3	11446	233	54289
4	11212	-1	1
5	11266	166	27556
6	11379	66	4356
7	11279	-29	841
8	11184	-99	9801
9	11114	103	10609
10	11316	27	729
11	11240	-175	30625
12	11038	-147	21609
13	11066	-153	23409
14	11060	148	21904
15	11361	5	25
16	11218	-134	17956
17	11079	136	18496
18	11349	-63	3969
19	11150	-108	11664
20	11105	-11213	1.26E+08

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	224260	11213	1.26E+08

Standard Deviation	
SD	117.41
2 x SD	234.82
3 x SD	352.23

ALPHA				BETA			
MDCR and MDC Calculations				MDCR and MDC Calculations			
Survey Speed:		MDCR =		Survey Speed:		MDCR =	
Probe Width:	N/A	MDC =	N/A	Probe Width:	N/A	MDC =	N/A

Performed by: _____

Date: _____

Reviewed by: _____

Date: _____

INSTRUMENT EFFICIENCY CALCULATION
Form RS-013.0-2

SITE: GKP **Date:** 1/27/2014

Instrument Information		Source Information	Alpha	Beta
Type/Serial #:	Ludlum 2929/176108	Initial Source Activity (A_0) (dpm)	17610	28510
Probe/Serial #:	43-10-1/181905	Source ID	A2-743	A2-771
Calibration Due Date:	April 30 2014	Source Isotope	Th-230	Tc-99
		Date Source was prepared	10/15/01	10/15/01
		Scaler Instrument Check Date	05/07/13	05/07/13
		Time since src prepared (T) (yrs):	1.16E+01	1.16E+01
		Half-Life of Source ($t_{1/2}$) (yrs)	7.54E+04	2.13E+05
		Current 2π emission rate (dpm)	17,608	28,509

ALPHA		
Count #	Bkgrd Counts/minute	Src Counts/minute
1	0	13873
2	0	13838
3	0	13901
4	0	14037
5	1	13524
6	0	13861
7	0	13686
8	0	13721
9	0	13846
10	2	13882
11	0	13606
12	0	13723
13	0	13798
14	0	13736
15	0	13860
16	2	13916
17	0	13937
18	0	13769
19	0	13639
20	0	13659
SUM	5	275812
Average	0.25	13790.60

BETA	
Bkgrd Counts/minute	Src Counts/minute
35	11178
34	11281
42	11589
38	11390
43	11375
31	11500
44	11529
38	11184
36	11114
49	11316
34	11240
32	11038
26	11066
30	11060
41	11361
37	11218
46	11079
37	11349
44	11150
34	11105
751	225122
37.55	11256.10

Inst. Eff = $\frac{\text{Avg Source CPM} - \text{Avg Bkgrd CPM}}{\text{Source } 2\pi \text{ emission rate (dpm)}}$

Inst Efficiency Alpha = 78.3%

Inst Efficiency Beta = 39.4%

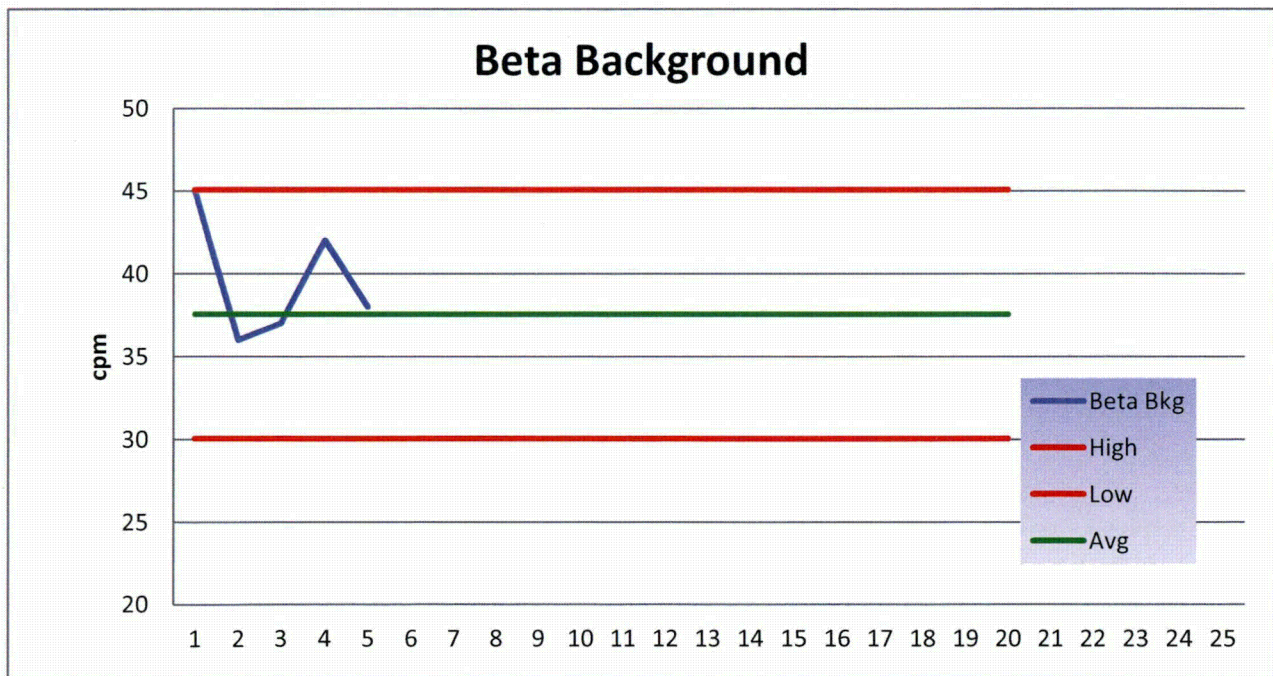
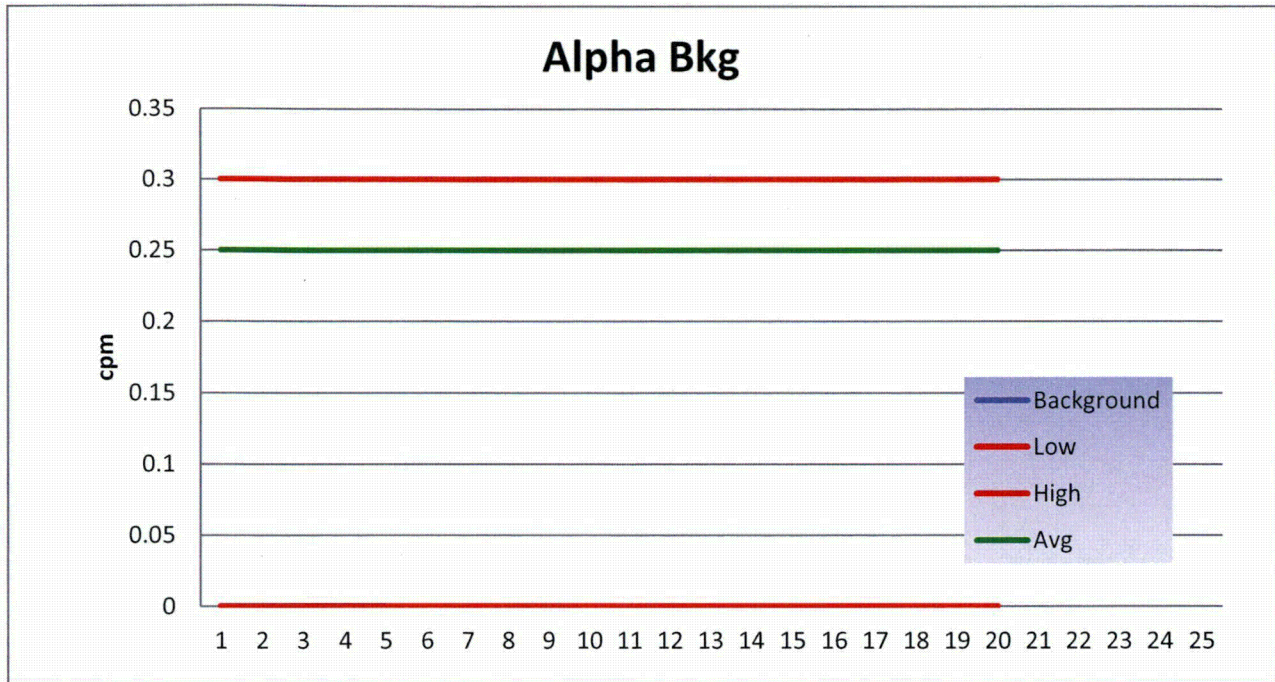
Performed by: _____

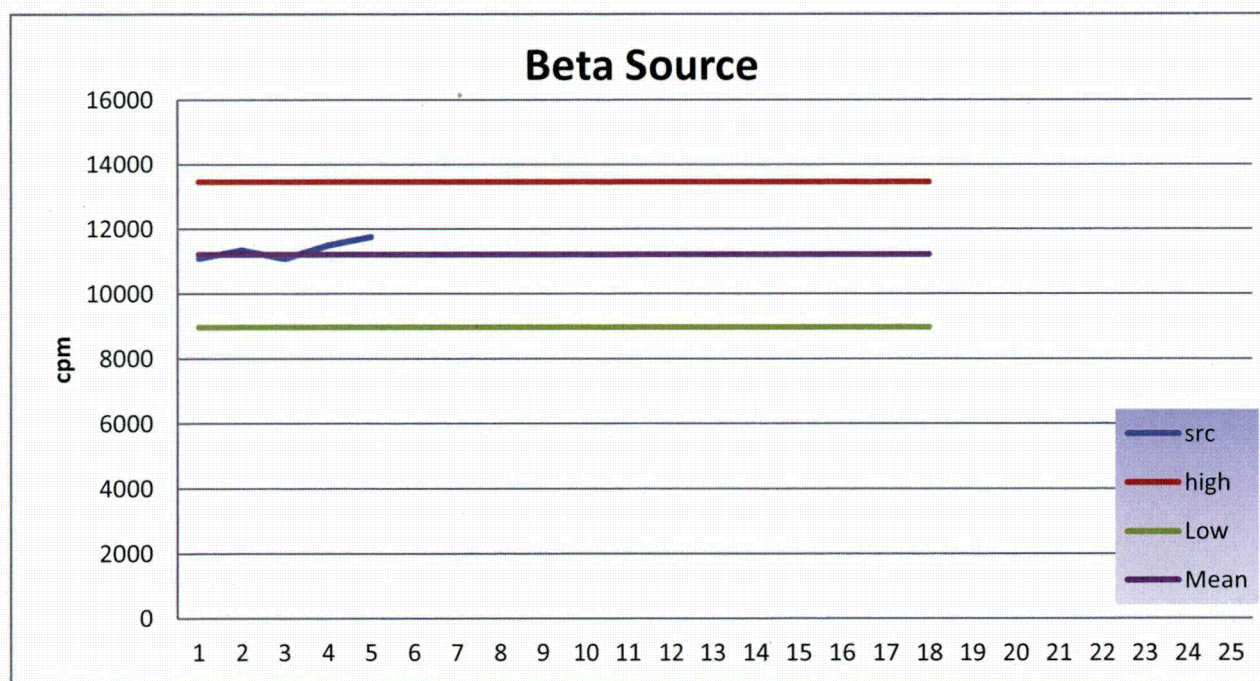
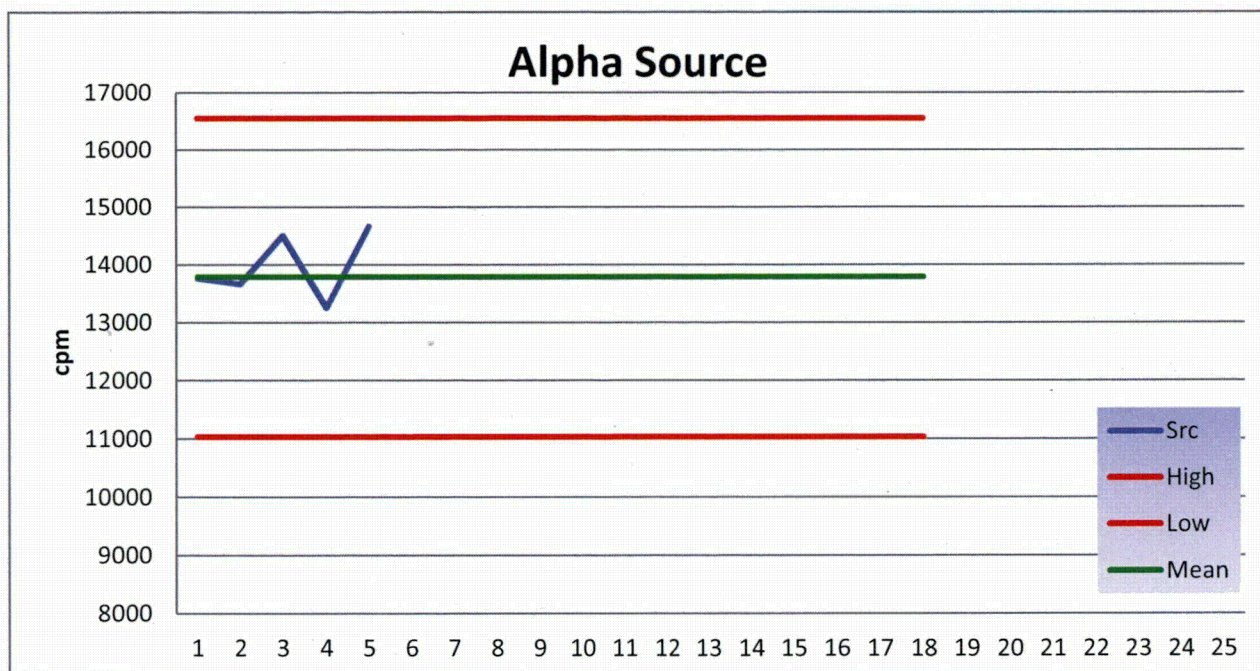
Date: _____

Reviewed by: _____

Date: _____

Date:





src

a

[illegible]

b

[illegible]

STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

SITE: GKP **Date:** 1/27/2014

Instrument Information		Source Information	Alpha	Beta
Type/Serial #:	Ludlum 3030/217607	Source Isotope	Th-230	Tc-99
Probe/Serial #:	43-10-1/229364	Source ID	A2-743	A2-771
Calibration Due Date:	April 30 2014			
Mode (count or dose)	Count			
Data Type (Src, Bkg)	Background			

If data type is a background for a specific material, list the material type =

Rm 321 desk

ALPHA			
D	C	C-(M)	[C-(M)] ²
1	0	-0.25	0.0625
2	0	-0.25	0.0625
3	0	-0.25	0.0625
4	0	-0.25	0.0625
5	1	0.75	0.5625
6	0	-0.25	0.0625
7	0	-0.25	0.0625
8	0	-0.25	0.0625
9	0	-0.25	0.0625
10	2	1.75	3.0625
11	0	-0.25	0.0625
12	0	-0.25	0.0625
13	0	-0.25	0.0625
14	0	-0.25	0.0625
15	0	-0.25	0.0625
16	2	1.75	3.0625
17	0	-0.25	0.0625
18	0	-0.25	0.0625
19	0	-0.25	0.0625
20	0	-0.25	0.0625

BETA			
D	C	C-(M)	[C-(M)] ²
1	35	-2.55	6.5025
2	34	-3.55	12.6025
3	42	4.45	19.8025
4	38	0.45	0.2025
5	43	-6.55	42.9025
6	31	6.45	41.6025
7	44	0.45	0.2025
8	38	-1.55	2.4025
9	36	11.45	131.1025
10	49	-3.55	12.6025
11	34	-5.55	30.8025
12	32	-11.55	133.4025
13	26	-7.55	57.0025
14	30	3.45	11.9025
15	41	-0.55	0.3025
16	37	8.45	71.4025
17	46	-0.55	0.3025
18	37	6.45	41.6025
19	44	-3.55	12.6025
20	34	-37.55	1410.003

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	5	0.25	7.75

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	751	37.55	2039.25

Standard Deviation	
SD	0.64
2 x SD	1.28
3 x SD	1.92

Standard Deviation	
SD	5.89
2 x SD	11.78
3 x SD	17.67

ALPHA				BETA			
MDCR and MDC Calculations				MDCR and MDC Calculations			
Survey Speed:		MDCR =		Survey Speed:		MDCR =	
Probe Width:	N/A	MDC =	7.18	Probe Width:	N/A	MDC =	44.50

Performed by: _____

Date: _____

Reviewed by: _____

Date: _____

STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

SITE: GKP **Date:** 1/27/2014

Instrument Information		Source Information	Alpha	Beta
Type/Serial #:	Ludlum 2929/176108	Source Isotope	Th-230	Tc-99
Probe/Serial #:	43-10-1/181905	Source ID	A2-743	A2-771
Calibration Due Date:	April 30 2014			
Mode (count or dose)	Count			
Data Type (Src, Bkg)	Source			

If data type is a background for a specific material, list the material type =

ALPHA			
D	C	C-(M)	[C-(M)] ²
1	13873	82.4	6789.76
2	13838	47.4	2246.76
3	13901	110.4	12188.16
4	14037	246.4	60712.96
5	13524	70.4	4956.16
6	13861	-104.6	10941.16
7	13686	-69.6	4844.16
8	13721	55.4	3069.16
9	13846	91.4	8353.96
10	13882	-184.6	34077.16
11	13606	-67.6	4569.76
12	13723	7.4	54.76
13	13798	-54.6	2981.16
14	13736	69.4	4816.36
15	13860	125.4	15725.16
16	13916	146.4	21432.96
17	13937	-21.6	466.56
18	13769	-151.6	22982.56
19	13639	-131.6	17318.56
20	13659	-13790.6	1.9E+08

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	275812	13790.6	1.9E+08

Standard Deviation	
SD	127.65
2 x SD	255.30
3 x SD	382.95

BETA			
D	C	C-(M)	[C-(M)] ²
1	11178	-35	1225
2	11220	7	49
3	11446	233	54289
4	11212	-1	1
5	11266	166	27556
6	11379	66	4356
7	11279	-29	841
8	11184	-99	9801
9	11114	103	10609
10	11316	27	729
11	11240	-175	30625
12	11038	-147	21609
13	11066	-153	23409
14	11060	148	21904
15	11361	5	25
16	11218	-134	17956
17	11079	136	18496
18	11349	-63	3969
19	11150	-108	11664
20	11105	-11213	1.26E+08

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	224260	11213	1.26E+08

Standard Deviation	
SD	117.41
2 x SD	234.82
3 x SD	352.23

ALPHA				BETA			
MDCR and MDC Calculations				MDCR and MDC Calculations			
Survey Speed:		MDCR =		Survey Speed:		MDCR =	
Probe Width:	N/A	MDC =	N/A	Probe Width:	N/A	MDC =	N/A

Performed by: _____

Date: _____

Reviewed by: _____

Date: _____

INSTRUMENT EFFICIENCY CALCULATION
Form RS-013.0-2

SITE: GKP **Date:** 1/27/2014

Instrument Information		Source Information	Alpha	Beta
Type/Serial #:	Ludlum 2929/176108	Initial Source Activity (A_0) (dpm)	17610	28510
Probe/Serial #:	43-10-1/181905	Source ID	A2-743	A2-771
Calibration Due Date:	April 30 2014	Source Isotope	Th-230	Tc-99
		Date Source was prepared	10/15/01	10/15/01
		Scaler Instrument Check Date	05/07/13	05/07/13
		Time since src prepared (T) (yrs):	1.16E+01	1.16E+01
		Half-Life of Source ($t_{1/2}$) (yrs)	7.54E+04	2.13E+05
		Current 2π emission rate (dpm)	17,608	28,509

ALPHA		
Count #	Bkgrd Counts/minute	Src Counts/minute
1	0	13873
2	0	13838
3	0	13901
4	0	14037
5	1	13524
6	0	13861
7	0	13686
8	0	13721
9	0	13846
10	2	13882
11	0	13606
12	0	13723
13	0	13798
14	0	13736
15	0	13860
16	2	13916
17	0	13937
18	0	13769
19	0	13639
20	0	13659
SUM	5	275812
Average	0.25	13790.60

BETA	
Bkgrd Counts/minute	Src Counts/minute
35	11178
34	11281
42	11589
38	11390
43	11375
31	11500
44	11529
38	11184
36	11114
49	11316
34	11240
32	11038
26	11066
30	11060
41	11361
37	11218
46	11079
37	11349
44	11150
34	11105
751	225122
37.55	11256.10

Inst. Eff = $\frac{\text{Avg Source CPM} - \text{Avg Bkgrd CPM}}{\text{Source } 2\pi \text{ emission rate (dpm)}}$

Inst Efficiency Alpha = 78.3%

Inst Efficiency Beta = 39.4%

Performed by: _____

Date: _____

Reviewed by: _____

Date: _____

DAILY INSTRUMENT RESPONSE CHECK
Form RS-013.0-3

SITE: GKP **Date:** 1/27/2014

Instrument Information	
Type/Serial #:	Ludlum 2929/176108
Probe/Serial #:	43-10-1/181905
Calibration Due Date:	April 30 2014

Source Information	Alpha	Beta
Isotope	Th-230	Tc-99
Serial Number	A2-743	A2-771
2 π emission rate	17,608	28,509

DATE	TIME	BKG CPM	Alpha Beta	SOURCE CPM Alpha Beta	COMMENTS	Tech Initials
1/27/2014	7:00:00 AM	0	45	13758 11091		AM
1/28/2014	7:00:00 AM	0	36	13661 11354		AM
1/29/2014	7:00:00 AM	0	37	14501 11086		AM
1/30/2014	7:00:00 AM	0	42	13249 11495		AM
1/31/2014	7:00:00 AM	0	38	14659 11752		AM
2/3/2014	7:00:00 AM	0	35	14875 11452		AM
2/4/2014	7:00:00 AM	0	42	13572 11895		AM
2/5/2014	7:00:00 AM	0	37	14736 10652		AM
2/6/2014	7:00:00 AM	0	34	14223 11349		AM
2/7/2014	7:00:00 AM	0	37	13542 10249		SR
2/10/2014	7:00:00 AM	0	40	14874 11210		SR
2/11/2014	7:00:00 AM	0	33	14236 11895		SR
2/12/2014	7:00:00 AM	1	37	13457 11987		SR
2/13/2014	7:00:00 AM	0	39	14745 11365		SR
2/14/2014	7:00:00 AM	0	37	13258 11753		SR
2/17/2014	7:00:00 AM	0	40	14965 10236		SR
2/18/2014	7:00:00 AM	0	38	15345 11465		SR
2/19/2014	7:00:00 AM	0	32	14546 10254		SR
2/20/2014	7:00:00 AM	0	40	15201 11476		SR
2/21/2014	7:00:00 AM	0	42	13125 11989		SR
2/24/2014	7:00:00 AM	0	45	13612 11301		AM
2/25/2014	7:00:00 AM	0	38	14258 10452		AM
2/26/2014	7:00:00 AM	1	36	13882 11248		AM
2/27/2014	7:00:00 AM	0	35	14201 10244		AM
3/3/2014	7:00:00 AM	0	47	13773 11276		AM

Mean from form RS-013.0-1
Background

0	Alpha
37.55	Beta

Mean from form RS-013.0-1
Source

13790.6	Alpha
11213	Beta

Background Acceptance Limits

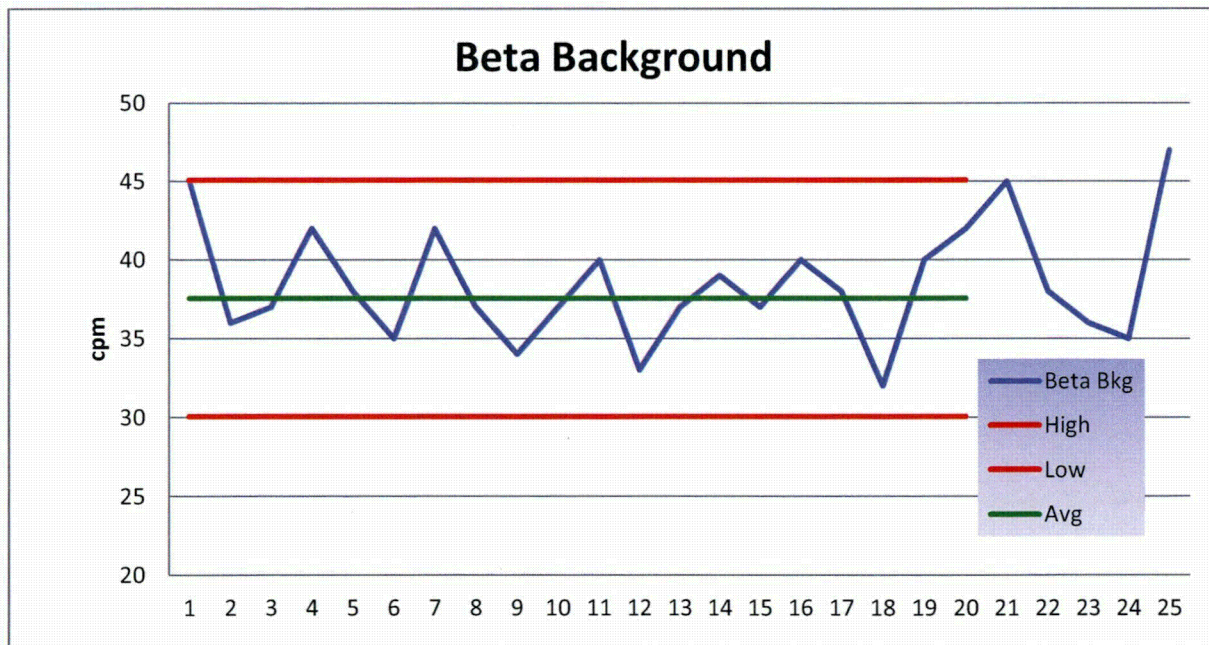
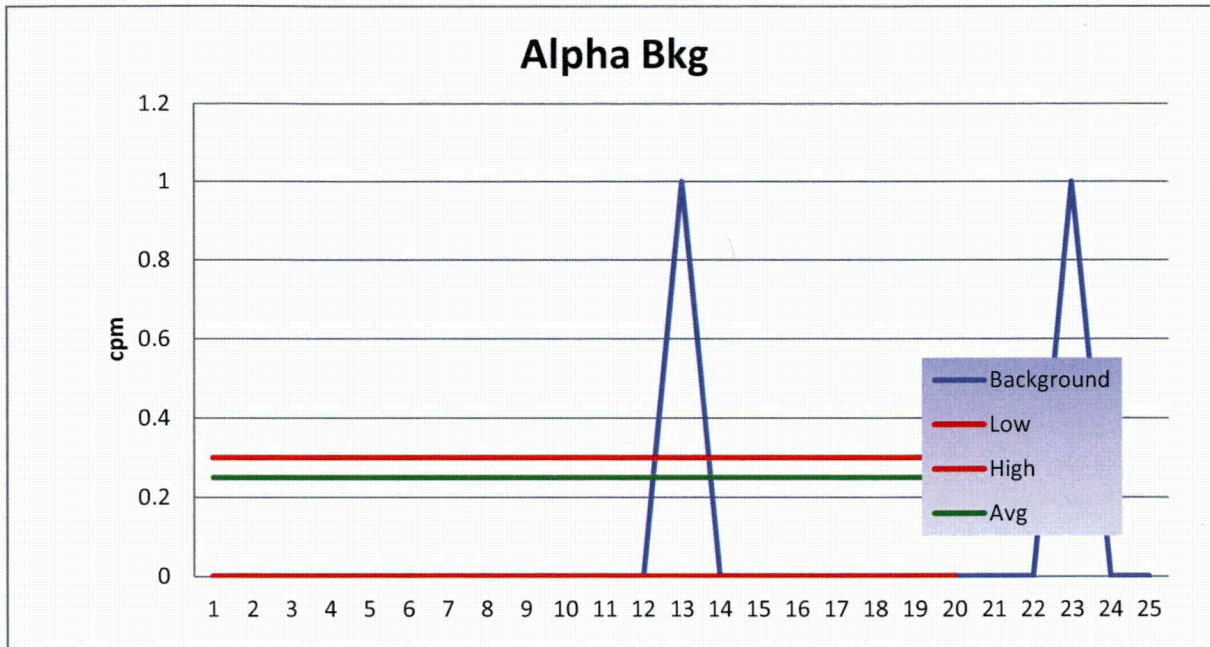
M-20%	0.2	M+20%	0.3	Alpha
M-20%	30	M+20%	45	Beta

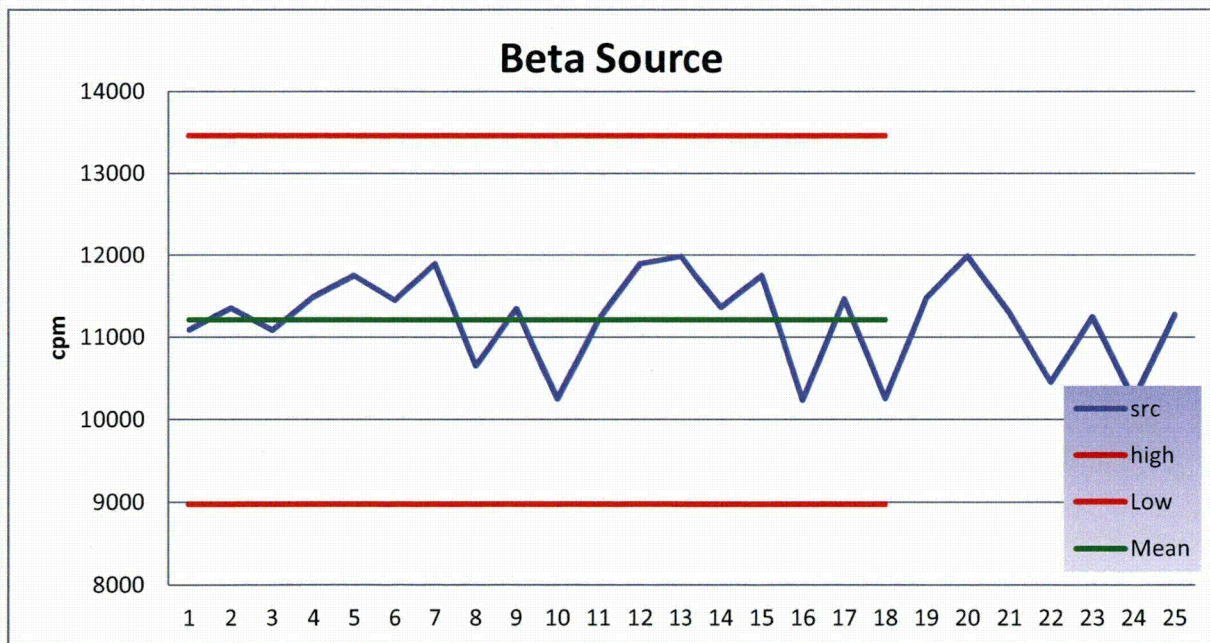
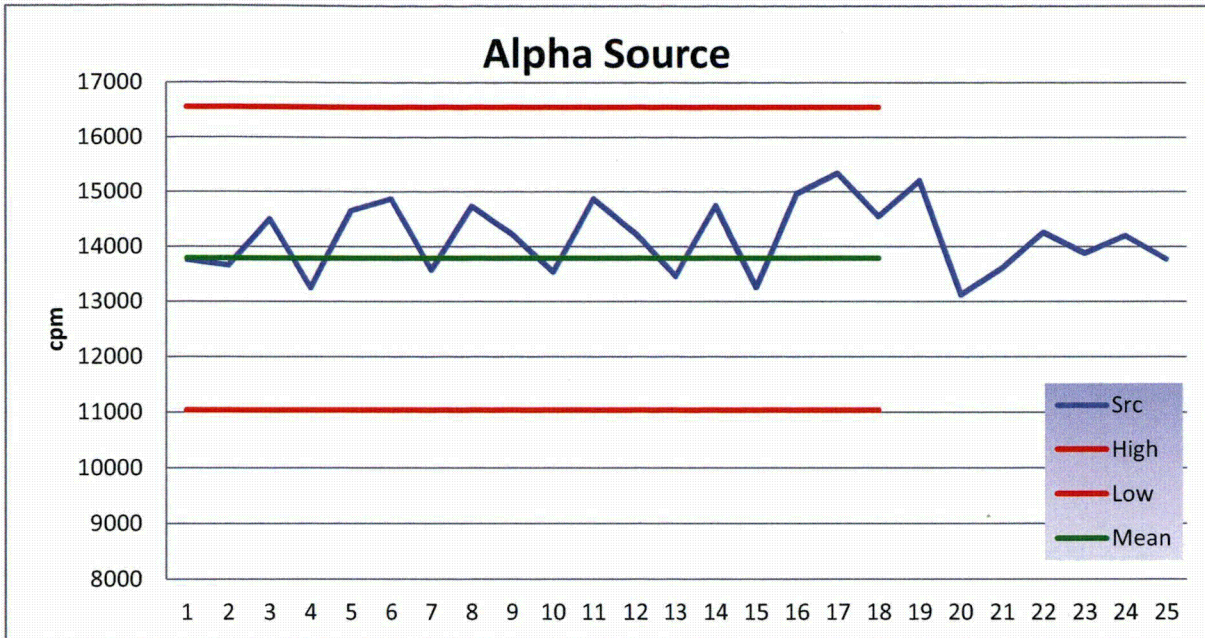
Source Acceptance Limits

M-20%	11032	M+20%	16549	Alpha
M-20%	8970	M+20%	13456	Beta

Reviewed by: _____

Date: _____





STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

SITE: GKP

Date: 12/17/13

For period: 12/14-1/14

Instrument Information		Source Information	Gamma
Type/Serial #:	URSA / 200124	Source Isotope	N/A
Probe/Serial #:	3X3/081107-2	Source ID	N/A
Calibration Due Date:	20-Nov-14		
Mode (count or dose)	Count		
Data Type (Src, Bkg)	Background		

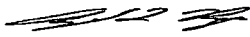
If data type is a background for a specific material, list the material type =

GAMMA			
D	C	C-(M)	[C-(M)] ²
1	11375	-1.45	2.10E+00
2	11332	-44.45	1.98E+03
3	11336	-40.45	1.64E+03
4	11350	-26.45	7.00E+02
5	11334	-42.45	1.80E+03
6	11665	288.55	8.33E+04
7	11497	120.55	1.45E+04
8	11263	-113.45	1.29E+04
9	11388	11.55	1.33E+02
10	11182	-194.45	3.78E+04
11	11296	-80.45	6.47E+03
12	11167	-209.45	4.39E+04
13	11498	121.55	1.48E+04
14	11132	-244.45	5.98E+04
15	11385	8.55	7.31E+01
16	11661	284.55	8.10E+04
17	11469	92.55	8.57E+03
18	11573	196.55	3.86E+04
19	11149	-227.45	5.17E+04
20	11477	100.55	1.01E+04

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	227529	11376.45	469679

Standard Deviation	
SD	157.23
2 x SD	314.45
3 x SD	471.68

Gamma			
MDCR and MDC Calculations			
Survey Speed:		MDCR =	
Probe Width:		MDC =	#REF!

Performed by: 

Date: 12/17/2013

Reviewed by: _____

Date: _____

STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

SITE: GKP

Date: 12/17/13

For period: 12/14-1/14

Instrument Information		Source Information	Gamma
Type/Serial #:	URSA / 200124	Source Isotope	Cs-137
Probe/Serial #:	3X3/081107-2	Source ID	101
Calibration Due Date	20-Nov-14		
Mode (count or dose)	Count		
Data Type (Src, Bkg)	Source		

If data type is a background for a specific material, list the material type =

Gamma			
D	C	C-(M)	[C-(M)] ²
1	605009	-5831.8	3.40E+07
2	606381	-4459.8	1.99E+07
3	614172	3331.2	1.11E+07
4	608093	-2747.8	7.55E+06
5	608583	-2257.8	5.10E+06
6	605749	-5091.8	2.59E+07
7	617493	6652.2	4.43E+07
8	611170	329.2	1.08E+05
9	608584	-2256.8	5.09E+06
10	612787	1946.2	3.79E+06
11	614321	3480.2	1.21E+07
12	605528	-5312.8	2.82E+07
13	606413	-4427.8	1.96E+07
14	616000	5159.2	2.66E+07
15	615154	4313.2	1.86E+07
16	615561	4720.2	2.23E+07
17	610026	-814.8	6.64E+05
18	606718	-4122.8	1.70E+07
19	611496	655.2	4.29E+05
20	617578	6737.2	4.54E+07

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	12216816	610840.8	3.48E+08

Standard Deviation	
SD	4278.08
2 x SD	8556.15
3 x SD	12834.23

BETA			
MDCR and MDC Calculations			
Survey Speed:		MDCR =	
Probe Width:		MDC =	N/A

Performed by: 

Date: 12/17/2013

Reviewed by: _____

Date: _____

DAILY INSTRUMENT RESPONSE CHECK
Form RS-013.0-3

SITE: GKP

Date: 12/17/13

For period: 1/14-2/14

Instrument Information	
Type/Serial #:	URSA / 200124
Probe/Serial #:	3X3/081107-2
Calibration Due Date:	20-Nov-14

Source Information	
Isotope	Cs-137
Serial Number	101
Activity	1 uCi

DATE	TIME	BACKGROUND CPM Gamma	SOURCE CPM Gamma	COMMENTS	Tech Initials
1/27/2014	7:00	11469	630379		HPO
1/28/2014	7:00	11593	617202		HPO
1/29/2014	7:00	11640	617367		HPO
1/30/2014	7:00	11368	605038		HPO
1/31/2014	7:00	11508	607014		HPO
2/3/2014	7:00	12924	500980		HPO
2/4/2014	7:00	11480	551547		HPO
2/5/2014	7:00	11984	583007		HPO
2/6/2014	7:00	13486	554786		HPO
2/7/2014	7:00	11360	601601		HPO
2/10/2014	7:00	10837	611050		HPO
2/11/2014	7:00	10542	610845		SRR
2/12/2014	7:00	10670	605637		HPO
2/14/2014	7:00	10433	608279		HPO
2/17/2014	7:00	10522	595137		HPO
2/18/2014	7:00	10748	598408		HPO
2/19/2014	7:00	10423	606300		HPO
2/20/2014	7:00	10543	604209		HPO
2/21/2014	7:00	10310	597266		HPO
2/24/2014	7:00	10729	605783		HPO
2/25/2014	7:00	10867	567288		HPO
2/26/2014	7:00	10904	586405		HPO
2/27/2014	7:00	10412	567225		HPO
3/3/2014	7:00	10160	587548		HPO

Mean from form RS-013.0-1
Background

0
11376.45 gamma

Mean from form RS-013.0-1
Source

0
610840.8 gamma

Background Acceptance Limits

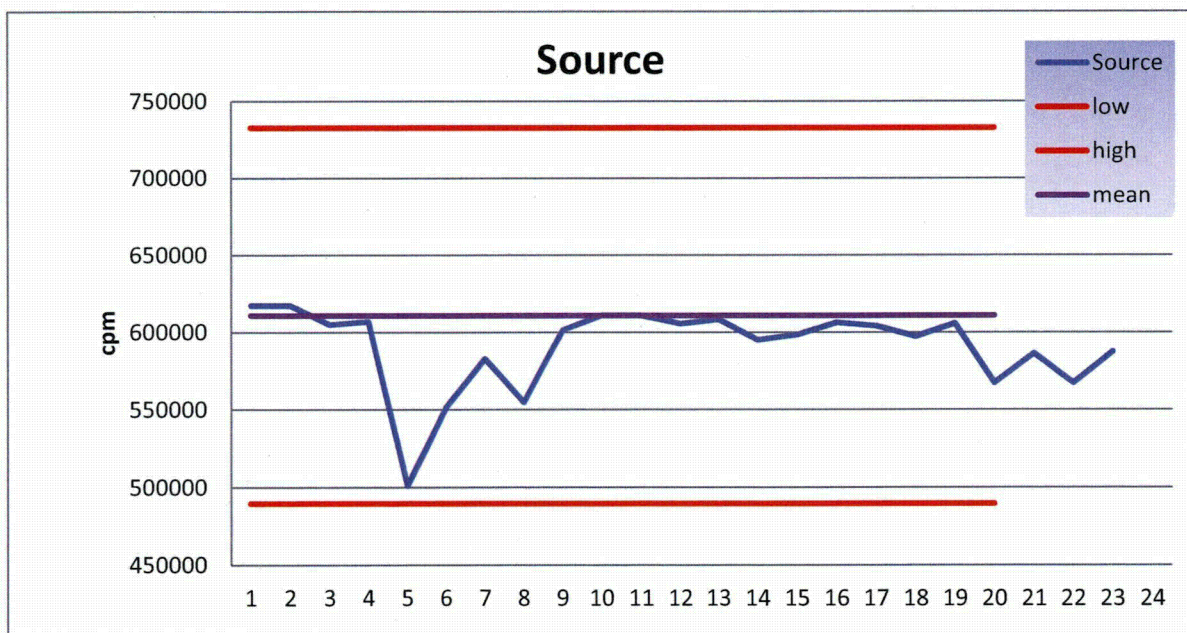
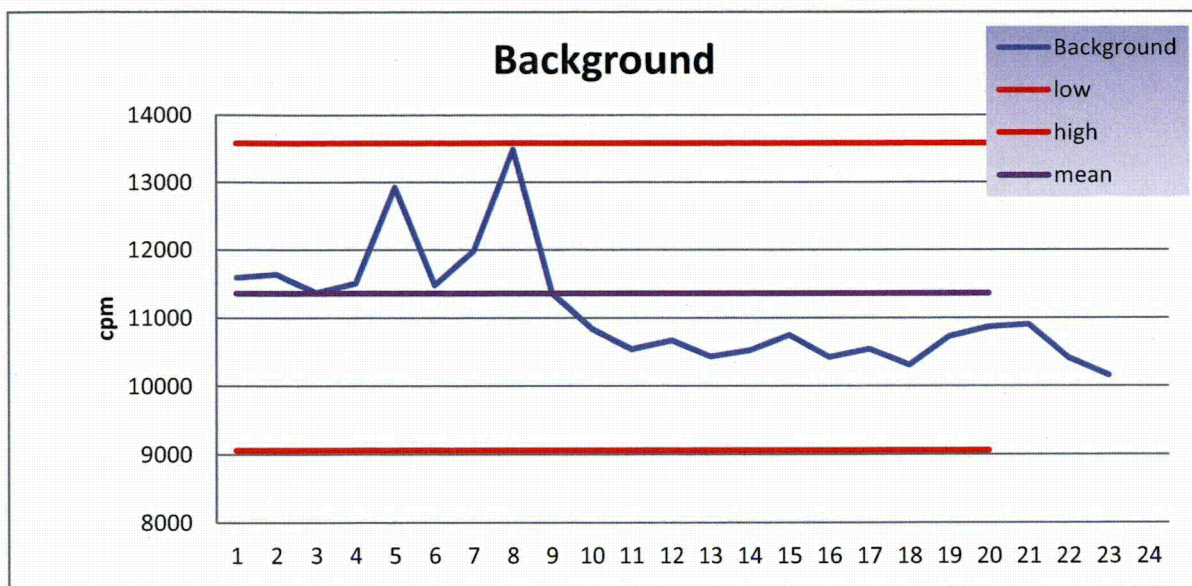
M-20%	0	M+20%	0	Alpha
M-20%	9101	M+20%	13652	Beta

Source Acceptance Limits

M-20%	0	M+20%	0	Alpha
M-20%	488673	M+20%	733009	Beta

Reviewed by: _____

Date: _____



STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

SITE: GKP

Date: 12/17/13

For period: 12/14-1/14

Instrument Information		Source Information	Gamma
Type/Serial #:	URSA / 200130	Source Isotope	N/A
Probe/Serial #:	3X3/081107-1	Source ID	N/A
Calibration Due Date:	20-Nov-14		
Mode (count or dose)	Count		
Data Type (Src, Bkg)	Background		

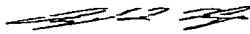
If data type is a background for a specific material, list the material type =

GAMMA			
D	C	C-(M)	[C-(M)] ²
1	10669	30.5	9.30E+02
2	10768	129.5	1.68E+04
3	10692	53.5	2.86E+03
4	10630	-8.5	7.23E+01
5	10711	72.5	5.26E+03
6	10714	75.5	5.70E+03
7	10494	-144.5	2.09E+04
8	10615	-23.5	5.52E+02
9	10563	-75.5	5.70E+03
11	10684	45.5	2.07E+03
12	10518	-120.5	1.45E+04
13	10636	-2.5	6.25E+00
14	10636	-2.5	6.25E+00
15	10643	4.5	2.03E+01
16	10692	53.5	2.86E+03
17	10574	-64.5	4.16E+03
18	10645	6.5	4.23E+01
19	10700	61.5	3.78E+03
20	10641	2.5	6.25E+00

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	212770	10638.5	94943

Standard Deviation	
SD	70.69
2 x SD	141.38
3 x SD	212.07

Gamma			
MDCR and MDC Calculations			
Survey Speed:		MDCR =	
Probe Width:		MDC =	#DIV/0!

Performed by: 

Date: 12/17/2013

Reviewed by: _____

Date: _____

STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

SITE: GKP Date: 12/17/13 For period: 12/14-1/14

Instrument Information		Source Information	Gamma
Type/Serial #:	URSA / 200130	Source Isotope	Cs-137
Probe/Serial #:	3X3/081107-1	Source ID	101
Calibration Due Date	20-Nov-14		
Mode (count or dose)	Count		
Data Type (Src, Bkg)	Source		

If data type is a background for a specific material, list the material type =

Gamma			
D	C	C-(M)	[C-(M)] ²
1	442063	-42845.9	1.84E+09
2	497459	12550.15	1.58E+08
3	508476	23567.15	5.55E+08
4	500048	15139.15	2.29E+08
5	508885	23976.15	5.75E+08
6	508085	23176.15	5.37E+08
7	510788	25879.15	6.70E+08
8	470510	-14398.9	2.07E+08
9	473237	-11671.9	1.36E+08
11	493868	8959.15	8.03E+07
12	466288	-18620.9	3.47E+08
13	494348	9439.15	8.91E+07
14	487546	2637.15	6.95E+06
15	478818	-6090.85	3.71E+07
16	490328	5419.15	2.94E+07
17	499298	14389.15	2.07E+08
18	461412	-23496.9	5.52E+08
19	446081	-38827.9	1.51E+09
20	502003	17094.15	2.92E+08

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	9698177	484908.9	8.74E+09

Standard Deviation	
SD	21449.94
2 x SD	42899.89
3 x SD	64349.83

BETA			
MDCR and MDC Calculations			
Survey Speed:		MDCR =	
Probe Width:		MDC =	N/A

Performed by: 

Date: 12/17/2013

Reviewed by: _____

Date: _____

INSTRUMENT EFFICIENCY CALCULATION
Form RS-013.0-2

SITE: GKP **Date:** 12/17/13 **For period:** 12/14-1/14

Instrument Information		Source Information		Gamma
Type/Serial #:	URSA / 200130	Initial Source Activity (A_0) (dpm)		
Probe/Serial #:	3X3/081107-1	Source ID		
Calibration Due Date:	20-Nov-14	Source Isotope		
		Date Source was prepared		
		Scaler Instrument Check Date		
		Time since src prepared (T) (yrs):		
		Half-Life of Source ($t_{1/2}$) (yrs)		
		Current 2π emission rate (dpm)		

GAMMA		
Count #	Bkgrd Counts/minute	Src Counts/minute
1	N/A	N/A
2		
3		
4		
5		
6		
7		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
SUM	0	0
Average	#DIV/0!	#DIV/0!

BETA		
Bkgrd Counts/minute	Src Counts/minute	
N/A	N/A	
0	0	
#DIV/0!	#DIV/0!	

Inst. Eff =
$$\frac{\text{Avg Source CPM} - \text{Avg Bkgrd CPM}}{\text{Source } 2\pi \text{ emission rate (dpm)}}$$

Inst Efficiency Alpha = #DIV/0!

Inst Efficiency Beta = #DIV/0!

Performed by: _____

Date: _____

Reviewed by: _____

Date: _____

DAILY INSTRUMENT RESPONSE CHECK
Form RS-013.0-3

SITE: GKP

Date: 12/17/13

For period: 12/14-1/14

Instrument Information	
Type/Serial #:	URSA / 200130
Probe/Serial #:	3X3/081107-1
Calibration Due Date:	20-Nov-14

Source Information	
Isotope	Cs-137
Serial Number	101
Activity	1 uCi

DATE	TIME	BACKGROUND CPM Gamma	SOURCE CPM Gamma	COMMENTS	Tech Initials
1/9/2014	7:00	11022	501249		ALR
1/13/2014	7:00	9849	410284		SRR
1/14/2014	7:00	9305	430872		SRR
1/15/2014	7:00	9895	445126		SRR
1/16/2014	7:00	9856	488558		SRR
1/17/2014	7:00	11658	500557		SRR
1/20/2014	7:00	10510	457286		SRR
1/21/2014	7:00	11159	493063		SRR
1/22/2014	7:00	10550	560052		SRR
1/23/2014	7:00	9991	466050		HPO
1/24/2014	7:00	9638	510818		HPO
1/27/2014	7:00	9505	477964		HPO
1/28/2014	7:00	10815	504714		AO
1/29/2014	7:00	10061	547119		AO
1/30/2014	7:00	10252	551418		AO
1/31/2014	7:00	9847	547962		AO
2/3/2014	7:00	10981	545248		AO
2/4/2014	7:00	9725	532413		AO
2/5/2014	7:00	10125	540041		AO
2/6/2014	7:00	11460	499875		AO
2/7/2014	7:00	10739	413816		AO
2/10/2014	7:00	10446	547983		AO
2/11/2014	7:00	10410	534102		SRR
2/12/2014	7:00	10048	490050		AO

Mean from form RS-013.0-1
Background

0	Alpha
10638.5	Gamma

Mean from form RS-013.0-1
Source

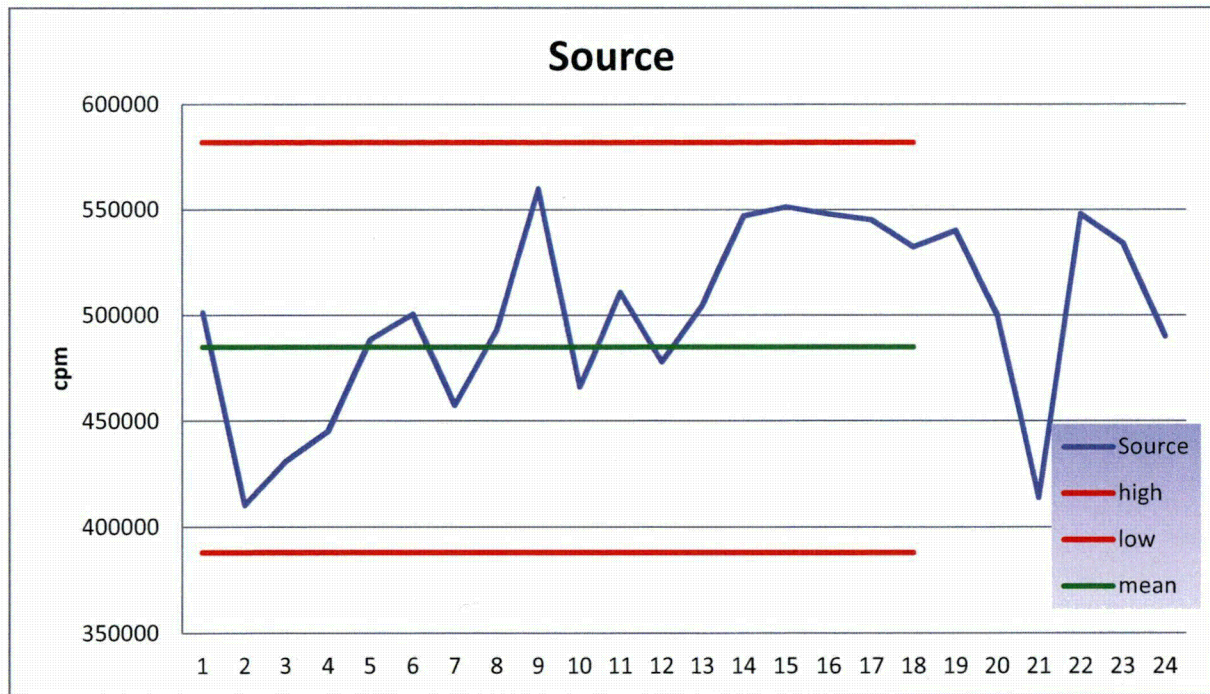
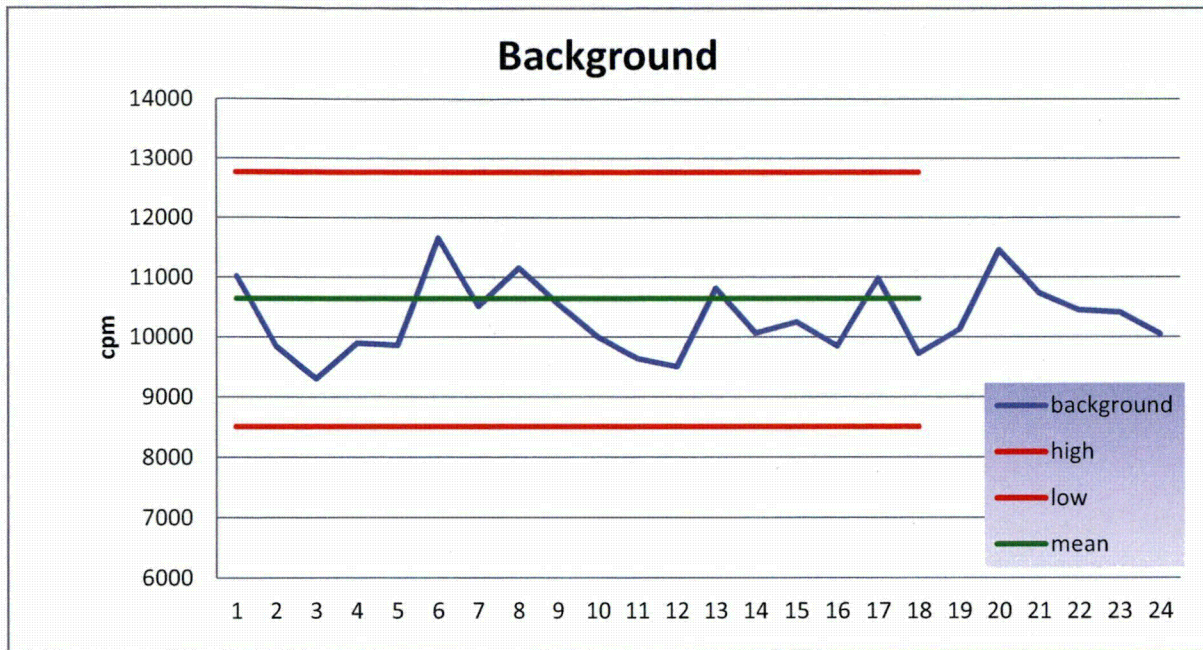
0	Alpha
484908.9	Gamma

Background Acceptance Limits				
M-20%	0	M+20%	0	Alpha
M-20%	8511	M+20%	12766	Gamma

Source Acceptance Limits				
M-20%	0	M+20%	0	Alpha
M-20%	387927	M+20%	581891	Gamma

Reviewed by: _____

Date: _____



STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

SITE: GKP

Date: 12/17/13

For period: 12/14-1/14

Instrument Information		Source Information		Gamma
Type/Serial #:	URSA / 200130	Source Isotope		N/A
Probe/Serial #:	3X3/081107-1	Source ID		N/A
Calibration Due Date:	20-Nov-14			
Mode (count or dose)	Count			
Data Type (Src, Bkg)	Background			

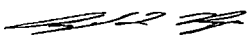
If data type is a background for a specific material, list the material type =

GAMMA			
D	C	C-(M)	[C-(M)] ²
1	10669	30.5	9.30E+02
2	10768	129.5	1.68E+04
3	10692	53.5	2.86E+03
4	10630	-8.5	7.23E+01
5	10711	72.5	5.26E+03
6	10714	75.5	5.70E+03
7	10494	-144.5	2.09E+04
8	10615	-23.5	5.52E+02
9	10563	-75.5	5.70E+03
11	10684	45.5	2.07E+03
12	10518	-120.5	1.45E+04
13	10636	-2.5	6.25E+00
14	10636	-2.5	6.25E+00
15	10643	4.5	2.03E+01
16	10692	53.5	2.86E+03
17	10574	-64.5	4.16E+03
18	10645	6.5	4.23E+01
19	10700	61.5	3.78E+03
20	10641	2.5	6.25E+00

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	212770	10638.5	94943

Standard Deviation	
SD	70.69
2 x SD	141.38
3 x SD	212.07

Gamma			
MDCR and MDC Calculations			
Survey Speed:		MDCR =	
Probe Width:		MDC =	#DIV/0!

Performed by: 

Date: 12/17/2013

Reviewed by: _____

Date: _____

STANDARD DEVIATION DATA TABLE
Form RS-013.0-1

SITE: GKP

Date: 12/17/13

For period: 12/14-1/14

Instrument Information		Source Information	Gamma
Type/Serial #:	URSA / 200130	Source Isotope	Cs-137
Probe/Serial #:	3X3/081107-1	Source ID	101
Calibration Due Date	20-Nov-14		
Mode (count or dose)	Count		
Data Type (Src, Bkg)	Source		

If data type is a background for a specific material, list the material type =

Gamma			
D	C	C-(M)	[C-(M)] ²
1	442063	-42845.9	1.84E+09
2	497459	12550.15	1.58E+08
3	508476	23567.15	5.55E+08
4	500048	15139.15	2.29E+08
5	508885	23976.15	5.75E+08
6	508085	23176.15	5.37E+08
7	510788	25879.15	6.70E+08
8	470510	-14398.9	2.07E+08
9	473237	-11671.9	1.36E+08
11	493868	8959.15	8.03E+07
12	466288	-18620.9	3.47E+08
13	494348	9439.15	8.91E+07
14	487546	2637.15	6.95E+06
15	478818	-6090.85	3.71E+07
16	490328	5419.15	2.94E+07
17	499298	14389.15	2.07E+08
18	461412	-23496.9	5.52E+08
19	446081	-38827.9	1.51E+09
20	502003	17094.15	2.92E+08

Data Table Summary			
# Data Points	Sum of C	Mean (M)	Sum Squares
20	9698177	484908.9	8.74E+09

Standard Deviation	
SD	21449.94
2 x SD	42899.89
3 x SD	64349.83

BETA			
MDCR and MDC Calculations			
Survey Speed:		MDCR =	
Probe Width:		MDC =	N/A

Performed by: 

Date: 12/17/2013

Reviewed by: _____

Date: _____

INSTRUMENT EFFICIENCY CALCULATION
Form RS-013.0-2

SITE: GKP

Date: 12/17/13

For period: 12/14-1/14

Instrument Information		Source Information		Gamma
Type/Serial #:	URSA / 200130	Initial Source Activity (A_0) (dpm)		
Probe/Serial #:	3X3/081107-1	Source ID		
Calibration Due Date:	20-Nov-14	Source Isotope		
		Date Source was prepared		
		Scaler Instrument Check Date		
		Time since src prepared (T) (yrs):		
		Half-Life of Source ($t_{1/2}$) (yrs)		
		Current 2π emission rate (dpm)		

GAMMA		
Count #	Bkgrd Counts/minute	Src Counts/minute
1	N/A	N/A
2		
3		
4		
5		
6		
7		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
SUM	0	0
Average	#DIV/0!	#DIV/0!

BETA	
Bkgrd Counts/minute	Src Counts/minute
N/A	N/A
0	0
#DIV/0!	#DIV/0!

Inst. Eff = $\frac{\text{Avg Source CPM} - \text{Avg Bkgrd CPM}}{\text{Source } 2\pi \text{ emission rate (dpm)}}$

Inst Efficiency Alpha = #DIV/0!

Inst Efficiency Beta = #DIV/0!

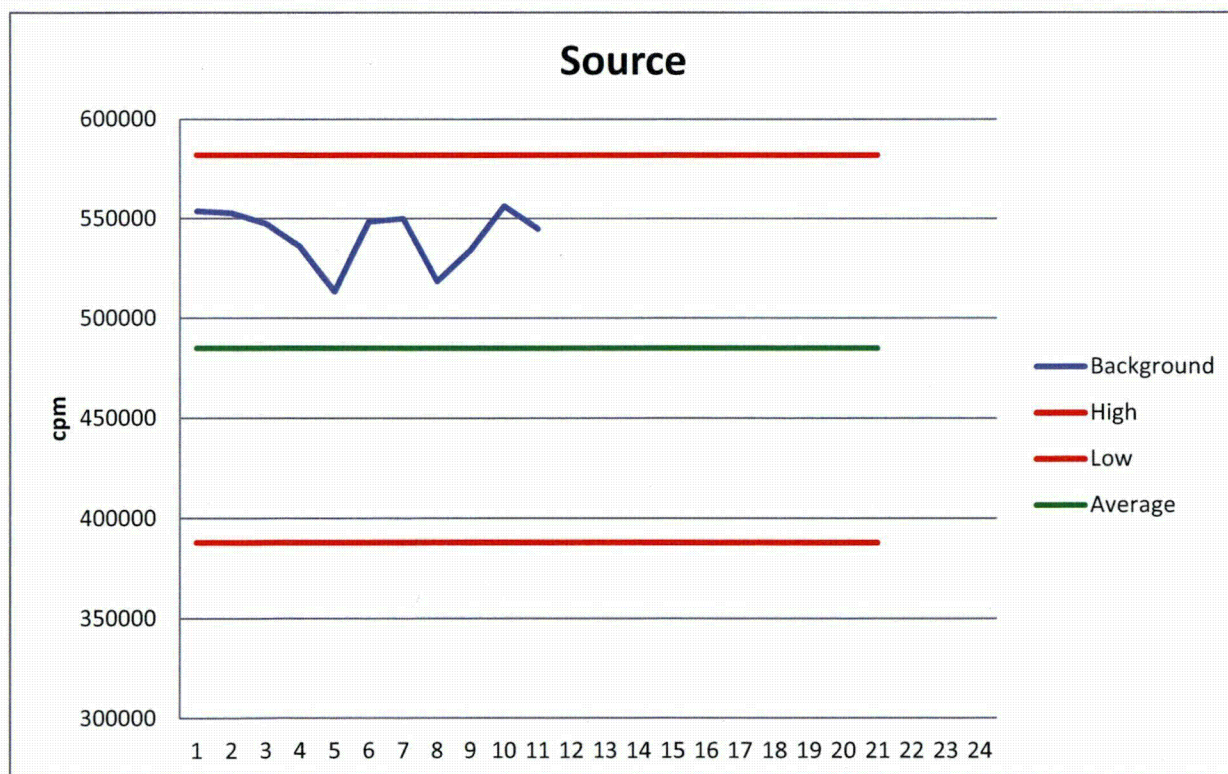
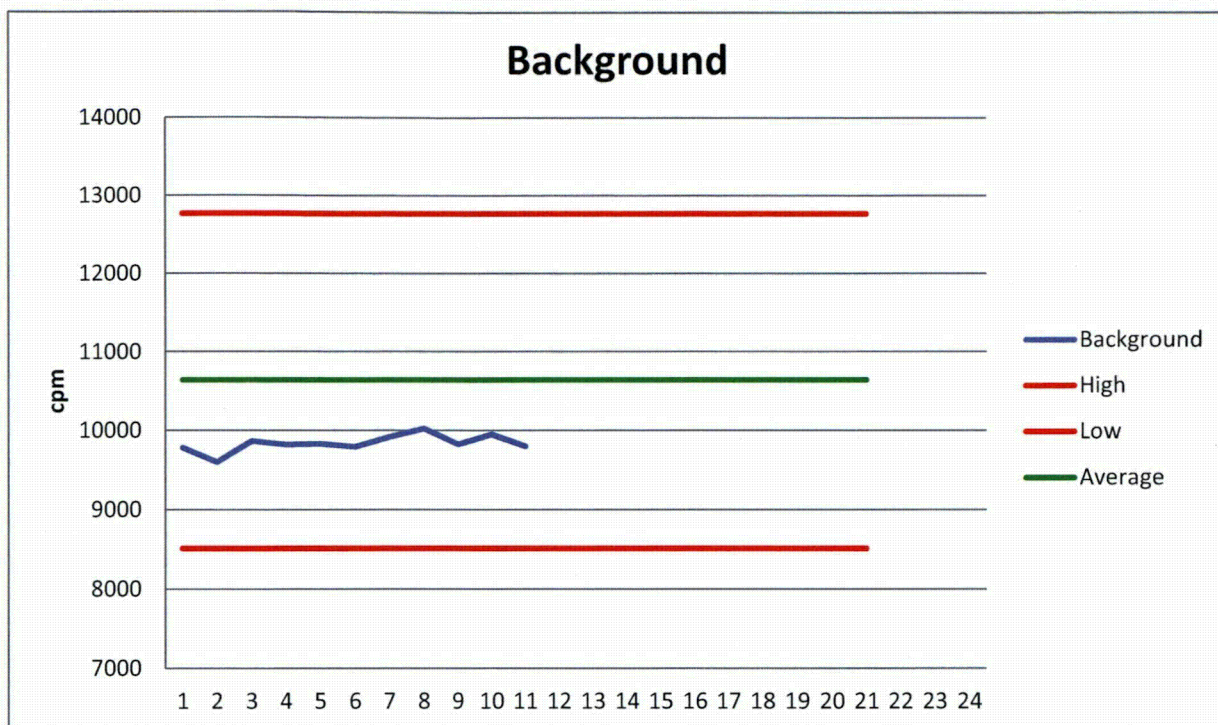
Performed by: _____

Date: _____

Reviewed by: _____

Date: _____

Date:



CERTIFICATE OF CALIBRATION (AIR SAMPLER)



RSA Laboratories, Inc.

19 Pendleton Drive, P.O. Box 61
Hebron, Connecticut 06248
(860) 228-0721 Fax (860) 228-4402

Customer and Contact: Cabrera Services, Inc., Attn: Charles Mikaitis (860) 569-0095
Customer Address: 473 Silver Lane, East Hartford, CT 06118

Inst. Mfr. HI-Q
Reference Inst. HI-Q Model HFC-50C

Inst. Model CF-973T

Inst. s/n 16826
Inst. s/n 4911

Cal. Date 18 June 2012

Due Date 18 June 2013

Cal. Interval 1 year

Barometric Press: Actual 29.80

Temperature: Actual 76°F

Filters Used: ☒ Particulate ☐ Charcoal/silver zeolite ☐ Other:

Corrected to: 29.80 in. Hg
Corrected to: 76°F

Measurement	Air Sampler Flow Rate (CFM)	Ref. Inst. Flow Rate (CFM)	Percent Deviation
1	14.63	14.89	1.69%
2	24.39	24.81	1.69%
3	34.15	33.74	-1.20%
4	43.90	42.67	-2.88%
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****Average percent deviation across the range = -0.17%**

This is to certify that RSA Laboratories, Inc. of Hebron, Connecticut, has on this date certified this air sampler to be within the accuracy specified above. The Reference Flow Device bears Letters of Certification traceable to the National Institute of Science and Technology. RSA Laboratories, Inc. ID# 14936.

Calibrated by: Kurt D. Newton

Date: 18 June 2012

CERTIFICATE OF CALIBRATION

(AIR SAMPLER)

Facility: RSA Laboratories, Inc. Customer: Cabrera-Services, Inc.

Calibrator Model HI-Q Model HFC-50C
Air Sampler Model HI-Q CF-973T

Calibrator Serial No. 4911
Air Sampler Serial No. 16826

AIR SAMPLER							CALIBRATOR		
Measurement	Inlet Temp. (°F)	Inlet Press (In-Hg)	Gauge Press (In-Hg)	Indicated Flow (CFM)	Temp/Press Correction Factor	Corrected Flow (CFM)	Indicated Flow (CFM)	Temp/Press Correction Factor	Corrected Flow (CFM)
1	76	29.80	n/a	15.0	0.976	14.63	15.0	0.992	14.89
2	76	29.80	n/a	25.0	0.976	24.39	25.0	0.992	24.81
3	76	29.80	n/a	35.0	0.976	34.15	34.0	0.992	33.74
4	76	29.80	n/a	45.0	0.976	43.90	43.0	0.992	42.67
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$$\text{Air Sampler Temp/Press Corr Factor} = \sqrt{\frac{530^{\circ}\text{R}}{\text{Inlet temp } (^{\circ}\text{F}) + 460^{\circ}\text{R}}} \times \frac{(\text{Inlet Press} - \text{Gauge Press})}{29.92 \text{ in. Hg}}$$

$$\% \text{ Deviation} = \frac{\text{Corrected Flow} - \text{Sampler Flow}}{\text{Corrected Flow}} \times 100$$

$$\text{Calibrator Temp/Press Corr Factor} = \sqrt{\frac{530^{\circ}\text{R}}{\text{Inlet temp } (^{\circ}\text{F}) + 460^{\circ}\text{R}}} \times \frac{\text{Inlet Press}}{29.92 \text{ in. Hg}}$$

$$\text{Corrected Flow} = (\text{Indicated Flow}) \times (\text{Temp/Press Corr Factor})$$

Calibrated by: Kurt D. Newton

Date: 18 June 2012

CERTIFICATE OF CALIBRATION (AIR SAMPLER)



RSA Laboratories, Inc.

19 Pendleton Drive, P.O. Box 61
Hebron, Connecticut 06248
(860) 228-0721 Fax (860) 228-4402

Customer and Contact: Cabrera Services, Inc., Attn: Charles Mikaitis (860) 569-0095
Customer Address: 473 Silver Lane, East Hartford, CT 06118

Inst. Mfr. **HI-Q**
Reference Inst. **HI-Q Model HFC-50C**

Inst. Model **CF-973T**

Inst. s/n **16831**
Inst. s/n **4911**

Cal. Date **23 July 2012**

Due Date **23 July 2013**

Cal. Interval **1 year**

Barometric Press: Actual **29.70**

Temperature: Actual **78°F**

Corrected to: **29.70 in. Hg**

Corrected to: **78°F**

Filters Used: ☒ Particulate ☐ Charcoal/silver zeolite ☐ Other:

Measurement	Air Sampler Flow Rate (CFM)	Ref. Inst. Flow Rate (CFM)	Percent Deviation
1	14.58	14.83	1.70%
2	24.30	24.72	1.70%
3	34.02	34.61	1.70%
4	43.74	44.00	0.59%
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****Average percent deviation across the range = 1.42%**

This is to certify that RSA Laboratories, Inc. of Hebron, Connecticut, has on this date certified this air sampler to be within the accuracy specified above. The Reference Flow Device bears Letters of Certification traceable to the National Institute of Science and Technology. RSA Laboratories, Inc. ID# 14999.

Calibrated by: **Kurt D. Newton**

Date: **23 July 2012**

CERTIFICATE OF CALIBRATION

(AIR SAMPLER)

Facility: RSA Laboratories, Inc. Customer: Cabrera Services, Inc.

Calibrator Model HI-Q Model HFC-50C

Calibrator Serial No. 4911

Air Sampler Model HI-Q CF-973T

Air Sampler Serial No. 16831

AIR SAMPLER							CALIBRATOR		
Measurement	Inlet Temp. (°F)	Inlet Press (In-Hg)	Gauge Press (In-Hg)	Indicated Flow (CFM)	Temp/Press Correction Factor	Corrected Flow (CFM)	Indicated Flow (CFM)	Temp/Press Correction Factor	Corrected Flow (CFM)
1	78	29.70	n/a	15.0	0.972	14.58	15.0	0.989	14.83
2	78	29.70	n/a	25.0	0.972	24.30	25.0	0.989	24.72
3	78	29.70	n/a	35.0	0.972	34.02	35.0	0.989	34.61
4	78	29.70	n/a	45.0	0.972	43.74	44.5	0.989	44.00
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$$\text{Air Sampler Temp/Press Corr Factor} = \sqrt{\frac{530^{\circ}\text{R}}{\text{Inlet temp } (^{\circ}\text{F}) + 460^{\circ}\text{R}}} \times \frac{(\text{Inlet Press} - \text{Gauge Press})}{29.92 \text{ in. Hg}}$$

$$\% \text{ Deviation} = \frac{\text{Corrected Flow} - \text{Sampler Flow}}{\text{Corrected Flow}} \times 100$$

$$\text{Calibrator Temp/Press Corr Factor} = \sqrt{\frac{530^{\circ}\text{R}}{\text{Inlet temp } (^{\circ}\text{F}) + 460^{\circ}\text{R}}} \times \frac{\text{Inlet Press}}{29.92 \text{ in. Hg}}$$

$$\text{Corrected Flow} = (\text{Indicated Flow}) \times (\text{Temp/Press Corr Factor})$$

Calibrated by: Kurt D. Newton



Date: 23 July 2012

CERTIFICATE OF CALIBRATION

(AIR SAMPLER)



RSA Laboratories, Inc.

19 Pendleton Drive, P.O. Box 61

Hebron, Connecticut 06248

(860) 228-0721 Fax (860) 228-4402

Customer and Contact: Cabrera Services, Inc., Attn: Charles Mikaitis (860) 569-0095

Customer Address: 473 Silver Lane, East Hartford, CT 06118

Inst. Mfr. HI-Q

Inst. Model CF-973T

Inst. s/n 16832

Reference Inst. HI-Q Model HFC-50C

Inst. s/n 4911

Cal. Date 23 July 2012

Due Date 23 July 2013

Cal. Interval 1 year

Barometric Press: Actual 29.70

Corrected to: 29.70 in. Hg

Temperature: Actual 78°F

Corrected to: 78°F

Filters Used: ☒Particulate ☐Charcoal/silver zeolite ☐Other:

Measurement	Air Sampler Flow Rate (CFM)	Ref. Inst. Flow Rate (CFM)	Percent Deviation
1	14.58	14.83	1.70%
2	24.30	24.72	1.70%
3	34.02	34.61	1.70%
4	43.74	44.00	0.59%
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****Average percent deviation across the range = 1.42%**

This is to certify that RSA Laboratories, Inc. of Hebron, Connecticut, has on this date certified this air sampler to be within the accuracy specified above. The Reference Flow Device bears Letters of Certification traceable to the National Institute of Science and Technology. RSA Laboratories, Inc. ID# 15000.

Calibrated by: Kurt D. Newton

Date: 23 July 2012

CERTIFICATE OF CALIBRATION

(AIR SAMPLER)

Facility: RSA Laboratories, Inc. Customer: Cabrera Services, Inc.

Calibrator Model HI-Q Model HFC-50C
Air Sampler Model HI-Q CF-973T

Calibrator Serial No. 4911
Air Sampler Serial No. 16831

AIR SAMPLER							CALIBRATOR		
Measurement	Inlet Temp. (°F)	Inlet Press (In-Hg)	Gauge Press (In-Hg)	Indicated Flow (CFM)	Temp/Press Correction Factor	Corrected Flow (CFM)	Indicated Flow (CFM)	Temp/Press Correction Factor	Corrected Flow (CFM)
1	78	29.70	n/a	15.0	0.972	14.58	15.0	0.989	14.83
2	78	29.70	n/a	25.0	0.972	24.30	25.0	0.989	24.72
3	78	29.70	n/a	35.0	0.972	34.02	35.0	0.989	34.61
4	78	29.70	n/a	45.0	0.972	43.74	44.5	0.989	44.00
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$$\text{Air Sampler Temp/Press Corr Factor} = \sqrt{\frac{530^{\circ}\text{R}}{\text{Inlet temp } (^{\circ}\text{F}) + 460^{\circ}\text{R}}} \times \frac{(\text{Inlet Press} - \text{Gauge Press})}{29.92 \text{ in. Hg}}$$

$$\% \text{ Deviation} = \frac{\text{Corrected Flow} - \text{Sampler Flow}}{\text{Corrected Flow}} \times 100$$

$$\text{Calibrator Temp/Press Corr Factor} = \sqrt{\frac{530^{\circ}\text{R}}{\text{Inlet temp } (^{\circ}\text{F}) + 460^{\circ}\text{R}}} \times \frac{\text{Inlet Press}}{29.92 \text{ in. Hg}}$$

$$\text{Corrected Flow} = (\text{Indicated Flow}) \times (\text{Temp/Press Corr Factor})$$

Calibrated by: Kurt D. Newton

Date: 23 July 2012

CERTIFICATE OF CALIBRATION (AIR SAMPLER)



RSA Laboratories, Inc.

19 Pendleton Drive, P.O. Box 61
Hebron, Connecticut 06248
(860) 228-0721 Fax (860) 228-4402

Customer and Contact: Cabrera Services, Inc., Attn: Charles Mikaitis (860) 569-0095

Customer Address: 473 Silver Lane, East Hartford, CT 06118

Inst. Mfr. **HI-Q**

Inst. Model **CF-973T**

Inst. s/n **18204**

Reference Inst. **HI-Q Model HFC-50C**

Inst. s/n **4911**

Cal. Date **07 November 2012**

Due Date **07 November 2013**

Cal. Interval **1 year**

Barometric Press: Actual **29.58 in.Hg**

Corrected to: **29.58 in.Hg**

Temperature: Actual **70°F**

Corrected to: **70°F**

Filters Used: ☒Particulate ☐Charcoal/silver zeolite ☐Other:

Measurement	Air Sampler Flow Rate (CFM)	Ref. Inst. Flow Rate (CFM)	Percent Deviation
1	9.77	9.94	1.70%
2	19.55	19.89	1.70%
3	29.32	29.33	0.04%
4	39.09	39.27	0.46%
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****Average percent deviation across the range = 0.63%**

This is to certify that RSA Laboratories, Inc. of Hebron, Connecticut, has on this date certified this air sampler to be within the accuracy specified above. The Reference Flow Device bears Letters of Certification traceable to the National Institute of Science and Technology. RSA Laboratories, Inc. ID# 15223.

Calibrated by: **Kurt D. Newton**

Date: **07 November 2012**

CERTIFICATE OF CALIBRATION

(AIR SAMPLER)

Facility: RSA Laboratories, Inc. Customer: Cabrera Services, Inc.

Calibrator Model HI-Q Model HFC-50C
Air Sampler Model HI-Q CF-973T

Calibrator Serial No. 4911
Air Sampler Serial No. 18204

AIR SAMPLER							CALIBRATOR		
Measurement	Inlet Temp. (°F)	Inlet Press (In-Hg)	Gauge Press (In-Hg)	Indicated Flow (CFM)	Temp/Press Correction Factor	Corrected Flow (CFM)	Indicated Flow (CFM)	Temp/Press Correction Factor	Corrected Flow (CFM)
1	70	29.58	n/a	10.0	0.977	9.77	10.0	0.994	9.94
2	70	29.58	n/a	20.0	0.977	19.55	20.0	0.994	19.89
3	70	29.58	n/a	30.0	0.977	29.32	29.5	0.994	29.33
4	70	29.58	n/a	40.0	0.977	39.09	39.5	0.994	39.27
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12									
13									

$$\text{Air Sampler Temp/Press Corr Factor} = \sqrt{\frac{530^{\circ}\text{R}}{\text{Inlet temp } (^{\circ}\text{F}) + 460^{\circ}\text{R}}} \times \frac{(\text{Inlet Press} - \text{Gauge Press})}{29.92 \text{ in. Hg}}$$

$$\% \text{ Deviation} = \frac{\text{Corrected Flow} - \text{Sampler Flow}}{\text{Corrected Flow}} \times 100$$

$$\text{Calibrator Temp/Press Corr Factor} = \sqrt{\frac{530^{\circ}\text{R}}{\text{Inlet temp } (^{\circ}\text{F}) + 460^{\circ}\text{R}}} \times \frac{\text{Inlet Press}}{29.92 \text{ in. Hg}}$$

$$\text{Corrected Flow} = (\text{Indicated Flow}) \times (\text{Temp/Press Corr Factor})$$

Calibrated by: Kurt D. Newton

Date: 07 November 2012

CLASS (Detectors 1/2)			Initial Source Counts	
Daily Source Readings		1/29/2013	Average	5038.53
Measurement	Result (cps)	Pass/Fail	-20%	4030.82
0	4590.94739	Pass/Fail	+20%	6046.23
1	4635.29351	Pass/Fail		
2	4609.80572	Pass/Fail		
3	4629.89837	Pass/Fail		
4	4629.82428	Pass/Fail		
5	4583.77859	Pass/Fail		
6	4700.78522	Pass/Fail		
7	4823.67688	Pass/Fail		
8	4567.76418	Pass/Fail		
9	4629.74783	Pass/Fail		
10	4702.13708	Pass/Fail		
11	4554.37935	Pass/Fail		
12	4634.36789	Pass/Fail		
13	4646.00031	Pass/Fail		
14	4605.57103	Pass/Fail		
15	4687.65015	Pass/Fail		
16	4616.58196	Pass/Fail		
17	4537.49893	Pass/Fail		
18	4653.15527	Pass/Fail		
19	4678.17293	Pass/Fail		
20	4641.67621	Pass/Fail		
21	4493.23487	Pass/Fail		
22	4466.4307	Pass/Fail		
23	4606.72155	Pass/Fail		
24	4625.20934	Pass/Fail		
25	4651.14882	Pass/Fail		
26	4617.73754	Pass/Fail		
27	4754.13997	Pass/Fail		
28	4606.72718	Pass/Fail		
29	4666.79616	Pass/Fail		
30	4720.74119	Pass/Fail		
31	4621.04618	Pass/Fail		
32	4620.8931	Pass/Fail		
33	4680.4066	Pass/Fail		
34	4568.61835	Pass/Fail		
35	4557.24444	Pass/Fail		
36	4565.81219	Pass/Fail		
37	4457.42176	Pass/Fail		
38	4537.5012	Pass/Fail		
39	4627.05506	Pass/Fail		
40	4673.87251	Pass/Fail		
41	4560.75002	Pass/Fail		
42	4532.17801	Pass/Fail		
43	4633.82845	Pass/Fail		
44	4672.86913	Pass/Fail		
45	4691.71349	Pass/Fail		
46	4634.36789	Pass/Fail		
47	4646.14204	Pass/Fail		

48	4618.81511	Pass/Fail
49	4544.82902	Pass/Fail
50	4589.63499	Pass/Fail
51	4746.23127	Pass/Fail
52	4551.60715	Pass/Fail
53	4646.00264	Pass/Fail
54	4743.81071	Pass/Fail
55	4713.1444	Pass/Fail
56	4525.0386	Pass/Fail
57	4598.79194	Pass/Fail
58	4672.16991	Pass/Fail
59	4631.98221	Pass/Fail
60	4567.67534	Pass/Fail
61	4662.25908	Pass/Fail
62	4652.28893	Pass/Fail
63	4754.1892	Pass/Fail
64	4651.17444	Pass/Fail
65	4573.85118	Pass/Fail
66	4691.88895	Pass/Fail
67	4632.66676	Pass/Fail
68	4633.90406	Pass/Fail
69	4704.60789	Pass/Fail
70	4642.84016	Pass/Fail
71	4645.37362	Pass/Fail
72	4701.5469	Pass/Fail
73	4608.80468	Pass/Fail
74	4619.66108	Pass/Fail
75	4647.30722	Pass/Fail
76	4616.65639	Pass/Fail
77	4573.30806	Pass/Fail
78	4673.93779	Pass/Fail
79	4527.43405	Pass/Fail
80	4662.92852	Pass/Fail
81	4619.65877	Pass/Fail
82	4667.19682	Pass/Fail
83	4775.25953	Pass/Fail
84	4651.08131	Pass/Fail
85	4600.4112	Pass/Fail
86	4565.3028	Pass/Fail
87	4691.29572	Pass/Fail
88	4608.03428	Pass/Fail
89	4705.9012	Pass/Fail
90	4582.86106	Pass/Fail
91	4577.68778	Pass/Fail
92	4714.85349	Pass/Fail
93	4594.5601	Pass/Fail
94	4704.43157	Pass/Fail
95	4635.67377	Pass/Fail
96	4512.70449	Pass/Fail
97	4592.16038	Pass/Fail
98	4595.55879	Pass/Fail

99	4651.68413	Pass/Fail
100	4615.96614	Pass/Fail
101	4726.45232	Pass/Fail
102	4675.40423	Pass/Fail



Calibration Certificate
ID Number: 0027441660153-0

Customer: Dennis Criswell
Cabrera Services, Inc.
2992 River Road
Vandergrift, PA 15690

Instrument
Thermo Scientific Model EPD-G Mk
2.5

Serial Number
00274416

Accuracy Check		
Target Value: 10.000 mrem	Tolerance: 9.000-11.000	
Exposure Value: 10.00 mrem	As Found	As Left
Calibration Factor	1	1
Exposure Values (in mrem)	10.4	10.4

As-Found Readings marked with * indicate ranges where As-Found readings are > 20% of Target value.

As-Left Readings marked with ** indicate ranges where As-Left readings are > 10% of Target value.

Calibration geometry: Instrument shot with phantom, facing Cs-137 beam.

Outer Physical Check: Pass

Tap Test: Pass

Calibrated by:

QA

Review:

Calibration Date: 07/13/2012

Expires: 07/13/2013

Atmospheric Conditions - Temperature: 74°F Humidity: 32% Barometric Pressure: 30.08in/hg

This calibration was performed by RSCS using a NIST Traceable radiation source (Cs-137 Beam Source SN S-1110), in conformance to the following standards: ANSI N323A (1987), RSCS New Hampshire Radioactive Material License Number: 381R. RSCS calibration services are performed in accordance with the RSCS Radiation Protection Program Manual and Standard Operating Procedure. This calibration certificate shall not be reproduced except in full without the express written consent of RSCS, Inc.
Estimated uncertainty for measurements collected using the J.L. Shepherd and Associates Model 89 calibrator: 2.7%
Estimated uncertainty for measurements collected using the Tech Ops Model 773 calibrator: 6.0%



Calibration Certificate
ID Number: 0027439160156-0

Customer: Dennis Criswell
Cabrera Services, Inc.
2992 River Road
Vandergrift, PA 15690

Instrument
Thermo Scientific Model EPD-G Mk
2.5

Serial Number
00274391

Accuracy Check		
Target Value: 10.000 mrem	Tolerance: 9.000-11.000	
Exposure Value: 10.00 mrem	As Found	As Left
Calibration Factor	1	1
Exposure Values (in mrem)	10.3	10.3

As-Found Readings marked with * indicate ranges where As-Found readings are > 20% of Target value.

As-Left Readings marked with ** indicate ranges where As-Left readings are > 10% of Target value.

Calibration geometry: Instrument shot with phantom, facing Cs-137 beam.

Outer Physical Check: Pass

Tap Test: Pass

Calibrated by:

QA

Review:

Calibration Date: 07/13/2012

Expires: 07/13/2013

Atmospheric Conditions - Temperature: 74°F Humidity: 32% Barometric Pressure: 30.08in/hg

This calibration was performed by RSCS using a NIST Traceable radiation source (Cs-137 Beam Source SN S-1110), in conformance to the following standards: ANSI N323A (1997).
RSCS New Hampshire Radioactive Material License Number: 381R. RSCS calibration services are performed in accordance with the RSCS Radiation Protection Program Manual and Standard Operating Procedure. This calibration certificate shall not be reproduced except in full without the express written consent of RSCS, Inc.
Estimated uncertainty for measurements collected using the J.L. Shepherd and Associates Model 89 calibrator: 2.7%
Estimated uncertainty for measurements collected using the Tech Ops Model 773 calibrator: 6.0%



Calibration Certificate
ID Number: 0027436960542-0

Customer: Dennis Criswell
Cabrera Services, Inc.
2992 River Road
Vandergrift, PA 15690

Instrument
Thermo Scientific Model EPD MK2+

Serial Number
00274369

Accuracy Check		
Target Value: 10.000 mrem	Tolerance: 9.000-11.000	
Exposure Value: 10.00 mrem	As Found	As Left
Calibration Factor	1	1
Exposure Values (in mrem)	10.4	10.4

As-Found Readings marked with * indicate ranges where As-Found readings are > 20% of Target value.

As-Left Readings marked with ** indicate ranges where As-Left readings are > 10% of Target value.

Calibration geometry: Instrument shot with phantom, facing Cs-137 beam.

Outer Physical Check: Pass

Tap Test: Pass

Calibrated by:

QA
Review:

Calibration Date: 07/27/2012

Expires: 07/27/2013

Atmospheric Conditions - Temperature: 74°F Humidity: 35% Barometric Pressure: 29.85in/hg

This calibration was performed by RSCS using a NIST Traceable radiation source (Cs-137 Beam Source SN S-1110), in conformance to the following standards: ANSI N323A (1997).
RSCS New Hampshire Radioactive Material License Number: 381R. RSCS calibration services are performed in accordance with the RSCS Radiation Protection Program Manual and Standard Operating Procedure. This calibration certificate shall not be reproduced except in full without the express written consent of RSCS, Inc.
Estimated uncertainty for measurements collected using the J.L. Shepherd and Associates Model 89 calibrator: 2.7%
Estimated uncertainty for measurements collected using the Tech Ops Model 773 calibrator: 6.0%



Calibration Certificate
ID Number: 0027439360540-0

Customer: Dennis Criswell
Cabrera Services, Inc.
2992 River Road
Vandergrift, PA 15690

Instrument
Thermo Scientific Model EPD MK2+

Serial Number
00274393

Accuracy Check		
Target Value: 10.000 mrem	Tolerance: 9.000-11.000	
Exposure Value: 10.00 mrem	As Found	As Left
Calibration Factor	1	1
Exposure Values (in mrem)	10.4	10.4

As-Found Readings marked with * indicate ranges where As-Found readings are > 20% of Target value.

As-Left Readings marked with ** indicate ranges where As-Left readings are > 10% of Target value.

Calibration geometry: Instrument shot with phantom, facing Cs-137 beam.

Outer Physical Check: Pass

Tap Test: Pass

Calibrated by:

QA

Review:

Calibration Date: 07/27/2012

Expires: 07/27/2013

Atmospheric Conditions - Temperature: 74°F Humidity: 35% Barometric Pressure: 29.85in/hg

This calibration was performed by RSCS using a NIST Traceable radiation source (Cs-137 Beam Source SN S-1110), in conformance to the following standards: ANSI N323A (1997). RSCS New Hampshire Radioactive Material License Number: 381R. RSCS calibration services are performed in accordance with the RSCS Radiation Protection Program Manual and Standard Operating Procedure. This calibration certificate shall not be reproduced except in full without the express written consent of RSCS, Inc. Estimated uncertainty for measurements collected using the J.L. Shepherd and Associates Model 88 calibrator: 2.7% Estimated uncertainty for measurements collected using the Tech Ops Model 773 calibrator: 5.0%



Calibration Certificate
ID Number: 0027439460541-0

Customer: Dennis Criswell
Cabrera Services, Inc.
2992 River Road
Vandergrift, PA 15690

Instrument
Thermo Scientific Model EPD MK2+

Serial Number
00274394

Accuracy Check		
Target Value: 10.000 mrem	Tolerance: 9.000-11.000	
Exposure Value: 10.00 mrem	As Found	As Left
Calibration Factor	1	1
Exposure Values (in mrem)	10.7	10.7

As-Found Readings marked with * indicate ranges where As-Found readings are > 20% of Target value.
As-Left Readings marked with ** indicate ranges where As-Left readings are > 10% of Target value.
Calibration geometry: Instrument shot with phantom, facing Cs-137 beam.

Outer Physical Check: Pass

Tap Test: Pass

Calibrated by:

QA
Review:

Calibration Date: 07/27/2012

Expires: 07/27/2013

Atmospheric Conditions - Temperature: 74°F Humidity: 35% Barometric Pressure: 29.85in/hg

This calibration was performed by RSCS using a NIST Traceable radiation source (Cs-137 Beam Source SN S-1110), in conformance to the following standards: ANSI N323A (1997), RSCS New Hampshire Radioactive Material License Number: 381R. RSCS calibration services are performed in accordance with the RSCS Radiation Protection Program Manual and Standard Operating Procedure. This calibration certificate shall not be reproduced except in full without the express written consent of RSCS, Inc.
Estimated uncertainty for measurements collected using the J.L. Shepherd and Associates Model 89 calibrator: 2.7%
Estimated uncertainty for measurements collected using the Tech Ops Model 773 calibrator: 6.0%



Calibration Certificate
ID Number: 0027441860539-0

Customer: Dennis Criswell
Cabrera Services, Inc.
2992 River Road
Vandergrift, PA 15690

Instrument
Thermo Scientific Model EPD MK2+

Serial Number
00274418

Accuracy Check		
Target Value: 10.000 mrem	Tolerance: 9.000-11.000	
Exposure Value: 10.00 mrem	As Found	As Left
Calibration Factor	1	1
Exposure Values (in mrem)	10.6	10.6

As-Found Readings marked with * indicate ranges where As-Found readings are > 20% of Target value.

As-Left Readings marked with ** indicate ranges where As-Left readings are > 10% of Target value.

Calibration geometry: Instrument shot with phantom, facing Cs-137 beam.

Outer Physical Check: Pass

Tap Test: Pass

Calibrated by:

[Signature] QA Review: *[Signature]*

Calibration Date: 07/27/2012

Expires: 07/27/2013

Atmospheric Conditions - Temperature: 74°F Humidity: 35% Barometric Pressure: 29.65in/hg

This calibration was performed by RSCS using a NIST Traceable radiation source (Cs-137 Beam Source SN S-1110), in conformance to the following standards: ANSI N323A (1997), RSCS New Hampshire Radioactive Material License Number: 381R. RSCS calibration services are performed in accordance with the RSCS Radiation Protection Program Manual and Standard Operating Procedure. This calibration certificate shall not be reproduced except in full without the express written consent of RSCS, Inc.
Estimated uncertainty for measurements collected using the J.L. Shepherd and Associates Model 89 calibrator: 2.7%
Estimated uncertainty for measurements collected using the Tech Ops Model 773 calibrator: 8.0%



Calibration Certificate
ID Number: 0027440260543-0

Customer: Dennis Criswell
Cabrera Services, Inc.
2992 River Road
Vandergrift, PA 15690

Instrument
Thermo Scientific Model EPD MK2+

Serial Number
00274402

Accuracy Check		
Target Value: 10.000 mrem	Tolerance: 9.000-11.000	
Exposure Value: 10.00 mrem	As Found	As Left
Calibration Factor	1	1
Exposure Values (in mrem)	9.9	9.9

As-Found Readings marked with * indicate ranges where As-Found readings are > 20% of Target value.
As-Left Readings marked with ** indicate ranges where As-Left readings are > 10% of Target value.
Calibration geometry: Instrument shot with phantom, facing Cs-137 beam.

Outer Physical Check: Pass

Tap Test: Pass

Calibrated by:

QA
Review:

Calibration Date: 07/27/2012

Expires: 07/27/2013

Atmospheric Conditions - Temperature: 74°F Humidity: 35% Barometric Pressure: 29.65in/hg

This calibration was performed by RSCS using a NIST Traceable radiation source (Cs-137 Beam Source SN S-1110), in conformance to the following standards: ANSI N323A (1997), RSCS New Hampshire Radioactive Material License Number: 381R. RSCS calibration services are performed in accordance with the RSCS Radiation Protection Program Manual and Standard Operating Procedure. This calibration certificate shall not be reproduced except in full without the express written consent of RSCS, Inc.
Estimated uncertainty for measurements collected using the J.L. Shepherd and Associates Model 89 calibrator: 2.7%
Estimated uncertainty for measurements collected using the Tech Ops Model 773 calibrator: 6.0%



Calibration Certificate
ID Number: 0027431860155-0

Customer: Dennis Criswell
Cabrera Services, Inc.
2992 River Road
Vandergrift, PA 15690

Instrument
Thermo Scientific Model EPD-G Mk
2.5

Serial Number
00274318

Accuracy Check		
Target Value: 10.000 mrem	Tolerance: 9.000-11.000	
Exposure Value: 10.00 mrem	As Found	As Left
Calibration Factor	1	1
Exposure Values (in mrem)	10.6	10.6

As-Found Readings marked with * indicate ranges where As-Found readings are > 20% of Target value.

As-Left Readings marked with ** indicate ranges where As-Left readings are > 10% of Target value.

Calibration geometry: Instrument shot with phantom, facing Cs-137 beam.

Outer Physical Check: Pass

Tap Test: Pass

Calibrated by:

QA
Review:

Calibration Date: 07/13/2012

Expires: 07/13/2013

Atmospheric Conditions - Temperature: 74°F Humidity: 32% Barometric Pressure: 30.08in/hg

This calibration was performed by RSCS using a NIST Traceable radiation source (Cs-137 Beam Source SN S-1110), in conformance to the following standards: ANSI N323A (1997), RSCS New Hampshire Radioactive Material License Number: 381R. RSCS calibration services are performed in accordance with the RSCS Radiation Protection Program Manual and Standard Operating Procedure. This calibration certificate shall not be reproduced except in full without the express written consent of RSCS, Inc.
Estimated uncertainty for measurements collected using the J.L. Shepherd and Associates Model 89 calibrator: 2.7%
Estimated uncertainty for measurements collected using the Tech Ops Model 773 calibrator: 6.0%



Calibration Certificate
ID Number: 0027439760154-0

Customer: Dennis Criswell
Cabrera Services, Inc.
2992 River Road
Vandergift, PA 15690

Instrument
Thermo Scientific Model EPD-G Mk
2.5

Serial Number
00274397

Accuracy Check		
Target Value: 10.000 mrem	Tolerance: 9.000-11.000	
Exposure Value: 10.00 mrem	As Found	As Left
Calibration Factor	1	1
Exposure Values (in mrem)	10.5	10.5

As-Found Readings marked with * indicate ranges where As-Found readings are > 20% of Target value.
As-Left Readings marked with ** indicate ranges where As-Left readings are > 10% of Target value.
Calibration geometry: Instrument shot with phantom, facing Cs-137 beam.

Outer Physical Check: Pass

Tap Test: Pass

Calibrated by:

QA

Review:

Calibration Date: 07/13/2012

Expires: 07/13/2013

Atmospheric Conditions - Temperature: 74°F Humidity: 32% Barometric Pressure: 30.08in/hg

This calibration was performed by RSCS using a NIST Traceable radiation source (Cs-137 Beam Source SN S-1110), in conformance to the following standards: ANSI N323A (1997).
RSCS New Hampshire Radioactive Material License Number: 381R. RSCS calibration services are performed in accordance with the RSCS Radiation Protection Program Manual and Standard Operating Procedure. This calibration certificate shall not be reproduced except in full without the express written consent of RSCS, Inc.
Estimated uncertainty for measurements collected using the J.L. Shephard and Associates Model 89 calibrator: 2.7%
Estimated uncertainty for measurements collected using the Tech Ops Model 773 calibrator: 6.0%



Calibration Certificate
ID Number: 0027399660152-0

Customer: Dennis Criswell
Cabrera Services, Inc.
2992 River Road
Vandergrift, PA 15690

Instrument
Thermo Scientific Model EPD-G Mk
2.5

Serial Number
00273996

Accuracy Check		
Target Value: 10.000 mrem	Tolerance: 9.000-11.000	
Exposure Value: 10.00 mrem	As Found	As Left
Calibration Factor	1	1
Exposure Values (in mrem)	10.8	10.8

As-Found Readings marked with * indicate ranges where As-Found readings are > 20% of Target value.
As-Left Readings marked with ** indicate ranges where As-Left readings are > 10% of Target value.
Calibration geometry: Instrument shot with phantom, facing Cs-137 beam.

Outer Physical Check: Pass

Tap Test: Pass

Calibrated by:

QA
Review:

Calibration Date: 07/13/2012

Expires: 07/13/2013

Atmospheric Conditions - Temperature: 74°F Humidity: 32% Barometric Pressure: 30.08in/hg

This calibration was performed by RSCS using a NIST Traceable radiation source (Cs-137 Beam Source SN S-1110), in conformance to the following standards: ANSI N323A (1997), RSCS New Hampshire Radioactive Material License Number: 381R. RSCS calibration services are performed in accordance with the RSCS Radiation Protection Program Manual and Standard Operating Procedure. This calibration certificate shall not be reproduced except in full without the express written consent of RSCS, Inc.
Estimated uncertainty for measurements collected using the J.L. Shepherd and Associates Model 89 calibrator: 2.7%
Estimated uncertainty for measurements collected using the Tech Ops Model 773 calibrator: 8.0%



Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.

501 Oak Street
325-235-5494

231 Sam Rayburn Parkway
865-270-8962

Sweetwater, TX 79556, U.S.A.

Lenoir City, TN 37771, U.S.A.

CUSTOMER CABRERA SERVICES

ORDER NO. 20208021/382888

Mfg. Ludlum Measurements, Inc. Model 2221 Serial No. 216482

Mfg. Ludlum Measurements, Inc. Model 44-20 Serial No. 88274126

Cal. Date 25-Sep-12 Cal Due Date 25-Sep-13 Cal. Interval 1 Year Meterface 202-159

Check mark ☒ applies to applicable instr. and/or detector IAW mfg. spec. T. 74 °F RH 42 % Alt 697.8 mm Hg

☐ New Instrument ☐ Instrument Received ☒ Within Toler. $\pm 10\%$ ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☒ Mechanical ck. ☒ Meter Zeroed ☐ Background Subtract ☒ Input Sens. Linearity

☒ F/S Resp. ck. ☒ Reset ck. ☒ Window Operation ☒ Geotropism

☒ Audio ck. ☐ Alarm Setting ck. 4.4 VDC

☒ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set Comments V Input Sens. Comments mV Det. Oper. Comments V at Comments mV Threshold Dial Ratio 100 = 10 mV

☒ HV Readout (2 points) Ref./Inst. 500 / 500 V Ref./Inst. 2000 / 1989 V

COMMENTS:

Peak settings Gross Counts Model 2221 currently set
High Voltage: 704 V 1050 V for gross counts.
Threshold dial: 642 100 (10mv) High voltage set with detector
Window dial: 40 n/a connected.
Window Position: "IN" "OUT"
Resolution for Cs137: $\approx 9.21\%$ n/a Firmware: 261028
Calibrated with 5' cable. OL checked but not set. 1 minute background count: 10,851cpm

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1K	400kcpm	400	400
x1K	100kcpm	100	100
x100	40kcpm	400	400
x100	10kcpm	100	100
x10	4kcpm	400	400
x10	1kcpm	100	100
x1	400cpm	400	400
x1	100cpm	100	100

*Uncertainty within $\pm 10\%$ C.F. within $\pm 20\%$

ALL Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
400kcpm	39983	39983	500kcpm	500kcpm	500kcpm
40kcpm	3998	3998	50kcpm	50	50
4kcpm	399	399	5kcpm	5	5
400cpm	40	40	500cpm	500	500
40cpm	4	4	50cpm	50	50

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques.

The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978

State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: ☐ 059 ☐ 280 ☐ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☐ 5105 ☐ 5717CO ☐ 5719CO

☐ 60646 ☐ 70897 ☐ 73410 ☐ E551 ☐ E552 ☐ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ T-304 ☐ T879 ☐ T10081 ☐ T10082 ☐ Y982

☐ Alpha S/N ☐ Beta S/N ☐ Other

☒ m 500 S/N 63893 ☐ Oscilloscope S/N ☒ Multimeter S/N 93870637

Calibrated By: Jeremy Thompson Date 25-Sep-12

Reviewed By: David H. Date 26-Sep-12

Bench Test Data For Detector

Detector 44-20 Serial No. PR274128

Customer CABRERA SERVICES

Order #. 20208021/382888

Counter 2221 Serial No. 216422

Counter Input Sensitivity 10 mV

Count Time 6 seconds

Distance Source to Detector Surface

Other _____

[illegible]

Signature Jerry Thompson

Date 25 Sep 12



Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.

501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.

☐ 231 Sam Rayburn Parkway
865-270-8962
Lenoir City, TN 37771, U.S.A.

CUSTOMER CABRERA SERVICES

ORDER NO. 20207566/382613

Mfg. Ludlum Measurements, Inc. Model 2221 Serial No. 216473
Mfg. Ludlum Measurements, Inc. Model 44-20 Serial No. 99262403
Cal. Date 19-Sep-12 Cal Due Date 19-Sep-13 Cal. Interval 1 Year Meterface 202-159

Check mark ☒ Applies to applicable instr. and/or detector IAW mfg. spec. T. 74 °F RH 49 % Alt 701.8 mm Hg

☐ New Instrument ☐ Instrument Received ☒ Within Toler. $\pm 10\%$ ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☒ Mechanical ck. ☒ Meter Zeroed ☐ Background Subtract ☒ Input Sens. Linearity

☒ F/S Resp. ck. ☒ Reset ck. ☒ Window Operation ☒ Geotropism

☒ Audio ck. ☐ Alarm Setting ck. ☒ Batt. ck. (Min. Volt) 4.4 VDC

☒ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set Comments V Input Sens. Comments mV Det. Oper. Comments V at Comments mV Threshold Dial Ratio 100 = 10 mV

☒ HV Readout (2 points) Ref./Inst. 500 / 499 V Ref./Inst. 2000 / 1994 V

COMMENTS:

Peak settings
High Voltage: 665 V
Threshold dial: 642
Window dial: 40
Window Position: "IN"
Resolution for Cs137: ~9.36%

Gross Counts
1000 V
100 (10mv)
n/a
"OUT"
n/a

Model 2221 currently set
for gross counts.
High voltage set with detector
connected.
Firmware: 261028

OL checked but not set.

1 minute background count ²⁷ 20,551 cpm

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1K	400kcpm	<u>400</u>	<u>400</u>
x1K	100kcpm	<u>100</u>	<u>100</u>
x100	40kcpm	<u>400</u>	<u>400</u>
x100	10kcpm	<u>100</u>	<u>100</u>
x10	4kcpm	<u>400</u>	<u>400</u>
x10	1kcpm	<u>100</u>	<u>100</u>
x1	400cpm	<u>400</u>	<u>400</u>
x1	100cpm	<u>100</u>	<u>100</u>

*Uncertainty within $\pm 10\%$ C.F. within $\pm 20\%$

ALL Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	Log Scale	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout						
<u>400kcpm</u>	<u>39968 (9)</u>	<u>39968 (9)</u>		<u>500kcpm</u>	<u>500k cpm</u>	<u>500k cpm</u>
<u>40kcpm</u>	<u>3993</u>	<u>3993</u>		<u>50kcpm</u>	<u>50</u>	<u>50</u>
<u>4kcpm</u>	<u>399</u>	<u>399</u>		<u>5kcpm</u>	<u>5</u>	<u>5</u>
<u>400cpm</u>	<u>40</u>	<u>40</u>		<u>500cpm</u>	<u>500</u>	<u>500</u>
<u>40cpm</u>	<u>4</u>	<u>4</u>		<u>50cpm</u>	<u>50</u>	<u>50</u>

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques.

The calibration system conforms to the requirements of ANSI/NCCL Z540-1-1994 and ANSI N323-1978

State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: ☐ 059 ☐ 280 ☐ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☐ 5105 ☐ 5717CO ☐ 5719CO

☐ 80646 ☐ 70897 ☐ 73410 ☐ E551 ☐ E552 ☐ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ T-304 ☐ T879 ☐ T10081 ☐ T10082 ☐ Y982

☐ Alpha S/N ☐ Beta S/N ☐ Other

☒ m 500 S/N 63893 ☐ Oscilloscope S/N ☒ Multimeter S/N 93870637

Calibrated By: Jeremy Thompson

Date 19-Sep-12

Reviewed By: Paul H.

Date 20-Sep-12

Bench Test Data For Detector

Detector 44-20 Serial No. PR262403

Customer CABRERA SERVICES

Order #. 20207566/382613

Counter 2221 Serial No. 216433

Counter Input Sensitivity 10 mV

Count Time 6 seconds

Distance Source to Detector Surface

	Other	Non-union	Union	Total
Number of employees	60	78	92	230
Percentage of total sample	26%	34%	40%	100%
Average age	38	37	36	37
Average tenure	12	11	10	11
Average salary	\$45,000	\$48,000	\$52,000	\$48,000
Average benefits	\$12,000	\$13,000	\$14,000	\$13,000
Average turnover	15%	12%	10%	12%
Average productivity	1.2	1.3	1.4	1.3
Average quality	95%	96%	97%	96%
Average safety	98%	99%	99%	99%
Average training	10	12	15	12
Average education	12	13	14	13
Average experience	15	16	17	16
Average skills	1.5	1.6	1.7	1.6
Average knowledge	1.8	1.9	2.0	1.9
Average attitude	1.2	1.3	1.4	1.3
Average motivation	1.5	1.6	1.7	1.6
Average commitment	1.8	1.9	2.0	1.9
Average loyalty	1.5	1.6	1.7	1.6
Average respect	1.8	1.9	2.0	1.9
Average honesty	1.5	1.6	1.7	1.6
Average integrity	1.8	1.9	2.0	1.9
Average responsibility	1.5	1.6	1.7	1.6
Average accountability	1.8	1.9	2.0	1.9
Average leadership	1.5	1.6	1.7	1.6
Average management	1.8	1.9	2.0	1.9
Average communication	1.5	1.6	1.7	1.6
Average teamwork	1.8	1.9	2.0	1.9
Average collaboration	1.5	1.6	1.7	1.6
Average innovation	1.8	1.9	2.0	1.9
Average creativity	1.5	1.6	1.7	1.6
Average problem-solving	1.8	1.9	2.0	1.9
Average decision-making	1.5	1.6	1.7	1.6
Average planning	1.8	1.9	2.0	1.9
Average organization	1.5	1.6	1.7	1.6
Average time-management	1.8	1.9	2.0	1.9
Average resource-management	1.5	1.6	1.7	1.6
Average budgeting	1.8	1.9	2.0	1.9
Average risk-taking	1.5	1.6	1.7	1.6
Average change-management	1.8	1.9	2.0	1.9
Average conflict-resolution	1.5	1.6	1.7	1.6
Average negotiation	1.8	1.9	2.0	1.9
Average persuasion	1.5	1.6	1.7	1.6
Average influence	1.8	1.9	2.0	1.9
Average inspiration	1.5	1.6	1.7	1.6
Average vision	1.8	1.9	2.0	1.9
Average strategy	1.5	1.6	1.7	1.6
Average tactics	1.8	1.9	2.0	1.9
Average execution	1.5	1.6	1.7	1.6
Average results	1.8	1.9	2.0	1.9
Average impact	1.5	1.6	1.7	1.6
Average legacy	1.8	1.9	2.0	1.9
Average reputation	1.5	1.6	1.7	1.6
Average brand	1.8	1.9	2.0	1.9
Average culture	1.5	1.6	1.7	1.6
Average values	1.8	1.9	2.0	1.9
Average beliefs	1.5	1.6	1.7	1.6
Average attitudes	1.8	1.9	2.0	1.9
Average emotions	1.5	1.6	1.7	1.6
Average behaviors	1.8	1.9	2.0	1.9
Average actions	1.5	1.6	1.7	1.6
Average decisions	1.8	1.9	2.0	1.9
Average choices	1.5	1.6	1.7	1.6
Average preferences	1.8	1.9	2.0	1.9
Average interests	1.5	1.6	1.7	1.6
Average hobbies	1.8	1.9	2.0	1.9
Average passions	1.5	1.6	1.7	1.6
Average dreams	1.8	1.9	2.0	1.9
Average goals	1.5	1.6	1.7	1.6
Average aspirations	1.8	1.9	2.0	1.9
Average ambitions	1.5	1.6	1.7	1.6
Average desires	1.8	1.9	2.0	1.9
Average needs	1.5	1.6	1.7	1.6
Average wants	1.8	1.9	2.0	1.9
Average requirements	1.5	1.6	1.7	1.6
Average expectations	1.8	1.9	2.0	1.9
Average standards	1.5	1.6	1.7	1.6
Average benchmarks	1.8	1.9	2.0	1.9
Average metrics	1.5	1.6	1.7	1.6
Average indicators	1.8	1.9	2.0	1.9
Average signals	1.5	1.6	1.7	1.6
Average cues	1.8	1.9	2.0	1.9
Average prompts	1.5	1.6	1.7	1.6
Average reminders	1.8	1.9	2.0	1.9
Average suggestions	1.5	1.6	1.7	1.6
Average advice	1.8	1.9	2.0	1.9
Average tips	1.5	1.6	1.7	1.6
Average tricks	1.8	1.9	2.0	1.9
Average shortcuts	1.5	1.6	1.7	1.6
Average hacks	1.8	1.9	2.0	1.9

[illegible]

Signature Jeremy Thompson

Date 19-Sep-12



Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.

501 Oak Street
325-235-5494

Sweetwater, TX 79556, U.S.A.

☐ 231 Sam Rayburn Parkway
865-270-8962

Lenoir City, TN 37771, U.S.A.

CUSTOMER CABRERA SERVICES

ORDER NO. 20211633/385041

Mfg. Ludlum Measurements, Inc. Model 2221 Serial No. 161580

Mfg. Ludlum Measurements, Inc. Model 44-20 Serial No. 98324157

Cal. Date 27-Dec-12 Cal Due Date 27-Dec-13 Cal. Interval 1 Year Meterface 202-159

Check mark ☒ Applies to applicable instr. and/or detector IAW mfg. spec. T. 70 °F RH 20 % Alt 699.8 mm Hg

☐ New Instrument ☐ Instrument Received ☒ Within Toler. +10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☒ Mechanical ck. ☒ Meter Zeroed ☐ Background Subtract ☒ Input Sens. Linearity

☒ F/S Resp. ck. ☒ Reset ck. ☒ Window Operation ☒ Geotropism

☒ Audio ck. ☐ Alarm Setting ck. ☒ Batt. ck. (Min. Volt) 4.4 VDC

☒ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set Comments V Input Sens. Comments mV Det. Oper. Comments V at Comments mV Threshold 100 = 10 mV

☒ HV Readout (2 points) Ref./Inst. 500 / 503 V Ref./Inst. 2000 / 1996 V

COMMENTS:

Peak settings Gross Counts Model 2221 currently set
High Voltage: 673 V 1000 V for gross counts.
Threshold dial: 642 100 (10mv) High voltage set with detector
Window dial: 40 n/a connected.
Window Position: "IN" "OUT" OL Checked but not set.
Resolution for Cs137: ~8.61% n/a Firmware: 261027
Calibrated with 5' cable. Background count for 44-20 is:

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1K	400kcpm	400	400
x1K	100kcpm	100	100
x100	40kcpm	400	400
x100	10kcpm	100	100
x10	4kcpm	400	400
x10	1kcpm	100	100
x1	400cpm	400	400
x1	100cpm	100	100

*Uncertainty within ± 10% C.F. within ± 20%

ALL Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400kcpm	40014 kcpm	Log Scale	500kcpm	50014 kcpm
	40kcpm	4001		50kcpm	501
	4kcpm	400		5kcpm	51
	400cpm	40		500cpm	500
	40cpm	4		50cpm	50

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSS Z540-1-1994 and ANSI N323-1978

State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: ☐ 059 ☐ 280 ☐ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☐ 5105 ☐ 5717CO ☐ 5719CO

☐ 60646 ☐ 70897 ☐ 73410 ☐ E551 ☐ E552 ☐ G112 ☐ M555 ☐ S-394 ☐ S-1054 ☐ T-304 ☐ T879 ☐ T10081 ☐ T10082 ☐ Y982

☐ Alpha S/N ☐ Beta S/N ☐ Other

☒ m 500 S/N 63893 ☐ Oscilloscope S/N ☒ Multimeter S/N 93870637

Calibrated By: [Signature] Date 27-Dec-12

Reviewed By: [Signature] Date 28-Dec-12

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FORM C22A 06/12/2012 Page 1 of 2

AC Inst. ☐ Passed Dielectric (Hi-Pot) and Continuity Test
Only ☐ Failed:



Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.

501 Oak Street
325-235-5494

☐ 231 Sam Rayburn Parkway
865-270-8962

Sweetwater, TX 79556, U.S.A. Lenoir City, TN 37771, U.S.A.

CUSTOMER CABRERA SERVICES

ORDER NO. 20205329/381338

Mfg. Ludlum Measurements, Inc. Model 2224-1 Serial No. 271539

Mfg. Ludlum Measurements, Inc. Model 43-93 Serial No. PR291930

Cal. Date 16-Aug-12 Cal Due Date 16-Aug-13 Cal. Interval 1 Year Meterface 202-783

Check mark ☒ applies to applicable Instr. and/or detector IAW mfg. spec. T. 74 °F RH 45 % Alt 696.8 mm Hg

☐ New Instrument ☐ Instrument Received ☒ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☒ Mechanical ck. ☒ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity

☐ F/S Resp. ck. ☒ Reset ck. ☒ Window Operation ☒ Geotropism

☒ Audio ck. ☐ Alarm Setting ck. ☒ Batt. ck. (Min. Volt) 2.2 VDC

☒ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set 725 V Input Sens. Comments mV Det. Oper. 725 V at Comments mV Threshold Dial Ratio = mV

☒ HV Readout (2 points) Ref./Inst. 500 1502 V Ref./Inst. 1500 1510 V

COMMENTS:

Efficiencies for Th230, Sr90Y90, Tc99, and Ni63 are as follows in 4pi:

Th230: act.3,220dpm ct. 710cpm -Bg1 ct.709cpm 22%

Sr90Y90: act.35,151dpm ct.12,910cpm -Bg226 ct.12,684cpm 36%

Tc99: act.33,200dpm ct.6910cpm -Bg226 ct.6,684cpm 20%

Ni63: act.278,580dpm ct.661cpm -Bg226 ct.435cpm 0.156% 4Pi

FIRMWARE:390092

Alpha Sensitivity:120mv

Instrument calibrated with 5' cable.

Beta Sensitivity:3.5mv

H.V. set with detector disconnected.

Beta Window:30mv

Overload set to simulate a light leak with Am-241 91mdpm.

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

see a Hack mod for cpm & (2pi)

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
X1000	400kcpm	400	400
X1000	100kcpm	100	100
X100	40kcpm	400	400
X100	10kcpm	100	100
X10	4kcpm	400	400
X10	1kcpm	100	100
X1	400cpm	400	400
X1	100cpm	100	100

*Uncertainty within ± 10% C.F. within ± 20%

ALL Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400kcpm	400819	400kcpm	400819	
	40kcpm	40091	40kcpm	40091	
	4kcpm	4010	4kcpm	4010	
	400cpm	400	400cpm	400	
	40cpm	40	40cpm	40	

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques.

The calibration system conforms to the requirements of ANSI/NCSS 2540-1-1994 and ANSI N323-1978

State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: ☐ 059 ☐ 280 ☐ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☐ 5105 ☐ 5717CO ☐ 5719CO

☐ 60646 ☐ 70897 ☐ 73410 ☐ E551 ☐ E552 ☐ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ T-304 ☐ T879 ☐ T10081 ☐ T10082 ☐ Y982

☒ Alpha S/N PU-239 #2928 ☒ Beta S/N TC-99 #5296 Sr90 #4016 ☐ Other

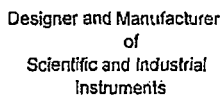
☒ m 500 S/N 238275 ☐ Oscilloscope S/N ☒ Multimeter S/N 70602489

Calibrated By: [Signature] Date 16-Aug-12

Reviewed By: [Signature] Date 20-Aug-12

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FORM C22A 06/12/2012 Page 1 of 2

AC Inst. ☐ Passed Dielectric (Hi-Pot) and Continuity Test
Only ☐ Failed:



LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Detector	<u>43-93</u>	Serial No.	<u>PR 291930</u>	Order #.	<u>20205329/381338</u>
Customer	<u>CABRERA SERVICES</u>			Alpha Input Sensitivity	<u>120</u> mV
Counter	<u>2224-1</u>	Serial No.	<u>271539</u>	Beta Input Sensitivity	<u>3.5</u> mV
Count Time	<u>1Minute</u>			Beta Window	<u>30</u> mV
Other				Distance Source to Detector	<u>Surface</u>

[illegible]

- | | |
|---|--|
| <input type="checkbox"/> Gas Proportional detector count rate decreased | ≤ 10% after 15 hour static test using 39" cable. |
| <input type="checkbox"/> Gas proportional detector count rate decreased | ≤ 10% after 5 hour static test using 39" cable and alpha/beta counter. |

Signature

Date _____



Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.

501 Oak Street
325-235-5494

Sweetwater, TX 79556, U.S.A.

☐ 231 Sam Rayburn Parkway
865-270-8962

Lenoir City, TN 37771, U.S.A.

CUSTOMER CABRERA SERVICES

ORDER NO. 20204774/381039

Mfg. Ludlum Measurements, Inc. Model 2224-1 Serial No. 227244

Mfg. Ludlum Measurements, Inc. Model 43-93 Serial No. P2244545

Cal. Date 8-Aug-12 Cal Due Date 8-Aug-13 Cal. Interval 1 Year Meterface 202-848

Check mark ☒ Applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 36 % Alt 702.8 mm Hg

☐ New Instrument ☐ Instrument Received ☒ Within Toler. +10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☒ Mechanical ck. ☒ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity

☒ F/S Resp. ck. ☒ Reset ck. ☒ Window Operation ☒ Geotropism

☒ Audio ck. ☐ Alarm Setting ck. ☒ Batt. ck. (Min. Volt) 2.2 VDC

☒ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set 950 V Input Sens. Comments mV Det. Oper. 950 V at Comments mV Threshold Dial Ratio = mV

☒ HV Readout (2 points) Ref./Inst. 500 / 501 V Ref./Inst. 1000 / 1005 V

COMMENTS:

Th230 SN:E121495 Size:19800dpm, Counts:4112cpm, Background:2cpm, 4pi Eff:20.75%

Tc99 SN:5280 Size:93200dpm, Counts:22481cpm, Background:248cpm, 4pi Eff:23.85%

SrY90 SN:5281 Size:98550dpm, Counts:36376cpm, Background:248cpm, 4pi Eff:36.65%

Ni63 SN:4017 Size:278834dpm, Counts:1320cpm, Background:248cpm, 4pi Eff:0.38%

Th230 SN:E121495 Size:10100cpm, Counts:4112cpm, Background:2cpm, 2pi Eff:40.69%

Tc99 SN:5280 Size:58300cpm, Counts:22481cpm, Background:248cpm, 2pi Eff:38.13%

SrY90 SN:5281 Size:68985cpm, Counts:36376cpm, Background:248cpm, 2pi Eff:52.37%

Ni63 SN:4017 Size:139417cpm, Counts:1320cpm, Background:248cpm, 2pi Eff:0.76%

Alpha Sens:120mv ; Beta Sens:3.5mv ; Beta Window:30mv ; Firmware:390094

Cal'd with 5ft cable ; HV set with detector not connected ; OL set to simulate light leak

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1000	800k cpm	800	800
x1000	200k cpm	200	200
x100	80k cpm	800	800
x100	20k cpm	200	200
x10	8k cpm	800	800
x10	2k cpm	200	200
x1	800 cpm	800	800
x1	200 cpm	200	200

*Uncertainty within ± 10% C.F. within ± 20%

ALL Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout			Log Scale		
800kcpm	800434	800434			
80kcpm	80644	80644			
8kcpm	8004	8004			
800cpm	800	800			
80cpm	80	80			

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The calibration system conforms to the requirements of ANSI/NCCL Z540-1-1994 and ANSI N323-1978

State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: ☐ 059 ☐ 280 ☐ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☐ 5105 ☐ 5717CO ☐ 5719CO

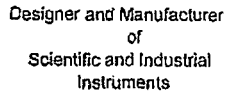
☐ 60646 ☐ 70897 ☐ 73410 ☐ E551 ☐ E552 ☐ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ T-304 ☐ T879 ☐ T10081 ☐ T10082 ☐ Y982

☒ Alpha S/N Pu239 SN:7053 ☒ Beta S/N Tc99 SN:5280, SN:5281 ☐ Other

☒ m 500 S/N 190566 ☐ Oscilloscope S/N ☒ Multimeter S/N 86250390

Calibrated By: [Signature] Date 8-Aug-12

Reviewed By: [Signature] Date 8-Aug-12



LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Detector	<u>43-93</u>	Serial No.	<u>PN 244545</u>	Order #.	<u>20204774/381039</u>
Customer	<u>CABRERA SERVICES</u>			Alpha Input Sensitivity	<u>120</u> mV
Counter	<u>2224-1</u>	Serial No.	<u>227244</u>	Beta Input Sensitivity	<u>3.5</u> mV
Count Time	<u>1Minute</u>			Beta Window	<u>30</u> mV
Other	<u></u>			Distance Source to Detector	<u>Surface</u>

[illegible]

- ☐ Gas Proportional detector count rate decreased \leq 10% after 15 hour static test using 39" cable.
- ☐ Gas proportional detector count rate decreased \leq 10% after 5 hour static test using 39" cable and alpha/beta counter.

Jason Fenn

Date 8-Aug-12



Designer and Manufacturer
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CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER **CABRERA SERVICES**

ORDER NO. **20204106/380582**

Mfg. **Ludlum Measurements, Inc.** Model **2360** Serial No. **202398**
Mfg. **Ludlum Measurements, Inc.** Model **43-93** Serial No. **PR211706**
Cal. Date **25-Jul-12** Cal Due Date **25-Jul-13** Cal. Interval **1 Year** Meterface **202-855**

Check mark ☒ applies to applicable instr. and/or detector IAW mfg. spec. T. **72** °F RH **24** % Alt **700.8** mm Hg

- ☐ New Instrument ☐ Instrument Received ☒ Within Toler. +10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments
- ☒ Mechanical ck. ☒ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
☐ F/S Resp. ck. ☒ Reset ck. ☒ Window Operation ☒ Geotropism
☒ Audio ck. ☐ Alarm Setting ck. ☒ Batt. ck. (Min. Volt) **2.2** VDC ☐ RS-232 Port OK
☒ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set **750** V

☒ HV Readout (2 points) Ref./Inst. **500 / 502** V Ref./Inst. **2000 / 2000** V

Firmware Version: **39010N27**

Alpha Threshold: **120 mV**

Beta Threshold: **3.5 mV**

Beta Window: **30 mV**

Overload **set to simulate a light leak**

Instrument calibrated with a **5' C- cable.**

High voltage set with detector **disconnected**

(EEPROM Settings)

User Time: **1.0 Minutes**

Alpha Alarm: **50000**

Beta Alarm: **50000**

A/B Alarm: **50000**

Model 2360 Date: **7/25/2012**

Calibration Date Due: **7/25/2013**

COMMENTS:

Tc99 Size: 28860dpm (18000cpm) Bkgd:~ 285cpm Rdn:~ 5744cpm 4 Pi Eff:~ 18.92% 2 Pi Eff:~ 30.33%
Sr90Y90 Size: 35204dpm (24643cpm) Bkgd:~ 285cpm Rdn:~ 12468cpm 4 Pi Eff:~ 34.61% 2 Pi Eff:~ 49.44%
Ni63 Size: 278697dpm (139349cpm) Bkgd:~ 285cpm Rdn:~ 1039cpm 4 Pi Eff:~ 2.71% 2 Pi Eff:~ 5.41%
Th230 Size: 19800dpm (10100cpm) Bkgd:~ 2cpm Rdn:~ 3967cpm 4 Pi Eff:~ 20.03% 2 Pi Eff:~ 39.26%

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1000	400 kcpm	400	400
x1000	100 kcpm	100	100
x100	40 kcpm	400	400
x100	10 kcpm	100	100
x10	4 kcpm	400	400
x10	1 kcpm	100	100
x1	400 cpm	400	400
x1	100 cpm	100	100

*Uncertainty within ± 10% C.F. within ± 20%

ALL Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400 kcpm	40028(0)	Log Scale		
	40 kcpm	4003			
	4 kcpm	401			
	400 cpm	40			
	40 cpm	4			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques.
The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978

State of Texas Calibration License No. LO-1963

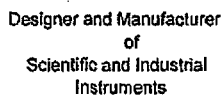
Reference Instruments and/or Sources: ☐ 73410 ☐ 1131 ☐ 781 ☐ 059 ☐ 280 ☐ 60646 ☐ 70897 ☐ Ra-226 S/N Y982
Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☒ Alpha S/N **Th230#121495** ☒ Beta S/N **Tc99#5279; Ni63#99NI2204017** ☐ Other

☒ m 500 S/N **251106** ☐ Oscilloscope S/N ☒ Multimeter S/N **15060230**

Calibrated By: **James M. Smith** Date **25 JUL 12**

Reviewed By: **Robert H. Smith** Date **27 JUL 12**



LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Detector	<u>43-93</u>	Serial No.	<u>PR211706</u>	Order #.	<u>20204106/380582</u>
Customer	<u>CABRERA SERVICES</u>			Alpha Input Sensitivity	<u>120</u> mV
Counter	<u>2360</u>	Serial No.	<u>202398</u>	Beta Input Sensitivity	<u>3.5</u> mV
Count Time	<u>1Minute</u>			Beta Window	<u>30</u> mV
Other	<u>platequid with a 5' C-cable</u>			Distance Source to Detector	<u>Surface</u>

[illegible]

- | | |
|---|--|
| <input type="checkbox"/> Gas Proportional detector count rate decreased | ≤ 10% after 15 hour static test using 39" cable. |
| <input type="checkbox"/> Gas proportional detector count rate decreased | ≤ 10% after 5 hour static test using 39" cable and alpha/beta counter. |

James M. SA

Date 25 JUL 12



Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER CABRERA SERVICES ORDER NO. 20198463/377281

Mfg. Ludlum Measurements, Inc. Model 3030E Serial No. 217611

Mfg. Ludlum Measurements, Inc. Model 43-10-1 Serial No. PA232046

Cal. Date 30-Apr-12 Cal Due Date 30-Apr-13 Cal. Interval 1 Year

Check mark ☒ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 36 % Alt 700.8 mm Hg

☐ New Instrument ☐ Instrument Received ☒ Within Toler. ☐ +10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☒ Mechanical ck. ☐ Window Operation

☒ Audio ck.

Alpha Sensitivity 120 mV Beta Sensitivity 4 mV Beta Window 50 mV

☒ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89.

Instrument Volt Set 575 V High Voltage set with detector connected.

☒ HV Readout (2 points) Ref./Inst. 500 / 501 V Ref./Inst. 1000 / 998 V

(EEPROM Settings)

Instrument in DPM mode.

(PC) Count Time: 1666.7

QC mode turned ☒ OFF ☐ ON

Alpha Alarm: 999999 cpm

Firmware version: 39013.16

Beta Alarm: 999999 cpm

Overload checked but not set.

Alpha/Beta Alarm: 999999 cpm

Battery voltage measured at 12.6 Vdc.

Calibration Due Date: 4/30/2013

C-14 Efficiency ~ 11.3 % (4 pi) Net

LOC (Loss of Count) time = 30 minutes (default)

	REFERENCE CAL POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Alpha Channel Digital Readout	400K cpm	39972 (0)	39972 (0)
	40K cpm	3998	3998
	4K cpm	400	400
	400 cpm	40	40
	40 cpm	4	4
Beta/Gamma Channel Digital Readout	400K cpm	39968 (0)	39968 (0)
	40K cpm	3998	3998
	4K cpm	400	400
	400 cpm	40	40
	40 cpm	4	4

*Uncertainty within $\pm 10\%$ C.F. within $\pm 20\%$

(0) Indicates 0.1 minute count

COMMENTS:

See Attachment for efficiencies.

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

☒ Alpha S/N Pu239 SN:7053 24900dpm ☒ Beta S/N Tc99 SN:5280 93200dpm ☐ Other

☒ m 500 S/N 190566 ☐ Oscilloscope S/N ☒ Multimeter S/N 86250390

Calibrated By: [Signature] Date 30-Apr-12

Reviewed By: [Signature] Date 30-Apr-12

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FORM C25-2E 03/11/2010 Page 1 of 2

AC Inst. ☐ Only ☒ Passed Dielectric (Hi-Pot) and Continuity Test
Failed:

Attachment

M3030E S/N:217611 43-10-1 SN:PR232046

Th230 SN:E121495

Source Size: 9900cpm Source Counts: 7837cpm
Background: 1cpm 2pi Eff: 79.15%

Tc99 SN:5280

Source Size: 46600cpm Source Counts: 34348cpm
Background: 58cpm 2pi Eff: 73.58%

SrY90 SN:5281

Source Size: 69345cpm Source Counts: 47415cpm
Background: 58cpm 2pi Eff: 68.29%

Ni63 SN:4017

Source Size: 140204cpm Source Counts: 11356dpm
Background: 58cpm 2pi Eff: 8.05%

Model 3030 Plateau Data

4/30/2012
10:59:41 AM

Header 1: John Q Pub\$yc
Header 2: Serial#217611
Header 3: DetSer#PR232046
Header 4: Room 7\$yastWall
Header 5: More Comments?
Header 6: More Comments?

Calibration Due Date: 4/30/2013

Model 3030 Date: 4/30/2012
Model 3030 Time: 4:19:32 AM

User PC Time: 1666.7

Alpha Isotope: Pu239
Alpha Source Size (dpm): 24900
Alpha Source Size (µCi): 0.011216216

Beta Isotope: Tc99
Beta Source Size (dpm): 93200
Beta Source Size (µCi): 0.041981982

Starting High Voltage: 525
Starting High Voltage: 650
High Voltage Increment: 25

Plateau Count Mode: SCALER
Source Count Time (min): 1.0
Background Count Time (min): 1.0

HV	ALPHA				CrossTalk	BETA			
	Source (Beta)	Background	Eff			Source (Alpha)	Background	Eff	Crosstalk
525	10701 (222)	1	43.0%	1.8%	24318 (38)	34	26.1%	0.2%	
550	10769 (377)	1	43.2%	3.1%	29690 (54)	47	31.8%	0.2%	
575	10556 (343)	1	42.4%	2.7%	34348 (39)	58	36.8%	0.1%	
600	10705 (271)	1	43.0%	1.9%	37235 (44)	72	39.9%	0.1%	
625	10640 (241)	0	42.7%	1.6%	38312 (49)	69	41.0%	0.1%	
650	10667 (287)	1	42.8%	1.9%	37331 (48)	80	40.0%	0.1%	



Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.

501 Oak Street
325-235-5494

☐ 231 Sam Rayburn Parkway
865-270-8962

Sweetwater, TX 79556, U.S.A.

Lenoir City, TN 37771, U.S.A.

CUSTOMER CABRERA SERVICES

ORDER NO. 20208023/382889

Mfg. Ludlum Measurements, Inc. Model 3 Serial No. 79498

Mfg. Ludlum Measurements, Inc. Model 44-9 Serial No. PRO73106

Cal. Date 25-Sep-12 Cal Due Date 25-Sep-13 Cal. Interval 1 Year Meterface 202-002

Check mark ☒ applies to applicable instr. and/or detector IAW mfg. spec. T. 75 °F RH 52 % Alt 700.8 mm Hg

☐ New Instrument ☐ Instrument Received ☒ Within Toler. +10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☒ Mechanical ck. ☒ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity

☒ F/S Resp. ck. ☒ Reset ck. ☐ Window Operation ☒ Geotropism

☒ Audio ck. ☐ Alarm Setting ck. ☒ Batt. ck. (Min. Volt) 2.2 VDC

☒ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set 900 V Input Sens. 26 mV Det. Oper. 900 V at 26 mV Threshold Dial Ratio = mV

☐ HV Readout (2 points) Ref./Inst. / V Ref./Inst. / V

COMMENTS:

2pi Efficiencies:

Source	SourceActivity	SourceCount	Background	Efficiency
Th230 (#5020)	1,609cpm	500cpm	50cpm	28%
Tc99 (#5279)	14,430cpm	6,700cpm	50cpm	46%
Sr90Y90 (#4016)	24,541cpm	14,300cpm	50cpm	58%
Ni63 (#4017)	139,185cpm	1,300cpm	50cpm	0.90%

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
X 100	400 K cpm	4 k	4 k
X 100	100 K cpm	1 k	1 k
X 10	40 K cpm	4 k	4 k
X 10	10 K cpm	1 k	1 k
X 1	4 K cpm	4 k	4 k
X 1	1 K cpm	1 k	1 k
X 0.1	400 cpm	4 k	4 k
X 0.1	100 cpm	1 k	1 k

*Uncertainty within ± 10% C.F. within ± 20%

ALL Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout			Log Scale		

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques.

The calibration system conforms to the requirements of ANSI/NCCL Z540-1-1994 and ANSI N323-1978

State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: ☐ 059 ☐ 280 ☐ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☐ 5105 ☐ 5717CO ☐ 5719CO

☐ 60546 ☐ 70897 ☐ 73410 ☒ E551 ☐ E552 ☒ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ T-304 ☐ T879 ☐ T10081 ☐ T10082 ☐ Y982

☒ Alpha S/N Th230(#5020) ☒ Beta S/N Sr90Y90(#4016), Ni63(#4017) ☒ Other Tc99(#5279)

☒ m 500 S/N 24789 ☐ Oscilloscope S/N ☒ Multimeter S/N 17500076

Calibrated By:

Date 25 Sep 12

Reviewed By:

Date 26 Sep 12

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.
FORM C22A 06/12/2012 Page 1 of 2

AC Inst. ☐ Passed Dielectric (Hi-Pot) and Continuity Test
Only ☐ Failed:



Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.

501 Oak Street

325-235-5494

Sweetwater, TX 79556, U.S.A.

☐ 231 Sam Rayburn Parkway

865-270-8962

Lenoir City, TN 37771, U.S.A.

CUSTOMER **CABRERA SERVICES**

ORDER NO. **20204106/380582**

Mfg. **Ludlum Measurements, Inc.** Model **3** Serial No. **166511**

Mfg. **Ludlum Measurements, Inc.** Model **44-9** Serial No. **PR073107**

Cal. Date **26-Jul-12** Cal Due Date **26-Jul-13** Cal. Interval **1 Year** Meterface **202-002**

Check mark ☒ applies to applicable Instr. and/or detector IAW mfg. spec. T. **72** °F RH **24** % Alt **700.8** mm Hg

☐ New Instrument ☐ Instrument Received ☒ Within Toler. $\pm 10\%$ ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☒ Mechanical ck. ☒ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity

☒ F/S Resp. ck. ☒ Reset ck. ☐ Window Operation ☒ Geotropism

☒ Audio ck. ☐ Alarm Setting ck. ☒ Batt. ck. (Min. Volt) **2.2** VDC

☒ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set **900** V Input Sens. **37** mV Det. Oper. **900** V at **37** mV Threshold Dial Ratio **=** mV

☐ HV Readout (2 points) Ref./Inst. **/** V Ref./Inst. **/** V

COMMENTS:

Tc99 Size: 18000 cpm Bkgd: ≈ 53 cpm Rdn: ≈ 12 kcpm 2 Pi Eff: ≈ 66.37 %
Sr90Y90 Size: 68856 cpm Bkgd: ≈ 53 cpm Rdn: ≈ 22 kcpm 2 Pi Eff: ≈ 31.87 %
Ni63 Size: 139343 cpm Bkgd: ≈ 53 cpm Rdn: ≈ 1.6 kcpm 2 Pi Eff: ≈ 1.11 %
Th230 Size: 10100 cpm Bkgd: ≈ 53 cpm Rdn: ≈ 3.1 kcpm 2 Pi Eff: ≈ 30.17 %
Calibrated with a 5' C-cable.

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
X 100	400 kcpm	4K	4K
X 100	100 kcpm	1K	1K
X 10	40 kcpm	4K	4K
X 10	10 kcpm	1K	1K
X 1	4 kcpm	4K	4K
X 1	1 kcpm	1K	1K
X 0.1	400 cpm	4K	4K
X 0.1	100 cpm	1K	1K

*Uncertainty within $\pm 10\%$ C.F. within $\pm 20\%$

All Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout			Log Scale		

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSS Z540-1-1994 and ANSI N323-1978

State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: ☐ 059 ☐ 280 ☐ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1896 ☐ 5105 ☐ 5717CO ☐ 5719CO

☐ 60646 ☐ 70897 ☐ 73410 ☐ E551 ☐ E552 ☐ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ T-304 ☐ T879 ☐ T10081 ☐ T10082 ☐ Y982

#99Ni2204017

☒ Alpha S/N **Th230#E121495** ☒ Beta S/N **Tc99#5279;Sr90Y90#5281;Ni63** ☐ Other

☒ m 500 S/N **251106** ☐ Oscilloscope S/N ☒ Multimeter S/N **15060230**

Calibrated By: **James McLeod** Date **26 Jul 12**

Reviewed By: **Shane H** Date **27 Jul 12**

CONVERSION CHART

Customer CABRERA SERVICES Date 26-Jul-12 Order # 20204106/380582

Model 3 Serial No. 166511 Detector Model 44-9 Serial No. PR073107

Source 6S137 (54 mCi) 6S137 (4 mCi) High Voltage 900 V

Input Sensitivity 37 mV

[illegible]

Signature:

James M. Galt

Date 26 JUL 12

EnergySolutions Services, Inc.
1570 Bear Creek Road
Oak Ridge, TN 37830
Phone: (877) 462-4873
Email: ISFStaff@energysolutions.com

CALIBRATION CERTIFICATE

This Certificate will be accompanied by Calibration Charts or Readings where applicable

CUSTOMER INFORMATION		INSTRUMENT INFORMATION		
Customer Name: EnergySolutions Services, Inc.		Manufacturer: Eberline		
Address: 1570 Bear Creek Road				
Contact Name: Tony Riggs		Model: RO-2A	Serial Number: 3704	
Customer Purchase Order Number: N/A	Work Order Number: N/A	Calibration Method: Source		
INSTRUMENT CALIBRATION INFORMATION				
Instrument Range	Calibration Standard Value	Instrument Response (Tolerance +/-10% of Calibration Std. Values)		Comments
		Before Calibration	After Calibration	
50 mR/hr	10 mR/hr	10.5 mR/hr	10 mR/hr	Temp/Press: 3590 Cal Due: 10/08/13
50 mR/hr	25 mR/hr	26 mR/hr	25 mR/hr	Humidity: 992290 Cal Due: 05/31/13
50 mR/hr	40 mR/hr	42 mR/hr	40 mR/hr	Temp: 20.9 °C Humidity: 41% Pressure: 746 mmHg
500 mR/hr	100 mR/hr	100 mR/hr	100 mR/hr	
500 mR/hr	250 mR/hr	250 mR/hr	250 mR/hr	
500 mR/hr	400 mR/hr	410 mR/hr	410 mR/hr	Precision Test at 2.5 R/hr
5 R/hr	1 R/hr	1.05 R/hr	1 R/hr	1) 2.5 R/hr 2) 2.5 R/hr 3) 2.5 R/hr Mean: 2.5 R/hr All readings within ± 10% of mean value Sat (✓) Unsat ()
5 R/hr	2.5 R/hr	2.65 R/hr	2.5 R/hr	
5 R/hr	4 R/hr	4.2 R/hr	3.9 R/hr	
50 R/hr	10 R/hr	10 R/hr	10 R/hr	Mechanical Zero:
50 R/hr	25 R/hr	25 R/hr	25 R/hr	As Found: 0 As Left: 0
50 R/hr	40 R/hr	38 R/hr	38 R/hr	Sources Used:
				Cs-137 #019701 Cert Date: 05/31/12
				Cs-137 #049711 Cert Date: 08/30/12
				U-238 #129680 Cert Date: 06/21/95
Other Tests		BCF Information	As Found	As Left
Geotropism	Sat (✓) Unsat ()	Window Open	70 mR/hr	70 mR/hr
Swing Arm Assembly	Sat (✓) Unsat ()	Window Closed	6 mR/hr	5.5 mR/hr
Desiccant	Sat (✓) Unsat ()	Beta Correction	3.70	3.67
Batteries	Sat (✓) Unsat ()	$BCF = \frac{I}{WO - WC} \quad (I = \text{Source Dose Rate}_{(mRad/hr)})$		
Over Range Test	Sat (✓) Unsat ()			
STATEMENT OF CERTIFICATION				
We Certify that the instrument listed above was calibrated and inspected prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible for damage incurred during shipment or use of this instrument).				
Instrument				
Calibrated By: M. Paul	Reviewed By: J. Dukemin	Date: 1/15/13		
Calibration Date: 01/15/2013		Calibration Due: 01/15/2014		



CALIBRATION CERTIFICATE

EnergySolutions Services, Inc.
1570 Bear Creek Road
Oak Ridge, TN 37830
Phone: (877) 462-4873
Email: JSFStaff@energysolutions.com

This Certificate will be accompanied by Calibration Charts or Readings where applicable

CUSTOMER INFORMATION		INSTRUMENT INFORMATION			
Customer Name: EnergySolutions		Manufacturer: Bicron			
Address: 1570 Bear Creek Road, Oak Ridge, TN 37830		Model: micro rem	Serial Number: 1482		
Contact Name: Tony Riggs		Probe: N/A	Serial Number: N/A		
Customer Purchase Order Number: N/A	Work Order Number: 2012-12319	Calibration Method: Electronic and Source			
INSTRUMENT CALIBRATION INFORMATION					
Instrument Range	Calibration Standard Value $\mu\text{Rem/hr}$	Instrument Response ($\pm 10\%$ of Calibration Standard Values)		Comments	
		Before Calibration	After Calibration	Calibration performed in accordance with CP-IN-WI-209	
		$\mu\text{Rem/hr}$	$\mu\text{Rem/hr}$	Pulser: 762	Cal Due: 07/27/2012
X1000	160,000	200,000	165,000	DVM: 94710023	Cal Due: 11/11/2012
X1000	40,000	48,000	40,000	Temp/Press: 3590	Cal Due: 09/21/2012
X 100	16,000	OFFSCALE	16,500	Humidity: 992290	Cal Due: 05/31/2013
X 100	4,000	5,500	4,000	Temp: 24.5°C	Humidity: 35%
X 10	1,600	OFFSCALE	1,680	Pressure: 739 mmHg	
X 10	400	520	4,00	BAT: SAT	Over range: SAT
X 1	160	170	-170	Geotropism: SAT	Audio: SAT
X 1	40 (Pulsed)	40	40	Reset: SAT	
X 0.1	16.0 (Pulsed)	16	16		
X 0.1	4.0 (Pulsed)	3.9	3.9	"HV ok" check As Found: SAT	
Mech Zero	0	0	0	"HV ok" check As Left: SAT	
Precision Test (mR/hr)--Reading #1: 40 #2: 40 #3: 40 Mean: 40 Precision Test: SAT					
NUCLIDE	SOURCE ID	CERTIFICATION DATE	CERTIFICATION DUE	**Indicates use of pulser to electronically generate calibration points shown**	
Cs ¹³⁷	019701	05/31/2012	05/31/2013		
Cs ¹³⁷	049711	08/31/2011	08/31/2012		
STATEMENT OF CERTIFICATION					
We Certify that the instrument listed above was calibrated and inspected prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible for damage incurred during shipment or use of this instrument).					
Instrument					
Calibrated By: M. Paul	Reviewed By:	Date: 6/27/12			
Certification Date: 06/27/2012			*Certification Due (6 mo.): 12/27/2012		
			* Certification Due (12 mo.): 06/27/2013		

* Calibration due date is dependant on users regulatory requirements.



EnergySolutions Services, Inc.
1570 Bear Creek Road
Oak Ridge, TN 37830
Phone: (877) 462-4873
Email: ISFStaff@energysolutions.com

CALIBRATION CERTIFICATE

This Certificate will be accompanied by Calibration Charts or Readings where applicable

CUSTOMER INFORMATION			INSTRUMENT INFORMATION	
Customer Name: EnergySolutions Services, Inc.			Manufacturer: Eberline	
Contact Name: Tony Riggs			Model: 6112-B	Serial Number: 69731
Address: 1570 Bear Creek Road, Oak ridge, TN 37763			Probe: N/A	Serial Number: N/A
Customer Purchase Order Number: N/A		Work Order Number: N/A	Calibration Method: Electronic and Source	

INSTRUMENT CALIBRATION INFORMATION					
Instrument Range	Desired	Tolerance (±10%)	Instrument Response		Comments:
			Before Calibration	After Calibration	
mR/hr					Calibrated in accordance with CP-IN-WI-213
2	0.50	0.45 - 0.55	0.55	0.50	Pulser: 43855 Cal Due: 02/22/13
2	1.0	0.90 - 1.10	1.10	1.00	DVM: 92260808 Cal Due: 02/21/13
2	1.5	1.35 - 1.65	1.75	1.60	Temp/Press: 3590 Cal Due: 10/08/13
50	5	4.5 - 5.5	4.5	4.5	Humidity: 992290 Cal Due: 05/31/13
50	15	13.5 - 16.5	15.5	15.0	
50	40	36 - 44	43	41	
R/hr					Temp: 20.9 °C Pressure: 746 mmHg Humidity: 40.5 %
2	0.2	0.18 - 0.22	0.17	0.19	
2	0.5	0.45 - 0.55	0.43	0.50	Sources Used: Cs ¹³⁷ #019701 Cert. Date: 05/31/12 Cs ¹³⁷ #049711 Cert. Date: 08/30/12
2	1.5	1.35 - 1.65	1.30	1.55	
50	2	1.8 - 2.2	2.1	2.0	
50	15	13.5 - 16.5	18.0	15.0	Geotropism: SAT Batteries: SAT
50	40	36 - 44	Off scale *	39	Precision Test: SAT Over Range: SAT
1000	50	40 - 60 (+/-20%)	35	40	Mechanical Zero: As Found: SAT
1000	400	320 - 480 (+/-20%)	Off scale *	400	As Left: SAT
1000	750	600 - 900 (+/-20%)	Off scale *	900	* High range detector faulty, replaced.
High Voltage					Limited use: 1000 R/hr scale +/-20% tolerance, all other scales +/-10%.
HV	-550 vdc	-495 to -605 vdc	-572 vdc	-572 vdc	

STATEMENT OF CERTIFICATION

We Certify that the instrument listed above was calibrated and inspected prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible for damage incurred during shipment or use of this instrument).

Instrument		Reviewed By:		Date: 1/16/13
Calibrated By:		Calibration Date: 01/15/2013		Calibration Due: 01/15/2014



EBERLINE
SERVICES

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# 7008
P.O.# 10-0260

Description of Standard:

Model No. DNS-11 Serial No. 7102-10 Isotope Th-230

Electroplated on polished SS disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolute counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated alpha source S/N 75322-201

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration date was:

8,850 ± 265

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc, was:

17,400 ± 523 (0.00785 μ Ci)

The uncertainty of the measurement is 3 %, which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: ART REUST

Reviewed by: [Signature]

Calibration Technician: [Signature]

Q.A. Manager: [Signature]

Calibration Date: 6-16-2010

Reviewed Date: 6/22/10

Source Manufacturing Lab
7021 Pan American Freeway NE
Albuquerque, New Mexico 87109-4238
(505) 761-5413 Fax (505) 761-5416
areust@eberlineservices.com



EBERLINE
SERVICES

CERTIFICATE OF CALIBRATION

Electroplated Beta Standard

S.O.# 6652

P.O.# 07-870

Description of Standard:

Model No. DNS-12 Serial No. 5803-07 Isotope Tc-99

Electroplated on polished SS disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2pi beta emission rate was measured using an internal gas flow proportional chamber. Absolute counting of beta particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated beta source S/N 4002-02.

Measurement Result:

The observed beta count rate from the surface of the disc per minute (cpm) on the calibration date was:

8,710 ± 261

The total disintegration rate (dpm) assuming 25% backscatter of beta particles from the surface of the disc, was:

13,900 ± 417 (0.00627 μ Ci)

The uncertainty of the measurement is 3%, which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: ART REUST Reviewed by: *Ken Smith*

Calibration Technician: *Art Reust* Q.A. Manager: *Anthony W. Toth*

Calibration Date: 7-26-2007 Reviewed Date: 7-26-07

Source Manufacturing Lab
7021 Pan American Freeway NE
Albuquerque, New Mexico 87109-4238
(505) 761-5413 Fax (505) 761-5416
areust@eberlineservices.com



Eckert & Ziegler

Isotope Products

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661-309-1010

Fax 661-257-8303

CERTIFICATE OF CALIBRATION GAMMA STANDARD SOURCE

Radionuclide:	Co-60	Customer:	CABRERA SERVICES, INC.
Half-life:	5.272 ± 0.001 years	P.O. No.:	12-0217
Catalog No.:	GF-060-D	Reference Date:	15-May-12 12:00 PST
Source No.:	1592-30-5	Contained Radioactivity:	1.040 µCi 38.48 kBq

Physical Description:

A. Capsule type:	D (25.4 mm OD x 6.35 mm THK)
B. Nature of active deposit:	Evaporated metallic salt
C. Active diameter/volume:	5 mm
D. Backing:	Epoxy
E. Cover:	Acrylic

Radioimpurities:

None detected

Method of Calibration:

This source was assayed using gamma ray spectrometry.

Peak energy used for integration:	1173, 1333 keV
Branching ratio used:	0.9986, 0.9998 gammas per decay

Uncertainty of Measurement:

A. Type A (random) uncertainty:	± 0.5 %
B. Type B (systematic) uncertainty:	± 3.0 %
C. Uncertainty in aliquot weighing:	± 0.0 %
D. Total uncertainty at the 99% confidence level:	± 3.0 %

Notes:

- See reverse side for leak test(s) performed on this source.
- EZIP participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (as in NRC Regulatory Guide 4.15).
- Nuclear data was taken from IAEA-TECDOC-619, 1991.
- This source has a working life of 5 years.


Quality Control

16-Apr-12
Date

EZIP Ref. No.: 1592-30

ISO 9001 CERTIFIED

Medical Imaging Laboratory
24937 Avenue Tibbitts Valencia, California 91355

Industrial Gauging Laboratory
1800 North Keystone Street Burbank, California 91504

RSO, Inc.
P.O. Box 1450
Laurel, MD 20725
(301) 953-2482

RSO Job No. 10502

Certificate of Calibration

ISSUED TO: Tidewater, Inc.
7161 Columbia Gateway Dr.
Columbia, MD 21046

INSTRUMENT: LUDLUM
MODEL: 2241-2
TYPE: RATEMETER
SN: 178651

CONTACT: Claude Wiblin
PHONE: (410) 353-6450

PO NO: PROJECT 0500

RSO, Inc. certifies that on 07/02/2013 the above described instrument was calibrated using a radioactive source to determine the efficiency for a specific radionuclide(s) and using electronically generated pulse for the linearity. Pulsed using Ludlum 500-2, S/N 159110.

The results are tabulated below. Calibration is traceable to NIST.

Calibration Data				
RANGE	EXPECTED	OBSERVED	C.F.	
AUTO	100	100 cpm	1.00	
	400	400 cpm	1.00	
RANGING	1000	1000 cpm	1.00	
	4000	4000 cpm	1.00	
SCALER	10000	10000 cpm	1.00	
	40000	40000 cpm	1.00	
	100000	100000 cpm	1.00	
	400000	400000 cpm	1.00	
C.F. AVERAGE			1.00	

Probe type(s)	Probe1: SCINTILLATOR	Probe2:	Probe3:					
MODEL	SER#	WINDOW	GEOMETRY	VOLT	ISOTOPE 1 EFF.(%)	ISOTOPE 2 EFF.(%)	ISOTOPE 3 EFF.(%)	ISOTOPE 4 EFF.(%)
44-10	N/A	NONE	CONTACT	900	Cs137	11		

Note: "As Found" condition +/- 10% of Expected values unless indicated.

INSTRUMENT CHECKS

BATTERY CHECK: NORMAL
CHECK SOURCE 1: N/A READING:
CHECK SOURCE 2: N/A READING:

ENVIRONMENTAL

TEMP: 23°C
PRESS: 763 mmHg
HUMID: 50 %

THE SUGGESTED RECALIBRATION DATE FOR THIS INSTRUMENT IS 07/02/2014

Calibrated By:

Dorley Austin

Reviewed By:

GAS

Cal Date: 07/02/2013

Maryland License MD-33-021-01

14074

1 min

source model 30 30E

Date 5/13/13

Due 5/13/14

- 1 13.873
2 13.838
3 13.901
4 14.037
5 13.524
6 13.861
7 13.686
8 13.721
9 13.846
10 13.882

- 11 13.606
12 ~~13.723~~ 13.723
13 13.798
14 13.736
15 13.860
16 13.916
17 13.937
18 13.769
19 13.639
20 13.659

- 1 11178
2 11220
3 11446
4 11212
5 11266
6 11379
7 11279
8 11184
9 11114
10 11316

- 11 11240
12 11038
13 11066
14 11066
15 11361
16 11218
17 11079
18 11349
19 11150
20 11105

- BK
1 0
2 0
3 0
4 0
5 1
6 0
7 0
8 0
9 0
10 2

- 11 0
12 0
13 0
14 0
15 0
16 2
17 0
18 0
19 0
20 0

- 1 35
2 34
3 42
4 38
5 43
6 31
7 44
8 38
9 36
10 49

- 11 34
12 32
13 26
14 30
15 41
16 37
17 46
18 37
19 44
20 34



**Isotope Products
Laboratories**

An Eckert & Ziegler Company

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661-309-1010
Fax 661-257-8303

**CERTIFICATE OF CALIBRATION
BETA STANDARD SOURCE**

Radionuclide: Tc-99
Half-life: (2.13 ± 0.05)E+05 years
Catalog No.: BF-099-32SS
Source No.: A2-771

Customer: J. STEWART BLAND ASSOCIATES, INC.
P.O. No.: VISA
Reference Date: 15-Oct-01 12:00 PST
Contained Radioactivity: 23.35 nCi 864.0 Bq

Physical description:

A. Capsule type:	Disk (32 mm OD x 0.76 mm THK)
B. Nature of active deposit:	Electrodeposited and diffusion bonded Technetium metal
C. Active Diameter:	25 mm
D. Backing:	Stainless steel
E. Cover:	50-100 µg Au/cm²

Radioimpurities:

Not determined

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement:

A. Type A (random) uncertainty:	± 0.5 %
B. Type B (systematic) uncertainty:	± 3.0 %
C. Uncertainty in aliquot weighing:	± 0.0 %
D. Total uncertainty at the 99% confidence level:	± 3.0 %

Notes:

- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a surface emission rate of 28510 β/min in 2π on 11 Oct 01.

Alma H Khan
Quality Control

12-Oct-01
Date Signed

IPL Ref. No.: 752-54

ISO 9001 CERTIFIED

Medical Imaging Laboratory
24937 Avenue Tibbitts Valencia, California 91355

Industrial Gauging Laboratory
1800 North Keystone Street Burbank, California 91504



**Isotope Products
Laboratories**

An Eckert & Ziegler Company

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661•309•1010
Fax 661•257•8303

CERTIFICATE OF CALIBRATION ALPHA STANDARD SOURCE

Radionuclide: Th-230 ✓
Half-life: (7.54 ± 0.03)E+04 years
Catalog No.: EAB-230 ✓
Source No.: A2-743 ✓

Customer: J. STEWART BLAND ASSOCIATES, INC.
P.O. No.: VISA
Reference Date: 15-Oct-01 12:00 PST
Contained Radioactivity: 16.53 nCi / 611.6 Bq
(Total alpha)

Physical description:

- | | |
|------------------------------|---|
| A. Capsule type: | ✓ Disk- 50.8 mm (2") OD x 0.76 mm (0.03") THK |
| B. Nature of active deposit: | Electrodeposited and diffusion bonded oxide |
| C. Active Diameter: | 44 mm |
| D. Backing: | Stainless steel |
| E. Cover: | 50-100 µg Au/cm² |

Radioimpurities:

See Technical Data Sheet

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement:

- | | |
|---|---------|
| A. Type A (random) uncertainty: | ± 0.8 % |
| B. Type B (systematic) uncertainty: | ± 3.0 % |
| C. Uncertainty in aliquot weighing: | ± 0.0 % |
| D. Total uncertainty at the 99% confidence level: | ± 3.1 % |

Notes:

- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a total alpha surface emission rate of 17610 α/min in 2π on 11 Oct 01.

Am H Khan
Quality Control

12-Oct-01
Date Signed

IPL Ref. No.: 752-54

ISO 9001 CERTIFIED

Medical Imaging Laboratory
24937 Avenue Tibbitts Valencia, California 91355

Industrial Gauging Laboratory
1800 North Keystone Street Burbank, California 91504

RSO, Inc.P.O. Box 1450
Laurel, MD 20725
(301) 953-2482

RSO Job No. 10720

Certificate of Calibration

ISSUED TO: Tidewater, Inc.
6625 Selnick Drive, Suite A
Elkridge, MD 21075INSTRUMENT: LUDLUM
MODEL: 19
TYPE: MICRO R
SN: 180302CONTACT: Chico Reyes
PHONE: (610) 310-1031

PO NO: N303

RSO, Inc. certifies that on 12/16/2013 the above described instrument was calibrated in a known radiation field using Cs-137 (662 keV) beam calibrator (J.L. Shepherd Model 28-6A, S/N 10056), RSO # CS-7A, RSO # 378 Certified check sources.

The results are tabulated below. Calibration is traceable to NIST.

Calibration Data				
RANGE	EXPECTED	OBSERVED	C.F.	
25	5	5 * uR/hr	1.00	
	20	20 * uR/hr	1.00	
	10	10 * uR/hr	1.00	
	40	40 * uR/hr	1.00	
250	50	55 uR/hr	0.91	
	200	200 uR/hr	1.00	
500	100	110 uR/hr	0.91	
	400	400 uR/hr	1.00	
5000	1000	1000 uR/hr	1.00	
	4000	4000 uR/hr	1.00	
C.F. AVERAGE			0.98	

* Electronically pulsed.

Probe type(s) Probe1: SCINTILLATOR

Probe2:

Probe3:


MODEL	SER#	WINDOW	GEOMETRY	VOLT	ISOTOPE 1 EFF.(%)	ISOTOPE 2 EFF.(%)	ISOTOPE 3 EFF.(%)	ISOTOPE 4 EFF.(%)
INTERNAL		NONE	FRONT	700				

Note: "As Found" condition +/- 10% of Expected values unless indicated.

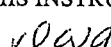
INSTRUMENT CHECKSBATTERY CHECK: NORMAL
CHECK SOURCE 1: N/A READING:
CHECK SOURCE 2: N/A READING:**ENVIRONMENTAL**TEMP: 22°C
PRESS: 765 mmHg
HUMID: 35 %

THE SUGGESTED RECALIBRATION DATE FOR THIS INSTRUMENT IS 12/16/2014

Calibrated By:


Richard Emmons

Reviewed By:



Cal Date: 12/16/2013

Maryland License MD-33-021-01

14654

CONTACT: Claude Wiblin
PHONE: (410) 353-6450

PO NO: PROJECT 0500

RSO, Inc. certifies that on 07/02/2013 the above described instrument was calibrated using a radioactive source to determine the efficiency for a specific radionuclide(s) and using electronically generated pulse for the linearity. Pulsed using Ludlum 500-2, S/N 159110.

The results are tabulated below. Calibration is traceable to NIST.

Calibration Data				
RANGE	EXPECTED	OBSERVED	C.F.	
AUTO	100	100 cpm	1.00	
	400	400 cpm	1.00	
RANGING	1000	1000 cpm	1.00	
	4000	4000 cpm	1.00	
SCALER	10000	10000 cpm	1.00	
	40000	40000 cpm	1.00	
	100000	100000 cpm	1.00	
	400000	400000 cpm	1.00	
		C.F. AVERAGE	1.00	

Probe type(s)	Probe1: SCINTILLATOR	Probe2:	Probe3:					
MODEL	SER#	WINDOW	GEOMETRY	VOLT	ISOTOPE 1 EFF.(%)	ISOTOPE 2 EFF.(%)	ISOTOPE 3 EFF.(%)	ISOTOPE 4 EFF.(%)
44-10	N/A	NONE	CONTACT	900	Cs137 11			

Note: "As Found" condition +/- 10% of Expected values unless indicated.

INSTRUMENT CHECKS

BATTERY CHECK: NORMAL

CHECK SOURCE 1: N/A

READING:

CHECK SOURCE 2: N/A

READING:

ENVIRONMENTAL

TEMP: 23°C

PRESS: 763 mmHg

HUMID: 50 %

THE SUGGESTED RECALIBRATION DATE FOR THIS INSTRUMENT IS 07/02/2014

Calibrated By:

Dorsey Austin
Dorsey Austin

Reviewed By:

GAS

Cal Date: 07/02/2013

Maryland License MD-33-021-01

14074

RSO, Inc.
P.O. Box 1450
Laurel, MD 20725
(301) 953-2482

RSO Job No. 10720

Certificate of Calibration

ISSUED TO: Tidewater, Inc.
6625 Selnick Drive, Suite A
Elkridge, MD 21075

INSTRUMENT: LUDLUM
MODEL: 3
TYPE: RATEMETER
SN: 116960

CONTACT: Claude Wiblin
PHONE: (410) 353-6450

PO NO: N303

RSO, Inc. certifies that on 12/16/2013 the above described instrument was calibrated using a radioactive source to determine the efficiency for a specific radionuclide(s) and using electronically generated pulse for the linearity. Pulsed using Ludlum 500-2, S/N 159110.

The results are tabulated below. Calibration is traceable to NIST.

Calibration Data					
RANGE		EXPECTED	OBSERVED		C.F.
X	0.1	100	100	cpm	1.00
		400	400	cpm	1.00
X	1	1000	1000	cpm	1.00
		4000	4000	cpm	1.00
X	10	10000	10000	cpm	1.00
		40000	40000	cpm	1.00
X	100	100000	100000	cpm	1.00
		400000	400000	cpm	1.00
C.F. AVERAGE					1.00

Probe type(s)		Probe1: PANGM			Probe2:			Probe3:				
MODEL	SER#	WINDOW	GEOMETRY	VOLT	ISOTOPE 1	EFF.(%)	ISOTOPE 2	EFF.(%)	ISOTOPE 3	EFF.(%)	ISOTOPE 4	EFF.(%)
44-9	PR120686	FIXED	CONTACT	900	Tc99	13	Cs137	21				

Note: "As Found" condition +/- 10% of Expected values unless indicated.

INSTRUMENT CHECKS

BATTERY CHECK: NORMAL
CHECK SOURCE 1: N/A READING:
CHECK SOURCE 2: N/A READING:

ENVIRONMENTAL

TEMP: 24°C
PRESS: 764 mmHg
HUMID: 28 %

THE SUGGESTED RECALIBRATION DATE FOR THIS INSTRUMENT IS 12/16/2014

Calibrated By:

Dorsey Austin
Dorsey Austin

Reviewed By:

RAE

Cal Date: 12/16/2013

Maryland License MD-33-021-01

14656

RSO, Inc.
P.O. Box 1450
Laurel, MD 20725
(301) 953-2482

RSO Job No. 10720

Certificate of Calibration

ISSUED TO: Tidewater, Inc.
6625 Selnick Drive, Suite A
Elkridge, MD 21075

INSTRUMENT: LUDLUM
MODEL: 3
TYPE: RATEMETER
SN: 175521

CONTACT: Claude Wiblin
PHONE: (410) 353-6450

PO NO: N303

RSO, Inc. certifies that on 12/16/2013 the above described instrument was calibrated using a radioactive source to determine the efficiency for a specific radionuclide(s) and using electronically generated pulse for the linearity. Pulsed using Ludlum 500-2, S/N 159110.

The results are tabulated below. Calibration is traceable to NIST.

Calibration Data					
	RANGE	EXPECTED	OBSERVED		C.F.
X	0.1	100	100 cpm		1.00
		500	500 cpm		1.00
X	1	1000	1000 cpm		1.00
		5000	5000 cpm		1.00
X	10	10000	10000 cpm		1.00
		50000	50000 cpm		1.00
X	100	100000	100000 cpm		1.00
		500000	500000 cpm		1.00
C.F. AVERAGE					1.00

Probe type(s)		Probe1: PANGM		Probe2:		Probe3:		
MODEL	SER#	WINDOW	GEOMETRY	VOLT	ISOTOPE 1 EFF.(%)	ISOTOPE 2 EFF.(%)	ISOTOPE 3 EFF.(%)	ISOTOPE 4 EFF.(%)
44-9	PR183775	FIXED	CONTACT	903	Tc99 14	Cs137 23		

Note: "As Found" condition +/- 10% of Expected values unless indicated.

INSTRUMENT CHECKS

BATTERY CHECK: NORMAL
CHECK SOURCE 1: N/A READING:
CHECK SOURCE 2: N/A READING:

ENVIRONMENTAL

TEMP: 24°C
PRESS: 764 mmHg
HUMID: 28 %

THE SUGGESTED RECALIBRATION DATE FOR THIS INSTRUMENT IS 12/16/2014

Calibrated By:

Dorsey Austin
Dorsey Austin

Reviewed By:

Rae

Cal Date: 12/16/2013

Maryland License MD-33-021-01

14655



**Isotope Products
Laboratories**

An Eckert & Ziegler Company

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661•309•1010
Fax 661•257•8303

**CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOURCE**

Radionuclide: Th-230 ✓
Half-life: (7.54 ± 0.03)E+04 years
Catalog No.: EAB-230 ✓
Source No.: A2-743 ✓

Customer: J. STEWART BLAND ASSOCIATES, INC.
P.O. No.: VISA
Reference Date: 15-Oct-01 12:00 PST
Contained Radioactivity: 16.53 nCi / 611.6 Bq
(Total alpha)

Physical description:

A. Capsule type: Disk- 50.8 mm (2") OD x 0.76 mm (0.03") THK
B. Nature of active deposit: Electrodeposited and diffusion bonded oxide
C. Active Diameter: 44 mm
D. Backing: Stainless steel
E. Cover: 50-100 µg Au/cm²

Radiopurities:

See Technical Data Sheet

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement:

A. Type A (random) uncertainty: ± 0.8 %
B. Type B (systematic) uncertainty: ± 3.0 %
C. Uncertainty in aliquot weighing: ± 0.0 %
D. Total uncertainty at the 99% confidence level: ± 3.1 %

Notes:

- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a total alpha surface emission rate of 17610 α/min in 2π on 11 Oct 01.

Am H Khan
Quality Control

12-Oct-01
Date Signed

IPL Ref. No.: 752-54

ISO 9001 CERTIFIED

Medical Imaging Laboratory
24937 Avenue Tibbitts Valencia, California 91355

Industrial Gauging Laboratory
1800 North Keystone Street Burbank, California 91504



**Isotope Products
Laboratories**

An Eckert & Ziegler Company

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661-309-1010
Fax 661-257-8303

**CERTIFICATE OF CALIBRATION
BETA STANDARD SOURCE**

Radionuclide: Tc-99
Half-life: $(2.13 \pm 0.05)E+05$ years
Catalog No.: BF-099-32SS
Source No.: A2-771

Customer: J. STEWART BLAND ASSOCIATES, INC.
P.O. No.: VISA
Reference Date: 15-Oct-01 12:00 PST
Contained Radioactivity: 23.35 nCi 864.0 Bq

Physical description:

A. Capsule type:	Disk (32 mm OD x 0.76 mm THK)
B. Nature of active deposit:	Electrodeposited and diffusion bonded Technetium metal
C. Active Diameter:	25 mm
D. Backing:	Stainless steel
E. Cover:	50-100 $\mu\text{g Au/cm}^2$

Radioimpurities:

Not determined

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement:

A. Type A (random) uncertainty:	$\pm 0.5 \%$
B. Type B (systematic) uncertainty:	$\pm 3.0 \%$
C. Uncertainty in aliquot weighing:	$\pm 0.0 \%$
D. Total uncertainty at the 99% confidence level:	$\pm 3.0 \%$

Notes:

- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a surface emission rate of 28510 β/min in 2π on 11 Oct 01.

Alvin H. Khan
Quality Control

12-Oct-01
Date Signed

IPL Ref. No.: 752-54

ISO 9001 CERTIFIED

Medical Imaging Laboratory
24937 Avenue Tibbitts Valencia, California 91355

Industrial Gauging Laboratory
1800 North Keystone Street Burbank, California 91504

CERTIFICATE OF CALIBRATION (MCA-BASED INSTRUMENT)



RSA Laboratories

19 Pendleton Drive, PO Box 61

Hebron, Connecticut 06248

860/228-0487 Fax 860/228-4402

Customer and Contact: Tidewater, Inc. Attn: Chico Reyes (410) 997-4458
Customer Address: 6625 Selnick Drive, Suite A, Elkridge, Maryland 21075

Inst. Mfr. & Model URSA-II
Det. Mfr. & Model Rexon
Cal Date 20 November 2013

Inst. Type MCA
Det. Type 3x3 NaI
Due Date 20 November 2014

Inst. s/n 200124
Det s/n 081107-2
Cal. Interval 1 year

Pre-calibration Checks:

- ☒ Contamination Survey
- ☒ Mechanical Check
- ☐ Meter Zero
- ☐ Geotropism Check

- ☐ Battery Check
- ☐ Audio Check
- ☐ Reset Check
- ☐ Fast Response Check

- ☐ Slow Response Check
- ☒ Window Operation
- ☐ Plateau Check
- ☐ Alarm Set

- ☐ Det Volts
- ☐ Threshold

☐ Pulse Generator s/n 106400

☐ Oscilloscope s/n 171-04928

☐ Voltmeter s/n 57410002

Comments: Settings for use with PPC software are as follows:

High Voltage	Threshold	Shaping Time	Signal Polarity	Coarse Gain	Fine Gain	Overall gain
840 V	100 mV	1 μ Sec	Negative	x35	x0.762	x26.660

Exposure Rate Data:

μ R/h	cpm
100	327,021
149	413,232
250	620,391
499	995,619

CHALLENGE ISOTOPE/ENERGY	INSTRUMENT INDICATION
Am-241/59.5 keV	Chn 137
Cs-137/662 keV	Chn 1411
Co-60/1173.2 keV	Chn 2492
Co-60/1332.5 keV	Chn 2828

No ranges were calibrated electronically.

- ☒ Sources used: ^{137}Cs 108.6 mCi s/n S-814
- ☒ Sources used: ^{137}Cs s/n PRS02
- ☒ Sources used: ^{241}Am s/n 47
- ☒ Sources used: ^{60}Co s/n FGS-12-004

RSA Laboratories Log ID# 131120-2. Instrument indicates within $\pm 10\%$ of calibration points unless otherwise indicated. RSA Laboratories certifies that the above instrument has been calibrated with standards traceable to the National Institute of Standards and Technology, or have been derived from accepted standards of natural physical constants, or have been derived by the ratio-type of calibration techniques.

Calibrated by: Kurt D. Newton

Date: 20 November 2013

CERTIFICATE OF CALIBRATION (SCINTILLATION DETECTOR)



RSA Laboratories

19 Pendleton Drive, PO Box 61
Hebron, Connecticut 06248
860/228-0487 Fax 860/228-4402

Customer and Contact: Tidewater, Inc. Attn: Chico Reyes (410) 997-4458
Customer Address: 6625 Selnick Drive, Suite A, Elkridge, Maryland 21075

Inst. Mfr. & Model URSA-II
Det. Mfr. & Model Ludlum 44-10
Cal Date 20 November 2013

Inst. Type MCA
Det. Type 2x2 NaI
Due Date 20 November 2014

Inst. s/n 200124
Det s/n 186962
Cal. Interval 1 year

Pre-calibration Checks:

- | | | | |
|--|--|--|------------------------------------|
| <input checked="" type="checkbox"/> Contamination Survey | <input type="checkbox"/> Battery Check | <input type="checkbox"/> Slow Response Check | <input type="checkbox"/> Det Volts |
| <input checked="" type="checkbox"/> Mechanical Check | <input type="checkbox"/> Audio Check | <input checked="" type="checkbox"/> Window Operation | |
| <input type="checkbox"/> Meter Zero | <input type="checkbox"/> Reset Check | <input type="checkbox"/> Plateau Check | <input type="checkbox"/> Threshold |
| <input type="checkbox"/> Geotropism Check | <input type="checkbox"/> Fast Response Check | <input type="checkbox"/> Alarm Set | |

☐ Pulse Generator s/n 106400

☐ Oscilloscope s/n 171-04928

☐ Voltmeter s/n 57410002

Comments: Settings for use with PC software are as follows:

High Voltage	Threshold	Shaping Time	Signal Polarity	Coarse Gain	Fine Gain	Overall gain
950 V	50 mV	1 μ Sec	Negative	x35	x0.703	x24.609

μ R/h	cpm
100	130,863
200	219,135
300	336,633
499	478,359
1001	875,904

CHALLENGE ISOTOPE/ENERGY	INSTRUMENT INDICATION
Am-241/59.54 keV	Chn 141
Lu-176/202 keV	Chn 410
Lu-176/307 keV	Chn 628
Cs-137/662 keV	Chn 1304
Co-60/1173.2 keV	Chn 2290
Co-60/1332.5 keV	Chn 2593

No ranges were calibrated electronically.

- ☒ Sources used: ^{137}Cs 108.6 mCi s/n S-814
☒ Sources used: ^{137}Cs s/n PRS02
☒ Sources used: ^{241}Am s/n 47
☒ Sources used: ^{60}Co s/n FGS-12-004

RSA Laboratories Log ID# 131120-3. Instrument indicates within $\pm 10\%$ of calibration points unless otherwise indicated. RSA Laboratories certifies that the above instrument has been calibrated with standards traceable to the National Institute of Standards and Technology, or have been derived from accepted standards of natural physical constants, or have been derived by the ratio-type of calibration techniques.

Calibrated by:  Kurt D. Newton

Date: 20 November 2013

CERTIFICATE OF CALIBRATION (SCINTILLATION DETECTOR)



RSA Laboratories

19 Pendleton Drive, PO Box 61
Hebron, Connecticut 06248
860/228-0487 Fax 860/228-4402

Customer and Contact: Tidewater, Inc. Attn: Chico Reyes (410) 997-4458
Customer Address: 6625 Selnick Drive, Suite A, Elkridge, Maryland 21075

Inst. Mfr. & Model URSA-II
Det. Mfr. & Model Alpha Spectra 20DT063QB2/5B
Cal Date 20 November 2013

Inst. Type MCA
Det. Type NaI FIDLER
Due Date 20 November 2014

Inst. s/n 200124
Det s/n 050307AY1
Cal. Interval 1 year

Pre-calibration Checks:

- | | | | |
|--|--|--|------------------------------------|
| <input checked="" type="checkbox"/> Contamination Survey | <input type="checkbox"/> Battery Check | <input type="checkbox"/> Slow Response Check | <input type="checkbox"/> Det Volts |
| <input checked="" type="checkbox"/> Mechanical Check | <input type="checkbox"/> Audio Check | <input checked="" type="checkbox"/> Window Operation | |
| <input type="checkbox"/> Meter Zero | <input type="checkbox"/> Reset Check | <input type="checkbox"/> Plateau Check | <input type="checkbox"/> Threshold |
| <input type="checkbox"/> Geotropism Check | <input type="checkbox"/> Fast Response Check | <input type="checkbox"/> Alarm Set | |

☐ Pulse Generator s/n 106400

☐ Oscilloscope s/n 171-04928

☐ Voltmeter s/n 57410002

Comments: Settings for use with PC software are as follows:

High Voltage	Threshold	Shaping Time	Signal Polarity	Coarse Gain	Fine Gain	Overall gain
960 V	35 mV	1 μ Sec	Negative	x125	x0.750	x93.750

CHALLENGE ISOTOPE/ENERGY	INSTRUMENT INDICATION
Lu-176/8 keV	Chn 85
Am-241/13.9 keV	Chn 150
Cs-137/32.89 keV	Chn 305
Lu-176/55 keV	Chn 498
Am-241/59.54 keV	Chn 524
Lu-176/202 keV	Chn 1700
Lu-176/307 keV	Chn 2529

No ranges were calibrated electronically.

- ☒ Sources used: ^{137}Cs s/n PRS02
☒ Sources used: ^{241}Am s/n 47
☒ Sources used: ^{176}Lu s/n 219

RSA Laboratories Log ID# 131120-1. Instrument indicates within $\pm 10\%$ of calibration points unless otherwise indicated. RSA Laboratories certifies that the above instrument has been calibrated with standards traceable to the National Institute of Standards and Technology, or have been derived from accepted standards of natural physical constants, or have been derived by the ratio-type of calibration techniques.

Calibrated by: Kurt D. Newton

Date: 20 November 2013

CERTIFICATE OF CALIBRATION (SCINTILLATION DETECTOR)



RSA Laboratories

19 Pendleton Drive, PO Box 61
Hebron, Connecticut 06248
860/228-0487 Fax 860/228-4402

Customer and Contact: Tidewater, Inc. Attn: Chico Reyes (410) 997-4458
Customer Address: 6625 Selnick Drive, Suite A, Elkridge, Maryland 21075

Inst. Mfr. & Model URSA-II
Det. Mfr. & Model Alpha Spectra 20DT063QB2/5B
Cal Date 19 November 2013

Inst. Type MCA
Det. Type NaI FIDLER
Due Date 19 November 2014

Inst. s/n 200130
Det s/n 050307AZ1
Cal. Interval 1 year

Pre-calibration Checks:

- ☒ Contamination Survey
- ☒ Mechanical Check
- ☐ Meter Zero
- ☐ Geotropism Check

- ☐ Battery Check
- ☐ Audio Check
- ☐ Reset Check
- ☐ Fast Response Check

- ☐ Slow Response Check
- ☒ Window Operation
- ☐ Plateau Check
- ☐ Alarm Set

- ☐ Det Volts
- ☐ Threshold

☐ Pulse Generator s/n 106400

☐ Oscilloscope s/n 171-04928

☐ Voltmeter s/n 57410002

Comments: Settings for use with PC software are as follows:

High Voltage	Threshold	Shaping Time	Signal Polarity	Coarse Gain	Fine Gain	Overall gain
960 V	35 mV	1 μ Sec	Negative	x125	x0.734	x91.797

CHALLENGE ISOTOPE/ENERGY	INSTRUMENT INDICATION
Lu-176/8 keV	Chn 85
Am-241/13.9 keV	Chn 150
Cs-137/32.89 keV	Chn 285
Lu-176/55 keV	Chn 498
Am-241/59.54 keV	Chn 540
Lu-176/202 keV	Chn 1680
Lu-176/307 keV	Chn 2485

No ranges were calibrated electronically.

- ☒ Sources used: ^{137}Cs s/n PRS02
- ☒ Sources used: ^{241}Am s/n 47
- ☒ Sources used: ^{176}Lu s/n 219

RSA Laboratories Log ID# 131119-1. Instrument indicates within $\pm 10\%$ of calibration points unless otherwise indicated. RSA Laboratories certifies that the above instrument has been calibrated with standards traceable to the National Institute of Standards and Technology, or have been derived from accepted standards of natural physical constants, or have been derived by the ratio-type of calibration techniques.

Calibrated by:

Kurt D. Newton

Date: 19 November 2013

CERTIFICATE OF CALIBRATION (MCA-BASED INSTRUMENT)



RSA Laboratories

19 Pendleton Drive, PO Box 61
Hebron, Connecticut 06248
860/228-0487 Fax 860/228-4402

Customer and Contact: Tidewater, Inc. Attn: Chico Reyes (410) 997-4458
Customer Address: 6625 Selnick Drive, Suite A, Elkridge, Maryland 21075

Inst. Mfr. & Model URSA-II
Det. Mfr. & Model REXON
Cal Date 19 November 2013

Inst. Type MCA
Det. Type 3x3 NaI
Due Date 19 November 2014

Inst. s/n 200130
Det s/n 081107-1
Cal. Interval 1 year

Pre-calibration Checks:

- | | | | |
|--|---|--|------------------------------------|
| <input checked="" type="checkbox"/> Contamination Survey | <input type="checkbox"/> Battery Check | <input type="checkbox"/> Slow Response Check | <input type="checkbox"/> Det Volts |
| <input checked="" type="checkbox"/> Mechanical Check | <input type="checkbox"/> Audio Check | <input checked="" type="checkbox"/> Window Operation | |
| <input type="checkbox"/> Meter Zero | <input type="checkbox"/> Reset Check | <input type="checkbox"/> Plateau Check | <input type="checkbox"/> Threshold |
| <input type="checkbox"/> Geotopism Check | <input type="checkbox"/> Fast Response Check | <input type="checkbox"/> Alarm Set | |
|
 | | | |
| <input type="checkbox"/> Pulse Generator s/n 106400 | <input type="checkbox"/> Oscilloscope s/n 171-04928 | <input type="checkbox"/> Voltmeter s/n 57410002 | |

Comments: Settings for use with PPC software are as follows:

High Voltage	Threshold	Shaping Time	Signal Polarity	Coarse Gain	Fine Gain	Overall gain
880 V	100 mV	1 μ Sec	Negative	x35	x0.742	x25.977

Exposure Rate Data:

μ R/h	cpm
100	312,414
149	413,166
250	621,492
499	978,990

CHALLENGE ISOTOPE/ENERGY	INSTRUMENT INDICATION
Am-241/59.5 keV	Chn 154
Cs-137/662 keV	Chn 1344
Co-60/1173.2 keV	Chn 2177
Co-60/1332.5 keV	Chn 2417

No ranges were calibrated electronically.

- ☒ Sources used: ^{137}Cs 108.6 mCi s/n S-814
- ☒ Sources used: ^{137}Cs s/n PRS02
- ☒ Sources used: ^{241}Am s/n 47
- ☒ Sources used: ^{60}Co s/n FGS-12-004

RSA Laboratories Log ID# 131119-2. Instrument indicates within $\pm 10\%$ of calibration points unless otherwise indicated. RSA Laboratories certifies that the above instrument has been calibrated with standards traceable to the National Institute of Standards and Technology, or have been derived from accepted standards of natural physical constants, or have been derived by the ratio-type of calibration techniques.

Calibrated by: Kurt D. Newton

Date: 19 November 2013

CERTIFICATE OF CALIBRATION (SCINTILLATION DETECTOR)



RSA Laboratories

19 Pendleton Drive, PO Box 61
Hebron, Connecticut 06248
860/228-0487 Fax 860/228-4402

Customer and Contact: Tidewater, Inc. Attn: Chico Reyes (410) 997-4458
Customer Address: 6625 Selnick Drive, Suite A, Elkridge, Maryland 21075

Inst. Mfr. & Model URSA-II
Det. Mfr. & Model Ludlum 44-10
Cal Date 19 November 2013

Inst. Type MCA
Det. Type 2x2 NaI
Due Date 19 November 2014

Inst. s/n 200130
Det s/n 186955
Cal. Interval 1 year

Pre-calibration Checks:

- ☒ Contamination Survey
- ☒ Mechanical Check
- ☐ Meter Zero
- ☐ Geotropism Check

- ☐ Battery Check
- ☐ Audio Check
- ☐ Reset Check
- ☐ Fast Response Check

- ☐ Slow Response Check
- ☒ Window Operation
- ☐ Plateau Check
- ☐ Alarm Set

- ☐ Det Volts
- ☐ Threshold

☐ Pulse Generator s/n 106400

☐ Oscilloscope s/n 171-04928

☐ Voltmeter s/n 57410002

Comments: Settings for use with PC software are as follows:

High Voltage	Threshold	Shaping Time	Signal Polarity	Coarse Gain	Fine Gain	Overall gain
1050 V	50 mV	1 μ Sec	Negative	x250	x0.742	x185.547

μ R/h	cpm
100	129,729
149	175,632
250	272,535
499	482,532

CHALLENGE ISOTOPE/ENERGY	INSTRUMENT INDICATION
Am-241/59.54 keV	Chn 128
Cs-137/662 keV	Chn 1323
Co-60/1173.2	Chn 2290
Co-60/1332.5	Chn 2583

No ranges were calibrated electronically.

- ☒ Sources used: ^{137}Cs 108.6 mCi s/n S-814
- ☒ Sources used: ^{137}Cs s/n PRS02
- ☒ Sources used: ^{241}Am s/n 47
- ☒ Sources used: ^{60}Co s/n FGS-12-004

RSA Laboratories Log ID# 131119-3. Instrument indicates within $\pm 10\%$ of calibration points unless otherwise indicated. RSA Laboratories certifies that the above instrument has been calibrated with standards traceable to the National Institute of Standards and Technology, or have been derived from accepted standards of natural physical constants, or have been derived by the ratio-type of calibration techniques.

Calibrated by: Kurt D. Newton

Date: 19 November 2013